# REPORT OF THE EXPERT GROUP MEETING ON STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

Harare, Zimbabwe, 27- 30 January 1998

## TABLE OF CONTENT

# I. INTRODUCTION

1. The Expert Group Meeting was hosted by the Government of Zimbabwe and organised by the United Nations Department of Economic and Social Affairs. The main objective of the Meeting was to provide an expert contribution to the forthcoming deliberations on «Strategic Approaches for Freshwater Management» that will take place in the Ad hoc Working Group of the UN Commission on Sustainable Development (New York, 23-29 February, 1998) and, later, during the sixth Session of the CSD (New York, 20 April – 1 May, 1998).

2. The Meeting was Co-Chaired by Mr. Robert Ainscow of the United Kingdom and Mr. Sibekile Mtetwa of Zimbabwe. At the opening of the Meeting, the Honorable Mrs. Joyce Mujuru, Minister of Rural Resources and Water Development of Zimbabwe, delivered a statement of behalf of the Host Country. The Meeting was attended by more than 170 experts from developed and developing countries and countries with economies in transition, international organisations from both within and outside of the United Nations, and from the non-governmental organisations and major groups of the civil society.

3. In addition to the Plenary meetings, four Working Groups were established in order to ensure an in-depth consideration of a number of specific themes on the agenda, namely «I. Water as the Key Resource in Sustainable Development», «II. Freshwater Ecosystems and Water Quality», «III. Economic and Financial Issues», and «IV. Participation and Institutions for Integrated Water Resources Management». The deliberations in each of the Working Groups were led by two Moderators as follows: Working Group I - Mr. James Bruce (Canada) and Ms. Krishna Singh (India); Working Group II – Mr. Ingvar Andersson (Sweden) and Mr. Armando Bertranou (Argentina); Working Group III – Mr. Torkil Jonch-Clausen (Denmark) and Mr. Sékou Touré (Côte d'Ivoire); and Working Group IV – Mr. Mohammed Jellali (Morocco) and Mr. Jean Claude Vial (France).

4. The participants noted a number of recent or forthcoming regional and international activities related to freshwater, in particular the adoption of the Cape Town Declaration of December 1997 and the preparations for the Ministerial meeting on Water Resources and Sustainable Development to take place in Paris in March 1998.

5. The participants expressed their appreciation to the Government and people of Zimbabwe for hosting the meeting and the hospitality extended to its participants. They also expressed their gratitude to the sponsors of the meeting – the Governments of Denmark, France, Ireland, the Netherlands, Sweden and the United Kingdom, and to the European Commission.

6. The report of the Meeting is presented as the co-chairmen's summary prepared in collaboration with the moderators. It attempts to assess - in broad terms - the overall outcome of the Meeting and to draw a number of key conclusions from the discussions held. The co-chairmen's summary is accompanied by the reports of the four Working Groups (Annex I - IV). Thy outline in much greater detail the main recommendations and proposals made by the participating experts regarding actions required – at the local, national and international levels

– in order to expedite the implementation of Chapter 18 and other water-related provisions of Agenda 21. Some of the proposals and recommendations included in the report may not enjoy the support by all of the participating experts and may therefore need to be further discussed in the future, in particular in the context of the policy dialogue on the strategic approaches to freshwater management under the aegis of the Commission on Sustainable Development.

## II. STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT: POLICY OPTIONS FOR CONSIDERATION BY THE COMMISSION ON SUSTAINABLE DEVELOPMENT AND POLICY-MAKERS: AN OVERVIEW

7. The rationale for sustainable development and the links between development and environment were clearly articulated in Agenda 21. The specific proposals concerning freshwater in Chapter 18 and other related provisions continue to be a basis for action. Since 1992, some countries have made progress on a path towards implementing the recommended actions at national and local levels through the adoption of integrated approaches to freshwater management. There are a number of areas, outlined in this report, which continue to build on Agenda 21. Nonetheless, there are other areas where more strategic actions are still needed in order to adapt to continually changing social and environmental circumstances and to address fundamental concerns of poverty alleviation, public health, food security and energy generation.

8. Demands for freshwater are driven by increases in population growth and sectoral pressures for both consumptive and non-consumptive uses. The sectoral demands include agriculture (irrigation and drainage), the provision of domestic water supply and sanitation, industry, energy generation, environmental requirements, amenity and tourism. The nature of these demands are further complicated by changes in patterns of consumption as a result of industrialisation, rural/urban shifts, migration, and unaccounted for water and are set against clear limits and variability in the available resource. It is increasingly clear that unprecedented demands for water supplies are resulting in continued degradation of the resource base and intensified competition for high quality water. A characteristic of these stresses is that all their components are not equally distributed in time and space.

9. There is evidence of progress in improving some aspects of freshwater resources management since 1992. Marked improvements in water quality have occurred in a number of river basins where public pressures for action have been strong. Lower discharge of toxic substances have reduced public health risks and improved the habitats of fish and wildlife in some river basins. New technologies and water demand management have resulted in improved efficiency in water use in irrigation, industrial processing and municipal supplies. Improved soil and water conservation through the explicit linkage of water with land and forestry policies has halted land degradation in vulnerable landscapes. Institutions for integrated water management have been strengthened in several developing countries along with the adoption of new or improved water policies, information systems and action plans

resulting in improvements in water use efficiencies, water quality and related ecosystems. Industrialised countries are replacing outmoded policy and regulatory frameworks as circumstances and socio-economic circumstances change. Several initiatives toward comprehensive and participatory river basin management, including international river basins, are replacing purely administrative and technical solutions. International networks in support of integrated water resources management have been created.

10. However, while many lessons have been learned, overall progress has been neither sufficient nor comprehensive enough to reduce general trends of increasing water shortages, deteriorating water quality and growing stresses on freshwater ecosystems. There is a compelling case for integrating these approaches to freshwater management into national economic frameworks as keys elements in policies for sustainable development and poverty alleviation. Socio-economic productivity can be enhanced and environmental integrity conserved as a result of this integration.

11. Integrated water resources management – within a national economic framework – is essential for achieving efficient and equitable allocation of water resources and thus for promoting sustainable economic development and poverty alleviation. The adoption of an integrated approach to environmentally sustainable management of water resources is also fundamental for protecting freshwater ecosystems, water quality and human health. At the same time, the financial sustainability of the water sector – together with policies for financial burden sharing and for ensuring access by the poor – are a prerequisite for the successful implementation of integrated water resources management. In order to be effectively implemented, integrated water resources management should also include institutional and legal capacity building, human resources development and participatory approaches. The basis for a strategic approach to integrated freshwater management can be founded on a set of key elements which bring together all the relevant parties and their particular socio-economic and environmental concerns that are bound by freshwater.

12. Most decisions and actions related to water take place at local, sub-national and national level since physical and socio-economic settings are diverse. However, local actions may have national and even regional implications for related areas of natural resource management.

13. There is much to be done, but an integrated approach is the way forward since it offers means of reconciling competing demands with dwindling supplies and a framework in which hard choices can be made and where effective operational actions can be taken. It is valuable for all countries and at all stages of development.

14. The view of the Expert Group meeting was that the future will present many challenges for the sustainable development of freshwater resources. Nevertheless, the judgement of the experts was that, in spite of the current serious concerns regarding scarcity and degradation of the quality of freshwater resources in large areas of the world, water need not become a limiting factor for sustainable development and human welfare. A series of crises, potentially with regional and even global implications, can be averted if vigorous action is taken now

toward an integrated approach to freshwater resources management. Key recommendations in this regard are set out below .

## III. KEY RECOMMENDATIONS FOR AN INTEGRATED APPROACH TO FRESHWATER RESOURCES MANAGEMENT

### A. General

15. **Sustainability**. There is a need to recognise water as a social and economic good with a vital role in the satisfaction of basic human needs, food security, poverty alleviation and the protection of ecosystems. The principle of sustainability must underpin an integrated approach to managing freshwater resources in order to maintain and extend the benefits derived from natural freshwater systems.

16. **Water policy and integrated management**. As recommended in Agenda 21, it is essential for all countries to develop national, and where relevant sub-national, water policies and continually review these policies as circumstances change. Fundamental to this process is the concept of an integrated approach to the planning, allocation, development, and management of freshwater resources at the level of river basins and aquifers. The basic management unit should be designated in these policies as river basins and aquifer units.

17. **Management of the Resource**. The management of the demand for, and the allocation of, water resources should be based on principles of equity and efficient use to promote sustainable development including health, the satisfaction of basic human needs, food security and environmental protection.

### B. Capacity Building

18. **Capacity Building**. Institutional and human capacities at national and local levels will need substantial strengthening if an integrated approach is to be implemented. The need to strengthen capacity at local levels is especially strong; the training of local entrepreneurs has an important role in implementing actions. There is also a need to promote the use of indigenous technologies and knowledge, in addition to the transfer of appropriate technologies.

### C. Information management

19. **Information Management**. There is a need to finance, establish and maintain effective data collection and dissemination, information management systems and research in order to provide a sound basis for policy formulation, planning and investment decisions and operational management of freshwater resources. The collection of all freshwater resource and

related socio-economic and environmental data and information needed for policy decisions, planning and management action and monitoring, should have a high and continued priority.

20. **Indicators of Progress**. Governments need to adopt, implement and monitor national water-related indicators of progress in achieving integrated water resources management, including water quality objectives. This should take account of the CSD work in this area.

### D. Environment and development

21. **Ecosystem integration**. The conservation of freshwater and related ecosystems is vital to sustainable development. These ecosystems are themselves users, water regulators and providers of freshwater-based resources (including fisheries). It is therefore necessary to promote an ecosystem approach in integrated water resources planning, development and management within the framework of river basin and aquifer systems.

22. **Human Interactions with the Environment**. There is a need to ensure that effective local and national systems are in a position to bring about productive and sustainable interactions between human activities and the ecological functioning of freshwater systems and to minimise downstream impacts including estuarine and marine environments and to reduce losses from droughts and floods.

23. **Water Quality and Environmental Sanitation**. There is a need to safeguard water quality as regards human health, productive uses of water and the protection of freshwater ecosystems. There is a need to implement measures, including sanitation programmes which have been notably neglected, to safeguard water quality recognising that poor environmental sanitation is the leading cause of human sickness in developing countries.

### E. Economics and finance

24. **Economics**. Water planning and management needs to be integrated into the national economy, recognising the vital role of water for the satisfaction of basic human needs, food security, poverty alleviation, ecosystem functioning and taking into account special conditions of non-monetary sectors of the economy.

25. **Allocation**. Water needs to be considered as a finite and vulnerable resource, and a social and economic good, and the costs and benefits of different allocation – social, economic and environmental– need to be assessed. The use of various economic instruments is important in guiding allocation decisions.

26. **Accountability**. It is essential to ensure efficiency, transparency and accountability in water resources management as a precondition for sustainable financial management.

## G. International co-operation

34. **Support for national action**. International co-operation and partnership in support of national actions are essential for achieving sustainable development, particularly in the water sector. This includes the need for mobilising and providing new and additional financial resources to developing countries as set out in Agenda 21, as well as the need for enhancing international co-operation is such areas as capacity building, transfer of technology, research and information exchange.

35. **Promoting a common approach**. The United Nations system should play an active role in harmonising, at international and national levels, the recommendations being made to countries for integrated water resources management strategies.

36. **Information exchange**. Governments should promote vital information exchange and dissemination through the greater use of Internet and other modern means of communication.

37. **Donor-recipient dialogue**. Governments and the international community need to strengthen consultation mechanisms aimed at improving donor/recipient dialogues for the mobilisation of financial resources in a well-targeted and predictable manner, based on national action plans with a special focus on integrated water resources management which recognises the need of the poorest communities.

38. **Regional consultations on drought and flood preparedness**. There is a need to establish or strengthen mechanisms for regional consultations on drought and flood preparedness and early warning systems and mitigation plans at local and national levels, regional emergency funds and/or collective insurance programmes. At the international level, there is a need to maintain support of these activities following the close of the IDNDR (1999).

39. **International Watercourses**. Riparian States are encouraged to co-operate among each other on matters related to transboundary water resources, building on existing agreements principles, arrangements, instruments and programmes of action, taking into account the interests of all riparian States concerned. Such efforts, upon common requests of concerned States, may need to be supported through international co-operation.

40. **Water-Related International Conventions and Programmes for Action**. In the formulation and implementation of integrated water resources management policies and programmes, there is a need to take into account actions to implement a number of existing Conventions and Programmes of Action relevant to freshwater, in particular conventions on Biodiversity, Desertification, Climate Change, Wetlands (RAMSAR) and International Trade in Endangered Species (CITES) as well as the Global Programme of Action for the Protection for the Marine Environment from Land-Based Sources of Pollution.

41. The Expert Group Meeting invites the Commission on Sustainable Development to give

consideration to the general conclusions and recommendations outlined above, together with more detailed proposals for action contained in the annexed reports of the four Working Groups. It is hoped that the CSD will support these recommendations and proposals for action, thus promoting an integrated approach to freshwater management at all levels while ensuring that national action is supported through adequate means of international co-operation.

42. Furthermore, the Expert Group Meeting recommends that the CSD invites countries to submit, by 2002, information concerning their national water policies and related plans and progress in their implementation.

# ANNEX I

## Water as a Key Resource in Sustainable Development

## Report of Working Group 1

## I. INTRODUCTION

43. The Working Group's discussion was based upon a recognition that water is fundamental to sustainable development and a basic component of national and regional ecosystems. In many parts of the world, current patterns of development and use are not sustainable, environmentally, socially and economically.

44. The four stage discussion process was; (a) a brief consideration of the stresses on freshwater; (b) a brief consideration of the role of integrated water resource management in easing the stresses and resolving competition for limited water resources; (c) a more detailed consideration of the policy responses and choices, the development of strategies or lines of approach and the choice of management options; and (d) the articulation of actions at international, regional, national and local level (in which 'local' comprises all sub-national levels from states, provinces, regions, municipalities, districts down to community level).

## II. THE STRESSES

45. There are a number of unprecedented demands for water supplies, resulting from population growth and sectoral pressures, both as consumptive and non-consumptive uses. This includes in particular, agriculture (particularly irrigation and drainage), the provision of domestic water supply and sanitation, industry, energy production, environment/amenity(including tourism)/ecosystems, changes in patterns of consumption as a result of industrialisation, rural/urban shifts, migration, and unaccounted for water. A characteristic of these stresses is that all their components are not equally distributed in time and space. All are seeking to maximise the stream of social and economic benefits from a limited resource base.

46. Unprecedented impacts on the water resource base include reduced base flows, declining aquifer reserves, point and non-point pollution to surface and groundwater, background levels of contamination, and climatic variability and hydrological uncertainty. These together are having unprecedented impacts on socio-economic development, which can lead to deteriorating public health (indicating that health aspects need to be explicitly factored into the planning process) users forced to internalise the externalities of other users (leading, for example, to upstream/downstream disputes), increasing costs of water development, limitations on development, and impacts on national security.

47. This can result in the degradation of the resource base, intensified competition for water quantity and quality (for example, agriculture looking for high volumes of low quality water, municipalities looking for small volumes of high quality water) and the loss of productivity related to water.

48. The strategic challenges is to ensure sustainability of the resource in the face of the above stresses.

## III. INTEGRATED WATER RESOURCES MANAGEMENT

49. There is a compelling case for adopting integrated water resources management approaches, although some past attempts have not been fully successful. To achieve success, water management should be conducted within a national economic framework as a key element in sustainable economic development and poverty alleviation. When doing so, countries should ask precisely what role water resources management can play in (a) promoting socio-economic productivity through co-ordination and integration of sectoral policies and explicit linkage of water in the economic framework and planning process; (b) promoting sustainability - maintaining the asset value of the water resource base; (c) mitigating climate change by using energy from water and the use of solar and wind energy for water pumping; (d) promoting soil and water conservation through explicit linkage of water with land and forestry policies; (e) promoting peace and security through co-operation in the management of international water systems.

50. Such management can also provide for: (a) reconciling equity and efficiency in the allocation of resources, provision of water services and the protection of the resource base, that is who pays ? and who benefits ? and; (b) promoting the use of best practices and appropriate technologies for managing water demand and supply.

51. Integrated water resources management is most effective when conducted in the spatial framework of the river basin or aquifer and should be supported by integrated information management systems.

## IV. THE IMPLICATIONS FOR POLICY RESPONSES AND MANAGEMENT STRATEGIES

### A. <u>The Development of National and Sub-national Water Policy and Programmes</u>

52. The Commission on Sustainable Development (CSD) should urge, as recommended in Agenda 21, that each country adopt a national water policy and accompanying programmes, where this already exists, review and revise such policy and programmes as necessary. The

CSD should call upon countries to submit information on their policy and national programmes in the year 2002. Policies should be developed in an open and transparent process with the participation of all stakeholders.

53. In some large countries, the responsibilities for the development and implementation of such policies and programmes may need to be divided between national and sub-national (state/province) entities.

54. The elements of such national instruments could include, *inter alia:*

(a) The formulation and implementation of research, monitoring and information management programmes for understanding the quantity and quality of the resource base and its variability in time and space, and the social and economic forces affecting them;

(b) The allocation of water resources, taking into account the principle that access to safe drinking water and sanitation is essential for satisfying basic human requirements, that other allocations should be based upon consideration of economic efficiency and equity, and that allocations should be based on sustainability of the resource base, including an ecosystem approach and environmental protection;

(c) The incorporation of health concerns into the freshwater management process through the adoption of explicit health objectives in planning, the use of health indicators in routine monitoring and the assessment of health outcomes in evaluation;

(d) The protection of the aquatic environment, including wetlands, from local and diffuse pollution sources and from threats posed by exotic influences to maintain physical and chemical balances and biological integrity;

(e) The management of demand as a key part of the policy, focusing on water conservation through re-cycling and re-use and where appropriate to be driven by pricing policies and by adopting best practices and appropriate technologies;

(f) The management of water supply in order to deal with annual and inter-annual variations, to support food security and other purposes;

(g) The provision of appropriate mechanisms for management of land and water resources on an integrated basis within natural hydrological and hydrogeological units (river basins and aquifers), providing for necessary interactions with administrative organisations where provincial, municipal and district boundaries do not coincide with basin or aquifer boundaries;

(h) The inclusions of provisions for coping with hydrological extreme events and disturbances, particularly droughts and floods and erosion, through implementation of programmes of drought preparedness and flood protection and mitigation including adequate monitoring and early warning systems;

(i) The development and sustenance of appropriate institutions including cross-sectoral water councils and recognising needs for capacity building, public information and education.

## B. Developing Management Strategies

55. Finding strategic management approaches to implement the policy and to support social, economic and environmental policies, as well as promoting the long term sustainability of the water resource base requires a choice among a number of management tools. Institutional design, economic instruments, advocacy, public education, ( *i.e.* the whole range of management tools) can be considered. Particular attention need to be paid to ensuring that the poor benefit from the strategy adopted. However, given that it is not possible to do everything at once and given the known constraints, the thematic areas in which strategic cross-sectoral interventions are possible are outlined below:

(a) Build awareness at all levels (International, regional and at shared basin/aquifer level). This includes the role of education and the recognition of the needs of specific groups, such as women;

(b) Build capacity including strengthening participatory frameworks, promoting community ownership and management, developing water resources management skills and institutions at basin/aquifer level, developing operational monitoring and evaluation procedures; developing operation and maintenance and, promoting public - private sector partnerships;

(c) Promote an enabling environment through;(i) declaring a water policy with explicit recognition of basin and aquifer management; (ii) continuously monitoring and evaluating policy and action plans; (iii) developing an effective legal and regulatory framework including those needed within a basin/aquifer framework; (iv) ensuring effective regulation; (v) decentralising the implementation of regulatory and operational functions to the extent practical; (vi) adopting appropriate instruments for allocation; and (vi) sustaining water and socio-economic data and information systems;

(d) Ensure sound sectoral strategies through: (i) setting sectoral targets and developing visible state, process response indicators, ensuring that targets are directed especially towards the poor; (ii) extend sustainable water supply and sanitation services; (iii) increasing agricultural/aquaculture productivity and food production per unit of water; (iv) promoting water conservation through judicious use of procedures and technology, old as well as new; (v) harmonizing water resources management and energy sector strategies; (vi) promoting soil and water conservation as part of basin-wide strategies;

(vii) integrating erosion and flood control with land and forestry development; and
(viii) integrating water/soil/air pollution control measures;

(e) Cope with variability and change including; structural and non-structural solutions for flood damage reduction; reducing impacts of flooding on inhabitants of affected areas, and developing programmes for drought preparedness;

(f) Promote regional co-operation through: (i) developing approaches to international management but building on a sound national base; (ii) adopting co-operative strategies; (iii) facilitating information exchange between riparians; and (iv) promoting river basin organisations and basin level planning and development.

## V. IMPLEMENTING THE MANAGEMENT STRATEGIES

56. Suggested actions to be taken within countries for implementing management strategies include:

(a) In considering the management strategies and implementation measures to be adopted, countries need to develop profiles of current freshwater management identifying the factors that impede progress toward integrated water resources management;

(b) Starting from the local level, there is a need to; analyse and identify capacity building requirements through research and analysis; design appropriate water resource and environmental management strategies; integrate local level initiatives in overall basin planning framework, and strengthen the capacity of communities in the management of their water resources;

(c) Develop consensus among all stakeholders through broad based consultations with a view to developing political will;

(d) Develop estimates of national water expenditures and benefits in order to demonstrate the significance of the water sector for the national economy and to assist in setting priorities;

(e) Adopt technologies combining indigenous and modern techniques, especially for water conservation, re-use and improved efficiency in irrigation and other sectors;

(f) Co-ordination and monitoring of water withdrawal at national or basin/aquifer level to ensure the sustainability of the resource base;

(g) Support water monitoring and undertake and publicise studies of the economic value of water data.

57. Recommendations at the international level include the following:

(a) The Expert Group Meeting recommended to the CSD the completion of the development of water sector indicators in the context of its programme of work on indicators of sustainable development, taking into account on-going work in this area;

(b) That international co-operation on water related natural disasters be continued after the end of IDNDR (1999), in particular through the maintenance of early warning systems and the exchanges of information on disaster loss reduction methods;

(c) Promotion by the international community of information exchange with special efforts to link all countries electronically;

(d) International organisations should mobilise and co-ordinate assistance for education, training and capacity building;

(e) Development of a consolidated United Nations Guidebook on integrated water resources management to replace existing sectoral guidelines;

(f) Support by Governments and the international community for the maintenance of international information and monitoring networks;

(g) Harmonisation by Governments of data collection at the basin/aquifer level;

(h) Multi and bi-lateral partners should emphasise integrated water resources management, taking into account the needs of the poorest communities.

## VI. TRANSBOUNDARY WATER SYSTEMS

58. Riparian States are encouraged to co-operate among each other on matters related to transboundary water resources, building on existing agreements principles, arrangements, instruments and programmes of action, taking into account the interests of all riparian States concerned. Such efforts, upon common requests of concerned States, may need to be supported through international co-operation.

# ANNEX II

Freshwater Ecosystems and Water Quality

Report of Working Group 2

## I. INTRODUCTION

59. The report provides a brief consideration of the role of freshwater ecosystems and water quality in integrated water resources management and sets out a range of specific actions which can be taken up by national Governments, as appropriate, to accelerate the implementation of chapter 18 and other water related chapters of Agenda 21. These actions are guided by policy choices (the stated objectives of governments) and strategic management options (how to put the policy into place within national social and economic frameworks). Finally, suggested objectives are recommended for the Commission on Sustainable Development .

## II. THE ROLE OF FRESHWATER ECOSYSTEMS AND PROTECTION OF WATER QUALITY IN INTEGRATED WATER RESOURCES MANAGEMENT

60. Chapter 18 of Agenda 21 states that one of the objectives of integrated water resources management is the "maintenance of ecosystem integrity, according to a management principle of preserving aquatic ecosystems, including living resources, and of effectively protecting them from any form of degradation on a drainage basin basis". It also recommends the adoption of an integrated approach to environmentally sustainable management of water resources, including the protection of aquatic ecosystems and freshwater living resources, and the integration of water quality elements into water resources management.

61. However, current integrated water resources management practices often consider ecosystems primarily as water users, with little attention given to their vital role as providers and regulators of water resources. Little consideration has been given to the other services and goods that ecosystems provide, such as flood regulation, Biodiversity conservation, fish and firewood. It is of fundamental importance to the long term availability and sustainable management of water resources that the maintenance of ecosystems and the strengthening of their role as providers of services and goods be recognised.

62. Similarly, in spite of high-level of commitments to action made at both the International Conference on Water and the Environment and the Earth Summit, water quality has invariably been subordinated to water quantity and sanitation has been neglected. The result of that neglect is an emerging crisis of water quality, damaging public health and restricting economic development. In order to deal effectively with this neglect of both freshwater ecosystems and

water quality protection, and thus accelerate the implementation of the activities in the area of freshwater ecosystems and water quality proposed in Chapter 18 of Agenda 21, a number of specific actions in both areas are recommended primarily to national governments.

## A. Proposed actions in the area of freshwater ecosystem management

63. The proposed actions in the area of freshwater ecosystems are aimed to achieve three major goals: (a) ensure the integration of the ecosystem approach into integrated water resources management, recognising the role of ecosystems as users, providers and regulators of freshwater and freshwater-based resources (including fisheries); (b) ensure the effectiveness of local or national systems for controlling interactions between human activities and functioning of ecosystems; (c) ensure participatory approaches to ecosystem management based on recognition of the economic and social value of freshwater ecosystems. The overall goal is to maintain the functioning of ecosystems and to protect water quality as a base for sustainable development. Most of the above-mentioned actions are for national or local levels but many will require appropriate international action and support.

### 1. Ensure the integration of the ecosystem approach into integrated water resources management, recognising the role of ecosystems as users, providers and regulators of freshwater and freshwater-based resources (including fisheries)

64. The following specific actions were identified to address these goals:

(a) Strengthen national programmes for gathering, analysing, monitoring and disseminating physical, economic and social data necessary for ecosystem management, build institutional capacity to understand and assess ecosystem functions and values, and incorporate them into the decision-making process;

(b) Carry out comprehensive assessments of functions and values of ecosystems in terms of their social, economic and environmental benefits and costs, in order to manage change;

(c) Promote research at both national and international levels to determine the economic value (in monetary terms) of both the benefits provided by ecosystems and the costs of their degradation;

(d) Raise awareness of ecosystem functions and values at all levels, from school children (local) to national policy-makers through both national and international campaigns.

2. Ensure effective local or national systems to control interaction between human activities and functioning of ecosystems

65. The following specific actions were identified to address this goal:

(a) Use environmental impact assessments to measure and monitor impact of human activities on ecosystems;

(b) Launch co-ordinated international programmes to identify and control plant and animal pest species, such as water hyacinths, that threaten ecosystem integrity;

(c) Establish a legal framework for allocating adequate amounts of water to ecosystems, including for the restoration of degraded ecosystems;

(d) Incorporate protection of human health dimension in the management of freshwater ecosystems;

(e) Ensure coverage of the major human impacts on freshwater ecosystems, such as in river structure management, impoundment, abstraction, point discharges, diffuse inputs and fisheries/aquaculture;

(f) courage countries to reduce or eliminate subsidies to activities that damage ecosystems;

(g) Apply basin-wide approaches to freshwater ecosystem management for both surface and ground water;

(h) Establish measurements and research programs for understanding the quantity and quality of the resource base and its variability in time and space.

3. Ensure participatory approaches to ecosystem management based on realisation of the economic and social value of freshwater ecosystems

66. The following specific actions were identified to address this goal:

(a) Promote and disseminate best practices and traditional knowledge in ecosystem management;

(b) Introduce measures to decentralise decision-making and empower local communities to participate in efforts to protect freshwater ecosystems;

(c) Launch information campaigns and information networks at both national and local levels to raise public awareness and foster social mobilisation to the need for protecting freshwater ecosystems;

(d) Improve local institutional capacity and promote human resources development to strengthen community participation, taking into particular account the role of women in rural communities as protectors of the environment.

### B. Proposed actions to protect water quality and human health

67. The proposed actions in the area of water quality are aimed to achieve four major goals: (a) establish objectives necessary to safeguard water quality as regards human health, productive uses of water and the protection of freshwater (b) implement measures in support of the objectives for safeguard water quality (c) establish effective data collection programmes to provide a sound basis for establishing goals and monitoring progress towards them (d) significantly accelerate access to environmental sanitation (including solid and liquid waste management) in order to reduce the threats to human health and freshwater ecosystems. Most of these actions are for national or local levels but many will require appropriate international action and support. It should be recognised that poor environmental sanitation results in serious degradation of ecosystems and is the leading cause of human diseases.

#### 1. Establish objectives necessary to safeguard water quality as regards human health, productive uses of water and the protection of freshwater ecosystems

68. The following specific actions were identified to address these goals:

(a) Set requirements for drinking-water quality;

(b) Set targets for ambient water quality in relation to intended uses and the protection of the freshwater ecosystem;

(c) Set requirements for effluent discharges and the control of pollution from non-point sources.

#### 2. Implement measures in support of the objectives for safeguarding water quality

69. The following specific actions were identified to address this goal:

(a) Raise political awareness of the cost of pollution and build up support for relevant reform, for example, through studies of the economic and health costs of water pollution;

(b) Document or initiate successful examples of complex programmes to remedy water quality problems as a basis for sharing know-how;

(c) Strengthen capacities to plan and implement programmes for capital investment, delivery of services, maintenance of systems, and for monitoring and regulating water quality requirements;

(d) At national and international levels, prioritise key knowledge gaps that inhibit effective water quality management and develop research programmes to fill the gaps.

3. <u>Establish effective data collection programmes to provide a sound basis for establishing goals and monitoring progress towards them</u>

70. The following specific actions were identified to address this goal:

(a) Establish standards for water quality data which ensure their reliability and consistency;

(b) Evaluate and modernise, as appropriate, data programmes so that they are cost-effective and focused on data needs for water policy and management decision-making;

(c) By 2002, carry out a national water quality inventories for surface and ground waters, and identify gaps in information.

4. <u>Accelerate significantly access to environmental sanitation (including solid and liquid waste management) in order to alleviate poverty, improve human health and protect freshwater ecosystems</u>

71. The following specific actions were identified to address these goals:

(a) Redress the imbalance in the resources devoted to sanitation, including capital investments, untapped community efforts, and innovative financing and credit mechanisms to expand sanitation coverage;

(b) Ensure that new water programmes are accompanied by safety disposal measures for the resulting waste water;

(c) In addition to actions by national and local authorities, introduce measures to empower local communities to participate in efforts to extend access to sanitation, taking into particular account the role of women;

(d) Improve sanitation services through hygiene education, innovative low-cost systems, such as dry- and low-water-use systems, and targeting projects on health objectives;

(e) Support recent national and international initiatives to expand sanitation coverage through information sharing among governments, communities NGOs and the international community.

### C. Overall goal for protecting freshwater ecosystems and water quality

72. Maintain the functioning of ecosystems and protect water quality as a base for sustainable development, and establish or strengthen systems to monitor progress on drinking-water supply and sanitation, as well as water quality and management generally, at local, national and international levels, and to identify emerging issues and needs.

### D. Support, in financial and operational terms, the integration of ecosystem approaches and water quality into integrated water resources management

73. The following specific actions were identified to address these goals:

(a) Donors should consider ensuring that an adequate share of their ODA is allocated to the protection of freshwater ecosystems;

(b) International financial organizations and donor Governments need to take steps towards the co-ordination of international financial flows in the form of direct grants and loans in concessional terms to recipient countries for the protection of freshwater ecosystems;

(c) Establish appropriate budgetary mechanisms specifically designed to finance measures to protect or reverse the degradation of freshwater ecosystems

## III. SUGGESTED OBJECTIVES FOR THE COMMISSION ON SUSTAINABLE DEVELOPMENT

74. The CSD is invited to recommend that each country adopt a national or local water policy, including measures to protect freshwater ecosystems, or where this exists, to review and revise as necessary. CSD may consider calling upon countries to report on their policy and the progress in the year 2002. Policies should be developed in an open and transparent process with public and stakeholder participation. It is recommended that such policies should be based on the recognition of water as a national and international heritage – with the protection of freshwater ecosystem as an integral part of this effort -- and should address *inter alia:*

(a) The principle that water resources allocation decisions should take into account that access to safe drinking water and sanitation is essential for satisfying basic human needs and that the allocation to other users must be based on economic efficiency and sustainability criteria;

(b) The need for demand management as a key element of integrated water resources management policy, focusing on water conservation through re-cycling and re-use, and where appropriate to be driven by pricing policies and by adopting best practices and appropriate technologies;

(c) The need to provide appropriate mechanisms for management of land and water resources on an integrated basis with national hydrological and hydrogeological units and to provide for the necessary interaction with administrative organisations across municipal and district boundaries;

(d) The need to formulate measures for coping with extreme climatic and meteorological events, droughts and floods, through implementation of programmes of drought preparedness and flood protection and mitigation including adequate monitoring and warning systems;

(e) The need to protect the aquatic environment, including wetlands, from local and diffuse pollution sources and from threats posed by exotic influences to maintain physical, chemical and biological balances;

(f) The need to develop and support appropriate institutions including cross-sectoral water councils and to recognise the importance of capacity building, public information and education;

(g) The need to take into account actions required to implement the Conventions on Biodiversity, Desertification, Climate Change, Wetlands (RAMSAR) and International Trade in Endangered Species (CITES) as well as close linkages with the implementation of the Global Programme of Action for the Protection for the Marine Environment from Land-Based Sources of Pollution.

# ANNEX III

## Economic and Financial Issues

## Report of working group 3

## I. INTRODUCTION

75. This annex provides a brief review of economic and financial issues that were discussed on the basis of recommendations of chapter 18 of Agenda 21 and recommendations by the Commission on Sustainable Development. The discussion aimed to elucidate a range of policy options aimed at enhancing the financing of water resources and the economic performance of water resources development and utilisation.

76. It was recalled that as stated in the Programme For The Further Implementation of Agenda 21, the inter-governmental process under the aegis of CSD on Freshwater will be fully fruitful only if there is a proved commitment by the international community to the provision of new and additional financial resources for the goals of this initiative.

## II. ECONOMIC AND FINANCIAL CONCERNS IN THE DEVELOPMENT AND UTILISATION OF WATER RESOURCES

77. Water is a finite and vulnerable environmental resource and a social and economic good. The allocation of scarce water resources among competing uses has fundamental effects on ecosystems and the national economic development in terms of employment and the generation and distribution of income and poverty alleviation. Such policies can also have significant impacts on land use planning and the movement of population from rural to urban areas. The access of suitable amounts of water for basic human needs should be incorporated in the formulation and implementation of economic policies for resource development and allocation.

78. The use of pricing policies and other economic instruments are essential for the effective and equitable allocation of the resource taking into account social and economic criteria as well as basic human needs. Economic evaluations need to consider positive and negative impacts on health, human and ecosystems. Inadequate economic policies have often contributed to the poor performance of water utilities thus decreasing their ability to attract financial resources from the public and private sector as well as from the international community. To the extent that subsidies are required for social reasons, they should be well targeted to the intended beneficiaries and managed in a fully transparent way. Subsidies should be seen in the context of poverty alleviation as measures which, in time, could be phased out. Additional funding, targeted mainly to peri-urban and rural areas, is required.

79. While the public sector has traditionally played a major role in financing water resources development, there is an increasing recognition of the need for the involvement of other

stakeholders (local private sector and community based organisations) and financial sustainability.

80. Financial support for the collection, processing and dissemination of timely, reliable and demand-oriented information is essential to the effective management of water resources.

81. In addition, the number of water related natural disasters (flood, drought) have been rising rapidly over the past decades. Therefore, the economic evaluation for the losses due to these phenomena and financial provision for their prevention and mitigation should be of priority.

## III REASONS FOR ANALYZING ECONOMIC AND FINANCIAL ISSUES IN THE WATER SECTOR

82. Several reasons justify the interest in analysing issues related to economic and financing considerations in the water sector. Among those are:

(a) The importance of water as a natural resource with a social as well as an economic good ;

(b) Given that the sector requires new and additional financial resources, the need to understand how and by whom the water resources sector is financed, particularly in the case of the service component of resource management;

(c) The importance of defining the role of the government and the private sector and their financial obligations;

(d) The need to take into account differences between rural and urban areas and the different users (agricultural, industrial, energy, etc...) in view of the wide range of water users in the economic spectrum;

(e) The need to ensure the security and provision of water through incentives provided by government for the purpose of satisfying basic human needs, taking into account that the provision of water supply to some areas of the sector is economically justified at the macro level despite the non profitability in terms of internal cost recovery, particularly in under privileged areas;

(f) The need to understand and use economic tools and apply them into the water sector to achieve greater efficiency;

(g) Decision makers need to know the cost of provision of water, establish long term economic perspective of water in the overall economy, and take into account the social implication of water resources, and determine appropriate development scenarios;

(h) The necessity to link performance and financing to cost recovery and to show users the benefits of using sustainable management solutions and the impact of such actions on the economy;

(i) Social and environmental cost/benefit analysis needed in water related projects;

(j) Deficient practices exist in budgeting development, operation and maintenance;

(k) Integration of water into national, sub-national, and river basin planning as the resource is needed in all sector activity;

(l) The fact that lack of water in an area will result in migration to areas where the resource is available, shows the need for integration of water resources development and management with land use planning which will result in stabilising rural populations through added employment opportunities and poverty alleviation.

(m) Reforms of the water sector will result in economic benefit, specially at local level;

(n) The need to finance capacity building to improve management;

(o) Funding basic water data collection and management must be sufficient to understand the nature and variations of the resource;

(p) Needed efforts to prevent and mitigate disaster losses;

(q) The fact that foreign and national private investments are increasing notably in urban areas does not minimise the need for significant increases in national and international financing in view of the very large investment requirements.

## IV STRATEGIC PRINCIPLES AND RELATED PROPOSED ACTIONS AND THEIR IMPLEMENTATION

### A. Goal 1: Ensure the integration of water into the national economy, recognising it as a social and economic good, vital for the satisfaction of basic human needs, food security, poverty alleviation, and the protection of ecosystem functioning, and applying economic instruments in its management

83. In order to achieve this goal, the following strategic issues were identified:

(a) Recognise water as a social good, for the satisfaction of basic human needs, to be provided to all, with due attention given to gender dimensions;

(b) Recognise water as a finite and vulnerable resource with a value in alternative uses, environment and ecosystem maintenance, and consider this value in the intersectoral allocation of water for different uses taking into account water quality;

(c) Estimate and consider «intangibles», such as social and environmental values of water in dealing with intersectoral allocations;

(d) Consider that special conditions apply in rural non/monetary sectors of the economy in which economic instruments may be difficult to apply.

84. The following specific actions were identified to address these issues.

(a) Apply demand management approaches based. on assessment of demands and users' willingness and ability to pay;

(b) Ensure that a proper regulatory environment exists for cross-sectoral consideration of user charges for different sub-sectors;

(c) Collect and disseminate internationally experiences, good practices and instruments for evaluation of water for different uses, including environmental and ecosystem maintenance. Establish mechanisms for applying these practices and instruments at the appropriate management levels;

(d) Develop and grant legal concessions for water abstractions and infrastructure management at the local level;

(e) Consider conditions in poor rural communities by focusing on low cost solutions, and factoring in contributions in kind by local users through labour and other inputs;

(f) Include environmental parameters in the evaluation of water related projects in all sub-sectors.

## B. Goal 2: Ensure efficiency, transparency and accountability in water resources management as a precondition for sustainable financial management

85. The following strategic issues were identified as being pertinent to achieving this goal:

(a) An efficient and transparent financial management is a precondition for effective cost recovery;

(b) The provision of high-quality services to users is a precondition for effective cost recovery;

(c) The allocation and use of revenues from water within the water sector itself, and within local communities, must be transparent;

(d) The application and acceptance of the principle of water as an economic good requires full transparency and accountability in charges, subsidies, cross-subsidies and taxes applied to different user groups;

(e) Investments in the water sector should be made with the objective of maximising the output and productivity of water resources.

86. The following specific actions were identified to address these issues.

(a) Ensure transparency in charges, subsidies, cross-subsidies and taxes;

(b) Ensure transparency in the management of water service providers (water utilities), and avoid monopolies whenever possible;

(c) Develop and apply criteria and standards for performance of utilities, and link these to user charges;

(d) Ensure regular public, independent audits of service providers;

(e) Monitor the performance of equipment, and ensure that procurement takes place in a transparent manner, and through international tender. Avoid to the extent possible procurement through tied aid;

(f) Develop and apply instruments for charges in the irrigation sector through studies and collection and dissemination of international experience;

(g) Develop and apply instruments for pollution charges through studies and collection and dissemination of international experience;

(h) Pay particular attention to avoiding cost and time overruns.

## C. Goal 3: Ensure the establishment of public/private partnerships

87. The following issues were identified as being pertinent to achieving this goal:

(a) The existence of a clear definition of and distinction between the role of government, the private sector and other stakeholders, where appropriate to local situations;

(b) The establishment of an environment conducive to private sector investment;

88. The following specific actions were identified to address these issues.

(a) Require environment reviews for export guarantee (credits) to attract private funds and services;

(b) Institute clarification and awareness building measures with respect to defining and understanding the role of private sector;

(c) Define the roles and responsibilities of the partners in public / private partnerships (PPP), including NGO's, local authorities and community based organisations. Promote organisational changes in Government accordingly;

(d) Define and take into consideration elements of risks in water resources management and specify risk responsibilities of the various partners;

(e) The resources to be provided by both the service provider and the Government have to be clearly defined, controlled and clearly spelled out

### D. Goal 4: Ensure financial sustainability

89. The following issues were identified as being pertinent to achieving this goal:

(a) The need for determining means and methods to be put in place to facilitate gradual transition towards full cost recovery, whereby all costs are recovered from users or otherwise funded on a sustainable basis;

(b) The need for considering different criteria to determine financial burden of the different users;

(c) The need to ensure that the sector should be financially self sustainable.

90. The following specific actions were identified to address these issues.

(a) Identify criteria for levels of cost recovery for different categories of users, through economic analyses and consultations with users groups;

(b) Develop financial and regulatory instruments to facilitate private investments;

(c) Implement adapted financial policies for poorest and rural areas;

(d) Develop adapted financial solutions for sanitation;

(e) Redirect public savings to «sustainable development» actions;

(f) Allocate resources from water charges for Research and Development purposes;

(g) Link financial self sustainability of local services with decentralisation through the participation of users and mobilisation of local entrepreneurs;

(h) Diversify sources of funding.

### E. Goal 5: Ensure adequate financing of the water sector

91. The following issues were identified as being pertinent to achieving this goal:

(a) The adequacy of absorptive capacity and availability of financial resources within the sector;

(b) The lack of political awareness and will to implement strategies aimed at recovering costs;

(c) The requirements of external finances limit the flows of resources to the sector.

92. The following specific actions were identified to address these issues:

(a) Improve donor – recipient dialogue on financing;

(b) Ensure to include in the estimation of costs, all operational, maintenance and other costs;

(c) Put in place a national fund for financial resources mobilisation and allocation;

(d) Urge the international community and Governments (in both recipient and donor countries) to maintain and consider increasing their financial support to freshwater resources development. The impact of such a support would be far more significant if it were well targeted and predictable;

(e) Improve communication and co-operation among sources of financing of the sector;

(f) Mobilise largely untapped community financing resources and provide credit mechanisms which foster self help efforts by individuals;

(g) Identify and mobilise innovative source of funding;

(h) Increase water sector finances where absorptive capacity exists. Where it does not, improve or upgrade the adsorptive capacity;

(i) Particular attention must be made to include operational, maintenance and depreciation costs in all water related projects.

F. Goal 6: Ensure financing of water resources data knowledge base as a basis for analysis and research for better understanding and decision making

93. The following specific actions were identified to address these issues:

(a) Foster links between environmental impact assessment with data base development;

(b) Create national water funds for the development of the water resource knowledge base, including contributions from users;

(c) Support integrated water resource information systems and their management, particularly early warning systems;

(d) Support for awareness program for understanding the need for data collection, decision making, policy impact assessment and public information as well as education.

G. Goal 7: Ensure that provision is made for economic costs analysis of extreme events or chronically prone areas to flooding and drought

94. The following specific actions were identified to address these issues:

(a) Create mechanisms of regional consultation including meetings, creation of regional solidarity funds with the assistance of the international community;

(b) Put in place drought and flood preparedness programs and early warning systems;

(c) Put in place mitigation plans at local and national levels;

(d) Put in place regional emergency funds and insurance programs for extreme events;

(e) Prepare drought as well as flood preparedness mitigation programs.

## IV. PRIORITY AREAS IN NEED OF FINANCING

95. Areas in need of financing were grouped into institutional and capacity building, integrated water resources planing and management, support to underprivileged area and investment initiatives:

(a) Institutional capacity building/support to policy including support to policy and legislation;

(b) Integrated Water Resources Management;

(c) Data collection, monitoring and integrated information management systems;

(d) Knowledge of hydro-ecosystems functioning;

(e) Demand and supply assessment;

(f) Feasibility and thematic studies;

(g) National, sub national and river basin action plans;

(h) Local support for sustainable solutions to communities, associations, local authorities and emerging local private sector;

(i) Investment for those without access to basic needs.

## V. STRATEGIES/ACTIONS FOR COST REDUCTION

96. Several strategies and actions could be recommended in addressing economic and financial issues related to integrated water resources management. Among the measures of particular interest are cost reduction means including:

(a) Restructuring of existing institutions to reduce cost;

(b) Improving existing management such as demand management/leak reduction;

(c) Promoting competition in service provision;

(d) Improving existing data collection network;

(e) Provision of financial incentives, including tax exemption for equipment and for private sector;

(f) Investing in under privileged areas;

(g) Reliance on low cost systems and appropriate technologies including indigenous technologies;

(h) Increasing accountability in system management.

## VI. SUMMARY OF KEY ISSUES AND RECOMMENDED ACTIONS

97. Water must be integrated into the national economy, recognising it as a social and economic good, vital for ecosystem functioning and applying economic instruments in its management. As such, economic policies must consider «intangibles» such as social and environmental values of water as well as the special conditions in non monetary sector economies.

98. Actions should be oriented towards applying demand based management approach taking into account the notion of users' willingness and ability to pay. Resources must help in the collection, dissemination and transfer of international experiences in economic evaluation and financial management of water resource. Where possible, support should be provided to strengthen private sector, community based participation as well as the development of appropriate and low cost technologies. Also, assistance should continue in favour of public institution in improving their role.

99. Efficiency, transparency and accountability are keys to sustainable financial management of water resources. For these, several actions are required. Information should be made public for performance indicators, procurement procedures, pricing policies and components, cost estimates and revenues. Determination and allocation of subsidies, cross-subsidies, charges should be transparent in order to maintain confidence and improve investment revenues in the sector. Instruments such as auditing could help achieve this goal.

100. Integrated water resource management required closed partnership between public and private sectors. As such, a clear definition and distinction should be made of the role of government, the private sector and other stakeholders, where appropriate to local situations. In doing so, it is important that the institutional and legal environments be conducive for private sector investment and the emergence of local water service providers. Particular attention has to be given to financial and economic risk assessment.

101. Regardless of policies, financial sustainability is a prerequisite for sustainable integrated water resource management. Therefore, it is a necessity to facilitate a gradual transition towards full cost recovery, criteria for financial burden sharing and the development of financial and regulatory instruments. Also, measures needed include adapted financial policies for the poorest and rural areas and the allocation of resources from water charges to research and development purposes. Emphasis should be placed on participation of users, training of local entrepreneurs and the diversification of sources of funding. Furthermore, a strong link should be made with the decentralisation process.

102. At the same time, it is important to ensure adequate financing of the water sector. Related issues in this case concern the adequacy of absorptive capacity and availability of financial resources within the sector, the lack of political awareness and will to implement strategies aimed at recovering costs as well as the requirements of external funding sources

which limit the flows of resources to the sector. Thus, actions should be aimed at improving donor – recipient dialogue on financing , the creation of national fund for financial resources mobilisation and allocation in the water resources sector. The international community and Governments (donors and recipients alike) should be urged to maintain and encourage to increase their assistance to the water resources sector in a predictable manner and targeted to solve specific problems. Value can be added by improving communication and co-operation among sources of financing as well as the mobilisation of largely untapped community financing resources and through the provision of credit mechanisms which foster self help efforts by individuals. This includes, the mobilisation of innovative source of funding.

103. Financing of water resources data knowledge base is a basis for analysis and research for better understanding and decision making. Decision making rely, to a large extent, on the existence and the availability of data and their analysis. Thus is essential that adequate financial resource be provided for better understanding of water resource knowledge base. This implies, among others, the fostering of links between physical, socio economic and environmental impact assessment with data base development, the creation of national water funds. Support should similarly be mobilised for integrated water resource information systems and their management, particularly early warning systems Also, awareness for understanding the need for data collection, decision making, policy impact assessment and public information as well as education deserve an attention.

104. The frequency of extreme events have increased in recent decades. Therefore, provision should be made for economic costs analysis of these events and for the management measures for chronically prone areas to flooding and drought. Several main actions may concurred to achieving this goal. The creation of mechanisms of regional consultation, regional solidarity funds, drought and flood preparedness programs and early warning systems, mitigation plans at local and national levels, regional emergency funds and insurance programs for extreme events could be considered.

105. In a broader perspective, several priority activities should be financed including institutional and capacity building, integrated water resources planning and management. Particularly, local support should be provided for sustainable solutions to communities, associations, local authorities and emerging local private sector.

106. Finally, financial resources can be best attracted to the sector when efforts are made to increase financial accountability and to reduce cost in particular. For this, specific actions could include restructuring of existing institutions, improving existing management through demand management/leak reduction, promoting competition in service provision, data collection and creating financial incentives, participation as well as the use of low cost technologies.

# ANNEX IV

## Participation and Institutions for Integrated Water Resources Management

## Report of working group 4

## I. INTRODUCTION

107. Water is not only a social and economic good but also an environmental resource. To consider water resources as a "common heritage" carries for some countries a too restrictive connotation. In its broad meaning, the water sector encompasses all activities related to integrated water resources management (IWRM) and to the development, distribution and utilisation of the resource (water supply and sanitation, agriculture, environment and ecosystems, hydropower, industry and other uses). The main difficulties faced in the formulation and implementation of IWRM policies and programmes are not due to lack of technical solutions but rather to the deficiency of institutional organisation and to insufficient legislation and/or enforcement of water acts and regulations. Institutional and legal frameworks are key elements of IWRM. Equally, the involvement of users and stakeholders is required if empowerment and ownership of the process is to ensure sustainability of IWRM and water resources development.

108. In most developing countries, institutions are viewed as too weak or too young to adequately carry out IWRM and need therefore to be strengthened. IWRM has a cost that needs to be carefully evaluated and covered. External Support Agencies (ESA) are urged to consider parallel financing of the creation/strengthening of IWRM institutions, as an integral part of water resources development projects.

109. In the following, all recommended actions are meant to complement or extend the recommendations of Chapter 18 of Agenda 21.

## II. ENHANCED PARTICIPATION FOR IMPROVED INTEGRATED WATER RESOURCES MANAGEMENT

110. The objective is to best manage the resource in an integrated fashion for the benefit of the users. Water policy and programmes should be co-ordinated with the overall economic planning of the country, particularly in the areas of agriculture and food security.

111. The focus areas for IWRM are as follows :

(a) Water resources assessments including monitoring, quality control and water-related environmental concerns, with special attention to the over-exploitation of aquifers;

(b) Socio-economic assessments including census data, patterns of water use and consumption, future needs, traditional customs, willingness to participate;

(c) Water resources planning within natural management units and at national and regional levels, reconciling the supply and the demand as they emerge from the assessments and effectively involving the key actors in preparing, revising and adopting documents which need be updated on a regular basis ; particular attention should be given to large infrastructure developments (such as dams and inter basin transfers);

(d) Implementation of the action plans with full involvement of the key actors;

(e) Day-to-day water resources management : adjustments of the plans with regard to the changing conditions of the water availability and needs. Specific attention should be given to extreme events (floods and droughts, including their long-term aspects) which need full engagement of the users and of the community at large to implement contingency plans and to the operation and maintenance of infrastructure;

(f) Water resources protection and conservation, with specific emphasis on improving water quality, environmental health conditions and sanitation (urban and rural areas), institutional and legal linkages within an ecosystem approach. Particular attention should be devoted to the spread of water-related diseases and of aquatic weeds in large water bodies;

(g) Mechanisms for prevention and resolution of water-related conflicts at local and national levels.

## III. KEY ACTORS AND FULFILMENT OF THEIR ROLE

112. An institutional framework includes a system of laws and regulations, economic and financial instruments and a clear definition of mandates and responsibilities among the various actors. This institutional framework must guarantee the involvement of all partners in the definition and in the implementation of national policies and strategies for IWRM at different levels (local, regional and national).

113. In keeping with Chapter 18 of Agenda 21, the following actors need to play a key role in the formulation and implementation of IWRM policies, strategies and action plans:

(a) Decision-makers;

(b) International organisations and External Support Agencies;

(c) Industrial water users;

(d) Scientific and research institutes;

(e) Water services providers, including private entrepreneurs, for drinking water supply and sanitation , irrigation and drainage, hydropower and other water uses;

(f) Water and water-related departments of the state;

(g) Municipalities and local authorities (elected and representing the states);

(h) Users and user groups;

(i) Professional organisations;

(k) National and international NGOs.

114. Specific recommendations for the involvement of key actors include:

(a) IWRM should integrate the interests of all users and stakeholders on a local, regional, national and international level in relation to water quality and quantity;

(b) National plans for IWRM should be developed in a constructive dialogue with users and stakeholders at the level of the management unit. They should make clear their interests and their role in the short, medium and long terms. This dialogue should include an assessment of the consequences of priority setting;

(c) There should be a clear distinction between the various stages of policy development and execution and the level of planning (local, sub-national, national and regional). The role and responsibility of the various actors should be clearly defined to avoid misunderstanding, but could change over time. The decision-making process should be at the appropriate lowest level taking into account these interests;

(d) Women should have an equal role in all management with regard to water resources, at the local, national and international level.

## IV. IMPROVEMENT OF THE INSTITUTIONAL AND PARTICIPATORY FRAMEWORK FOR INTAGRATED WATER RESOURCES MANAGEMENT

115. IWRM should integrate and reconcile interests regarding water quantity, quality and aquatic ecosystems of all actors. Community involvement is a key element in this process. The planning and implementation budgets must include all costs, infrastructure, management and operation and maintenance.

116. The following specific actions were identified to address these goals:

(a) Establish or update national policy and strategies for the entire water sector that are integrated with overall socio-economic development (including the co-ordinating mechanisms). The elaboration of policy, strategies and legal instruments should be a concerted process. A clear distinction has to be made for the implementation of IWRM between policy and standard settings, regulatory control/enforcement and the provision of services. An iterative planning process as a « bottom-up and top-down » dialogue is to be encouraged;

(b) Prepare, validate and adopt legislative and regulatory measures (including water administration, provision of services, standards for equipment, water quality and uses);

(c) Encourage countries to promote the use of economic and financial instruments, including appropriate incentives to improve water demand management;

(d) Promote the effective application of the "polluter-pays principle" and of the users-pay approach to generate revenues and regulate resource use with a view to an equitable allocation and redistribution of water benefits and charges, with special attention for low-income population groups;

(e) Ensure a clear operational framework at local, national and regional for the implementation of the action plans which should be well understood and accepted and include:

- the role of the state and public/private operators, including basin organisations and sectoral operators;
- the level and role of stakeholders in the management of basin institutions in a multidisciplinary mode;
- the partnership mechanisms that ensure smooth financing, implementation and maintenance of all water supply systems.

(f) Involve users and operators in the choice of the technological options and in the determination of services to be provided, taking into account existing local technologies and economic considerations.

(g) Promote the development of comprehensive water information systems that include water resources and socio-economic data bases;

(h) As part of capacity-building efforts, provide support to general education focusing on youth, as important advocates for information dissemination and attitude changes, and exchange of information, using as much as possible modern media and Internet;

(i) Strengthen the capacity building of decentralised agencies and community-based organisations for IWRM, particularly for water conservation and resource protection and promote the creation of an enabling environment for the participation of the providers of commercially-based services, taking into account national conditions and the type of services needed;

(j) Prepare water codes and other regulatory measures together with enforcement mechanisms;

(k) Formulation and implementation of specific educational, participatory, regulatory, economic and financial measures for the control of non-point sources of pollution;

(l) Consider the impacts of upstream decisions on downstream environments, especially on estuaries and coastal zones, taking into account other water-related intergovernmental conventions.

(m) The international community, including donor organizations, need to play an important catalytic role in support of national efforts towards the formulation and implementation of national plans, capacity building, technology transfer, and in the provision of technical cooperation, taking into consideration local and regional experiences.

## V. SUMMARY OF KEY RECOMMENDATIONS

117. IWRM should integrate the interests of all users and stakeholders on a local, regional, national and international level in relation to water quality and quantity and ensure effective community involvement at all levels and at all stages of the process. A clear operational framework at local, national and regional levels for the implementation of the action plans which should be well understood and accepted and should include:

(a) The role of the state and public/private operators, including basin organisations and sectoral operators;

(b) The level and role of stakeholders in the management of basin institutions in a multidisciplinary mode;

(c) The partnership mechanisms that ensure smooth financing, implementation and maintenance of all water supply systems;

(d) National plans for IWRM should be developed in a constructive dialogue with users and stakeholders at the level of the management unit. They should make clear their interests and their role in the short, medium and long terms. IWRM must consider specifically non-point source pollution and the impacts of upstream decisions on downstream environments, especially on estuaries and coastal zones, and should take into account other water-related intergovernmental conventions;

(e) A clear distinction between the various stages of policy development and execution and the level of planning (local, sub-national, national and regional). Establishment/update of national policy and strategies for the entire water sector that are integrated with overall socio-economic development (including essential co-ordinating mechanisms);

(f) The elaboration of policy, strategies and legal instruments should be a concerted process but a clear distinction has to be made for the implementation of IWRM between policy and standard settings, regulatory control/enforcement and the provision of services; encourage an iterative planning process as a « bottom-up and top-down » dialogue;

(g) The preparation, validation and adoption of legislative, regulatory and enforcement measures (including water administration, provision of service, standards for equipment, water quality and uses);

(h) The promotion the use of economic and financial instruments, including appropriate incentives to improve water demand management; effective application of the « polluter-pays » principle and users-pay systems to generate revenues and regulate resource use; equitable allocation and redistribution of water benefits and charges, with special attention for low-income population groups;

(i) The necessary capacity-building and information management *sensu lato* ; general education focusing on youth, as important advocates for information dissemination and attitude changes;

(j) The exchange of information using as much as possible modern media and Internet;

(k) The promotion of comprehensive water information systems that include water resources and socio-economic data bases;

(l) The capacity building of decentralised agencies and community-based organisations for IWRM, particularly for water conservation and resource protection;

(m) The role of women that should be equal in all management with regard to water resources, at local, national and international levels;

(n) The international support to the overall and efficient financing of IWRM costs. External Support Agencies and United Nations agencies could play a catalytic role in national plan preparation and implementation, capacity building, technology transfer and technical assistance, capitalising on local and regional experiences;

(o) The development of mechanisms to encourage riparian states to co-operate among each other on matters related to the management of transboundary water resources (including groundwater), building on existing agreement principles, arrangements, instruments and programmes of action, taking into account interests of the concerned states.

# FINAL LIST OF PARTICIPANTS

## EXPERT GROUP MEETING

## ON

## STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

**27 - 30 January 1998**

**Harare, Zimbabwe**

| Name (title) | | Country | Position/ Organization | Address Phone(s)/ Fax/ E-mail | Field of Expertise |
|---|---|---|---|---|---|
| Abdou, Ousmane | Mr. | Niger | Water Resources Director/ Ministry of Water Resources | P.O. Box 257 Niamey, Niger<br>Tel: 227 723889<br>Fax: 227 724015 | Remote Sensing and Water Resources Management |
| Abdullah, Keizrul | Mr. | Malaysia | Director General/ Director of Irrigation and Drainage | Jalan Sultan Salahuddin, 50626 Kuala Lumpur, Malaysia<br>Tel: 603 298 2618<br>Fax: 603 291 4282<br>E-mail: kpjps@smtp.moa.my. | Water resources planning and development, irrigation, drainage, river engineering |
| Ainscow, Robert | Mr. | United Kingdom | Co-chair of Harare Expert Group Meeting | 86 Yale Court, Honeyborne Road, NW6 1JH, London, United Kingdom<br>Tel./ Fax: 44 171 435 2281 | Co-chair of the meeting |
| Al Baz, Ismail | Dr. | Carl Duisberg Gesellschaft | Program Manager | Section for Protection of the Environment and Natural Resources, Lützowufer 6-9 D-10785, Berlin, Germany<br>Tel: 49 30 254 82107<br>Fax: 49 30 254 82103 | Water supply and waste water management, water quality control, training programs in water sector |
| Amuri, Lucas | Mr. | Kenya | Conference Interpreter | P.O. Box 54708 Nairobi, Kenya<br>Tel: 254 2 574638<br>Fax: 254 2 562214 | |
| Andah, Winston Ekow Issiw | Dr. | Ghana | Senior Scientific Officer/ Water Research Institute | WRI, P.O. Box m32, Accra, Ghana<br>Tel: 233 21 779515<br>Fax: 233 21 777170 | Irrigation, water resources management, hydrology |
| Andersson, Ingvar | Mr. | Sweden | Division Head/ Sida | 10528 Stockholm, Sweden<br>Tel: 46 8 698 5386<br>Fax: 46 8 698 5653<br>E-mail: ingvar.andersson@sida.se. | Moderator<br>Rural and peri-urban water supply and sanitation |

| | | | | | |
|---|---|---|---|---|---|
| Appleton, Brian. | Mr. | WSSCC | Communication Officer | Water Supply and Sanitation Collaborative Council, c/o World Health Organization, 20 Avenue Appia, CH-1211 Geneva 27, Switzerland.<br>Tel: 41 22 791 3517<br>Fax: 41 22 791 4847<br>E-mail: appletonb@who.ch | Water supply and sanitation and press relations, collaboration, council |
| Aragones Beltran, Juan Manuel | Mr. | Spain | Presidente de RIOC (Red Internacional de Organismos de Cuenca) | Confederacion Hidrografica del Jugar, Av. Blasco Ibanez, 48, 46010-Valencia, Spain<br>Tel: 34 6 3938855<br>Fax: 34 6 3938802<br>E-mail: enlace.rioc@chj.mma.es | General management of river basins |
| Ardon, Ger | Mr. | Netherlands | Head Water Supply and Waste Water Department, on behalf of the World Water Council | Ministry of Housing, Spatial Planning and the Environment, P.O Box 30945, 2500 6x The Hague, The Netherlands<br>Tel: 31 70 3394248<br>Fax: 31 70 3391288<br>E-mail: ardon@ddwl.dgm.minvrom. | |
| Askew, Arthur | Dr. | WMO | Chief | Hydrology and Water Resources Division, World Meteorological Organization, Avenue Giuseppe-Motta 41, P.O. Box 2300, CH-1211 Geneva 2, Switzerland<br>Tel: 41 22 730 8355<br>Fax: 41 22 734 8250<br>E-mail: aaskew@www.wmo.ch | Hydrological data collection, hydrological modeling, water resource systems analysis |
| Alfonsi, Felix V. | Mr. | Benin | Chef du Service/ Direction de l'Hydraulique | 01 BP 385, Cotonou, Benin<br>Tel: 229 313298 / 313487<br>Fax: 229 310890<br>E-mail: gmale.dh@bow.intnet.bj | Hydrogeology, geophysics, environment |
| Bakheit, Hayder Yousif | Mr. | Sudan | Technical Manager/ Ministry of Irrigation and Water Resources | P.O. Box 878, Khartoum, Sudan<br>Tel: 249 11 777082<br>Fax: 249 11 773838<br>E-mail: nilesud@sudanet.net | Hydrology and water resources |

| | | | | | |
|---|---|---|---|---|---|
| Barrosso, Francisco | Mr. | Venezuela | Director of Autonomy Service of Soil and Basin Conservation | Ministry of Environment and Renewable Resources, Edf. Camejo, Piso 1, El Silencio, Venezuela<br>Tel.: 58 2 483 7062<br>Fax: 58 2 483 7062 | Water resources management and planning, international waters |
| Bartholin, Eduardo A. | Mr. | Chile | Civil Engineer/ Hydraulic Works Director | Ministry of Public Works, Morande, 59, 5-o Piso, Santiago, Chile<br>Tel: 56 2 6986207<br>Fax: 56 2 6710764<br>E-mail: ebarthol@mop.cl | Hydraulic engineering in irrigation and drainage, irrigation works construction |
| Bergkamp, Ger | Dr. | IUCN | Water Resources Specialist | International Union on Conservation of Nature, Rue Mauverney 28, CH-1196 Gland, Switzerland<br>Tel: 41 22 999 0262<br>Fax: 41 22 999 0025<br>E-mail: gjb@hq.iucn.org. | Hydrology, freshwater ecosystems |
| Bertranou, Armando | Mr. | Argentina | Investigator/ CELRA-IMA; Director/ COMICET | Paso de los Andes 1235 -9500-Mendoza, Argentina<br>Tel: 54 61 285284 (w); 54 61205174 (h)<br>Fax: 54 61 285416<br>E-mail: abentran@rziz.uncu.edu.ar | Moderator<br>Economics of water resources, irrigation economics |
| Blasco, Delmar | Mr. | Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR) | Secretary-General | Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR, Iran, 1971), Rue Mauverney 28, CH 1196 Gland, Switzerland<br>Tel. 41 22 999 0179<br>Fax: 41 22 999 0169<br>E-mail: dab@hq.iucn.org | Anthropologist |
| Briscoe, John | Dr. | World Bank | Senior Water Adviser | The World Bank, Washington DC, 20433, USA<br>Tel: 1 202 473 5557<br>Fax: 1 202 522 3306<br>E-mail: jbriscoe@worldbank.org | |
| Bruce, James Philip | Mr. | Canada | Chair International Advisory Committee/ UNU, INWEH | The United Nations University/ International Network on Water, Environment and Health, 1875 Juno Ave., Ottawa, Ontario, Canada K1H6S6<br>Tel: 613 731 5929<br>Fax: 613 731 3509<br>E-mail: jpbruce@sympatico.ca | Moderator<br>Climate, water resources (quality, disaster mitigation, river basin planning & management) |

| | | | | | |
|---|---|---|---|---|---|
| Bullock, Andy | Mr. | United Kingdom | Hydrological Adviser,, Zimbabwe Dept. For International Development | Institute for Hydrology Wallingford, Oxom, United Kingdom<br>Tel: 49 1 838800<br>E-mail: abullock@africaonline,co.zw | |
| Burke, Jacob | Mr. | United Nations, DESA | Technical Adviser | Water Management and SIDS Branch, United Nations Department for Economic and Social Affairs, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 8558<br>Fax: 1 212 963<br>E-mail: burkej@un.org | Conference Secretariat |
| Campbell, Stephanie Copus | Ms. | Australia | Policy Adviser/ AusAID | Australian Agency for International Development, GPO Box 887, Canberra, ACT 2601, Australia<br>Tel: 61 26 206 4841<br>Fax: 61 26 206 4870<br>E-mail: stephanie-copus-campbell@ausaid.gov.au. | Policy Development |
| Cebolo Monteiro Jose Alberto | Mr. | Portugal | Engineer, Instituto Da Agra | Ave. Gago Couthinho, 30 1000 Lisbon, Portugal<br>Tel: 8430075 | |
| Chabarika, S.B. | Mr. | Zimbabwe | Journalist, Africa Information Afrique (AIA) | 12 Forwham House, Livinstone Avenue, Harare, Zimbabwe<br>Tel: 263 4 756250<br>Fax: 263 4 756257 | |
| Challenger, Brian | Mr. | Antigua and Barbuda | Technical Coordinator/ Ministry of International Transport | P.O. Box 416, Cassada Gardens, St. John's, Antigua and Barbuda<br>Tel: 268 462 3022<br>Fax: 268 462 2516 | Environmental project manager, environmental policy and law in Small Island Developing States, climate change impact |
| Changaya, Charles | Mr. | Save the Children Fund (UK) | Deputy Programme Director, Malawi | P.O. Box 30335, Capital City, Lilongwe 3, Malawi.<br>Tel: 265 781 433.<br>Fax: 265 781 443.<br>E-mail: compuserve@100632,2755 | Rural water supply and emergency water supply, community based resource management |

| | | | | | |
|---|---|---|---|---|---|
| Chaudhry, Mohammad Aslam | Mr. | United Nations, DESA | Chief, Technical Adviser | P.O. Box 551, UNDP, Sana'a, Yemen<br>Tel: 967 1 231530<br>Fax: 967 1 231530 | Water resources economics, water policy analysis, water resources management, institutional and organizational development |
| Chene, Jean-Michel | Mr. | United Nations, DESA | Interregional Technical Adviser | Water Management and SIDS Branch, Department for Economic and Social Affairs, DC1-834, United Nations, New York, NY, 10017, USA<br>Tel: 1 212 963 8575<br>Fax: 1 212 963 1270<br>E-mail: chenej@un.org | Conference secretariat, Integrated water resources management, transboundary rivers, water and environment strategies |
| Chidziva | Mr. | Zimbabwe | Mupfure Catchment Board | Bag 868, Chegutu, Zimbabwe<br>Tel: 263 154 707861 | |
| Chigumaozi Constance | Mr. | Zimbabwe | Senior Administrative Officer/Foreign Affairs | 4 Margaret Close Logan Park, Harare, Zimbabwe<br>Tel: 263 4 794681<br>Fax: 263 4 705161 | |
| Chinogwenya, Sophia N. | Mrs. | Zimbabwe | Development Economist, Department of Water | Bag 7767, Harare, Zimbabwe<br>Tel: 264 4 706040 | |
| Chisipo, Jabykawu | Mr. | Zimbabwe | Journalist, Zimbabwe Mirror | Mass Media House, 1st. Fl. 19 Selous Avenue, Harare, Zimbabwe<br>Tel: 263 4 704951/2 | |
| Chiuta, Tabeth Matiza | Ms. | IUCN | Regional Field Programmes Coordinator | International Union on Conservation of Nature, Regional Office for Southern Africa, P.O. Box 745, Harare, Zimbabwe<br>Tel: 263 4 728266/7<br>Fax: 263 4 720738<br>E-mail: tmd@lucnrosa.org.zw | Wetlands conservation, geography, resource assessment, water issues, remote sensing, gender issues |
| Choga, Vavarirai | Mr. | Zimbabwe | Director of Water Development/ Ministry of Rural Resources and Water Development | P/Bag 7712, Causeway, Harare, Zimbabwe Tel: 263 4 708 102<br>Fax: 263 4 792 130 / 722752 | Water resources development and management |
| Collier, Koenraad | Mr. | Mozambique | Programme Officer UNIDO | P.O. Box 4595, Maputo, Mozambique<br>Tel: 258 1 492075<br>Fax: 258 1 490871<br>E-mail: Collier@earthling.net | |

| | | | | | |
|---|---|---|---|---|---|
| Coly, Seny | Mr. | Senegal | Chief/ Water Management Bureau, Ministry of Hydraulics | MH/SGPRE - BP 4021 - EX - CAMP LAT DIOR, Dakar, Senegal<br>Tel: 221 822 2154<br>Fax: 221 822 9581 | Surface water resources management (hydrology) |
| Corrales, Luis Ernesto Cantero | Mr. | Cuba | Hydrologist/ NIWR | National Institute of Water Resources, Virtudes #680, Centro Habana, Ciudao Habana - Cuba<br>Tel: 53 7 62 0507 / 79 6787<br>Fax: 53 7 24 0680 | Hydrology services, water resources management |
| Cruse, Guillaume | Mr. | France | Chief of Mission - Environment/ Caisse Francaise de Developpement | 35 rue Boissy d'Anglas, 75379 Paris CEDEX 08, France<br>Tel: 33 1 40 06 36 28<br>Fax: 33 1 40 06 38 69<br>E-mail: tlx@cfd.fr | Environment, natural resources |
| Da Graça Mulambo, Elcina | Mrs. | Mozambique | Hydrologist/ National Directorate for Water | Av. 25 De Setembro, No. 942, P.O. Box 1143, Maputo, Mozambique<br>Tel: 258 1 420 469<br>Fax: 258 1 303 100<br>E-mail: elcina@drhdna.vem.mz | Hydrological database and surface water management |
| Da Graça Saranga, Suzana | Ms. | Mozambique | Water and Environmental Manager/ National Directorate for Water | 25th Septembro Av., 942, 10th Floor, Maputo, P.O. Box 1611, Mozambique<br>Tel: 258 1 420 469<br>Fax: 258 1303 100<br>E-mail: suzy@drhdna.vem.mz | Management of international rivers |
| Daley, Ralph J. | Dr. | UNU/INWEH | Director | The United Nations University/ International Network on Water, Environment and Health, McMaster University, John Hodgins Engineering Building, 1280 Main Street West, Hamilton, Ontario, Canada<br>Tel: 905 525 9140 ext. 23140<br>Fax: 905 529 4261<br>E-mail: daleyr@inweh.unu.edu. | Capacity building, water quality, limnology, watershed management |

| | | | | | |
|---|---|---|---|---|---|
| David, Anne | Mrs. | BRGM | Hydrogeologis, Project manager | 1039 rue de Pinville 34000, Montpellier, France<br>Tel: 33 2 38 643 076<br>Fax: 33 2 38 643 305<br>E-mail: a.david@brgm.fr | Water resource survey and monitoring, water resource management, data bases and GIS |
| David, Elysabeth | Mrs. | Switzerland | Environmental Affairs Officer, United Nations Convention to Combat Desertification (UNCCD) | 11-13 Chemir des Anemones, Geneva, Executive Center 1202 Geneva, Switzerland<br>Tel: 41 22 9178421<br>Fax: 41 22 9178031<br>E-mail: edavid@unccd.ch | |
| Davis, Dennis A. | Dr. | | Water Resources Consultant / WMO | 45 Windcrest Court, Kanata, Ontario, Canada K2T 1B5<br>Tel.: 1 613-599 1008<br>Fax: 1 613 599 4035<br>E-mail: denis.davis@sympatico.ca | Water resources management, water policy, transboundary conflict resolution |
| De Augusto, Jesus | Mr. | Mozambique | Press Correspondent/ Noticias-Maputo | Rua Joaquin Lapa 55, Maputo , Mozambique<br>Tel: 258 1 749305<br>Fax: 258 1 749305 | |
| Dengo, Manuel | Mr. | United Nations, DESA | Chief | Water Management and SIDS Branch, United Nations Department for Economic and Social Affairs, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 4208<br>Fax: 1 212 963<br>E-mail: dengo@un.org | Conference Secretariat |
| Deschamps, Roland | Mr. | Zimbabwe | Programme Officer UNIDO | C/O Takira House UNDP Office Union Ave. 67-69, Harare, Zimbabwe<br>Tel: 263 4 792682<br>Fax: 263 4 728695 | |
| Devillez, P. | Mr. | Zimbabwe | Technical Assistant, E.U. | P.O. Box HG 804, Highlands, Harare, Zimbabwe<br>E-mail: devillez@zol.co.zw | Implementation of water resource exploitation and management projects |

| | | | | | |
|---|---|---|---|---|---|
| Dhewa, Charles | Mr. | Zimbabwe | Journalist, Farming World Magazine | P.O. Box MP 1283 Mount Pleasant, Harare, Zimbabwe<br>Tel: 263 4 745955<br>Fax: 263 4 745956 | |
| Diphoorn, Bert | Mr. | Netherlands | Senior Policy Adviser/ IWRM, Ministry of Foreign Affairs | International Environmental Policy, Instruments and Water Management Division, P.O. Box 20061 - 2500 EB, The Hague, The Netherlands<br>Tel: 31 70 348 4518<br>Fax: 31 70 348 4303<br>E-mail:diphoorn@dml.minbuza.nl | IWRM, irrigation, water supply and sanitation, HRO |
| Dodds, Felix | Mr. | UNED-UK | Director | 3 Whitehall Court, London, SW1 A2EL, United Kingdom<br>Tel: 44 171 930 2931<br>Fax: 44 171 930 5893<br>E-mail: una@mcr1.poptel.org.uk | Coordination of NGO's for CSD and facilitator of UK Freshwater Group |
| Doma, T.W. | Mr. | Zimbabwe | Chief Photographer, | Ministry of Information Photo Section, Old Stables Union Ave./Fourth Street Harare, Zimbabwe<br>Tel: 263 4 702067 | |
| Donkor, Stephen Maxwell | Mr. | ECA | Water Resources Adviser | Food Security and Sustainable Development Division Economic Commission for Africa (ECA), P.O. Box 3001, Addis Ababa, Ethiopia<br>Tel: 251 1 51 72 00<br>Fax: 251 1 51 44 16<br>e-mail: donkor@un.org | Regional adviser, water management specialist, research and training, consulting |
| Durham, David Stuart | Mr. | Zimbabwe | Deputy Director - Planning and Hydrology/ Ministry of Rural Resources and Water Development | P/Bag 7712, Causeway, Harare, Zimbabwe Tel: 263 4 708102<br>Fax: 263 4 722752 | Planning and management of water resources |
| Eisa, M | Mr. | UNIDO | | UNIDO, Environment and Energy Branch, P.O. Box 300, A-1400 Vienna, Austria<br>Tel: 43 1 21131 4696<br>Fax: 43 1 21131 6803 | |
| El Atfy, Hussein | Mr. | Egypt | Undersecretary/ Minister's Office Affairs, Ministry of Public Works and Water Resources | Kornish El Nil, Imbaba, Giza 12666, Egypt<br>Tel: 20 2 312 2967 / 312 3258<br>Fax: 20 2 310 9591 / 312 3257 | Irrigation, drainage, and water resources management |

| | | | | | |
|---|---|---|---|---|---|
| El Sherbiny, Amr | Mr. | Egypt | Diplomatic Attaché | Environment and Sustainable Development Division - Division 1, Ministry of Foreign affairs, Cairo, Egypt | Diplomat in the field of environment and sustainable development |
| El-Hadj Ely Ould | Mr. | Mauritanie | Directeur De L;Hydraulique, Ministere de L'Hydraulique et de L'énergie | BP4913, Nonakchatt, Mauritanie<br>Tel: 222 2 57140<br>Fax: 222 2 57402 | Hydraulic and energy engineer |
| Enderlein, Rainer | Mr. | ECE | Environmental Affairs Officer | Economic Commission for Europe, Environment and Human Settlements Division, CH-1211 Geneva 10, Switzerland<br>Tel: 41 22 917 2373<br>Fax: 41 22 917 0107<br>e-mail: rainer.enderlein@unece.org | |
| Facon, Thierry G. | Mr. | France | Chief of Mission/ General Secretariat, International Conference on Water and Sustainable Development | B182, Center de Conferences Internationales 19, Ave. Kleber,75116 Paris, France<br>Tel: 33 1 4317 7734<br>Fax: 33 1 4317 6735<br>E-mail: diplo3@iway.fr | Water resources management, rural water development, irrigation development, wetlands, participatory approaches |
| Faehrmann, Kerstin | Ms. | Germany | First Secretary/ German Embassy | 14 Samora Machel Ave., Harare, Zimbabwe<br>Tel: 263 4 731955<br>Fax: 263 4 790680 | Development Cooperation |
| Fernandez, Basil P | Mr. | Jamaica | Managing Director/ Water Resources Authority | Hope Gardens, P.O. Box 91, Kingston 7, Jamaica<br>Tel: 876 927 1878<br>Fax: 876 977 0179<br>E-mail: commander@toj.com | Groundwater contamination |
| Fiil, Erik | Mr. | Denmark | Ambassador/ Royal Danish Embassy, Harare | 1st floor, UDC - Centre, 59 Union Avenue, PO Box 4711, Harare, Zimbabwe<br>Tel: 263 4 758185/8<br>Fax: 263 4 758189 | Development aid policies, sustainable development |

| | | | | | |
|---|---|---|---|---|---|
| Garrido, Raymundo Jose Santos | Mr. | Brazil | Director of Department/ Ministry of Environment | Alameda Umbuzeiros 347, Caminho das Arvores - Salvador/BA, Brazil<br>Tel: 556 1 317 1348<br>Fax: 556 1 223 5366<br>E-mail: rjgarrido@mma.gov.br | Water resource management, charging and system of permits for the use of water resources, legal framework models |
| Ghagan, Scott, | Mr. | United Kingdom | Environment International Division, Department of the Environment, Transport and the Regions | A513 Romney House, 43 Marsham St. London SWIP 3P4, United Kingdom<br>Tel: 44 171 2768160<br>Fax: 44 171 2768861 | Administration, CSD process. |
| Ghosh, Gourisankar | Mr. | UNICEF | Chairman / UNICEF, Water Section, Programme Division | Water, Environment and Sanitation Cluster, United Nations Children's Fund (UNICEF), 3 UN Plaza (TA-26A), New York, NY 10017, USA<br>Tel: 1 212 824 6664<br>Fax: 1 212 824- 4802<br>e-mail: gghosh@unicef.org | Chairman of the ACC Subcommittee on Freshwater from 1998 |
| Gleditsch, Mona | Ms. | Norway | Senior Water Adviser/ NORAD | P.O. Box 8034 Dep., 0030 Oslo, Norway Tel: 47 22 314400<br>Fax: 47 22 314509<br>E-mail: mona.gleditsch@norad.no | Rural WSS, water resource management policy, water sector and environmental sector public institutions |
| Godwell Mhamo | Mr. | Zimbabwe | Programme Officer (Soer-Zambezi) | ARAC-IMERCSA No.15 Downie Avenue Belgravia, Harare, Zimbabwe<br>Tel: 263 4 737301 / 720814<br>Fax: 263-4 7838693<br>E-mail: imercsa@samara.co.zw | |
| Granit, Jakob J. | Mr. | Sweden | First Secretary/ Swedish Embassy, Harare | 52 Samora Machel Avenue, P.O. Box 4110, Harare, Zimbabwe<br>Tel: 263 4 790651<br>Fax: 263 4 754265<br>E-mail:. jakob.granit@sida.se | Responsible for coordination of Sida's southern Africa regional water resources programme |

| | | | | | |
|---|---|---|---|---|---|
| Grondin, Pierre Marie | Mr. | Programme "Solidarite Eau" | Executive Secretary | PSEau c/o GRET, 211-213 Rue La Fayette, 75010, France<br>Tel.: 33 1 40 05 61 30 / 23<br>Fax: 33 1 40 05 61 10<br>E-mail: brianh@dbsa.org | Institutional links, management of equipment, participative approach, water supply and sanitation |
| Gujja, Biksham | Dr. | WWF International | Manager, Freshwater Programme | World Wide Fund for Nature, Avenue Mont Blanc, CH-1996, Gland, Switzerland.<br>Tel: 41 22 364 9509<br>Fax: 41 22 364 3239<br>E-mail: bgujja@wwfnet.org | Freshwater policy, wetland management, watershed management, community involvement in water management |
| Hales, David F. | Mr. | United States of America | Director, Global Environment Center | USAID/G/ENV., Ronald Reagan Building, Rm. 3.08, Washington, DC, 20523-3800, USA<br>Tel: 1 202 712 5419<br>Fax: 1 202 216 3174<br>E-mail: dhales@usaid.gov | Sustainable development, environmental policy, development financing |
| Hall, Alan William | Mr. | European Commission | Head/ Overseas Development Unit, HR Wallingford | Howbery Park, Wallingford, Oxon OX10 8BA, United Kingdom<br>Tel: 44 149 1822443<br>Fax : 44 149 1826352<br>E-mail : awh@hrwallingford.lo.uk. | Water resources planning and irrigation; consultancy team leader for the preparation of the EC guidelines in the water resources sector |
| Hartmann, Daniel A. | Mr. | Switzerland | Official in Charge of Groundwater Protection/ Federal Office of Environment, Forests and Landscape | Buwal, CH-3003, Berne, Switzerland<br>Tel: 41 31 3229359<br>Fax: 41 31 3230371<br>E-mail: daniel.hartmann@buwal.admin.ch | Groundwater protection and monitoring, sustainable use of drinking water resources |
| Hartnack, Jorgen | Mr. | Denmark | Minister Counselor, Deputy Director/ Ministry of Foreign Affairs (DANIDA) | 2 Asiatisk Plads, DK-1448 Copenhagen K, Denmark<br>Tel: 45 33 921688<br>Fax: 45 33 921678 | Development aid policies, sustainable development |
| Heese, M. | Mrs. | South Africa | Conference Interpreter | P.O. Box 378 Halfway House 1685 South Africa<br>Tel: 27 11 3141140<br>Fax: 27 11 3141140<br>E-mail: heese@icon.co.za | |

| | | | | | |
|---|---|---|---|---|---|
| Heyns , Piet | Mr. | Namibia | Director of Resource Management/ Department of Water Affairs, Ministry of Agriculture, Water and Rural Development | Private Bag 13193, Windhoek, Namibia<br>Tel: 264 61 2963074<br>Fax: 264 61 238861<br>E-mail: heynsp@mawrd.gov.na | Water resource management, international waters, water sector restructuring, strategic water project planning |
| Hodzi R.A. | Dr. | Zimbabwe | UNESCO | UNESCO P.O. Box H9435, Highlands, Harare, Zimbabwe<br>Tel: 263 4 776114/5 | |
| Holländer, Robert H. | Dr. | Germany | Water Protection Division, Ministry for the Environment, Nature Conservation and Nuclear Safety | Postfach 12 06 29, D - 53048 Bonn, Germany<br>Tel: 49 228 305 2533<br>Fax: 49 228 305 2397<br>E-mail: wa136004@wpgate.bma.de. | Water management, water protection |
| Hollingworth, Brian Edwin | Mr. | Development Bank of Southern Africa | Water Resources Specialist | PO Box 1234, Halfway House, 1685 South Africa<br>Tel: 27 11 3133332;<br>Fax: 27 11 3133086<br>E-mail: brianh@dbsa.org | Finance, policy, water resources management |
| Honorati, Paola | Mrs. | Zimbabwe | Secretary, Italian Embassy | 7 Bartholomew Close Greendale , Harare, Zimbabwe<br>Tel: 263 4 498373<br>Fax: 263 4 498199<br>E-mail: amitalia@samaza.co.zw: | |
| Hungwe, Shadreck | Mr. | Zimbabwe | Economist Zimbabwe Farmers Union | Box 3755, Harare, Zimbabwe<br>Tel: 263 4 772859<br>Fax: 263 4 750456 | |

| | | | | | |
|---|---|---|---|---|---|
| Ichimura, Masakazu | Mr. | Japan | Adviser to the Ministry of Foreign Affairs, Senior Researcher | OECC (Overseas Environmental Cooperation Center), 3-1-8 Shiba Koen, Minato-ku, Tokyo 105, Japan<br>Tel: 81 3 5472 0144<br>Fax: 81 3 5472 0145<br>E-mail: mxicmr@oecc.or.jp | Environmental engineering, basin-wide water quality management, integrated pollution control, international cooperation |
| Ijjas, Istvan | Prof. | Hungary | Professor of water resources development | Technical University of Budapest, Muegyetem rakpart 3, 1111 Budapest, Hungary<br>Tel: 36 1 242 2716 / 463 1894<br>Fax: 36 1 242 0154 / 463 1532<br>E-mail: Ijjas@vit.bme.hu<br>E-mail: 100324.3434@compuserve.com | Water and Environmental Management and Administration, Water Resources Policy and Strategy |
| Ikin, Derrick Owen | Mr. | Switzerland | SDC | Swiss Agency for Development and Coordination, SDC (Maputo), EDA Kurierdienst, 3003 Bern, Switzerland<br>Tel: 258 1 431070<br>Fax: 258 1 421339 / 302 2454 | Urban and rural water and sanitation programmes, institution building, commercialization, social marketing |
| Jarawaza, M. | Mrs. | Zimbabwe | Chief Chemist, City of Harare | Dept. Of Works P.O. Box 1583, Harare, Zimbabwe<br>Tel: 263 4 726021<br>Fax: 263 4 750403 | |
| Jellali, Mohamed | Mr. | Morocco | General Director for Hydraulics/ Department of Equipment, Ministry of Agriculture, Equipment and Environment | Rue Hassan Benchekroun, Agdal, Rabat, Maroc<br>Tel: 212 7 77 87 42<br>Fax: 212 7 77 86 96<br>E-mail: mjellali@atlasnet.net.mr | Moderator<br>Water development and management, Institutional arrangements for water management |
| Jønch-Clausen, Torkil | Mr. | Global Water Partnership | Managing Director and Chairman | Institute for the Water Environment (UKI), Agern Alle 11, DK-2970 Horsholm, Denmark<br>Tel: 45 45 16 92 15<br>Fax: 45 45 16 92 92<br>E-mail: tjc@vkl.dk | Moderator<br>Water resources management |
| Jonga, J. K. | Mr. | Zimbabwe | Director General DDF | Bab 7756, Causeway, Harare, Zimbabwe<br>Tel: 263 4 725450 | |

| | | | | | |
|---|---|---|---|---|---|
| KagimuGava, Moses | Mr. | Uganda | Assistant Commissioner | Directorate of water Development, P.O. Box 20026, Kampala, Uganda<br>Tel: 256 41 22 07 75<br>Fax: 256 41 22 07 76 | |
| Kampata, Jonathan Mwiinga | Mr. | Zambia | Water Engineer, Board Secretary | Ministry of Energy and Water Development, Water Development Board, P.O. Box 51059, Lusaka, Zambia<br>Tel: 260 1 251 525<br>Fax: 260 1 250 721<br>E-mail: kampata@zamnet.zm | Water resources management and development |
| Karimamzira, R.P. | Mrs. | Zimbabwe | Acting Director Dept. Of Meteorology | Box BE 150 Belvedere, Harare, Zimbabwe<br>Tel: 263 4 774893<br>Fax: 263 4 774890<br>E-mail: rpk@weather.utande.co.zw | |
| Kasanga Muteba | Mr. | South Africa | Interpreter Secretarial | 15 Vezewood 122 Grayston DZ10Z Sandton, Johannesburg, South Africa<br>Tel: 27 11 7846590<br>Fax: 27 11 4344724 | |
| Katko, Tapio S. | Mr. | Finland | Senior Research Engineer/ Tampere Univ. of Technology, Inst. Of Water and Environmental Engineering | P.O. Box 541, FIN-33101 Tampere, Finland<br>Tel: 358 3 365 2183<br>Fax: 358 3 365 2052<br>E-mail: katko@cc.tut.fi | Water Supply and Sanitation, Institutional Development of Water Services, HRD |
| Katno, Laureen | Ms. | Zimbabwe | Translator, MacMag | Elcombe Building, 2nd Fl. Kenneth Kaunda St., Harare, Zimbabwe<br>Tel: 263 4 773096 | |
| Kershaw, Ian | Mr. | Australia | First Secretary/ AusAID, Australian High Commission, Harare | PO Box 4541, Harare, Zimbabwe<br>Tel: 263 4 757 774<br>Fax: 263 4 757 764<br>E-mail: ian.kershw@ausaid.gov.au | Development assistance |

| | | | | | |
|---|---|---|---|---|---|
| Keyser, De Stefan | Mr. | Belgium | Agronomist , Belgian Agency for Development Cooperation | Embassy of the Kingdom of Belgium, Tanganyika House, 5th Floor 23 Third St./Union Ave. P.O. Box 2522, Harare, Zimbabwe<br>Tel: 263 4 794891/2<br>Fax: 263 4 724704<br>E-mail: belcoop@harare,iafrica,com | |
| Khatso, James Lucian | Mr. | Zimbabwe | General Manager/ Regional Water Authority | P.O. Box CY617 Causeway, 128 Samora Machel Avenue, Harare, Zimbabwe<br>Tel: 263 4 795325 / 796980<br>Fax: 263 4 728999 | Irrigation water management from rivers and dam systems |
| Klohn, Wulf | Mr. | FAO | Senior Officer Water Resources | Development and Management Service, Land and Water Development Division, Food and Agriculture Organization (FAO), Via delle Terme di Caracalla, 00100 Rome, Italy<br>Tel: 39 6 570 54543<br>Fax: 39 6 570 56275<br>E-mail: wulf.klohn@fao.org. | Water information, water policy, river basin management |
| Kukosh, Valeri Semenovich | Mr. | Russia | Chief, of Informatics Section | Ministry of Natural Resources, Moscow, Russia<br>Tel: 7 095 207 5469 / 207 6732<br>Fax: 7 095 975 1613<br>E-mail: root@kukosh.msk.su | Informatics and Information Resources |
| Kuylenstierna, Johan | Mr. | United Nations, DESA | Project Coordinator for the Expert Group Meeting | Natural Resources Branch, United Nations Department for Economic and Social Affairs, DC2-2284, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 3794<br>Fax: 1 212 963 1795<br>E-mail: kuylenstierna@un.org | Conference Secretariat |
| Kwaramba, Joe | Mr. | Zimbabwe | Journalist | Zimbabwe Newspapers P. Bag CY822 Causeway, Zimbabwe<br>Tel: 263 4 666228 | |
| Lacomb, Jean-Michel | Mr. | France | General Secretary/ International Conference on Water in Paris | Centre des Conferences Internationales - Bureau 194, 19 Avenue Kleber, 75116 Paris, France<br>Tel: 33 1 43 17 67 30<br>Fax: 33 1 42 17 67 35 | |

| | | | | | |
|---|---|---|---|---|---|
| Lane, Jon | Mr. | Water Aid | Water Aid | WaterAid, Prince Consort House, 27-29 Albert Embankment, London SE1 7UB, United Kingdom<br>Tel: 44 171 793 4513<br>Fax: 44 171 793 4545.<br>E-mail: wateraid@compuserve.com | Community managed drinking water and sanitation |
| Lane, Stuart | Mr. | Canada | First Secretary CDN High commission | 45 Baines Ave. Harare, Zimbabwe<br>Tel: 263 4 733881<br>Fax: 263 4 732917 | |
| Larson Debbie | Ms. | United States of America | Policy and Program Analyst, NOAA, National Weather Service | 1325 East-West Highway Silver Spring, M.D. 20910, USA<br>Tel: 301 7131762 Ext. 175<br>Fax: 301 587 4524<br>E-mail: debra.larson@noaa.gov | |
| Latimer, Alan | Mr. | United States of America | US Permanent Representative to UNEP/ US Department of State | US Embassy, P.O. Box 30137, Moi Avenue, Nairobi, Kenya<br>Tel.: 254 2 334 141 ext. 419<br>Fax: 254 2 219 595<br>E-mail: latimeral@nairowpoa.us-state.gov | |
| Liebaert, André | Mr. | European Commission | Principal Administrator/ Infrastructure Unit, European Commission, DG VIII | 200, rue de la Loi, 1049, Brussels, Belgium<br>Tel: 32 2 2992753<br>Fax : 32 2 2969840<br>E-mail : andre.liebaert@dg8.cec.be. | EC funded water related projects in Eastern and Southern Africa; coordination of water resources policy issues for DG VIII |
| Lopes, Carlos | Mr. | UNDP | Resident Representative in Harare | Office of the Resident Representative, 9th Floor, Takura House, 67-69 Union Avenue, P.O. Box 4775, Harare, Zimbabwe<br>Tel.: 263 4 792 681/6<br>Fax: 2634 728 695 | |
| Lotz, Rainer E. | Dr. | Germany | Head/ Infrastructure Division, Ministry for Economic Cooperation and Development | Friedrich Ebert Allee 40, 53113 Bonn, Germany<br>Tel: 49 228 5353760<br>Fax: 49 228 5353755<br>E-mail: lotz@bmz.bmz.bund400.de | Development policy, infrastructure |

| | | | | | |
|---|---|---|---|---|---|
| Lövkvist, Pia | Ms. | Sweden | Ministry for Foreign Affairs | 10339 Stockholm, Sweden<br>Tel: 46 8 4053455<br>Fax: 46 8 7231176<br>E-mail: pia.lovkvist@foreign.ministry. | CSD process |
| Lundquist, Jan | Mr. | Sweden | Professor/ Linköping University | Linköpings Universitet, Tema Vatten, 58183 Linköping, Sweden<br>Tel: 46 13 28 22 72<br>Fax: 46 13 13 36 30<br>E-mail: janlu@tema.liu.se. | Transdisciplinary research, water resources allocation, water rights and wrongs, urban-rural competition, policy challenges |
| Machena, Cecil | Dr. | Zimbabwe | Acting Deputy Director, Department of National Parks & Wildlife Management | PO Box 140, Causeway, Harare, Zimbabwe<br>Tel: 263 4 792 784/9<br>Fax: 263 4 724 914 | |
| Magadza, Christopher H. | Mr. | Zimbabwe | Director/ University of Zimbabwe | U.L.K.R.S., P.O. Box MP 167, Mt. Pleasant, Harare, Zimbabwe<br>Tel: 263 4 303-211, ext. 1449<br>Fax: 263 4 333-407<br>E-mail: profmagadza@baobab.cszim.com.zw | Water quality, ecology, conservation |
| Mahove, Christopher | Mr. | Zimbabwe | Journalist, Zimbabwe Mirror | 15 Fl. Mass Media House, 19 Second Avenue, Harare, Zimbabwe<br>Tel: 263 4 216613 | |
| Manyandure, Daniel | Mr. | Zimbabwe | Press, Sunday Standard | One Union Ave. Harare, Zimbabwe<br>Tel: 263 4 752552 | |
| Manzou, James | Mr. | Zimbabwe | Under-Secretary, Ministry of Foreign Affairs | Box 4240 Harare, Zimbabwe<br>Tel: 263 4 727424 | |
| Mâra, Liliana | Mrs. | Romania | Director/ Ministry of Water, Forest and Environmental Protection | 12, B-dul Libertatii, sector 5, Bucharest, Romania<br>Tel: 40 1 4104465<br>Fax: 40 1 4102032 | Strategy and regulation of water resources; integrated water management |
| Masanja, Faustin M. | Mr. | Tanzania | Senior Hydrologist/ Ministry of Water | P.O. Box 35066, Dar Es Salaam, Tanzania<br>Tel: 255 51 48342<br>Fax: 255 51 43793<br>E-mail: dwr-maji@intafrica.com | Surface hydrology |

| | | | | | |
|---|---|---|---|---|---|
| Mashoko, Philemon | Mr. | Zimbabwe | Senior Engineer/ Department of Water | 63A Falcon Rd. P.O. Hatfield, Harare, Zimbabwe<br>Tel: 263 4 707861 | |
| Matuszak, John Michael | Mr. | United States of America | Adviser | USAID/G/ENV., Ronald Reagan Building, Rm. 3.08, Washington, DC, 20523-3800, USA<br>Tel: 1 202 712 5419<br>Fax: 1 202 216 3174<br>E-mail: jmatuszak@usaid.gov | Watershed management, environmental policy, biodiversity conservation |
| Maviya Johnson | Mr. | Zimbabwe | Environmental Management Specialist | Water Resources Management Strategy, P. Bag 7767 Causeway, Harare, Zimbabwe<br>Tel: 263 4 729223/4<br>Fax: 263 4 791240 | |
| Mhike, Christinei | Mr. | Zimbabwe | Reporter, Catholic News | Africa Synoa Hse,. 4th St. Selous Ave. Harare, Zimbabwe<br>Tel: 263 4 705569 | |
| Mlanda, Lovemore | Mr. | Zimbabwe | Principal Engineer, Harare Municipality | Department of Works P.O. Box 1583, Harare, Zimbabwe<br>Tel: 263 4 726021 | |
| Mommer Jean | Mr. | Belgium | Head of Sector Infrastructure, Embassy of Belgium, Cooperation Section | Tangaryika House 23 Third Street/car Union Ave., Harare, Zimbabwe<br>Tel: 263 4 794891<br>Fax: 263 4 724794<br>E-Mail: belcoop@harare.iafrica.com | |
| Mongellaz, Josianne | Mme | France | Chef International Office of Water | Direction de la Coopération Internationale, BP 75, 06902 Sophia Antipolis Cedex, France<br>Tel: 33 4 92 94 58 16<br>Fax: 33 4 93 65 44 02<br>E-mail:jmongellaz@oieau.fr | |
| Mora-Castro, Daniel | Mr. | Switzerland | Sr. Water Development Expert UNHCR | UNHCR HQTSOO, Casse Postale 2500 CH-1211 Geneva 2, Switzerland<br>Tel: 41 22 7398235<br>Fax: 4122 7397371<br>E-mail: mora@unhcr.ch | |

| | | | | | |
|---|---|---|---|---|---|
| Moreno Mejia, Sergio | Mr. | Mexico | Subdirector General de Administracion/ Commission National del Agua | Av. Insurgentes Sur 2140, Col. Ermita, Mexico, D.F.C.P. 01070<br>Tel: 525 661 0680<br>Fax: 525 6613590<br>E-mail: cnascaa@mail.internet.com.mx | Water resource management (law enforcement) |
| Moreno, Henry | Mr. | Colombia | Head/ Housing and Public Services, National Planning Department | Calle 26, #13-19 (P-17), Bogota, Colombia<br>Tel: 571 334 0031<br>Fax: 571 334 0386<br>E-mail: hmoreno@dnp.gov.co | Water supply and sanitation policies and projects |
| Mosley, Michael Paul | Dr. | New Zealand | New Zealand Hydrological Society | P.O. Box 159, Lincoln University, Canterbury, New Zealand<br>Tel: 643 325 2356<br>Fax: 643 325 2944<br>E-mail: mosley@lincoln.pc.nz. | Water resources policy, water resources assessment, environmental management |
| Moyo, N. | Dr. | Zimbabwe | Doctor/ University of Zimbabwe | Biology Department, P.O. Box M. C. 167, Mt. Pleasant, Harare, Zimbabwe<br>Tel: 263 4 303-211, ext. 1446 | |
| Mpamhanga, Cleopas Abbey | Mr. | Zimbabwe | Deputy Secretary, Ministry of Local Government and National Housing | P.Bag 7706, Causeway, Harare, Zimbabwe Tel: 263 4 705 776 or 790 601/9<br>Fax: 263 4 792 307/14 | Management of rural and urban supply |
| Mpofu Thomas P.Z. | Mr. | Zimbabwe | Environment Coordinator UNDP | Box 4775, Harare, Zimbabwe<br>Tel: 263 4 792681 | |
| Mr. Fred Neto | Dr. | United Nations, DESA | | Natural Resources Branch, United Nations Department for Economic and Social Affairs, DC2-2282, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 4826<br>Fax: 1 212 963 1795<br>E-mail: neto@un.org | Conference Secretariat |
| Mtakiwa, Paul | Mr. | Zimbabwe | Officer, Foreign Affairs | Ministry of Foreign Affairs, Box 4240 Harare, Zimbabwe<br>Tel: 263 4 727005t | |

| | | | | | |
|---|---|---|---|---|---|
| Mtetwa, Sibekile | Mr. | Zimbabwe | Senior Water Pollution Control Officer/ Department of Water Development | Department of Water Resources, Water Pollution Control Section, P.O. Box 7712, Causeway, Harare, Zimbabwe<br>Tel/Fax: 263 4 792130<br>E-mail: mtetwa@baobab.cszim.co.zw | Co-chair of the meeting<br>Waste water management |
| Mudzengerere, K, | Mr. | Zimbabwe | Provincial Water Engineer, DWD | Mining Rural Resources P.B. 7712 Causeway, Harare, Zimbabwe<br>Tel: 263 4 738781<br>Fax: 263 4 722752 | |
| Mujiri, D, | Mr. | Zimbabwe | Press, Zis | Zis Box CJ 859 Causeway, Harare, Zimbabwe<br>Tel: 263 4 702067 | |
| Mujuru, J.T.R. | Mrs. | Zimbabwe | Minister of Rural Resources & Water Development | Ministry of Rural Resources & Water Development, P. Bag 7767, Harare, Zimbabwe<br>Tel: 263 4 729020 | |
| Muller, Andreas | Dr. | IAHR | Senior Research Scientist | International Association for Hydraulic Research, IHW - HIF C46.7, CH 8093, Zurich, Switzerland.<br>Tel: 41 1 633 3078<br>Fax: 41 1 6331061<br>E-mail: mu@ihw.baum.ethz.ch. | Hydraulic research |
| Munenga Michael | Mr. | Zimbabwe | Photographer | Harare, Zimbabwe<br>Tel: 263 4 702492 | |
| Mupezeni, Kossam | Mr. | Zimbabwe | Senior Administrative Officer/Ministry of Foreign Affairs | Box 4240, Harare, Zimbabwe<br>Tel: 263 4 727005<br>Fax: 263 4 705161 | |
| Murty A.S. | Mr. | Zambia | Senior Engineer, Zambezi River Authority | P.O. Box 30233, Kariba House 32 Chachachard, Lusaka, Zambia<br>Tel: 260 1 236601<br>Fax: 260 1 227498 | |
| Murungweni Z. N. | Mr. | Zimbabwe | Chief Engineer GTZ/Department of Water Development | Min. Of Rural Resources & Water Development GTZ. P. Bag 7712 Causeway, Harare, Zimbabwe<br>Tel: 263 4 737816<br>Fax: 263 4 722752 | |

| | | | | | |
|---|---|---|---|---|---|
| Mutakati, Rosenthal | Mr. | Zimbabwe | Producer ZBC | Hg 444 Highlands, Harare, Zimbabwe<br>Tel: 263 4 498630<br>Fax: 263 4 498613 | |
| Mutasa, Togara | Mr. | Zimbabwe | Cameraman Producer, Dept. Of Natural Resources | Dept. Of Natural Resources Box CY385 Causeway, Harare, Zimbabwe<br>Tel: 263 4 705671 | |
| Mutede, Mutandwa N. | Mrs. | Zimbabwe | Acting Chief Planning Engineer, Dept. Of Water Development | Bag 7712 Causeway, Harare, Zimbabwe<br>Tel: 263 4 722760 | |
| Mutendera J. | Mr. | Zimbabwe | Press | Ministry of Information PTC, Box Ly859, Causeway, Harare, Zimbabwe<br>Tel: 263 4 702492 | |
| Mutiwazuka, Alfred | Mr. | Zimbabwe | 1st Secretary | Permanent Mission of the Republic of Zimbabwe to the United Nations, 128 East 56th Street, New York, NY 10022<br>Tel: 1 212 980 9511, 980 5084<br>Fax: 1 212 755 4188 | |
| Muzamhindo, R.J. | Mrs. | Zimbabwe | Chief Water Engineer, DDF | 2500 Caydon Glen Lorne, Zimbabwe<br>E-mail: muzamhin@samara.co | |
| Najlis, Pierre | Mr. | United Nations, DESA | Chief | Natural Resources Branch, United Nations Department for Economic and Social Affairs, DC2-2270, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 4800<br>Fax: 1 212 963 1795<br>E-mail: najlis@un.org | Head of the Conference Secretariat |
| Naoro, Bester | Mr. | Zimbabwe | Photographer, Multimedia | 116 M-Nehandza St. Harare, Zimbabwe<br>Tel: 263 4 792487 | |
| Ndubiwa, Michael Mkanyiso | Mr. | City of Bulawayo | Town Clerk, Chief Executive | Municipal Buildings, P.O. Box 591, Bulawayo, Zimbabwe<br>Tel: 263 975 011 (w) / 263 978 046 (h)<br>Fax: 263 969 701 | City administration, provision of sustainable services (including water) |

| | | | | | |
|---|---|---|---|---|---|
| Neto, Felix Matias | Mr. | Angola | National Director/ Ministry of Energy and Water | Rua Rainha Ginga Nr 210, 1st Floor, P.O. Box 143, Luanda, Angola<br>Tel: 244 239 0677<br>Fax: 244 233 4037<br>E-mail: proj.dsa.minea@ebonet.net | Water resource management |
| Nguyen Quoc Dat | Mr. | Viet-Nam | Senior Officer/ Ministry of Agriculture and Rural Development | 2 Ngoc Ha Street, Hanoi City, Vietnam Tel: 84 4 733 2205<br>Fax: 84 4 845 4319<br>E-mail: nqdat@netnam.org.vn | Strategy of agriculture and rural development |
| Nigam, Ashok | Dr. | New York | Policy Adviser, UNICEF | 3 UN PLAZA, New York, NY, 10017, USA<br>Tel: 1 212 824 6717<br>Fax: 1 212 824 6491<br>E-Mail anigam@unicef.org | |
| Oatridge, James William | Mr. | WBCSD | Director of Environmental & Corporate Controls | World Business Council for Sustainable Development, Severn Trent Plc, 2297 Coventry Road, Birmingham, B26 3PU<br>Tel: 44 121 722 4903<br>Fax: 44 121 722 4892<br>E-mail: ecc@severntrent.co.uk | Water and waste water treatment and service provision |
| Ongley, Edwin David | Dr. | WHO Collaborating Centre | Director | Burlington, Canada, P.O. Box 5050, Burlington, Ontario Canada L7R4A6<br>Tel: 1 905 336 6439<br>Fax: 1 905 336 4582<br>E-mail: ed.ongley@cciw.ca | |
| Oudshoorn, Bob | Mr. | Netherlands | Senior Policy Officer/ Ministry of Transport, Public Works and Water Management | International Water Policy Division, PO Box 20906, NL 2500 EX, the Hague, the Netherlands<br>Tel: 31 70 351 8223<br>Fax: 31 70 351 9078 | International water policy regarding fresh and marine waters in various frameworks: CSD, OSPAR Convention |
| Pacheco Cristoval | Mr. | Mozambique | Civil Engineer Water National Directorate | Ave. 25 de Septembro, P.O. Box 1611 Maputo, Mozambique<br>Tel: 258 1 423269<br>Fax: 258 1 430110 | |

| | | | | | |
|---|---|---|---|---|---|
| Pama, Jean Pierre | Mr. | Kenya | Interpreter | 81 Airport View Estate, Nairobi, Kenya<br>Tel: 254 2 722305-9<br>Fax: 254 2 722024 | |
| Paraiwa M. G. | Mr. | Zimbabwe | Director, DDF | DDF Zimbabwe, P.B. 7756 Causeway, Harare, Zimbabwe<br>Tel: 263 4 732695 | |
| Pazvakavambwa, S. | Mr. | Zimbabwe | Technical Coordinator W.R.M.S. | P.O. Box 7767 Causeway, Zimbabwe<br>Tel: 263 4 729223/4<br>Fax: 263 4 791240 | |
| Pochat, Victor | Mr. | Argentina | National Director/ National Direction of Water Resources Management | Yrigoyen 250 - Piso 11 - of. 1110, (1310) Buenos Aires - Argentina<br>Tel: 54 1 349 7584 (w)<br>Tel.: 54 1 783 5933 (h)<br>Fax: 54 1 349 7596<br>E-mail: vpochat@mecon.ar. | Water resources planning and management |
| Qudah, Ali Ahmed | Mr. | Jordan | Administrator/ Amman Governorate Water Admin., Water Authority of Jordan | Amman, Jabel Al Hussein - P.O. Box 922918, Post Code 11192, Jordan<br>Tel: 962 6 692660<br>Fax: 962 6 692660<br>E-mail: AliQudah@oms.com.jo | Management of water and waste water systems and facilities |
| Rama Kant Parashar | Mr. | India | Commissioner/ Ministry of Water Resources | 411 Shram Shakti Bhawan,<br>New Delhi, 110001, India<br>Tel: 91 11 3710107 (w)<br>Tel: 91 11 467 5373, 467 6417(h)<br>Fax: 91 11 335 0051 | Water resources planning, development and management |
| Ramirez, Patricia | Ms. | Costa Rica | Director General/ National Meteorological Institute | P.O. Box 5583-1000, San Jose, Costa Rica<br>Tel: 506 258 1140<br>Fax: 506 223 1837<br>E-mail: pramirez@meteoro.imn.ac.cr | Meteorology and hydraulic resources |

| | | | | | |
|---|---|---|---|---|---|
| Ramoeli, Phera | Mr. | Southern African Development Community (SADC) | Senior Environment Officer | SADC Water Sector Coordination Unit, Red Cross Building, 23 Mabile Road, Maseru, Ministry of Natural Resources, P/Bag A440, Maseru 100, Lesotho<br>Tel. 266 310022 / 313160<br>Fax: 266 310465<br>E-mail: sadcwscu@lesofjf.co.za | |
| Rast, Walter | Mr. | UNEP | Deputy Director | Water Branch, United Nations Environment Programme, P.O. Box 30552, Nairobi, Kenya<br>Tel: 254 2 623 244<br>Fax: 254 2 624 249<br>E-mail: walter.rast@unep.org | Limnology, water quality management, integrated water resources management |
| Ray, Kalyan | Mr. | HABITAT | Chief | Building Infrastructure and Technology Section, United Nations Centre for Human Settlements, P.O. Box 30030, Nairobi, Kenya<br>Tel: 254 2 623 039<br>Fax: 254 2 623 588<br>E-mail: kalyan.ray@unchs.org. | Urban water resources management, community participation, demand management, capacity building |
| Redaud, Jean-Luc | Mr. | France | Technical Coordinator/ International Conference on Water | Direction de la Coopération Internationale, BP 75, 06902 Sophia Antipolis Cedex, France<br>Tel: 33 1 43 17 74 29<br>Fax: 33 1 43 17 67 31 | |
| Rigola, Miquel | Mr. | UNIDO | Director | Environment & Industrial Sectors Division, UNIDO, P.O. Box 300, A-1400 Vienna, Austria<br>Tel: 43 1 21131-4696<br>Fax: 43 1 21131-6803 | |
| Robarts, Richard | Dr. | Canada | Chief, Environmental Sciences Division, from Apr. 98 Director, UNEP and WHO GEMS/WATER Collaborating Centre | National Hydrology Research Institute, Environment Canada, 11 innovation Boulevard, Saskatoon, SK S7N 3H5, Canada<br>Tel: 1 306 975 6047<br>Fax: 1 306 975 5143<br>E-mail: robartsr@nhrisv.nhrc.sk.ec.gc.ca | Limnology, lakes, reservoirs, wetlands, blue-green algae, microbial processes, phosphorus cycles, organic carbon cycles, GEMS/WATER |

| | | | | | |
|---|---|---|---|---|---|
| Robinson, Kenza | Mrs. | United Nations, DESA | | Water Management and SIDS Branch, United Nations Department for Economic and Social Affairs, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 8559<br>Fax: 1 212 963 1270<br>E-mail: robinsonk@un.org | Conference Secretariat |
| Robinson, Peter B. | Mr. | Zimconsult | Principal/ Zimconsult | P O Box A2228, Avondale, Harare, Zimbabwe<br>Tel: 263 4 335869<br>Fax: 263 4 302496<br>E-mail: robinson@icon.co.zw | |
| Roe, Ashley | Mr. | United Kingdom | Market Development Manager | Severn Trent Water International, 2308 Coventry Road, Sheldon, Birmingham, B26 3IZ, United Kingdom<br>Tel: 44 121 722 6130<br>Fax: 44 121 722 6138<br>E-mail: ashley.roe@severntrent.co.uk | Water and wastewater management, privatisation, contract operations, consultancy |
| Salcedo, Abraham | Mr. | Venezuela | Director of Environment Information | Ministry of Environment and Renewable Resources , Edf. Camejo, Mezanina Este, Centro Simon Bolivar, Caracas, Venezuela<br>Tel: 58 2 541 43 64<br>Fax: 58 2 542 0607<br>E-mail: asalcedo@marur.gov.ve | Hydrology and hydrometeorology |
| Samasuwo, Nesbert | Mr. | Zimbabwe | Senior Administrative Officer, Ministry of Foreign Affairs | P.O. Box 4240, Harare, Zimbabwe<br>Tel: 263 4 727005 | |
| Santiago, Vicente | Mr. | Japan | Programme Officer, UNEP-IETC | 1091 Oroshimo-Cho Kusatsu City, Shiga 525 Japan<br>Tel: 81 77 5684585<br>Fax: 81 77 5684587<br>E-mail: vstiago@unep.or.jp | |

| | | | | | |
|---|---|---|---|---|---|
| Sauveplane, Claude | Mr. | United Nations, DESA | Interregional Adviser | Water Management and SIDS Branch, Department for Economic and Social Affairs, One United Nations Plaza, United Nations, New York, NY, 10017, USA<br>Tel: 1 212 963 8541<br>Fax: 1 212 963 1270<br>E-mail: sauveplane@un.org | Conference Secretariat |
| Savenike, Hubert | Dr. | Netherlands | Professor, IME, Delft | IME, P.O. Box 3015, Delft, The Netherlands<br>Tel: 31 15 2151829<br>Fax: 31 15 2122921<br>E-mail: hsa@ihe.nl | |
| Selim Yavuz | Mr. | Turkey | Water Adviser Ministry of Foreign Affairs | Ministry of Foreign Affairs Balgat Ankara<br>Tel: 312 287 2555 Ext.1910<br>Fax: 312 287 1648<br>E-mail: drtw@mfa.gov.tr | |
| Shepeherd Sithole | Mr. | Zimbabwe | Land Water Use Planner/WRMS | Bag 7767 Causeway, Harare, Zimbabwe<br>Tel: 263 4 791240 | |
| Shibata, Takao | Mr. | Japan | Counselor/ Embassy of Japan, Harare, Zimbabwe | 18F Karigamombe Centre, 53 Samora Machel Avenue, Harare, Zimbabwe<br>Tel: 263 4 757861<br>Fax: 263 4 757864 | |
| Shonhiwa, Stephen | Mr. | Zimbabwe | Engineer, Ministry of Rural Resources and Water Development | Box 4715 Causeway, Harare, Zimbabwe<br>Tel: 263 4 738781<br>Fax: 263 4 722752 | |
| Siamonga, E. | Mr. | Zimbabwe | Journalist, South Media Features | Box CY 2651 Causeway, Harare, Zimbabwe<br>Tel: 263 4 727533<br>Fax: 263 4 727533 | |
| Sibanda, Zibusiso | Mr. | Zimbabwe | Translator MacMag | Elcombe House, 2nd Floor, Harare, Zimbabwe<br>Tel: 263 4 773092-6<br>Fax: 263 4 773092-6 | |
| Simango Sivukile | Mr. | Zimbabwe | Reporter, National News | P.O. Box UA530, Union Ave. Harare, Zimbabwe<br>Tel: 263 4 750339 | |

| | | | | | |
|---|---|---|---|---|---|
| Simcock, Alan | Mr. | United Kingdom | Head of Marine, Land & Liability Division | Department of the Environment, Transport & the Regions, Marine, Land & Liability Division, Room B4.46, Romney House, 43 Mersham Street, London SW1P 3PY, United Kingdom<br>Tel: 44 171 276 8833<br>Fax: 44 171 276 8603<br>E-mail: doe.marine@gtnet.gov.uk | CSD process |
| Singh, Krishna | Ms. | India | Adviser/ Planning Commission | Planning Commission, Yojana Bhavan, Parliament Street, Room No. 204, New Delhi-110001<br>Tel.: 91 11 371 0051<br>Fax: 91 11 371 7681 | Moderator<br>Social infrastructure, health, urban development, water supply and sanitation |
| Smith-Kebe Rosemary | Ms. | Zimbabwe | AIIC Interpreter | 4 Nyangara Tsungo Close Rolf Valley, Harare, Zimbabwe<br>Tel: 263 4 884941<br>E-mail: girasol@samara.co.zw | |
| Soenarno | Dr. | Indonesia | Commissioner/ P.T. Wijaya Karya | Jl.D.I. Panjaitan Kav. 9 Jakarta 13340, Indonesia<br>Tel: 62 21 850 8627 (w) 769 6961 (h)<br>Fax: 62 21 819 1235 (w) 769 6960 (h) | Water resources & irrigation engineer |
| Spitzer, Hanno | Mr. | Germany | Alternate Water Expert | Friedrich Ebert Allee 40, 53113 Bonn, Germany<br>Tel: 49 228 535 3759<br>Fax: 49 228 535 3755<br>E-mail: spitzer@bmz.bmz.bund400.de. | Development Policy, Infrastructure |
| Ssensaula, Gerald Maggel | Mr. | Uganda | Cabinet Minister | Ministry of Natural Resources, Amber House, PO Box 7270, Kampala, Uganda Tel: 256 41 233 331<br>Fax: 256 41 230 220 | |
| Stanislawski, Dariusz Jan | Mr. | Poland | Adviser to the Minister | Ministry of Environmental Protection, Natural Resources & Forestry, ul. Wawelska 52/54, 00922, Warsaw, Poland<br>Tel: 48 22 25 87 06<br>Fax: 48 22 25 27 04<br>E-mail: dstanisl@mos.gov.pl | Water Resources Development Planning, Water Supply and Sanitation Systems, River Cathment Based Water Management Systems |

| | | | | | |
|---|---|---|---|---|---|
| Stout, Glenn Emanuel | Mr. | IWRA | Former President | International Water Resources Association, University of Illinois, 1101 West Peabody, Urbana, IL 61801, USA<br>Tel: 1 217 333 6275<br>Fax: 1 217 333 8046<br>E-mail: g-stout@uiue.edu | Hydrometeorology, water resources management, public involvement, capacity building |
| Sugihara, Hiromi | Mr. | Japan | Special Assistant | 18F Karigamombe Centre, 53 Samora Machel Avenue, Harare, Zimbabwe<br>Tel: 263 4 757861<br>Fax: 263 4 757864 | Political/Economc/ Development |
| Swain, Martyn | Mr. | South Africa | Conference Interpreter | UNDP 1 Crown St.Observatory 7925 Cape Town, South Africa<br>Tel: 27 21 472925<br>Fax: 27 21 472930 | |
| Symons, Ian George | Mr. | United Kingdom | 1st Secretary/ Mission to the United Nations | Permanent Mission of the United Kingdom to the United Nations, One Dag Hammarskjöld Plaza, New York, NY 10017, USA<br>Tel: 1 212 745 9215<br>Fax: 1 212 745 9316<br>E-mail: i.symons@undp.org | Commission on Sustainable Development |
| Takata, Kimio | Mr. | Japan | Officer, Economic Cooperation Bureau | Ministry of Foreign Affairs, 2-2-1 Kasumigaseki, Chiyoda-Ku 100, Japan Tel: 81 3 3581 2965<br>Fax: 81 3 3593 8021<br>E-mail: kimio.takata@mota.go.jp | General affairs of the economic cooperation |
| Tallaksen, Einar | Mr. | Norway | Adviser/ Royal Norwegian Ministry of Foreign Affairs | Postboks 8114 dep, 0032 Oslo, Norway Tel: 47 22 24 36 21<br>Fax: 47 22 24 27 82<br>E-mail: ressurs@ud.dep.telemax.no | Socio-economic affairs |
| Tanriverdi, Mustafa | Mr. | Turkey | Planning Engineer/ MSCE, DSI (State Water Works) | P.K. 8, 06581, Bakanliklar, Ankara, Turkey<br>Tel: 312 417 8300 / 2121<br>Fax: 312 417 1378<br>E-mail: dsigmep@tr-net.net.tr | Water resources planning and management |

| | | | | | |
|---|---|---|---|---|---|
| Tau, Khomoatsana Alexander | Mr. | Lesotho | Director/ Department of Water Affairs | P.O. Box 772, Maseru - 100, Lesotho<br>Tel: 266 317 516<br>Fax: 266 310 437<br>Tel/Fax: 266 313 602 | Hydrology |
| Tchitchaou, Moussa | Mr. | Tchad | Director | Direction de l"hydraulique, Ministry of Environment and Water, BP 1769, N'Djamena, Republic of Tchad<br>Tel: 235 525 668 / 525 176<br>Fax: 235 525 668 | Rural and Urban Hydrology, Financial mobilization |
| Thatte, Chandrakant Damodhar | Mr. | ICID | Secretary-General | International Commission on Irrigation and Drainage 48 Nyaya Marg, Chanakyapuri, New Delhi, 110021, India.<br>Tel: 91 11 611 6837<br>Fax: +91 11 611 5962<br>E-mail: icoiad@giasd101.vsnl.net.in. | Water resources development and management |
| Tiega, Anada | Mr. | Convention on Wetlands of International Importance | Regional Coordinator, Africa | Convention on Wetlands of International Importance Especially as Waterfowl Habitat (RAMSAR, Iran, 1971), Rue Mauverney 28, CH 1196 Gland, Switzerland<br>Tel. 41 22 999 0164<br>Fax: 41 22 999 0169<br>E-mail: abt@hq.iucn.org. | Watershed management |
| Tincani, Amos | Mr. | European Commission | Head of Division Sustainable Development/ European Commission, DG VIII | 200, rue de la Loi, 1049 Brussels, Belgium<br>Tel: 32 2 295 9444<br>Fax: 32 2 296 6472<br>E-mail : tincani@dg8.cec.be | Sustainable development, Africa |
| Toledo, Cesar Herrera | Sr. | Mexico | Subdirector General de Programacion/ Commission National del Agua | Insurgentes Sur. No. 2140, 2o piso, C. P. 01070, Col. Ermita, Deleg. Alvaro Obregon, Mexico, D.F.<br>Tel. 525 661 23 05 / 661 2840<br>Fax: 525 237 4112<br>E-mail: cnasp@supernet.com.mx | Strategic approaches to sustainable and integrated water management, economics and finance |

| | | | | | |
|---|---|---|---|---|---|
| Tomboc, Carlos | Mr. | Philippines | General Manager/ Casuna Lake Authority | Km. 70 Bugy Bangya, Calauan, Laguna, Philippines<br>Tel: 91 2 313 4455<br>Fax: 91 2 631 4157 | Fresh water management |
| Toure, Sekou | Mr. | Côte d'Ivoire | High Commissioner on Hydraulics/ Office of the Prime Minister | P.O. Box 278, Abidjan, Côte d'Ivoire<br>Tel. 225 322192<br>Fax: 225 322192<br>E-mail :toures@globeaccess.net | Moderator |
| Tsoroti, Stephen | Mr. | Zimbabwe | Journalist, South Media Features | Box Cy 2651 Causeway, Harare, Zimbabwe | |
| Tydeman, Chris Francis | Dr. | WWF International | Chief Scientist | World Wide Fund for Nature, WWF-UK Panda House, Weyside Park, Godalming, Surrey, GU7 1XR, United Kingdom<br>Tel: 44 1483 426 444<br>Fax: 44 1483 426 409<br>E-mail: ctydeman@wwfnet.org | Wetlands, Biodiversity, Habitat Restoration and Creation, Legislation, Conservation and wise use |
| Van Vliet, H. | Dr. | South Africa | Director/ Institute for Water Quality Studies, Dept. of Water Affairs and Forestry | Private Bag X313, Pretoria, 0001<br>Tel: 27 12 8080381<br>Fax: 27 12 8080338<br>E-mail: eaa@dwaf-hri.pwv.gov.za | Water quality and water resource management |
| Vasilyev, Andrey | Mr. | United Nations, DESA | | Office of the Director, Division for Sustainable Development, United Nations Department for Economic and Social Affairs, DC2-2224, United Nations, New York, New York 10017, USA<br>Tel: 1 212 963 5949<br>Fax: 1 212 963 4260<br>E-mail: vasilyev@un.org | Conference Secretariat |
| Verbrugge, Geneviéve | Mme | France | MATE/D.G.A.D. | 20 Avenue de Segur,75006 Paris<br>Tel: 33 1 42 19 17 75<br>Fax: 33 1 42 19 17 72<br>E-mail: verbrugge@environnent.gouv.fr | Sustainable development, public participation, financing mechanisms |

| | | | | | |
|---|---|---|---|---|---|
| Vial, Jean Claude | Mr. | France | Director/ Sein-Normandy Basin Agency | 51 Rue Salvador Allende 92027 Nawterre Cedex, France<br>Tel: 33 141 20 17 04<br>Fax: 33 141 20 16 09<br>E-mail: deer@aesn.fr | Moderator |
| Villalobos, Ileana | Ms. | Venezuela | Licentiate in International Affairs/ Ministry of Environment and Renewable Resources | Torre Sur, Piso 18, Ofic. 18-05, C. S. B. El Silencio, Venezuela<br>Tel: 58 2 481 1473/ 408 1230<br>Fax: 58-2 483 2445<br>E-mail: odepri@marnr.gov.ve | Environmental protection, international affairs |
| Visscher, Jan Teun | Mr. | IRC | Interim Director | International Water and Sanitation Centre, PO Box 93190, 2509 AD The Hague, The Netherlands.<br>Tel: 31 70 3068955<br>Fax: 31 70 3589964.<br>E-mail: general@irc.nl | Sanitary engineering, technology transfer and institutional development |
| Vogel, Wilhelm | Mr. | Austria | Head of Department/ Federal Environment Agency | Spitellauer Lände 5, A-1090 Vienna, Austria<br>Tel: 43 1 31304 3550<br>Fax: 43 1 31304 5400<br>E-mail: vogel@ubqvie.gv.at. | Water monitoring strategies, ecotoxicology |
| Walker, Ross M. | Mr. | Australia | Assistant Secretary/ Land and Water Resources Division, Resource Policy Branch, Commonwealth Department of Primary Industries and Energy | GPO Box 858, Canberra, ACT 2601, Australia<br>Tel: 61 2 6272 4874<br>Fax: 61 2 6272 5618<br>E-mail: roos.walker@apie.gov.au | Natural resource policy development and implementation, capacity building, integrated catchment management, community participation in environmental, sustainable rural development and agriculture initiatives |
| Ward, Diane | Ms. | European Commission | Research Assistant / HR Wallingford | Howbery Park, Wallingford, Oxon OX10 8BA, United Kingdom<br>Tel: 44 1491 822443<br>Fax: 44 1491 826352<br>E-mail : awh@hrwallingford.co.uk | Environmental law, member of the consultancy team for the preparation of the EC guidelines in the water resources sector |

| | | | | | |
|---|---|---|---|---|---|
| Wardhaugh, Alasdair | Mr. | United Kingdom | Environment Policy Department, DFID | Department for International Development, Environment Policy Department, 94 Victoria Street, London, SW1E 5JL, United Kingdom<br>Tel: 44 171 917 0702<br>Fax: 44 171 917 0679<br>E-mail: a-wardhaugh@dfid.gtnet.gov.uk | |
| Warner, Dennis | Dr. | WHO | Chief | Rural Environmental Health, Division of Operational Support in Environmental Health, World Health Organization (WHO),20 Avenue Appia, CH-1211 Geneva 27, Switzerland<br>Tel: 41 22 791 3546<br>Fax: 41 22 791 4159<br>E-mail: warnerd@who.ch | Water supply, sanitation and human health, environmental health, water resources planning |
| Williams, Hugh Bowen | Mr. | Zimbabwe | Catchment Planner/ Ministry of Water | Kurima House, Mandela Avenue, Harare, Zimbabwe<br>Tel: 263 4 706049<br>Fax: 263 4 722752<br>E-mail: williams@mango.zw | Water resources planning |
| Woltu, Teferra Tamene | Mr. | Ethiopia | Team Leader/ | Projects Planning, Evaluation and Policy Preparation, Ministry of Water Resources P.O. Box 16336, Addis Ababa, Ethiopia<br>Tel: 251 1 182766<br>Fax: 251 1 611700 | Ag. Economist, Project preparation and evaluation, policy preparation |
| Wray, Alistair | Mr. | United Kingdom | Senior Water Resources Adviser | Department for International Development, 94 Victoria Street, London, SW1E 5JL, United Kingdom<br>Tel: 44 171 917 0394<br>Fax: 44 171 917 0072<br>E-mail: a-wray@dfid.gtnet.gov.uk | |
| Wulfeen, Bernd | Mr. | Germany | Director Foreign Office | Simrockaee 53173 Bonn, Germany<br>Tel: 49 228 172787<br>Fax: 49 228 173785 | |

| | | | | | |
|---|---|---|---|---|---|
| Yakowitz, Marilyn | Ms. | OECD | Coordinator for Sustainable Development | Organization for Economic Co-operation and Development, 2 rue André-Pascal, RAN 1562, 75775 Paris CEDEX 16, France<br>Tel: 33 1 4524 9058<br>Fax: 33 1 4524 1650<br>E-mail: marilyn.yakowitz@oecd.org | OECD region, financial flows, agriculture and environment, development assistance |
| Young, Gordon J. | Dr. | IAHS | Secretary General | International Association of Hydrological Sciences, Waterloo, Canada<br>Tel: 1 519 884 1970<br>Fax: 1 519 846 0968<br>E-mail: 44iahs@mach1.wlu.ca | General hydrology and water resources, snow and ice hydrology. Coordinator role (Dublin Conference; as past chair, UNESCO IHP; as Chair, International Water Associations Liaison Committee |
| Zeegers, Hubert | Mr. | BRGM | International Director | Geology and Mining International, 3 avenue Claude Guillemin, B.P. 6009 - 45060 Orleans CEDEX 2, France<br>Tel: 33 2 38 643 076<br>Fax: 33 2 38 643 305<br>E-mail: h.zeegers@brgm.fr | International cooperation, natural resource management |
| Zhang, Qi Shun | Mr. | China | Director/ Academic Committee of IWHR China; Vice-President/ ICID | 20 West Chedong Zhuang Rd., P.O. Box 366, Beijing 100044, China<br>Tel: 86 010 684 12316<br>Fax: 86 010 684 12316<br>E-mail: headiwhr@public3.bta.net.cn | Water resources, river harnessing |
| Zhang, Yue | Mr. | China | Second Secretary | Department of International Organizations, Ministry of Foreign Affairs, No. 2 Chao Yang Men Nan Da Jie, Beijing, China 100701<br>Tel: 86 10 6596 3178<br>Fax: 86 10 6596 3120 | Economic and environmental affairs |

# [Expert group meeting on strategic approaches to freshwater management : papers presented]

Harare, Zimbabwe
27 - 30 January 1998

## CONTENTS

UNITED NATIONS

Advanced unedited copy

Economic and Social Council

Distr.
GENERAL

E/CN.17/1998/3

ORIGINAL: ENGLISH

COMMISSION ON SUSTAINABLE DEVELOPMENT
Sixth Session
20 April - 1 May 1998

# ACTIVITIES OF THE ORGANIZATIONS OF THE UNITED NATIONS SYSTEM IN THE FIELD OF FRESHWATER RESOURCES

Report of the Secretary-General

CONTENTS

## INTRODUCTION

1. The present report has been prepared pursuant to Economic and Social Council conclusion 1997/3, by which the Council urged the ACC Subcommittee on Water Resources 1/ to analyze in detail the activities that are currently being carried out by the organizations of the United Nations system in the field of freshwater resources, and the interrelationship between them, and requested the Secretary-General to prepare a report by the end of 1997, as an input into the preparatory process leading up to the sixth session of the Commission on Sustainable Development (CSD).

2. Section I provides a synoptic view of both the involvement of and cooperative arrangements among the organizations of the system. Section II focuses on strategic responses of the United Nations system to challenges faced by Governments and the international community in striving towards the sustainable development and utilization of water resources. A comprehensive review of cooperative arrangements among organizations of the system in the field of water resources was provided in the Report of the Secretary-General on Freshwater, including clean and safe water supply and sanitation (document no. E/1997/70), submitted to the coordination segment of the 1997 Substantive Session of the Economic and Social Council.

## I. NATURE AND INTERRELATIONSHIP OF THE ACTIVITIES OF THE ORGANIZATIONS OF THE UNITED NATIONS SYSTEM IN THE FIELD OF WATER RESOURCES

3. The activities of the organizations of the United Nations system in the field of water resources are wide-ranging in scope and nature. Table 1 presents a synoptic view of the involvement of organizations in various aspects of water resources assessment, development and management, based on the programme areas of chapter 18 of Agenda 21. The three main natures of activity are (a) data gathering/analysis and preparation of studies and reports, (b) organization and servicing of meetings and workshops and (c) technical cooperation, including advisory services and field projects. Table 2 presents a synoptic view of cooperative arrangements among organizations of the system.

### A. Water for socio-economic development

#### 1. Integrated Water Resources Management

4. The United Nations Department for Economic and Social Affairs (DESA) provides support to the General Assembly, the Economic and Social Council, the Commission on Sustainable Development, the Committee on Natural Resources and the ACC Subcommittee on Water Resources. The Department functions as the secretariat for the ACC Subcommittee. The Department assists many countries in their efforts to translate the internationally adopted water-related programme of Agenda 21 into country-specific programmes and projects in the context of the holistic management of water and the integration of water sector plans and programmes into the framework of national, economic and social development plans.

**Table 1. Involvement of organizations of the United Nations system in the field of water resources according to strategic management functions and nature of activity**

| STRATEGIC MANAGEMENT FUNCTIONS | DATA GATHERING, ANALYSIS AND STUDIES | ORGANIZATION AND SERVICING OF MEETINGS | TECHNICAL COOPERATION |
|---|---|---|---|
| **A. WATER FOR SOCIO-ECONOMIC DEVELOPMENT** | | | |
| **Integrated water resources management** | DESA, ECA, ECE, ECLAC, ESCAP, ESCWA, UNDP, UNEP, UNU, INSTRAW, FAO, UNESCO, WORLDBANK | DESA, ECE, ECLAC, ESCAP, ESCWA, UNU, FAO, UNESCO | DESA, ECE, ECLAC, ESCAP, ESCWA, UNDP, UNEP, UNU, FAO, WORLDBANK, |
| **Water for sustainable food production and rural development** | ECA, ESCAP, ESCWA, UNEP, FAO, WHO, WORLDBANK | ESCAP, UNEP, FAO | DESA, ECA, ESCWA, UNDP, UNHCR, FAO |
| **Water supply and sanitation** | DESA, ECE, ECLAC, ESCAP, UNICEF, UNDP, UNEP, HABITAT, UNHCR, UNU, INSTRAW, WHO, WORLDBANK | DESA, ESCAP, ECE, WORLDBANK, UNU, INSTRAW, HABITAT, UNICEF, WHO | DESA, ESCAP, ESCWA, UNU, INSTRAW, HABITAT, UNICEF, UNDP, UNHCR, FAO WHO, WORLDBANK, |
| **Water for sustainable urban development** | ESCAP, UNDP, UNEP, HABITAT, UNESCO, WHO, WMO, WORLDBANK | ESCAP, UNDP, HABITAT, UNESCO, WMO | ESCAP, UNICEF, UNEP, HABITAT, FAO, UNESCO, WMO |
| **Industrial water use** | ESCWA, UNEP, UNU, UNIDO, IAEA | UNIDO, IAEA | ECLAC, ESCWA, UNU, UNIDO, IAEA |
| **In-stream uses of water resources** | ECA, ESCAP, UNEP, WORLDBANK | ESCAP, UNEP, WORLDBANK | DESA, ESCAP, UNDP, UNEP, WORLDBANK, UNIDO |
| **Mitigation of water-related *natural disasters*** | ESCAP, IDNDR, FAO, UNESCO, WMO | ESCAP, IDNDR, UNESCO, WMO | DESA, ESCAP, IDNDR, UNDP, FAO, UNESCO, WORLDBANK, WMO |
| **B. HEALTH AND PRODUCTIVITY OF THE AQUATIC ENVIRONMENT** | DESA, ECE, ECLAC, ESCAP, ESCWA, CBD, UNFCCC, UNDP, UNEP, UNU, FAO, UNESCO, WHO, WORLDBANK, UNIDO | ECE, ESCAP, CBD, UNFCCC, UNEP, UNU, UNESCO | DESA, ECE, ESCAP, ESCWA, UNDP, UNEP, HABITAT, UNU, FAO, UNIDO, WHO, WORLDBANK |
| **C. INFORMATION MANAGEMENT** | DESA, ECA, ESCAP, ESCWA, FAO, IAEA, WORLDBANK, UNICEF, UNESCO, UNEP, UNU, WHO, WMO | ESCAP, ESCWA, UNICEF, UNESCO, UNU, WHO, WMO, UNEP | DESA, ESCAP, ESCWA, FAO, IAEA, WORLDBANK, UNICEF, UNDP, UNESCO, UNEP, UNU, WHO, WMO |
| **D. FINANCIAL ASSISTANCE** | ECA, ESCWA, ESCAP, UNICEF, UNDP, UNEP, UNU, UNESCO, WHO, WORLDBANK, WMO, IAEA | DESA, ECA, ECE, ECLAC, ESCAP, ESCWA, UNICEF, UNDP, UNEP, HABITAT, INSTRAW, IDNDR, UNU, FAO, UNESCO, WHO, WORLDBANK, WMO, UNIDO | HABITAT, UNICEF, UNDP UNU, FAO, UNESCO, WHO, WORLDBANK, WMO, UNIDO, IAEA |
| **E. CAPACITY BUILDING** | ECLAC, ESCAP, ESCWA, UNICEF, UNDP, UNEP, UNU, INSTRAW, UNESCO, WHO, WMO, IAEA | ESCAP, ESCWA, UNICEF, UNDP, UNEP, UNU, INSTRAW, UNESCO, WHO, WMO, IAEA | DESA, ECLAC, ESCAP, ESCWA, UNICEF, UNDP, UNEP, HABITAT, UNU, INSTRAW, IDNDR, FAO, UNESCO, WHO, WORLDBANK, WMO, UNIDO, IAEA |

**Table 2. Current cooperative arrangements among organizations of the united nations system in the field of water resources, according to strategic management functions**

| STRATEGIC MANAGEMENT FUNCTIONS | MAJOR COOPERATIVE ARRANGEMENTS (As per Report of the Secretary-General on Freshwater, including clean and safe water supply and sanitation; Report of the ACC Subcommittee on Water Resources on its 18th session and inputs to this report) |
|---|---|
| **Integrated Water Resources Management** | • **ACC Subcommittee on Water Resources**: DESA, ECA, ECE, ECLAC, ESCAP, ESCWA, UNICEF, UNDP, UNEP, HABITAT, UNHCR, UNU, INSTRAW, CBD, CCD, UNFCCC, IDNDR, FAO, UNESCO, WHO, WORLDBANK, WMO, UNIDO and IAEA<br>• **ACC Subcommittee Working Group on Integrated Approaches to Land and Water Management**: DESA, FAO, IAEA, UNICEF, ESCAP, UNESCO, UNEP and WHO<br>• **Joint Programme on Integrated Land and Water Management**: FAO and UNESCO<br>• **Interagency Committee on Water Resources in Africa**: ECA and several other ACC Subcommittee members<br>• **Interagency Committee on Water Resources in Asia and the Pacific**: ESCAP and several other ACC Subcommittee members |
| **Water for Sustainable Food Production and Rural Development** | • **Effective Planning and Management of Irrigated Agriculture**: FAO, UNEP and WMO<br>• **Technical Consultation on Sustainable Agriculture and Rural Water Management**: FAO, WORLDBANK, UNICEF, UNDP and WHO |
| ***Water Supply and Sanitation*** | • ***Cooperation and Coordination Mechanisms in Water Supply and Sanitation***: HABITAT, UNICEF and UNDP<br>• **Interagency Steering Committee on Water Supply and Sanitation**: DESA, FAO, IAEA, WORLDBANK, INSTRAW, HABITAT, UNICEF, UNDP, ECA, ESCAP, ECE, ECLAC, ESCWA, UNESCO, UNEP, UNHCR, UNIDO, UNU, WHO and WMO<br>• **Joint activities towards Universal Access to Water Supply and Sanitation in Asia and the Pacific**: DESA, WORLDBANK, INSTRAW, UNICEF, UNDP, ESCAP and WHO<br>• **Joint initiative on Participatory Methods for Hygiene Behaviour Change and Sanitation**: WORLDBANK, UNICEF, UNDP, WHO<br>• **Joint initiative on Prevention and Control of Water-related Diseases in Europe**: ECE, UNEP and WHO<br>• **Joint Monitoring Programme (JMP) for Water Supply and Sanitation**: UNICEF and WHO<br>• **Memorandum of Understanding on Water and Environmental Sanitation**: WORLD BANK and UNICEF<br>• **Promotion of Sustainable Water Supply and Sanitation Programme**: WORLDBANK, UNDP and WHO<br>• **Water Supply and Sanitation Programme**: WORLDBANK and UNDP<br>• **Water Supply and Sanitation Programme in Rural Areas**: DESA, UNDP and UNCDF (UN Capital Development Fund)<br>• **Water Working Group of the System-Wide Special Initiative on Africa**: DESA, FAO, IAEA, WORLDBANK, HABITAT, UNICEF, UNDP, ECA, UNESCO, UNEP, UNIDO, WHO and WMO |
| **Water for Sustainable Urban Development** | • **Collaboration on Urban Sanitation Technologies**: HABITAT and UNICEF<br>• Urban Hydrology Cooperation Project: UNESCO and WMO |
| **Industrial Water Use** | • **Collaboration on Industrial Pollution Prevention and Abatement Guidelines**: UNEP, WHO, WORLDBANK and UNIDO |
| **In-stream Uses of Water Resources** | • **Global Research Initiative on Ecohydrology**: UNDP and UNESCO |
| **Mitigation of Water-related Natural Disasters** | • **Implementation of the International Decade for Natural Disaster Reduction**: IDNDR and WMO<br>• **Typhoon Committee and Panel on Tropical Cyclones**: ESCAP and WMO<br>• **World Climate Programme/Water**: UNESCO and WMO |
| **Health and Productivity of the Aquatic Environment** | • **ACC Subcommittee Steering Committee for Implementation of the GPA**: DESA, FAO, UNESCO, UNEP, UNU, WHO and WMO<br>• **ACC Subcommittee Water Quality Initiative**: DESA, UNESCO, UNEP, UNU and WHO<br>• **Global Freshwater Quality Monitoring Programme (GEMS)/Water**: ECE, UNESCO, UNEP, WHO and WMO<br>• **Panel of Experts on Environmental Management for Vector Control (PEEM)**: FAO, HABITAT, UNEP and WHO |
| **Information Management** | • **ACC Subcommittee Internet Modernization Project**: DESA, UNU and other ACC Subcommittee member agencies<br>• **African Water Resources Assessment Strategy**: ECA and WMO<br>• **Global Information Network on Activities of the United Nations System in the Field of Water Resources**: DESA, UNU and other ACC Subcommittee member agencies<br>• **Inter-agency Working Agreement on Water Resources Assessment**: UNESCO and WMO<br>• **Joint Project on GIS Application to Water Resources**: FAO and UNESCO<br>• **Water and Sanitation Monitoring System (WASAMS)**: UNICEF and WHO<br>• **World Hydrological Cycle Observing System (WHYCOS)**: WORLDBANK and WMO |
| **Financial Assistance** | • **[most cooperative arrangements mentioned in this table involve some financial assistance]** |
| **Capacity Building** | • **1998 World Water Day Celebration**: DESA, UNICEF and other ACC Subcommittee member agencies<br>• **Joint initiative on School water supply, sanitation hygiene education**: UNICEF and WHO<br>• **Women, Water Supply and Sanitation Training Package**: DESA, INSTRAW, ILO, UNDP, ESCAP and UNICEF |

5. UNEP's activities include assistance to Governments in the development of integrated river basin management plans for sustainable water use through its programme on the "Environmentally-Sound Management of Inland Waters (EMINWA); basin diagnostic studies and action programmes for international river and lake basins. As Chair of the Water Working Group of the United Nations system-wide Special Initiative on Africa, UNEP is working to coordinate UN agency efforts to achieve specific social, economic and environmental goals in the sustainable use of freshwater resources in the region.

6. UNU's activities in this area focus on river basin governance and the development of new water management tools, which includes detailed assessments of sustainable management challenges in international river basins. FAO is involved in the in the implementation of a number of field projects in integrated watershed management throughout the world, many of which include a focus on achieving environmental stability aimed at the protection of fresh water resources to satisfy demand in both upland and lowland areas. UNESCO's activities focus on the organization or facilitation of meetings, conferences and workshops, including a recent international conference on Risk, Reliability, Uncertainty and Robustness of Water Resources Systems, a workshop on Negotiations on Water in Areas of Conflict and an envisaged regional workshop on international river basins. UNDP funds many projects aimed at integrated water resources development and management in all developing country regions. The World Bank also provides loans and technical assistance to dozens of ongoing projects in the area of natural resources management in many developing countries.

7. With regard to the regional commissions, ECA focuses on the production of technical documents on options for integrated water resources management in selected African countries. ESCAP has been responsible for several workshops and seminars, publications and advisory missions to countries in the region, especially in the area of integrated river basin planning. ECE activities focus mainly on support for the implementation of the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, including assistance to countries with economies in transition to protect and manage transboundary waters, integrated management of water and related ecosystems and land-based pollution control. ECLAC focuses on promoting policies for establishing or strengthening institutions at the river basin level and on assistance in the field of water law. ESCWA has organized several of expert group meetings and provided of advisory services to its member States, particularly in the areas of optimal utilization of shared water resources, water legislation and the impact of water pricing on water demand.

### 2. Water for sustainable food production and rural development

8. FAO is currently responsible for about 100 technical cooperation projects in the area of water for food production and rural development. Because of the dominant role of agricultural water use in many regions of the world, such projects bear a strong relationship to the integrated management of water resources. Its International Action Programme on Water and Sustainable Agricultural Development (IAP/WASAD) incorporates broad reviews of national water sectors, including river basin master planning, management issues and environmental sustainability, and is FAO's major instrument for assisting United Nations member States to implement water policies for sustainable agricultural development and management, as defined in chapter 18 of Agenda 21. FAO's Special Programme for Food Security is designed to enhance the food production capacity of Low Income Food Deficit Countries. The water sector of this programme aims to provide assistance to the respective governments to expand low-cost, medium- and small-scale irrigation.

5. UNEP's activities include assistance to Governments in the development of integrated river basin management plans for sustainable water use through its programme on the "Environmentally-Sound Management of Inland Waters (EMINWA); basin diagnostic studies and action programmes for international river and lake basins. As Chair of the Water Working Group of the United Nations system-wide Special Initiative on Africa, UNEP is working to coordinate UN agency efforts to achieve specific social, economic and environmental goals in the sustainable use of freshwater resources in the region.

6. UNU's activities in this area focus on river basin governance and the development of new water management tools, which includes detailed assessments of sustainable management challenges in international river basins. FAO is involved in the in the implementation of a number of field projects in integrated watershed management throughout the world, many of which include a focus on achieving environmental stability aimed at the protection of fresh water resources to satisfy demand in both upland and lowland areas. UNESCO's activities focus on the organization or facilitation of meetings, conferences and workshops, including a recent international conference on Risk, Reliability, Uncertainty and Robustness of Water Resources Systems, a workshop on Negotiations on Water in Areas of Conflict and an envisaged regional workshop on international river basins. UNDP funds many projects aimed at integrated water resources development and management in all developing country regions. The World Bank also provides loans and technical assistance to dozens of ongoing projects in the area of natural resources management in many developing countries.

7. With regard to the regional commissions, ECA focuses on the production of technical documents on options for integrated water resources management in selected African countries. ESCAP has been responsible for several workshops and seminars, publications and advisory missions to countries in the region, especially in the area of integrated river basin planning. ECE activities focus mainly on support for the implementation of the 1992 Convention on the Protection and Use of Transboundary Watercourses and International Lakes, including assistance to countries with economies in transition to protect and manage transboundary waters, integrated management of water and related ecosystems and land-based pollution control. ECLAC focuses on promoting policies for establishing or strengthening institutions at the river basin level and on assistance in the field of water law. ESCWA has organized several of expert group meetings and provided of advisory services to its member States, particularly in the areas of optimal utilization of shared water resources, water legislation and the impact of water pricing on water demand.

### 2. Water for sustainable food production and rural development

8. FAO is currently responsible for about 100 technical cooperation projects in the area of water for food production and rural development. Because of the dominant role of agricultural water use in many regions of the world, such projects bear a strong relationship to the integrated management of water resources. Its International Action Programme on Water and Sustainable Agricultural Development (IAP/WASAD) incorporates broad reviews of national water sectors, including river basin master planning, management issues and environmental sustainability, and is FAO's major instrument for assisting United Nations member States to implement water policies for sustainable agricultural development and management, as defined in chapter 18 of Agenda 21. FAO's Special Programme for Food Security is designed to enhance the food production capacity of Low Income Food Deficit Countries. The water sector of this programme aims to provide assistance to the respective governments to expand low-cost, medium- and small-scale irrigation.

FAO promotes water harvesting techniques in arid and semi-arid areas in order to alleviate water shortages associated with supplementary irrigation techniques in crop production. It also executes many field projects on the use of marginal quality waters, such as saline drainage water and municipal or industrial wastewater, and promotes the transfer of small scale irrigation technologies for peri-urban areas in developing countries.

9. The World Bank provides loans and technical assistance to irrigation and drainage projects in developing countries and those with economies in transition. UNDP also funds several ongoing projects aimed to improve water resources management for agricultural use. UNDP, the World Bank, FAO and the International Commission for Irrigation and Drainage (ICID) are the co-sponsors of the International Programme for Technology Research in Irrigation and Drainage, which assists countries in the identification of critical R&D gaps, the formulation of R&D projects and the mobilization of donor support. UNHCR's operational activities include the development of emergency water facilities to meet the agricultural requirements of refugee communities in such way that the level of technology and long-term operation and maintenance are compatible with the capacity of the beneficiary communities

10. ECA is currently preparing a major technical document on fisheries as a contribution to food security in Africa. ESCAP has recently held two workshops on irrigation water supply and on pricing policies for urban and rural water supply, both of which resulted in the subsequent publication of technical documents. ESCWA is currently carrying out a study on the development of non-conventional sources of freshwater resources in rural areas, including desalination, wastewater reuse, use of marginal water and water harvesting, and a comprehensive regional evaluation of progress in the implementation of chapter 18 of Agenda 21, with particular emphasis on sustainable agricultural production.

### 3. Water supply and sanitation

11. As secretariat of the Interagency Steering Committee for Water Supply and Sanitation, WHO acts as a focal point in the United Nations system for fostering cooperation in this programme area. Its water supply and sanitation activities, both in terms of studies and field projects, focus primarily on human settlements, basic services, health, water quality and behavioural change.. WHO's Drinking-Water Quality Guidelines are promoted through regional workshops and country consultations, while surveillance of drinking water is supported with training and provision of analytical tools. The WHO's country-based "Africa 2000" initiative aims to accelerate investment in water supply and sanitation in the region by means of a new partnership between countries and the external development community.

12. UNICEF has also historically played a leading role in this area, in particular by supporting the capacity building of the Governments and communities, in over a hundred countries, in their efforts to increase the coverage of access to safe drinking water and environmental sanitation, with a focus on the rights of the child to a safe environment, safe water and sanitation for survival, protection and development of children and their mothers. UNICEF has often used this intervention to mainstream gender issues and promote the empowerment of women through women hand pump caretakers, women managed water committees, sanitation programmes and micro-credit schemes for income generation, often in close cooperation with INSTRAW and other institutions. UNICEF's "Strategy in Water and Environmental Sanitation" stresses the need for greater attention to environmental sanitation, hygiene promotion, development and field testing of the low cost appropriate technologies for water supply and sanitation, operation and maintenance centred on vulnerable groups, including the urban poor, and capacity building of

the private entrepreneurship through training and technology transfer in the production and marketing of hand pumps, drilling rigs and other water technologies.

13. UNDP and the World Bank both provide substantial funds and technical assistance to developing countries and economies in transition for projects in both urban and rural areas. The UNDP/World Bank Water and Sanitation Programme promotes investments in the water and sanitation sector by supporting communities and governments through capacity building, enhancing the involvement of stakeholders in the selection, operation and maintenance of systems and by fostering the involvement of the private sector, NGO's and user groups.

14. DESA, in collaboration with UNDP and the United Nations Capital Development Fund (UNCDF), has been involved in cooperative efforts to assist developing countries, particularly least developed countries, in the management of water supply and sanitation programmes in rural areas. These programmes are usually linked to the national programmes for poverty eradication, income generation, enhancing the role of women in economic and social development, and to other developmental efforts. HABITAT, in collaboration with UNICEF and other organizations outside the system, promotes the development and use of urban sanitation technologies to expand access to water supply and sanitation services for the urban poor. UNHCR's water sector activities aims to foster a preventive health approach in favour of beneficiaries of refugee assistance programmes throughout the world. INSTRAW is the major advocate for the role of women in water supply and sanitation within the United Nations system and, in this capacity, it has prepared policy statements for various intergovernmental meetings, produced two multi-media training packages on "Women, Water Supply and Sanitation" and conducted national, sub-regional and regional training seminars in cooperation with DESA, UNICEF, UNDP and ESCAP. FAO's activities in this field are limited to interventions within integrated rural development initiatives.

15. ESCAP's activities in this area focus on mobilization of community participation and resources to contribute towards universal access to water supply and sanitation. These activities have been carried out mostly in collaboration with other United Nations agencies, particularly DESA, INSTRAW, UNICEF, WHO, UNDP and the World Bank. Activities in this area include the organization of workshops and seminars in the region, including, four national workshops on the use of the training modules of the above-mentioned training package on Women, Water Supply and Sanitation . ECE focuses mainly on support for the implementation of the water supply and human health objectives of the above-mentioned Convention on the Protection and Use of Transboundary Watercourses and International Lakes. Together with WHO, UNEP and the European Commission, ECE is preparing an international instrument on the prevention, control and reduction of water-related diseases to be presented to the 1999 London Ministerial Conference on Environment and Health. ECLAC's activities in this area focus on private participation in water supply and sanitation and its regulation, including the provision of advice to countries of the region. ESCWA's activities in this area focus on provision advisory services to member States, such as, for example, advice to Qatar on the management of drinking-water in rural areas.

### 4. Water for sustainable urban development

16. The Habitat II preparatory process included an international conference on "Managing water resources for large cities and towns", held in Beijing, China, in March 1996 and organized by HABITAT in

cooperation with DESA, UNEP and other United Nations organizations. The "Beijing Declaration" focused on the urgency of undertaking greater efforts to promote management to improve the efficiency of water use, as well as the importance of innovative financing mechanisms and broad-based partnerships bringing together the public and private sectors and local communities. As the first major follow-up to the Habitat II Conference in Istanbul, HABITAT and UNDP, in collaboration with major African NGOs organized an International Consultation on Partnerships in the Water Sector for Cities in Africa was held in Cape Town, South Africa, in December 1997. The Consultation, addressed the need for a broad-based partnership approach to meet the rapidly growing water demand in African cities. As the focal point for this programme area within the United Nations system, HABITAT is also involved in other initiatives, such as, a project on integrated management of urban water resources by promoting partnerships among local authorities, the private sector, NGOs and community user associations.

17. Activities by other organizations include the WMO and UNESCO initiatives on urban hydrology; UNEP's promotion of environmental impact assessments of human water use in peri-urban areas and of environmental technologies focusing on the water needs of urban areas; and ESCAP's organization of several workshops and the undertaking of many advisory missions aimed to improve urban water resources management. both UNDP and the World Bank fund several projects with components focusing on sustainable urban water resources development and management.

5. Industrial water use

18. UNIDO's current programmes and projects focus on design and application of infrastructure for industrial water use and water treatment in industrial processes, on improving efficiency of industrial water use, including recycling and conservation, and on industrial effluent reduction. The organization acts as a clearing house for information on industrial water use and provides assistance in the manufacture of water supply and treatment equipment. UNEP is currently working on the development of a benchmark publication on environment, water and sustainable development that includes a review of industrial water use. IAEA's activities in this area focus on the efficient utilization of water for cooling purposes in the nuclear industry and on the use of nuclear energy for desalination of seawater. ECLAC's activities are related to the environmental management in the mining industry.

6. In-stream uses of water resources

19. Both UNDP and the World Bank have funded several projects involving specific in-stream uses of water resources, in particular hydro-electric dams, in recent years. A workshop on the future of large dams jointly hosted by the World Bank and the World Conservation Union (IUCN) in Gland, Switzerland, in April 1997, brought together leading experts and major stakeholder representatives from Governments, civil society, international organizations and the private sector. As an outcome of the workshop, a two-year World Commission on Dams is being set up to assess the experience of large dams and to evaluate their development effectiveness; to develop decision-making criteria, policy and regulatory frameworks for assessing alternatives to energy and water resources development; to develop internationally-accepted standards for large dams, including the promotion of best practices; and to identify the implications for institutional, policy and financial arrangements so that benefits, costs and risks are equitably shared at the global, national and local levels.

20. DESA provided support for a small-scale hydropower project. ECA is undertaking a study of the economic viability of manufacturing turbines and generators for mini-hydro projects in Africa. ESCAP is implementing a Programme for Asian Cooperation on Energy and the Environment, which includes a management component focusing on private sector participation in hydropower generation and its consequences on environmental quality. UNIDO works with energy ministries, utilities and private energy companies to raise awareness of new and innovative ways of financing more efficient power generating capacity, including several hydropower projects worldwide.

7. Mitigation of water-related natural disasters

21. The Secretariat of the International Decade for Natural Disaster Reduction (IDNDR) is involved in the implementation of its Risk Assessment Tools for Diagnosis of Urban Areas against Seismic Disasters (RADIUS) project. The Secretariat is also involved in annual public awareness-raising campaigns which, in 1997, was organized around the theme "Water: Too much, Too little ... Leading Cause of Natural Disasters", the implementation of pilot activities to reduce risk of water-related natural disasters in selected small island States, and a task force on floods in Central and Eastern Europe. The Secretariat works closely with WMO in ensuring that the General Assembly and other intergovernmental bodies are appraised of the importance of establishing and maintaining appropriate and cost-effective early warning systems. The findings of two reports on the improvement of early-warning capacities submitted to the General Assembly in 1995 and 1997 respectively, will form the basis for the International Conference on Early-Warning for Natural Disasters, to be held in Potsdam, Germany, in 1998.

22. As part of its basic mission, WMO coordinates national activities aimed at monitoring and forecasting floods and droughts. WMO works with UNESCO on water-related aspects of the World Climate Programme, including the planning of the Second International Conference on Climate and Water, to be held in Finland in August 1998. As part of activities related to integrated water resources management in arid and semi-arid zones, UNESCO is implementing a project entitled "Coping with Water Scarcity and is organizing an international conference on Drought Management, to be held in South Africa in 1998. Under the aegis of a project entitled "Non-structural flood control measures to balance risk-cost-benefit in flood control management in urban areas", UNESCO plans to develop a real-time urban flood management decision support system in a pilot basin within the São Paulo (Brazil) metropolitan area and to hold a workshop on Non-structural Flood Control in Urban Areas, also in São Paulo, in April 1998. A document entitled, "Impacts of Climate Change and Climate Variability on Hydrological Regimes" will soon be published as part of UNESCO's International Hydrology Series.

23. DESA has been involved in activities related to integrated flood and typhoon management for small islands and in projects dealing with the mitigation of extreme meteorological events in the South Pacific and the Persian Gulf. ESCAP's work on natural disaster reduction includes the organization of a major regional workshop, held in Bangkok Thailand, in March 1997, on appropriate land-use planning and watershed management to reduce damage owing to water-related disasters, the publication of a detailed study entitled "Natural Hazards and Natural Disaster Reduction in Asia and the Pacific", the annual celebration of IDNDR Day in the region and the provision of advisory services to countries on water-related natural disasters. In cooperation with WMO, ESCAP continues to support the efforts of the Typhoon Committee and the Panel on Tropical Cyclones. FAO assists several countries in the establishment of flood protection and

management systems. The World Bank provides loans and technical assistance to many projects throughout the developing world, particularly in the area of flood protection. UNDP also funds several projects is this area, including two programmes to save the Aral Sea and two projects on drought prevention in Ethiopia.

B. Health and productivity of the aquatic environment and impacts on human health from the degradation of water resources

24. The water quality monitoring programme of the Global Environment Monitoring System (GEMS/Water), co-sponsored by WHO, UNEP, WMO and UNESCO constitutes the major United nations system for water quality monitoring. Global and regional assessments on water quality have been carried out, including on groundwater quality in Asia and the Pacific and on water quality problems in the former Soviet Union. A global register of rivers flowing into the oceans (GEMS/Glori) has also been established to provide pollutant fluxes for more than 400 rivers world-wide. Institutional support for GEMS water data gathering and analysis is provided by a Global Water Quality Data Centre and a Global Runoff Data Centre located in Canada and Germany, respectively.

25. UNEP, as both secretariat of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities facilitates the implementation of the water quality components of the programme. DESA is collaborating with government organizations to enhance national capacity to address the problem of water pollution, by establishing control measures for major industries and commercial enterprises, encouraging reuse and recycling of waste waters and improving agricultural practices. The World Bank provides significant loans to projects dealing with environmental protection of freshwater resources. UNDP also funds many ongoing projects in this programme area, including three separate projects aimed at reversing environmental degradation in the Aral Sea and an emergency water hyacinth reduction programme on Lake Victoria. UNU has several activities dealing with water monitoring, including the Asia-Pacific Mussel Watch programme. UNIDO's activities to prevent and control land-based sources of industrial pollution include the implementation of a major project aimed to protect and restore the health of the large marine ecosystem of five countries in the Gulf of Guinea.

26. UNESCO's International Hydrological Programme is currently implementing two projects on "Interactions between river systems, flood plains and wetlands" and on "Comprehensive assessment of surficial ecohydrological processes". Its project on Land/Inland Water Ecotones also published two major documents on freshwater biodiversity. The biological diversity of inland water ecosystems was actually the thematic focus of the third meeting of the Subsidiary Body on Scientific, Technical and Technological Advice to the CBD, held in September 1997, which put forward recommendations for a work programme on inland water biological diversity. With the legally binding commitments contained, the CBD aims to ensure sustainable maintenance of biological diversity, including aquatic biological diversity, thereby contributes to the health and productivity of the aquatic environment. FAO, through its various activities aims to ensure appropriate water quality for optimum crop, fish and animal production, to enable safe use and disposal of municipal waster water in agriculture, and to protect downstream water sources from non-point sources of pollution from agricultural activities. It also conducts activities concerning wetland management and control of waterlogging and salinization in irrigated lands. FAO and UNESCO are jointly responsible for the implementation of an integrated land and water management programme aimed to prevent pollution of groundwater due to agricultural practices.

27. The disease control and eradication programmes of WHO, notably its programmes for diarrhoeal diseases, guinea worm, schistosomiasis and river blindness, as well as the joint WHO/FAO/UNEP/HABITAT Panel of Experts on Environmental Management for Vector Control (PEEM), have had a significant impact on the way in which water resources are being managed in many countries. The PEEM is collaborating with the World Conservation Union (IUCN) in a project on Conservation and Resource Utilization in selected wetlands of the Zambezi River basin, and is actively involved in the promotion of environmental management for vector control in dams and reservoirs for hydropower generation. In collaboration with the London School of Hygiene and Tropical Medicine and with the United Kingdom's Overseas Development Institute respectively, the PEEM is producing guidelines on urban environmental management for disease vector control and promoting disease vector control through agricultural extension programmes.

28. The Global Environment Sanitation Initiative (GESI), as endorsed by the Fourth Global Forum of the Water Supply and Sanitation Collaborative Council, held in Manila, Philippines, from 3 to 7 November 1997, and in which ACC Subcommittee members are taking a leading role, is another good example of system-wide action to improve the current situation in the area of environmental sanitation.

29. ESCAP's activities in this area include the organization of an expert group meeting on the Protection of water resources, water quality and aquatic ecosystems, a workshop on Water-related problems in low-lying coastal areas, the publication of a document entitled "Protection of Water Resources, Water Quality and Aquatic Ecosystems in Asia and the Pacific" and several advisory missions. ECE's involvement in the implementation of the 1992 Convention on the Protection and Use on Transboundary Watercourses and International Lakes also includes several activities related to protection of water resources. ECLAC's activities centres on formulation of alternative instruments for the management of water quality in freshwater bodies and on coastal and estuarine areas. ESCWA's activities include studies on water quality and water pollution in selected urban areas and on harmonization of environmental standards in the water sector of its member States, as well as the provision of advisory services aimed at the sustainable water resources management.

## C. Information management

30. WMO has taken the lead in efforts to improve the capacity of national and regional water resources assessment services, through programmes like the World Hydrological Cycle Observing System (WHYCOS). That initiative is already under way in Mediterranean countries and southern Africa, with the support of the World Bank and other organizations outside the United Nations system, and plans are well advanced in other regions. Related activities include the implementation African Water Resources Assessment Strategy adopted by the African Conference on Water Resources, convened jointly by WMO and ECA in Addis Ababa, Ethiopia, in March 1995. WMO is also responsible for several other activities aimed to improve both water resources assessment and networks of hydrological observation stations for monitoring the quality and quantity of both surface and ground water, including substantial support for the operation of the Global Runoff Data Centre (GRDC), situated in Koblenz, Germany. UNESCO's activities in this area include the FRIEND project to support international efforts to collect and process hydrological data; several initiatives on urban hydrology, such as, for example, two projects on surface and groundwater management in the urban environment and on integrated urban drainage modelling in different climates; and

a joint project with FAO on the application of Geographical Information Systems (GIS) to water resources. In addition to this joint activity, FAO continues to develop its statistical global database on rural water use and irrigation (AQUASTAT) and has also developed manuals and guidelines to estimate peak floods and annual runoff of small river basins in Africa where no hydrological data exist. UNDP funds several projects is this area, including the Sub-Saharan Africa Hydrological Assessment, in cooperation with the World Bank, a water resources information project in Bangladesh and a groundwater data bank in the Philippines.

31. Through its activities concerning the integrated management of water resources, DESA provides policy advice to developing countries for information management. Modern computer technologies and up-to-date groundwater software have been introduced and promoted in many developing countries. The water supply and sanitation Joint Monitoring Programme (JMP), established by WHO and UNICEF, is primarily aimed at the development of national capacities for sector monitoring and, as a secondary objective, at the preparation of national and international assessments. IAEA's technical cooperation programme in isotope hydrology covers a broad spectrum of fields, including applications related to hydrogeological investigations of groundwater and hydraulic interactions (including geothermal systems); applications in surface water systems, including sediment transport and hydro-engineering problems; and analytical techniques related to isotope and chemical analyses of water samples for hydrological applications.

32. ECA is currently preparing an inventory of existing conventions, treaties and agreements on shared water resources in Africa. ESCAP has focussed its activities in this area on the introduction of computer applications for assessment of water resources in its region, through the publication of several documents, the organization of workshops and several advisory missions. ESCWA has been responsible for several activities aimed at improving water resources assessment in western Asia.

## D. Capacity building to Enhance participatory Approaches and Improve Institutional and Regulatory Frameworks

33. All ACC Subcommittee members are involved, in one way or another, in various capacity building activities in the field of water resources. UNDP's technical cooperation programmes are concentrating their efforts on applying capacity building strategies aimed at creating an enabling environment with appropriate policy, legal and regulatory frameworks; institutional development including community participation; human resources development and strengthening of managerial systems; and information networks. The Global Capacity-Building Programme for Sustainable Water Sector Development -- which is partly funded by UNDP -- is designed to produce a process of capacity-building initiated by a water sector assessment; a nucleus of officials and specialists trained in sustainable water sector development; water sector assessment reports, including planning frameworks; improved cross-sectoral collaboration; and improved coordination among national agencies and external support agencies.

## E. Financing of water resources development and utilization

34. The magnitude of the involvement of organizations of the United Nations system in the field of water resources can be appreciated from the expenditures on technical cooperation activities of the two major funding agencies in the system. UNDP's funding to over 121 ongoing water projects in about 60 developing countries and those with economies in transition amounts to US$ 192 million. World Bank loans to 240 water projects (or natural resources projects with major water components) implemented during the 1990s in about 80 developing countries and those with economies in transition amounted to over US$ 21

billion. In addition, the grants and concessional funds disbursed by the Global Environment Facility (GEF) during fiscal year 1996 was US$ 37.7 million. Also during 1996, the Project Preparation and Development Facility (PDF) of the GEF provided US$ 1.9 million for the formulation of seven projects in this area from the initial concept stage through final design.

35. Several other major United Nations organizations involved in the field of water resources, such as FAO and UNICEF, also provide substantial funds for the implementation of many projects in their respective core areas of activity. Between 1994 and 1996, for example, UNICEF's expenditures on water supply and sanitation activities (excluding expenditure on emergency water supply and sanitation activities) amounted to no less than US$ 220 million. In addition, a significant amount of regular budget and extra-budgetary funds is usually allocated by ACC Subcommittee member organizations for activities supporting technical cooperation programmes, including (a) data collection and analysis, (b) preparation of studies and reports and (c) organization of workshops, seminars and conferences.

36. The UNDP is currently involved in the testing of innovative financing mechanisms in Senegal and South Africa aimed at attracting loans from local banks and other credit institutions for community water supply, small scale irrigation and sanitation. Local banks are interested provided the project generates a cash flow (from income generating activities, such as small scale irrigated agriculture and cottage industry) and their loan can be protected from default by loan guarantees from another bank or fund. Local NGOs are involved in order to provide technical and administrative support to the communities. The World Bank is also providing increasing attention to programmes that make formal financial services available to the rural and urban poor, including consultation with other donors regarding long-term support and funding for micro-credit programmes, and financial assistance for the establishment or support of financial institutions providing credit for lower-income groups in developing countries. As mentioned above, UNICEF has also promoted the empowerment of women through initiatives such as women managed water committees and micro-credit schemes for income generation.

## II. STRATEGIC RESPONSES BY THE ORGANIZATIONS OF THE UNITED NATIONS SYSTEM

37. Given the complexity of water resources issues and the nature of mandates of different organizations of the United Nations system, a certain amount of overlap and even duplication is, at times, inevitable. It is not possible to have an absolute demarcation of responsibilities. What is of paramount importance is that the organizations proceed on the basis of a common understanding of basic principles and approaches, that they have on-going information about each other activities in order to enhance cooperation and avoid duplication, and that they increase cooperation concerning country level activities.

38. The ACC Subcommittee on Water Resources increasingly provides channels of communications through its formal sessions, informal communications and various cooperative arrangements. Additional steps towards enhancing the flow of information are being taken through the linking of websites of the various organizations. In order to improve coordination of activities at the field level, the members of the ACC Subcommittee are now initiating a process of organizing a working group composed of their experts working in the field in support of the Resident Coordinator's efforts.

39. Because of the role of the regional commissions with regard to assistance in implementing Agenda 21 within their respective regions, they can be instrumental in coordinating system-wide activities at the regional level. In this regard, the various coordination efforts being carried out throughout the system, and particularly through the Subcommittee, need to benefit from the regular participation of the regional commissions.

40. Governments and the international community face many challenges in the road towards achieving the sustainable development and management of water resources. Approaches and issues regarding the activities of the organizations concerning these strategic questions are described below.

### A. Water for socio-economic development

41. A major challenge facing organizations of the United Nations system is to assist Governments in bringing about coherent institutional approaches by outlining a set of policy and management options based on the principle of efficiency, equity, participation and sustainability. There is now a clear understanding of the need to formulate concerted approaches to integrated water resources development and management. The World Bank Policy Paper, the General Framework formulated by FAO on behalf of the ACC Subcommittee on Water Resources, a report prepared by the former Department of Development Support and Management Services to the third session of the Committee on Natural Resources, and the report of UNDP's International Symposium on "A Strategy for Water Resources Capacity Building", provide a basis for this common understanding.

42. Not withstanding the need for integration, the efficient management of sectoral issues remains essential. Nothing short of a major international programme, particularly with regard to environmental sanitation, involving local and national authorities, the international community, non-governmental organizations and the private sector, will suffice to accelerate and sustain the satisfaction of these basic human needs. The management of water resources for agricultural purposes remains essential in order to minimize its wasteful use to control pollution and to avoid land degradation.

43. At the country level, efforts to integrate these conceptual approaches are evident in such programmes as FAO's International Action Programme on Water and Sustainable Agricultural Development (IAP/WASAD). Activities concerning water supply and sanitation are increasingly carried out in the context an integrated approach. Nevertheless, for the most part, cooperation with Governments with regard to sectoral issues does take place in a context of the fragmented institutional arrangements that exists in countries in which such cooperation is taking place. Organizations dealing primarily with sectoral issues, (FAO, WHO, UNICEF, UNIDO) need to work together with those organizations dealing with broader aspects of water resources development and management (DESA, UNDP, World Bank, FAO, and the regional commissions) in order to ensure support in the integrated management efforts of Governments. This can be, and is being achieved, via diagnostic studies conducted by Governments in order to determine institutional constraints and remedies, as well define overall priorities, objectives and sectoral requirements.

### B. Health and productivity of aquatic ecosystems and impact of human health from the degradation of water resources

44. The interrelation between land, water resources, the health of coastal areas and oceans and the health of ecosystems has one of the most neglected areas of water resources management. The existing evidence

suggests that the economic losses resulting from the loss of natural capital as a result of the degradation of ecosystems, and the loss of human productivity from water-borne diseases often far exceeds short-term benefits that my be derived from development schemes that ignore such consequences.

45. Increased attention is being given by the organizations of the United Nations system to the close relationship that exists between land and water development and the degradation that one can inflict upon the other. Ultimately, however the effectiveness of these programmes will hinge on the extent to which they become an integral part of the system's concerted efforts in assisting Governments in devising approaches to the integrated management of their water resources. These programmes need to be seen in the light of the support to governments in the implementation water-related concerns of the Conventions on Desertification and Drought, on Biological Diversity and on Climate Change, the International Decade for Natural Disaster Reduction, as well as the implementation of the Global Plan of Action for the Protection of the Marine Environment from Land-based Activities and the comprehensive assessments carried out by the Intergovernmental Panel on Climate Change (IPCC), particularly its Second Assessment Report, published in 1995, which includes chapters on hydrology, freshwater ecology and water resources management.

## C. Information management

46. The Comprehensive Assessment of the Freshwater Resources of the World showed that the capability to provide accurate water quality and quantity data is sorely lacking in the majority of countries, and that for years, the capacity of hydrology offices in developing countries, particularly in Africa, has been declining. For the most part, knowledge about groundwater resources is inadequate. The assessment also concluded that it is difficult to obtain reliable, systematic information on water resources management in most developing countries, and that there is a scarcity of good data on water use and on land degradation related to water use. The hardship incurred by national programmes in these domains as a result of budgetary constraints has been needlessly exacerbated by a fragmentation of national agencies dealing with water resources assessment and by the lack of linkages to the water management process. At the country level, organizations of the United nations system need to develop concerted approaches in order to assist Governments in the formulation and implementation of integrated information strategies aimed at maximizing the development and management value of information.

47. The seriousness of the situation with regard to the sustainable development and use of water resources world-wide warrants the periodic re-examination of progress and trends towards more sustainable pathways. However, the scope and extent of the analysis undertaken for comprehensive assessments would continue to be limited by both the scarcity of reliable information and the absence of national and international harmonized information systems and common ways of analysis of the information unless steps are taken to improve the current situation. With regard to water quality, members of the ACC Subcommittee on Water Resources are in the process of developing a comprehensive water quality programme based on a carefully selected global network of representative drainage basins encompassing a broad spectrum of environments so that future extrapolation to unmonitored basins can be achieved. Given the need for the integration of existing information systems, the members of the Subcommittee are also taking steps towards linking various websites with a view to facilitating access to available information and facilitating the harmonization of methodologies.

D. Capacity Building to Enhance participatory Approaches and Improve Institutional and Regulatory Frameworks

48. In view of the ever-increasing complexity of water resources issues, United Nations system organizations need to strive towards providing an integrated capacity-building framework in support of national efforts. National Water Sector Assessments should thus be considered as a starting-point for the identification of capacity-building needs and priorities, as well as the definition of capacity building programmes, within the broader context of integrated water resources management. National Governments and United Nations organizations need to engage in long-term commitments to facilitate programmes for capacity-building as a steady and continuing process. Opportunities need to be taken for the networking of institutions, in particular, for the exchange of experiences and capacities among developing countries.

E. Financing of water resources development and utilization

49. The enhancement of the effectiveness of the United Nations system's support to Governments in the formulation of policies for the generation and effective utilization of financial resources hinges on its ability to assist Governments in fostering an enabling environment that encourages investments from both public and private sources and in designing and implementing pricing policies for cost recovery, efficient allocation of water, and water conservation, taking into account the country's level of development. This is of particular significance with regard to financing water supply and sanitation in the fast growing urban and peri-urban areas, as well as for the organization of poor rural communities to enable them to generate the required financial resources.

50. The financial assistance in terms of grants and loans provided by the organizations of the United Nations system are, and will remain small relative to total requirements. Nevertheless, in addition to the more traditional grants and loans, they can play an important role in leveraging investments from other sources, notably, regional banks and funds, bilateral agencies, non-governmental organizations, national financial organizations and the private sector, including commercial banks. Organizations of the United Nations system can and are already assisting Governments to forge partnership with the private sector, in the context of large urban areas and in leveraging activities the form of loan guarantees or small loans for community water supply schemes in small towns, peri-urban areas and rural communities or for small scale irrigation projects.

Notes

1/ The membership of the Subcommittee is as follows: Department of Economic and Social Affairs (**DESA**); Economic Commission for Africa (**ECA**); Economic Commission for Europe (**ECE**); Economic Commission for Latin America and the Caribbean (**ECLAC**); Economic and Social Commission for Asia and the Pacific (**ESCAP**); Economic and Social Commission for Western Asia (**ESCWA**); United Nations Children's Fund (**UNICEF**); United Nations Development Programme (**UNDP**); United Nations Environment Programme (**UNEP**); United Nations Centre for Human Settlements (**HABITAT**); United Nations High Commissioner for Refugees (**UNHCR**); United Nations University (**UNU**); International Research and Training Institute for the Advancement of Women (**INSTRAW**); Secretariat of the United Nations Convention on Biological Diversity (**CBD**); Secretariat of the United Nations Convention to Combat Desertification (**CCD**); Secretariat of the United Nations Framework Convention on Climate Change (**UNFCCC**); Secretariat of the United Nations International Decade of Natural Disaster Reduction (**IDNDR**); Food and Agriculture Organization of the United Nations (**FAO**); United Nations Educational, Scientific and Cultural Organization (**UNESCO**); World Health Organization (**WHO**); International Bank for Reconstruction and Development (**WORLDBANK**); World Meteorological Organization (**WMO**); United Nations Industrial Development Organization (**UNIDO**); and International Atomic Energy Agency (**IAEA**).

UNITED NATIONS

Advanced unedited copy

Economic and Social Council

Distr.
GENERAL

E/CN.17/1998/2

ORIGINAL: ENGLISH

COMMISSION ON SUSTAINABLE DEVELOPMENT
Sixth Session
20 April - 1 May 1998

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

Report of the Secretary-General

CONTENTS

## INTRODUCTION

1. The Comprehensive Assessment of the Freshwater Resources of the World (document E/CN.17/1997/9), submitted to the fifth session of the Commission on Sustainable Development and to the nineteenth Special session of the General Assembly, concluded that currently, about one third of the World's population lives in countries that are experiencing moderate-to-high water stress and by the year 2025, as much as two thirds of the world's population could be under such stress conditions. The implications for developing countries are evident from the fact that a full three quarters of the population living under moderate-to-high stress conditions, amounting to 26 per cent of the total world population, are located in low-to-lower middle income countries. There is reason to fear that by 2025, countries in these income categories and stress conditions could amount to 47 per cent of the total world population. A stress of a different kind but just as serious is found in countries located in arid and semi-arid areas, including much of Sub-Saharan Africa, characterised by water shortages in spite of little water use even relative to low availability, as a result of insufficient financial resources, technical expertise and institutional support. The Assessment concludes that water shortages and pollution are causing widespread public health problems, limiting economic and agricultural development, and harming a wide range of ecosystems. These problems may threaten global food supplies and lead to economic stagnation in many areas of the world. The result could be a series of local and regional water crises with global implications.

2. The present report has been prepared with a view to facilitating the intergovernmental dialogue called for in paragraph 35 of the Programme for the further implementation of Agenda 21 adopted by the General Assembly at its 19th Special Session in June 1997 (document A/S-19/29). It endeavours to highlight key issues requiring urgent attention and outline starting points for strategic actions on paths towards sustainable development in the context of the recommendations contained in Chapter 18 of Agenda 21 and other international water conferences. The reader may also wish to refer to the recommendations contained in Section VI of the Report of the High-Level Advisory Board on Sustainable Development for the 1997 review of the Rio commitments (document E/CN.17/1997/17/Add.1).

## I. THE PROBLEM CLUSTERS: IDENTIFICATION OF AREAS FOR ACTION

3. Water quality is somewhat more amenable to policy choice since raw water and wastewater can be treated. In the face of a widening gap between demands and supply, both in terms of quantity and quality, what is entirely determined by policy is the approach to water resource management and the subsequent planning of investment in water infrastructure. To date the bulk of the approaches at national level have been supply-led and authority over the allocation of the freshwater resources held ultimately by the State through declarations of public interest and the use of public funds. This style of intervention is proving unsustainable, particularly in developing countries with burgeoning populations and limited financial resources.

4. As societies' demands for water supplies grow and become more concentrated in urban areas, competition for freshwater between economic sectors is increasing in many countries, particularly in arid and semi-arid zones. Competition is particularly intense between those sectors looking for large volumes of low quality water (irrigated agriculture) and those looking for relatively small volumes of high quality water Disputes over limited resources have and will continue to develop between agricultural, industrial and urban users unless water management measures to prioritize household water supply are taken.

5. The need for integration and orderly management of sectoral issues thus remains essential. Three sectoral uses stand out as being of particular importance: drinking water supply and sanitation, water for agricultural production and the utilisation of clean and efficient technologies for the use of water in industrial production. Each of these uses generate demands for different types of water. Irrigated agriculture will generally use untreated water, industry may demand bulk supplies to be treated to varying standards and water supply business requires acceptable bulk supplies that it can then treat to potable retail standards. In addition, three principal non-sectoral issues stand out: progressively degraded hydro-environments, chronically undervalued water resource assets and serious institutional weaknesses.

**A. Access to urban and rural water supply and sanitation services**

6. In spite of efforts during the International Drinking Water Supply and Sanitation Decade about 20 percent of the world population lacks access to safe water and about 50 percent lacks access to adequate forms of sanitation. Current trends in the provision of services remain insufficient to achieve full service coverage in the near future. For sanitation in particular, the Water Supply and Sanitation Collaborative Council meeting in Manila, the Philippines, in November 1997, concluded that at present rates of progress, the world could not achieve full service coverage by the year 2100. Breakdowns in public health as a result of insufficient coverage and the poor operation and maintenance of existing water supply systems are now frequent, though rarely reported until spectacular rates of epidemiological transmission occur. The problem of water supply and sanitation is particularly acute in dense urban areas where construction has overtaken the rate at which reticulated supply systems and sanitation services can be installed economically and within the financial capacity of municipalities. Many large towns and cities in developing countries experience chronic losses of pressure in piped water distribution systems and high leakage rates when subjected to pressure. Combined with lack of sufficient water treatment, the ingress of polluted soil and groundwater into these systems has become a major source of water-borne disease and poses serious threats to public health.

7. Rural communities are generally well dispersed within a watershed and have intimate links with small scale catchments and aquifers although there is evidence that these localised sources are becoming increasingly polluted from dug pit latrines and waste heaps. For the rapidly growing peri-urban communities, these remain ignored by reticulated urban systems that may have been designed many years before the location and rate of growth was anticipated. Consequently peri-urban communities are often thrown back onto highly localised sources of water that are severely contaminated due to the concentration of habitation with rudimentary sanitation arrangements and unregulated industrial activity.

**B. Water for sustainable food production and rural development**

8. The water demands of irrigation schemes to satisfy grain production take up the bulk (around 85 percent) of the world's mobilised water resources. Many schemes are operating well below their design levels because poor operation and maintenance, as well as inequitable distribution with tail-enders always receiving smaller allocations than designed. Lack of drainage often leads to waterlogging and salinity taking land out of production and further degrading surface and groundwater.

9. The concept of national food security loses much of its significance in an increasingly global economy. Water resources need not necessarily be allocated to the production of food if they can be used more

profitably in other sectors of the economy thereby generating the necessary income to import food products. Under these circumstances, countries are striving to make a transition from food self-sufficiency, in which the country is wholly dependant upon domestic production, to food self-reliance where both domestic and international markets are used to source the requirements. However, the transition from an agricultural to an industrial economy needs to be carefully managed if serious social inequities and geographic dislocations are to be avoided. Rural communities in developing countries that depend upon subsistence agriculture are profoundly linked with small first-order catchments and the water, biomass and soil resources that occur therein. This linkage dominates subsistence and economic productivity through cash crops cultivation and livestock rearing, but does not tend to appear in national economic budgets until water resource availability declines and remedial intervention is required to avoid starvation and migration.

**C. The growth in the demands and impacts of industrial use**

10. The potential for water conservation and use of clean technologies to manage demand and minimise the environmental impact of effluent disposal is high when the industrial sectors are well regulated with access to capital and technology. Unfortunately for many developing countries and economies in transition, the push to allow industrial sectors to grow has left environmental regulation behind. This combined with a lack of access to capital and clean technology has resulted in insignificant investment in wastewater treatment with downstream users being forced to internalise the costs of treatment.

**D. Degraded environments**

11. The continued neglect of water resources requirements for ecosystems , both in terms of quantity and quality, is having devastating consequences in terms of a loss of natural capital, aquatic biodiversity and human health. This type of breakdown is communicated down the water and sediment cascades having an impact well beyond the original source of the degradation and even into coastal marine environments. As pressure for farm land increases, the impact on mountain and forested areas mounts and the ability of these catchment areas to buffer runoff to watercourses and recharge areas is compromised. Super-imposed upon environmental degradation is the impact of climatic variability which determines the range of hydrological responses to extreme climatic events (droughts and floods). The linkages of water to biodiversity and land degradation, particularly in arid and semi-arid zones, are also significant. Groundwater plays a pivotal role in buffering the effects of drought particularly. However, the increasing contamination of groundwater, overpumping well beyond their replenishment rate, and the unplanned depletion of fossil groundwater systems are threatening many urban centres particularly in arid and semi-arid zones.

12. The balance between environment and development needs to be founded on a clear understanding of the environmental systems and the resources they can furnish without compromising their overall long-term integrity. The economic implications of environmental degradation and ignorance of climatic variability can account for significant percentages of GDP in lost productivity. However, their direct costs are often internalised by downstream users and their long term economic implications (including *in-situ* values) and over-utilisation are rarely factored into long term marginal costing for investment in infrastructure.

**E. Undervalued water resources**

13. The economics of water resources rarely influence water policy, even in water-short regions. As a result, the principle asset -- the water resource base -- remains highly undervalued and readily used without

much concern for its value to others, the structural role of water in the economy and its *in situ* value as an environmental asset.

14. While many countries have policies that prioritise categories of water use, particularly in times of shortage, very few have implemented regulations or incentives designed systematically to use water in an economically efficient manner. Water tariffs rarely reflect long run marginal costs, let alone full economic pricing (including opportunity costs and pollution charges). Consequently, all types of water remain undervalued in economic terms and the associated water services severely under-priced. This mis-calculation continues to result in profligate use within some sectors, notably agriculture, and chronic shortages to meet basic human needs. More importantly, there is no clear economic signal sent to competing sectoral users or to the state organisations responsible for regulating freshwater resource use and allocating between economic sectors.

### F. Weak institutional and regulatory frameworks

15. Water institutions in many developed and developing countries remain relatively weak, unable to command regular budget allocations and deprived of the policy instruments and management tools to implement sound water management. The failure of institutions to implement progressive policies is often linked as much to a lack of public awareness and consensus as to lack of financial resources. In reaching out to diverse and diffuse national populations, even well crafted technocratic solutions have failed to make the expected impacts when not accompanied by serious attempts to involve consumers in urban and rural areas. Many spatial disparities are evident at sub-national levels, with remote regions and districts lagging behind the central zones of economic activity in terms of water service provision. The weakness is reinforced by the tendency to mix policy making, regulation and operational functions in single institutions.

## II. KEY ISSUES IN FRESHWATER MANAGEMENT: THE IMPLICATIONS FOR POLICY CHOICES AND MANAGEMENT OPTIONS

### A. Current gaps in freshwater management

#### 1. Overall lack of awareness of the scope and function of freshwater management

16. The overall awareness of the hydro-environmental limits to water resource mobilisation is generally poor. Apart from countries with limited options, political commitment and public education to promote resource protection and conservation is inadequate. Indeed, awareness of water issues is usually only heightened in times of extreme shortage or dramatic degradation in quality with little attention to long-term preventive measures.

#### 2. Absence of explicit linkages with socio-economic development

17. The explicit linking of water issues to human development and economic productivity is generally lacking both in terms of national policy declarations and supporting legislative and administrative support. One of the most important consequences of this gap is the extremely low importance placed on the integration of physical and socio-economic information.

3. Declining capacity to assess the availability and variability of water resources

18. The effective assessment and management of water resources, including the prevention and mitigation of water-related disasters is not possible without adequate physical and socio-economic information flows. Yet the capability to provide accurate water quality and quantity data is deficient in many countries. For years, the capacity of hydrological offices in developing countries, particularly in Africa, has been declining in terms of operation and maintenance and the extent of hydrologic networks. Few, if any, developing countries have a significant capability for water quality monitoring. In addition, the fragmentation of national organisations dealing with water resources assessment and the lack of integration of hydrological and land use data, as well as economic and demographic data, severely limit the usefulness of existing information. The possibility of climate change increases uncertainty concerning the variability in the distribution of water resources. The trends in hydro-environmental behaviour induced by climatic variability and present consumption patterns are now posing unprecedented problems for water resource managers making their tasks increasingly complex.

4. Mobilisation of financial resources

19. The mobilisation of financial resources to develop, utilise and manage water resources is lagging behind actual sectoral needs. The annual total investments required for the effective assessment, development and utilisation of water resources (including wastewater treatment) greatly exceed the capacity of Governments and the international community under current patterns of financing. According to the World Bank, the overall level of current investment in water-related infrastructure in developing countries amounts to US$75 billion annually, with about US$15 billion being allocated for hydro, US$35 billion for irrigation and drainage and US$25 billion for water supply and sanitation. The financial resources necessary to achieve full water supply and sanitation coverage by the year 2000 are estimated to be more than three times the current rate of expenditure. It is also proving very difficult to mobilise financial resources for investment in wastewater treatment and this will continue to limit improvements in water quality. It is now clear that whatever approaches to regional and local government are taken, governments will never be in a position to extend more services to local under-served population groups from government budgets alone. While external support agencies have and will continue to play an important role in generating financial resources, this contribution will constitute only a small percentage of the total requirements. The adoption of pricing policies geared toward cost recovery will enable the public and private sectors to generate the financial resources needed for capital investment and for operation and maintenance.

**B. Implications for action: guiding principles and strategic themes**

20. Strategic approaches to freshwater management need to be based on a set of principles if they are to work progressively toward the goals of equity and sustainability. These principles and themes, which have evolved since the United Nations Water Conference, held in Mar del Plata, Argentina, in 1977, through the ensuing set of international conferences -- including the 1990 New Delhi Global Consultation on Safe Water and Sanitation, the 1992 Dublin International Conference on Water and the Environment, the subsequent elaboration in Chapter 18 of Agenda 21 by the United Nations Conference on Environment and Development and the 1994 Noordwijk Ministerial Conference on Drinking Water and Environmental Sanitation -- and now offer a guiding framework upon which specific actions can be based. In addition, these principles were reinforced or elaborated by other major recent United Nations conferences, including the Global Conference on the Sustainable Development of Small Island Developing States, held in

Bridgetown, Barbados, in 1994; the World Summit for Social Development, held in Copenhagen, Denmark, in 1995; the Second United Nations Conference on Human Settlements (Habitat II), held in Istanbul, Turkey, in June 1996; and the World Food Summit, held in Rome, Italy, in November 1996. These principles are summarised below:

1. Integrated management as an overall approach

21. Integration of all water related activities through a mix of institutional and economic instruments is a key requirement to address goals of social welfare, environmental integrity and economic productivity. In striving to reconcile socio-economic demands with the available resources, three fundamental areas of action may be recognised: (a) the pivotal role of participation and the principle of subsidiarity, (b) the role of economics and financing to drive productivity gains and (c) the need to protect hydro-environmental integrity and recognize environmental limits. Addressing specific water issues under each of these areas requires awareness and political commitment. Awareness raising has to be matched by incentives to change. Clear economic signals may do some of this by, for example, informing consumers of present and future costs or by indicating levels of profligate use. If it is to be effective at all, a carefully orchestrated initiative of public education, pricing policy and engagement of consumer and interest groups needs to be considered.

22. An open, transparent and continuous process of consultation and participation is essential if national water resources are to be managed in an equitable and sustainable fashion and resources found to extend water services to those currently deprived of access to water and sanitation. The role of regional and central government as policy maker and provider of technical support must be complemented by local (district level) government action as a mobiliser or promoter of community based management to yield positive results in terms of health, income generation and environmental protection.

2. Water allocation policies to satisfy basic human needs and promote employment and income generation

23. Failure to adapt to the finite nature of water as a resource and to recognise its social and economic value is leading to haphazard sectoral allocations in water, as well as sub-optimal impacts on employment and income generation, and the satisfaction of basic needs. An integrated approach to the efficient and equitable development and allocation of water resources requires the use of economic and regulatory instruments designed to maximise social net benefits. The use of 'market' and 'non-market' instruments to allocate water resources has received much attention in recent years. While administrative solutions and the rigorous application of laws and regulations are more commonly used to allocate water, market mechanisms are becoming increasingly introduced. The pricing of bulk and retail water at somewhere near the long term marginal cost is becoming inevitable as subsidies become unrealistic or are no longer found acceptable. Nevertheless, in setting up tariffs, there is a need to accommodate those sectors of the population which cannot afford minimum levels of services. Pollution charges send economic signals to users encouraging wastewater treatment and re-use. Informal markets in both bulk water and water services are used by many rural economies in which transactions between neighbouring farmers and transient demands and supplies (agro-pastoral communities for example) are arranged. These occur in unstructured fashion and can involve a degree of self-regulation, particularly in semi-arid zones with long dry seasons. In some circumstances, informal groundwater markets are proving unsustainable as farmers seek to maximise agricultural output in the short run. Formal market mechanisms have been used under special circumstances where infrastructure

and regulation allow marketing of user rights and where the sectoral competition is severe such as between the agricultural and urban sectors in California or in the case of Chile.

24. Regulatory and economic instruments also need to be designed to maintain the overall stock of environmental assets linked to freshwater. It is incumbent upon the international community to demonstrate the full range of tools that can be used to allow national policy makers to select those that are most appropriate and for the use of which consensus can be obtained. As countries review their water legislation, the first thing that is usually examined is enhanced regulation and enforcement. However, the resources are rarely available to enforce detailed regulations and standards. Legal and institutional arrangements can perform an important enabling function since they may significantly influence the manner in which individuals, institutions and enterprises relate to natural resources. Equally, recognition of customary uses and water rights might enhance trust in Government activities and programmes. Allowing socially and environmentally acceptable transfers of water and land rights may also encourage more productive uses.

3. Institutional reform: separation of policy, regulatory and operational functions

25. The drive toward integrated management might suggest the need for a government authority responsible for all aspects of the hydrological cycle. However, experience with water resource management demonstrates the need for clear separation of policy, regulation and operational functions, the commercial autonomy of water service utilities, and for adapting existing arrangements to promote integrated water resources management at a technical level. For this to happen a policy dialogue to adapt mandates and responsibilities has to be initiated. Despite the common perception is that the water utility business is currently being 'de-regulated' as state monopolies are commercialised or privatised, there is a need to re-regulate to allow private actors and financially autonomous water utilities to engage in a fair and transparent commercial environment and protect public and environmental interests.

4. Negotiation of shared transboundary water resources

26. The recently agreed Convention on the Law of the Non-navigational Uses of International Watercourses (document A/51/869) as well as existing regional agreements and conventions provide the basis of negotiation. By addressing individual national priorities within the framework of these recommendations, it is expected that individual countries can work towards mutually beneficial sharing arrangements. Sharing of key sets of data, and agreement about social and economic principles often prove essential in making progress in such negotiations.

5. Improved information management and information flows

27. The demand for linked hydrological and socio-economic information needs to be clearly established if information gathering systems are to receive sufficient support. Relevant and detailed hydrological and socio-economic information is as much for planners and managers as for policy makers and water users and an adequate flow of information is needed to alert planners to trends and potential gaps.

6. Progressive financing of all water related services, including irrigation and drainage and sanitation

28. Financing of water (including irrigation and drainage) and sanitation services can no longer be assumed to be an exclusive role of the State, even though the public interest in water and sanitation services

is high. There is clearly a great scope for the improvement of cost-recovery in water infrastructure and demand management of water use at national level. Governments and communities are turning towards alternative actors to contribute capital and expertise. These may be autonomous public utilities, large multinational companies who are prepared to invest in urban infrastructure or small village communities committed to improve their use and management of limited water resources. As the fiscal pressure mounts for the state to withdraw from direct investment in water services, the transfer of operational responsibility and ownership to various user groups requires careful planning. For larger scale investments in flood control, hydropower and municipal supplies and wastewater treatment, state controlled corporations or state guaranteed support contracts to the private sector have become necessary. Lessons learned from the uneven success of these public-private partnerships have led to improvements in the forms and methods of partnership and to the recognition of the need for adequate regulation. This calls for a fresh examination of the role of economic instruments, the contribution of consultative and participatory processes, the enabling functions of legislation and customary law and a fundamental appreciation of the value of the physical processes that bind hydro-environmental systems.

## III. STRATEGIC ACTIONS

29. In dealing with a resource in which the public interest is high and whose environmental role is vital, certain principles of equity, transparency, efficiency and sustainability should be respected. There is a need to identify the starting points in a process of adaptation so that well informed policy choices and management options can be taken at local, national and regional levels. This process of adaptation and innovation is an iterative process which needs constant revision as environmental and socio-economic changes take place. It also needs to be able to reconcile long term visions for water management with short-term realities that apply in specific countries and regions.

### A. Promote ownership and participation of key user and interest groups

30. The engagement of key user and interest groups, including women, in rural and peri-urban zones, municipalities, farmers, industrialists and NGOs is necessary if such stakeholders are to play their respective roles in progressive freshwater management. If governments are to disengage from centralised provision of services then the burden of responsibility for financing, operation and maintenance of water infrastructure falls to the user groups. Conditions for such participation requires clear identification of the actors, their rights and responsibilities in relation to water. This will usually require the formulation of a water code and a parallel process of open consultation and engagement of stakeholders through public fora and meetings.

### B. Promote productivity gains and sustainability through enhanced regulation and the use of economic instruments

31. The joint use of regulatory and economic instruments needs to be promoted to create the conditions for the productive and sustainable engagement of all economic agents. Identifying stable water user rights and permitting their transfer on open markets, subject to tests of beneficial use, may be one way to formalise presently unstructured water trading and create opportunities for productivity gains through more efficient use of land and water resources. The formal negotiation and trading in water and pollution at basin level between industry, municipalities and rural communities and users upstream and downstream is more

complex but can be started once a clear picture of environmental constraints and economic opportunities is drawn up. Since most economies can no longer afford to supply bulk and retail water in simple response to demand, demand management will become more important. Water efficiency gains in irrigated agriculture offer the best opportunity to reduce demand for bulk water and high quality groundwater. Here issues of land tenure and water user rights need to be addressed in designing policy reforms.

## C. Promote sound sectoral policies and improve sectoral co-ordination

32. Sectoral imperatives need to be addressed within an integrated framework, but the implementation of innovative strategic approaches will occur within well defined sectoral limits. The types of key sectoral actions that can be considered are as follows.

### 1. Water supply and sanitation: a major international effort towards universal coverage

33. As we look towards the start of the 21st century, it has become painfully evident that nothing short of major initiative at national, regional and global levels will lead towards achieving the ultimate objective of full water supply coverage in the early years of the new century and to generate the needed momentum towards the provision of basic sanitation services. A starting point is the speedy implementation of the recommendations contained in the Action Programme of the Noordwijk Ministerial Conference on Drinking Water and Environmental Sanitation. Particular attention is drawn to the Conference's recommendation concerning the need to undertake resources assessments to produce an inventory of the current situation and to identify problems and constraints in providing water supply and environmental sanitation services. The Conference also recommended the development, review or revision by 1997, and the implementation in the context of national sustainable development strategies, consistent with Agenda 21, of measures for drinking water and environmental sanitation, taking into account the goals set by the World Summit for Children. The Forward Looking Assessment on the Implementation of the Noordwijk Action Programme on Drinking Water Supply and Sanitation, submitted to the 5th session of the CSD (document E/CN.17/1997/15) urged countries to review their policies, giving increased priority to improving sanitation services and focussing on five key components of sustainability (social, environmental, institutional, financial and technical).

34. Specific actions recommended in this area include:

**At the national level**:

• Promotion of participation of local communities (including women and the poor) and user groups;

• Development of urban and rural development strategies aimed to improve incomes of the urban, peri-urban and rural poor, together with the provision of improved water supply and sanitation services;

• Promotion of partnerships between the public and private sectors and between national and local institutions;

• Development of strategic approaches for the provision of adequate financial resources for water supply and sanitation improvements, including economic mechanisms for promoting efficient water use and cost recovery.

**At the regional and global levels**:

• Strengthening of regional and international cooperation for the exchange of information on national experiences in water supply and sanitation improvements by establishing or strengthening clearing-house mechanisms to promote the sharing of successful experiences and water technologies;

• Assistance to governments, at their request, in creating an enabling institutional and legislative environment for the effective contribution of public and private utilities to the provision of water supply and sanitation to urban and rural communities.

2. Water and Health

35. With water as a primary agent in maintaining human health and transmitting disease, the imperative to manage all freshwater sources to maintain chemical and biological quality to minimum acceptable standards remains. This can only be realised if adequate attention is paid to the treatment and management of waste-water from all sectors. Key actions that will work towards protection and improvement of water quality include:

**At the national level**:

• Priority for sanitation, including the provision of safe excreta disposal services at relatively low cost, and to education about personal hygiene;

• Mitigation and disaster preparedness in order to ensure prompt action to limit adverse effects on health.

**At regional and global levels**:

• Monitoring of bacteriological and parasitic waterborne diseases at the basin level;

• Prevention or minimization of contamination of water by heavy metals and other chemicals.

3. Water and food security

36. The management and use of water resources for agriculture needs to be seen in the context of competing demands for the resources and of the fact that more than 500 million people throughout the world, and particularly in developing countries, do not have enough food to meet their basic nutritional needs. In pledging their political will and their common national commitment to achieving food security for all and an ongoing effort to eradicate hunger in all countries, the participants at the 1996 World Food Summit stressed the need to achieve increased food production, including staple food, within the framework of the sustainable management of natural resources and the eradication of poverty. There is a clear imperative to improve the efficiency of water use in irrigated agriculture and to assess the opportunity cost of continuing such large allocations to the sector. The sector maintains a strong programme of international research and development in water use, but the economic benefit from the allocation to the sector needs to be re-evaluated in a broader, cross-sectoral perspective. To do this, key actions recommended include:

**At the national level**:

• Promotion of policy reviews about the amount of water countries allocated for food production as compared to other uses taking into consideration trade options of food in the global market;

• Introduction of measures to improve the technical efficiency of agricultural water use, including close monitoring of irrigation system performance, re-use of waste water and promotion of adaptive technological research and development;

• Promotion of environmentally sound aquaculture;

• Consideration of adequate policy mixes including market incentives to reduce wastage, promote stakeholder participation and use water resources development to reduce poverty;

• Development of integrated approaches to water use in rainfed and irrigated agriculture;

• Promotion of efficient water allocation, including charging systems for efficient water use, cost recovery policies to provide secure sustained efficient operations and maintenance of irrigation systems, taking into account the satisfaction of basic human needs and global food security.

**At the regional and global levels**:

• Promotion of regional co-operation for food production and trade;

• Promotion of clearing-house mechanism for sharing of successful experiences and technologies in the provision of water resources for food production.

4. Water for industry

37. As industrial demand grows and pressure for a modification of inter-sectoral allocations mounts, the need to pre-empt growth in chemical pollution will become more and more apparent. Key actions that need to be considered in regulating industrial use include:

• Promotion of clean technologies through information, regulation and incentives;

• Promotion of environmental auditing within specific industrial sectors;

• Formulation and implementation of economic instruments, such as pollution charges and incentives for introduction of cleaner technologies.

## D. Strengthening the enabling environment

38. As stressed in the Report of the 1992 International Conference on Water and the Environment, "recognising the need for a central mechanism capable of ensuring co-ordination of national social and economic interests, the role of governments needs to be reviewed to ensure that users, local institutions and the formal and informal private sector can play a more direct part. A key aim must be to improve accountability to the public. The levels at which management decisions can be taken and problems solved will vary widely from country to country and case to case. In any given situation, however, water resources should be managed at the lowest appropriate levels." Specific actions recommended include:

**At the national level**:

• Review of existing institutional arrangements with a view to determine the existence of institutional fragmentation and to ensure proper linkages with socio-economic decision-making processes;

• Clarification of legislation concerning land and water rights, taking into account customary law;

• Development of regulatory frameworks providing an enabling environment for the effective participation of the public and private sectors.

**At the regional and global levels**:

• Cooperation among international watercourse states in their harmonious development;

• Promotion of regional water resources development and use strategies in the context of regional economic and social development policies and strategies.

## E. Strengthening information management and promote the penetration and flow of key data

39. A clear rationale for strengthening information management has to be made. The respective technical and economic departments and government agencies may be able to start combining data sets with existing resources through regular collaborative meetings and exchanges, but need to be given clear reasons and instructions to do so. Establishing the demand for data to justify an adequate provision of flow of financial resources may need to involve the pro-active marketing of data to key decision makers.

40. Specific actions recommended in this area include:
**At the national level**:
• Assessment of existing data collection and information management systems to ensure that they meet management and decision making requirements, are cost effective and client oriented;
• Strengthening or development of strategic approaches to data gathering and requirements, in terms of water quantity and quality (both surface and groundwater) and water use, in relation to national, regional and local developmental and environmental objectives;
• Establishment of information management systems capable of integrating, analysing and disseminating physical, and socio-economic data for decision-making;
• Strengthening of local capacity and participation in monitoring and assessing water resources, in order to enable local people and decision makers to understand the options available for development.
**At the regional and global levels**:
• Establishment of regional data, research and training centres in support of national requirements and for the monitoring and analysis of regional issues concerning the sustainable development of water resources;
• Strengthening of global water information networks to compile data on water quality, quantity and water use and to support ongoing efforts in the collection and dissemination of data and information as related to integrated river basin management;
• Assistance by industrialized countries, international organizations and aid agencies in the transfer of information management technology, evaluation of observational networks and assist in capacity building in developing countries and economies in transition;
• Periodic updating by the UN agencies, in cooperation with other organizations, including NGOs, of comprehensive global an regional assessments of freshwater resources.

## F. Management of hydro-meteorological uncertainty

41. The need to cope with hydro-meteorological extremes and climatological shifts requires clear operational and planning guidelines based on present understanding of events and reasoned projections. The key actions that can be recommended are:
**At the national level**:
• Implementation of national drought management strategies;
• Formulation or updating of flood protection operational guidelines;
• Formulation and execution of measures protect the integrity of land and water ecosystems, in particular in the case of Small island Developing States (SIDS).
**At the regional and global levels**:
• Promotion of integrated basin drought and flood management strategies;
• Mobilization of resources for data gathering and analysis;
• Assessment of possible impacts of climate change.

## G. Mainstreaming environmental concerns

42. The explicit incorporation of freshwater management in overall environmental policy is critical to maintain the stock of environmental assets and associated economic and environmental services, and should include the following set of thematic interventions:

1. Integration of land and water resources management

43. Specific actions recommended include:

**At the national level**:

• Promotion of integrated land and water management within the framework of national development plans and study the linkages between regional economic development programmes and integrated river basin management;

• Control the use of fertilisers and pesticides to minimise non-point pollution sources and promote integrated pest management through appropriate regulatory and economic instruments.

**At the regional and global levels**:

• Development of River Basin Action Plans -- especially for priority high risk basins, including their rivers, lakes and aquifers -- aimed (a) to integrate land-use planning, especially in upstream regions, with water management and conservation, (b) to co-ordinate the activities of provincial, national and international agencies and (c) to address transboundary issues;

• Support the implementation of the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification , particularly in Africa; the Convention on Biodiversity; and the Convention on Wetlands of International Importance (RAMSAR Convention).

2. Protect water quality and prevent water pollution

44. Specific actions recommended include:

**At the national level**:

• Promotion of economic mechanisms based upon the polluter pay principle

• Strengthening or promotion of local participation in pollution control efforts;

• Formulation and implementation of basin action plans to address transboundary pollution issues and to initiate contingency plans to control accidental spills;

• Promotion of integrated approach to quantity and quality components of water resources management;

• Integration of land use management and sustainable water management.

**At the regional and global levels**:

• Establishment of links to the recommendations of the Global Program of Action for the Protection of the Marine Environment from Land-based Sources of Pollution;

• Recognition of freshwater, coastal and marine environments as a management continuum;

• Implementation of actions to protect upstream areas (mountains and forests) in order to preserve water quality downstream, recognising the important link between land management and water quality.

3. Incorporate freshwater management in overall eco-system protection and management

45. Specific actions recommended include:

**At the national level**:

• Promotion of national environmental valuation and accounting;

• Assessment of the water requirements of natural systems, including wetlands, to maintain integrity for sustained productivity;

• Formulation of strategic action plans for the protection and management of aquatic eco-systems, within the framework of the Convention on Biological Diversity, Desertification, the RAMSAR Convention, and the GEF operational programmes,

• Promotion of local involvement in efforts to protect eco-systems.

**At the global and regional levels:**
• Strengthening of regional co-operation in the efforts to protect eco-systems of transboundary rivers, lakes and wetlands;
• International co-operation to promote water conservation and recycling, pollution prevention and control, and environmentally-sound agricultural and industrial practices.

## H. Finance for water supply and sanitation to meet basic human needs and for wastewater treatment

46. It is clear that the overall level of current investment in water infrastructure is insufficient to meet basic human needs and acceptable levels of socio-economic development. As mentioned above, the current rate of expenditure in water supply and sanitation is estimated to be only a third of the amount required to achieve full coverage. While ODA is an important source of water sector finance in the poorest countries, in most developing countries, the bulk of investments required to develop, upgrade or maintain water resources infrastructure will have to come from national sources. In order for this to happen, Governments need to foster an enabling environment that encourages investments from both public and private sources and to formulate and implement pricing policies for greater cost recovery, efficient allocation of water and water conservation, taking into account the country's level of development. In addition, Governments need to allocate a significantly higher proportion of their budget expenditures to public investments in water supply and sanitation with a view to increasing the rate of coverage considerably. This is particularly true in the case of sanitation (and sewage treatment), which is not only lagging behind water supply coverage, but also has more limited opportunities for cost recovery.

47. Nonetheless, given the insufficient rate of investment in water-related infrastructure in developing countries, and as clearly stated in the report of the General Assembly, at its 19th Special Session (see document A/S-19/29), Overseas Development Assistance (ODA) remains an important source of external funding for many developing countries, particularly the least developed countries. It can thus be considered as essential for the effective implementation of Agenda 21 as it cannot always be replaced by private capital flows. ODA can play an important complementary and catalytic role in promoting economic growth and may, in some cases, play a catalytic role in encouraging private investment and, where appropriate, all aspects of country-driven capacity-building and strengthening.

48. The 20/20 initiative agreed upon at the World Social Summit in Copenhagen called for an agreement on a mutual commitment between interested industrialized and developing country partners to allocate, on average, 20 percent of ODA and 20 percent of the national budget, respectively, to basic social services, including water supply and sanitation. Current UNICEF estimates suggests that developing countries on average are spending only about 13 percent of government budgets and that about 10 percent of ODA is spent on basic social services. There are many opportunities for innovative financing arrangements for water development with risks spread amongst a broader range of beneficiaries and stakeholders. A move toward full cost recovery by guaranteeing the commercial and managerial autonomy of water services is one essential element of financial sustainability. The key actions in this process are:
**At the national level:**
• Identification of all potential actors at local and regional levels to ensure that all possible sources of expertise and finance can be tapped;

• Strengthening of the role of government at various levels as a provider of development financing for specific development projects and as provider or guarantor of credits to public and private ventures;
• Development of criteria and approaches to pricing policies related to the provision of water resources and demand management, taking into account basic human needs, cost recovery requirements, allocation efficiency, internalisation of environmental costs and benefits, and other socio-economic considerations;
• Development of public-private partnerships to improve efficiency of water provision and to tap private investments for the expansion or improvement of water infrastructure.

**At the regional and global levels**:
• Fulfilment by industrialized countries of their commitments to reach the accepted United Nations target of 0.7 per cent of GNP as soon as possible;
• Formulation of regional financing strategies, involving regional financial organisations in partnership with other international organizations and the private sector;
• Coordination of international financial resource flows in the form of direct grants and loans in concessional terms to developing countries, in particular the least developed countries, in addition to the mobilisation of the private sector.

49. Mobilising finance for wastewater treatment can be initiated not only through punitive environmental and public health regulation, but also through imaginative use of information exchange and partnering with communities, municipalities and industry. New low-cost techniques for small scale sewerage and treatment are now available, including the use of pond systems. For industry, net savings may be possible if relatively small investments are made in clean technologies. In water-scarce regions, municipalities may be able to enter into wastewater re-use profitably if pricing polices reflect long run marginal costs.

## I. Start a process of nationally owned diagnosis and obtain consensus and commitment

50. A compelling case for integration of water management into the national development process and cross-sectoral programme formulation has to be made at a high level and endorsed at all levels. The first step for such an initiative may be a diagnostic assessment of current physical and socio-economic circumstances surrounding water, predictions of trends in consumption patterns and the formulation of feasible solutions. This start needs to be nationally owned and internalised if they are to lead to sustained national commitment to change and reform. External support from specialised UN agencies, multi-lateral agencies, bilateral agencies and international NGOs can be sought when they are able to support the process financially and offer specific advice and peer review in their areas of comparative advantage

## J. Build balanced and sustainable capacity in water management

51. The water managers of the future will have to be much more multi-disciplinary to cope with new policy agendas and operational procedures. In addition to the traditional set of hydrologists and hydraulic engineers, biologists, accountants, environmentalists, economists and social scientists will all have important roles to play in advancing sustainable freshwater management. Key steps in building such capacity are:
• Assessment of present and future national capacities in this broad range of disciplines and specify future training needs;
• Implementation of a long term training programme to keep a critical stock of human resources in place;
•.Establishment of human resources management programmes aimed at enhancing employment opportunities and remunerating water management professionals in line with other sector professionals.

# VISION 21: WATER, SANITATION AND GLOBAL WELLBEING

A Statement from the Water Supply and Sanitation Collaborative Council (WSSCC)
DRAFT

# VISION 21: WATER, SANITATION AND GLOBAL WELLBEING

A Statement from the Water Supply and Sanitation Collaborative Council


## Summary

Integrated management of water is now an accepted principle. But without strong political commitment backed up with economic resources, integrated approaches can end up squeezing the poor and delaying further the urgent need to meet the goals of drinking water and sanitation for all. Recent experience suggests this may already be happening in some parts of the world.

This note underlines the vital importance of strengthening commitments to meeting the basic water and sanitation needs of all the world's people early in the 21st century.

Substantial advances over recent years indicate that both the knowledge and the resources are now available to turn aspirations of water and sanitation for all, to reality. The urgent lesson is that inadequate political commitment is the only barrier to restoring these basic rights to millions who remain unserved. No excuses of knowledge, technology or finance exist.

The millennium ahead can begin with the advantage of demonstrated new approaches to the achievement of coverage and service goals. Milestone events since the 1980s have indicated what needs to be done, and how.

Acknowledgement of water as a finite resource is evident in the acceptance of integrated management for freshwater resources, which needs now to ensure that the water needs of the poor are not marginalised by more powerful sectors. There is a perceptible shift in decision-making powers to levels closer to users. Many authorities are moving toward new roles as facilitators, rather than providers, while fresh opportunities have emerged for community initiatives and the private sector in a host of possible partnerships and arrangements.

International experience demonstrates beyond any doubt that services to

the poor will fail if people themselves are not directly involved in decision-making. Considerations of equity must therefore be a powerful accompaniment to the recognition of water as an economic good. In this, the needs and capacities of women is a particularly important element.

These considerations of empowerment have profound political implications. The acceptance of such different political challenges must now be the ultimate measure of a will for change. Nothing else is needed to achieve a world in which water and sanitation is secured for all.

Recognition of water and sanitation as human rights has encouraged a strong emphasis on genuinely participatory structures that empower communities toward new responsibilities. Acknowledgement of water as a scarce resource and as an economic good is encouraging norms of financial performance which correspond to actual demands as well as to better accountability.

Awareness that limited finances can go much further than they presently do builds a strong case for re-targetting investments, through better technological options which can respond to community needs for services as well as demands for equity.

Despite these indicators of progress, a sharp disparity exists between achievements in water and those in sanitation, compounded by inattention to wastewater treatment. A serious threat now exists to the ecology as well as to economic growth through losses in health and productivity.

The crisis in sanitation represents an unacceptable scandal. The cost of poor sanitation in development terms is rarely understood, nor its particular impact on women given adequate attention. Rapid urbanisation can accelerate this burden enormously over the next fifty years, in the absence of a quick global response.

Broadening the technological options and choices is therefore the essential strategy for re-targetting the sector's investments. This can be the key to stretching resources within a climate of increasing financial strategy. Dramatic increases in coverage are possible if low-cost technologies are preferred over high-tech practices which so far have concentrated on the more affluent.

# VISION 21: WATER, SANITATION AND GLOBAL WELLBEING

## I. THE FOUNDATION TO BUILD ON

### Achievement and Constraint

**'Safe water and sanitation for all'** is a global aspiration. It could serve as a practical symbol of a new commitment - to begin the new millennium with a deeply significant contribution to human wellbeing. While achievement of that target will not be easy, experience clearly indicates that both knowledge and resources are available to turn aspiration to reality. But it will demand a new order of political awareness and commitment. It also will demand assurance that in the welcome moves toward better management of scarce water resources, the needs of the poor do not take second place to the demands of the more powerful and vocal sectors.

Since 1980, the share of people with access to water has more than doubled in rural areas and expanded considerably in urban areas, despite major increases in population. In total, access to safe drinking water in developing countries rose by more than half, from 41 per cent to 69 per cent. In East Asia, access has reached 94 per cent, while in South Asia, it increased by 60 per cent in the decade between 1985 and 1995. In the first four years of the 1990s, over 780 million people gained access to safe water, most of them in Asia and the Pacific. In Africa, 38 million additional people gained access and in Latin America and the Caribbean, an additional 30 million.

More appropriate technologies have helped accelerate the pace of new services. New partnerships have emerged, contributing fresh attitudes and ideas. The realisation has taken root that water is a finite source which demands the most careful conservation. This understanding of water as a scarce resource has led to its recognition as an economic good, reflected in global and national policies.

Management approaches have emerged which attempt to replace the waste and inefficiency of supply-driven approaches with user involvement based on actual demand and the ability to pay. Simultaneously, access to safe water and sanitation is gaining ground as a basic human right, inextricably linked to human dignity and to an acceptable quality of life. Toward such aims, the need for teamwork between disciplines and sectors is being reflected in a new openness to integrated planning and joint action.

These changes provide confidence for addressing the daunting scale of unfinished tasks, turning the strength of experience to the needs of those who are still unserved. The urgent lesson is that the knowledge, technology and finances are available, here and now, to make safe water and sanitation an achievable right for every human being on this planet. While political will, not resources, remains the critical constraint to the achievement of water and sanitation goals, an emerging consensus offers the vision of a new determination.

**Milestones of Consensus**

An early milestone was Safe Water 2000 and its New Delhi Declaration of 1990. This was the new decade's call for renewed political commitment combined with new communication and mobilisation efforts. Together these could provide the "fundamental new approaches" without which broad-scale deprivation could turn into an unmanageable crisis.

A two-pronged approach (reduction in the cost of services through more efficient and lower-cost technologies, mobilisation of additional finances) was also proposed. Both would support the challenge of equity; 'Some for all, rather than more for some'.

Guiding principles recommended were protection of the environment and health through integrated management approaches, institutional reforms in their support, community management beyond mere participation through capacity building (particularly of women) and the strengthening of participatory institutions, and sound financial practices toward increased efficiency and mobilisation of resources.

Two years later, new approaches were again the call when the International Conference on Water and the Environment met in Dublin to consider the development and management of freshwater resources. Recognition of the interdependence of all peoples and of their place in the natural world would need new levels of commitment at every level of governance and society. These in turn required investments, awareness, legislative and institutional changes, technology development, and building the capacities of human resources. The pivotal role of women as providers and users of water was seen to demand positive policies to address their special needs, as well as to equip and empower women in the sector's decision-making and implementation.

Agenda 21 soon emerged from Rio, literally a watershed event. Rio firmly established water and sanitation as critical elements in human and economic development. National targets were suggested for reducing waterborne diseases and for meeting urban/rural water and sanitation needs, while protecting the freshwater needs of future generations as a guiding principle.

The aim of the 1994 Ministerial Conference in Noordwijk was to ensure a follow-up of the freshwater recommendations set forth in Agenda 21. Reiterating their support for the guiding principles of New Delhi, the Ministers stressed that "governments do not solve problems, people do". Five actions were emphasized: involving stakeholders more strongly in partnerships for decision-making, integrating water resource management into planning for other key sectors, strengthening the institutions responsible for service provision, mobilising financial resources for the future and improving the quality of international support for the sector.

Most recently, the European Union has in 1997 called for a programme of action toward the needs of the next century, reaffirming the recognition of safe drinking water and sanitation as fundamental rights which are both economic and social. A conceptual framework focussed on the quantity of quality water required to meet basic human needs of health and sanitation, as well as goals of equity and efficiency.

**Unfinished Tasks**

Today, 1.2 billion people still lack access to safe water, while some 3 billion have no access to sanitation. An estimated 10 million people, mostly children, die each year from diseases associated with contaminated water resources.

According to the Human Development Report (HDR), which includes access to safe water as one of five critical variables in its poverty index, "The key problem has been lack of political commitment of lack of priority for the sector in national planning... Sanitation was the most neglected" (HDR, page 109).

The disparity between achievements in water and those in sanitation is sharp. Increasing numbers are without sanitation. This neglect is compounded by that of wastewater treatment. Together, they threaten health and the environment, as well as the sustainability of freshwater resources and economic growth.

**Lessons**

These milestones and tasks yet to finish have had a clear influence on official policies and strategies that can now influence the new millennium. They reflect new areas of learning and consensus on water and sanitation as key entry points for human development.

The understanding of water as a finite resource is evidenced through wider acceptance of the principles of integrated management of freshwater resources toward sustainability (with the river basin as the most appropriate management unit). The inter-disciplinary nature of problem-solving in this sector has underlined the importance of encouraging and facilitating teamwork between many sectors, disciplines and authorities.

Demonstrations of intent have been made toward devolving management powers to the lowest appropriate level. Understanding the need for systems of good governance has also been stimulated by perceptible shifts in the role of central authorities from one of implementation to enabling and regulating peoples' initiatives.

Understanding water as both an economic and social good has brought new recognition of water and sanitation as core human rights in a changing environment. Genuinely participatory structures are seen as indispensable to sustainability. Participation and equity have focussed on women's roles and the urgency of their needs. Decision-making in water and sanitation has been brought closer to those once regarded as beneficiaries and now increasingly as actors. Concepts of demand management have gained currency through fresh understanding of the sector's resource needs and of the financial strategies which can help meet them.

Coverage figures provide little insight to the degree to which facilities are effectively used. Involvement of stakeholders in decision-making is inadequate, and mostly restricted to water. Seldom are stakeholders involved in sanitation. Institutional and political challenges pose problems implementing integrated approaches. The treatment of water as an economic good is still largely understood to mean cost recovery in operation and maintenance. There is need for more systematic exchange of experience regionally and inter-regionally. Inadequate attention is given to creating the enabling environment essential for cross-sectoral and inter-disciplinary teamwork. As a result, poor implementation of policies is probably the weakest part of implementation, as governments accept sector principles but often fail to act on them. At the operational level, resistance to change remains strong.

**Sanitation: "a shameful scandal**

Sanitation is emerging as the touchstone of real commitment toward change. At its November 1997 meeting in Manila, the Water Supply and Sanitation Collaborative Council noted that at present rates of progress the world could not achieve sanitation for all by the year 2100: "a shameful scandal that is totally unacceptable".[1/] The gathering demanded an immediate campaign to mobilise resources toward accelerating achievement of sanitation goals for all people as soon as possible in the new millennium.

Pollution is a major environmental concern, due to agricultural and industrial malpractices as well as pollution from urban growth and development projects. By far the most serious source of pollution is human waste, particularly in developing countries. Each year as many as four million children die due to the lack of environmental sanitation and clean water. The amount of wastewater discharged in the world is expected to double between 1980 and 2000, in addition to the two million tons of human excreta which daily pollute the planet's rivers and ground waters. Despite this alarming situation, few water projects include a sanitation component.

The past neglect of sanitation reflects specific challenges. Water has always commanded a central role in peoples' cultures and value systems. Immediately accepted as a factor of survival and of human dignity, the sanctity and importance of water are reflected in the priority attached to its supply in most societies. Sanitation is a far more difficult issue, surrounded by taboos and the disgust associated with handling human excreta. Politicians are often seen in the proximity of handpumps and pipelines, never at latrines.

The opportunity cost of poor sanitation in terms of economic and social development, and most particularly, on women in development, is almost never

---

[1/] Richard Jolly, Chairperson, WSSCC, Manila, November 1997.

taken into account. It is a burden which is becoming progressively heavier, accelerated by rapid migration into cities. Within the next 50 years, between 2 and 3 billion people will add to the challenge of urban sanitation.

Despite these staggering figures, the capability to deal with the challenge exists. Dublin and Rio recognised the powerful argument for greater investment in sanitation within integrated water resource management. In essence, rapid degradation of water quality and depleting water resources combine as a serious barrier to economic growth. Inadequate human sanitation is a prime contributor to this crisis, and only rapid investment in sanitation improvement can reverse the degradation. Conservation and protection of existing water resources can be more cost-effective and more sustainable than continuous investment in new supplies.

It has also been demonstrated that the sector cannot progress without giving priority for hygiene education. Comparatively small investments in hygiene education can rapidly translate into effective demand for the means to clear excreta and wastewater from neighbourhoods.

## II. WHAT NEEDS TO CHANGE

### Rights and Responsibilities

Knowledge that the "shameful" situation of global sanitation can and must end is a reflection of the growing recognition of water and sanitation as fundamental human rights, and of sanitation as essential to any acceptable concept of human dignity.

Tensions can exist between this social perspective and the simultaneous emphasis on water as an economic resource and good. The latter perspective recognizes the pressing need for economic efficiency essential to managing water as a finite resource which must not be wasted. It also recognizes the need for services that are demand-driven and which reflect what people need, want, can afford and are willing to pay for.

What needs emphasis is the role of the market as one instrument for facilitating access and control of water and sanitation by people, through systems that are genuinely participative. A clear case of economic efficiency can emerge without any compromise of the rights of millions who are still deprived. The economic aspects underline the responsibilities which accompany the acceptance of water and sanitation as sacred rights, basic to human dignity and wellbeing; some for all, rather than all for some.

**The Politics of Participation as Empowerment**

The need to put people at the centre of action in water and sanitation was the main lesson of the Water Decade, reflecting the imperative for development to be a process driven by those with most to gain from it and most affected by it. For millions, access and protection of water is the biggest environment issue of all. Empowerment is required to enable communities to understand the options for change, to choose from among them, and then to realise the choices which they have made. The view was advocated in the New Delhi Declaration: community management, not mere participation, must empower and equip communities to own and control their own systems. It has been confirmed by international experience. It demonstrates that provision of services to the poor will fail if people themselves are not directly involved in the processes of decision-making and implementation.

The participatory approach was one of two guiding principles enunciated at Dublin (the other was on water as an economic good). Without these, commitments made in Rio would remain empty rhetoric. The approach was specifically defined as decisions taken at the lower appropriate level with full public consultation and involvement of users. Empowerment and equality were thus the cornerstones of Dublin's new approaches, demanding democratic institutions which can respond as the first points of contact between communities and authorities.

Power-sharing can seldom be contained within a single sector. Rather, it requires an overarching acceptance of participatory governance and action, which in turn allows and facilitates real progress in water and sanitation. The essential need for putting people at the centre of this activity is therefore a political act in a process with profoundly challenging political implications. These demand the most careful understanding.

A commitment to participatory approaches, with all its implications, is not enough. If participation is to enable people to take charge, empowerment will require a variety of legal, institutional and training actions. In several countries, women have proved to be the best treasurers of water committees, with commanding influence on payment collections, as well as the most efficient handpump mechanics. Yet to function as mechanics and treasurers, capacitation through basic education, technical skills, and management knowhow can be important preconditions. Human resource development, most particularly addressed to the needs and capacities of women, must therefore be a simultaneous thrust with any genuine effort at decentralised, people-run water and sanitation systems.

**Empowerment and Gender**

Gender issues are often at the heart when establishing water and sanitation services for all. In many cultures men and women have different needs and requirements for water and sanitation; they use water and sanitation facilities differently, have knowledge on different aspects and differ in their contributions to their establishment and continuation. Hence both need to be consulted and have a say in decisions and management and share in the support according to their capacity and knowhow. Both women and men also have a right to share in the benefits of the service and the service establishment process, such as training and jobs. Focussing only on men means that women's knowledge and commitment are bypassed, which have negative impacts for their development as well as for the efficiency and effectiveness of the service. Focussing only on women and bypassing men runs the risk of overburdening women and by excluding men and men's responsibilities establishing services that are unsustainable in the longer term. Hence the necessity to share access to information, decision-making, training, functions and service control and benefits equitably between men and women of the different classes, sections and ethnic and religious groups.

**Integrated Management and Institutional Change**

The awareness that finances are limited, but can go much farther than they presently do, re-inforces the case for a more integrated approach to planning in the sector. It is not only that water and sanitation need to be much better integrated. Recognition is also needed that quicker progress in the sector is a precondition for more rapid economic growth through better health and higher productivity, as well as protection of the aquatic ecosystem.

Such an understanding of the sector's key role in sustainable development demands that planning for water and sanitation be better integrated with planning for other sectors, and strengthened with multi-benefit analyses. Such integration must help to ensure the utmost priority for the needs of the poor and marginalised, who are comparatively voiceless with regard to more powerful sectors clamoring for water supply. The international community can assist through guidance on such an approach to integrated planning and action. It can have wide-ranging implications on such issues as land management, agricultural practices, biodiversity and the use of the hydrographic basin concept as an appropriate management unit. The cadres who manage this approach will need better data and information systems to support new capabilities, strengthened through training opportunities which go beyond technology to the broader concerns of participation, equity and the need for inter-disciplinary teamwork.

Improved financial performance also requires that concepts of decentralisation are backed by institutional reform. As the role of governments shifts from service delivery to facilitation and regulation, public utilities will need autonomy and the power to fix their charges and enter into new alliances and partnerships. The role of private interests, so often promoted as a panacea, will in this sector need to be guided by the clear understanding that market mechanisms must be one of several instruments to facilitate people's access to better systems and to services which are genuinely participatory. The private sector will need encouraged to offer competitive services under systems of accountability and regulation innovated for this purpose.

The role of the private sector may have particular significance in towns and cities while peri-urban and rural areas may require mixed initiatives. Private initiatives need also to be of several varieties, and not restricted to concepts of business for profit. New institutional arrangements may be needed to facilitate fresh roles for public and private institutions and for their complementarity and partnership. These could include the private management of public assets. Where full community management of water and sanitation may be the best option (as in some rural or peri-urban situations), new institutional and legal arrangements may be necessary. Whatever the partnerships and arrangements, the bottom line must always be that users participate and get involved in decisions which affect the choice of technologies, service levels and payment mechanisms.

**Making Technology Appropriate**

Technology provides the means for much of the change that is needed, including response to the special needs of women in such new roles as handpump mechanics or promoters of sanitation systems. Building on the R&D of the 'eighties, major advances have taken place in broadening the technological options and choices now available to communities, be they handpumps, latrines or other essential components of water and sanitation systems. New techniques for water conservation and for the recycling or disposal of wastes are being discovered almost daily.

The challenge for tomorrow is to ensure the consistent application of technologies which are appropriate to the cultural, financial and physical conditions of their setting. "Appropriate technology" may also require standardisation toward use in similar settings, demonstrated by the dramatic improvements in maintenance and system reliability through standardised handpumps. The importance of sustained R&D is highlighted by the continuing need for low-cost sanitation options for urban areas, given their inherent challenge of hygienic waste disposal. Studies presented at Noordwijk demonstrated the dramatic extensions of services and resources that are possible with lower-cost solutions that allow the re-targetting of sector investments.

**Investment Patterns: How Much Do We Need?**

Re-targetting of investments can be the key to change in the present climate of increasing financial strategy. While investments in new concepts and principles will inevitably depend on whether the necessary finance is available, the supply of resources can seldom be expected to keep pace with accelerating demand. Projections reveal that aiming for universal coverage by 2010 would mean providing 165 million people a year with water and 200 million with sanitation. On the basis of experience between 1981 and 1990, the finances needed to achieve these targets could be anything between $31 billion and $35 billion annually, or between two and three times the average rate of spending during the Water Decade. Clearly unit costs must be reduced. Past approaches will no longer do. They are clearly incapable of achieving universal coverage within an acceptable time-frame, and must therefore yield quickly to new ones.

An important factor in analysing the Decade's spending on water and sanitation is that the figures used reflect investments by governments and donors. They ignore the considerable expenditures which are made by the unserved toward their own survival, as well as investments by those seeking to improve upon unreliable services. Further, it has been estimated that 80 per cent of investments during the 1980s represented high-tech services to a relatively small number of affluent urban dwellers. If future investments were targetted at optimising benefits for the unserved and at environmental improvement, the need for more expensive technologies would fall dramatically, releasing major resources for service extension.

Studies on investment alternatives also reveal that 80 per cent of the unserved can be reached for just 30 per cent of the investment needed to provide the highest level of service to all (and even this figure assumes that half the unserved would be beneficiaries of high-technology schemes). For the same investment needed to provide 1,000 people with a new urban sewerage system, 14,000 of their less fortunate neighbours could benefit from communal latrines or on-site sanitation, or as many as 35,000 of the rural poor could be helped to build their own simple pit latrines. Enormous possibilities are available if investment priorities can be shifted. Their impact would be considerable not only on statistics coverage but even more significantly on the alleviation of poverty, the improvement of the environment and on community health.

Considerations of equity can thus be a powerful accompaniment to the recognition of water as an economic good that should command its value. The basic right to water and sanitation also demands careful attention to schemes for 'lifeline' supplies, subsidised by revenues from those who can afford the true value of the services they consume. Genuine participation in the sector's planning and implementation can be a key to ensuring such principles of equity, as well as to recognition of the high opportunity cost of misuse and waste. It can also be the best guarantee for reflecting the true requirements of users as expressed by their willingness to pay for selected services. Again, such measures can help to redress the growing inequity of drinking water users paying for the uncontrolled water use by other sectors, reflected in the rising costs necessitated by the need to dig deeper and to transport drinking water over long distances.

The strategies that are needed would combine several dimensions: lower-cost technologies; mobilisation of private initiatives; and a practical approach to community contributions. More realistic government policies to water charges (particularly from industry and agriculture) and pollution penalties would encourage measures to improve sector efficiency through reduction in loss and waste.

Such reforms do imply difficult political challenges. Yet their acceptance must now be the measure of a will for change. Implementation would also strengthen the argument for increased spending by governments and donors, demonstrating that slow progress in the sector is both economically unnecessary and inefficient.

## Assessing Progress

The emerging approaches represent a major shift from monitoring progress in water and sanitation in terms of coverage and expenditure. Now, equal emphasis will be needed on the quality of services, their use, and their impact in terms of benefits in economic terms: of health, equity, dignity and an acceptable quality of life. Sound management within an increasingly competitive environment demands that such progress be capable of rigorous measurement, and that measurements be applied to improvement of performance. Monitoring and evaluation skills will therefore be a key to effective advocacy for the sector and its efficient management, using indicators that reflect the challenge of changing attitudes, behaviours and environments.

These skills can help ensure that the sector learns from experience and is guided toward best practices. There is international interest in developing appropriate indicators for water and sanitation, and in organising the information data systems essential to efficient monitoring and evaluation. In addition, the sector can draw on global experience in methods that are genuinely participatory as well as scientifically rigorous. The gradual shift of monitoring and evaluation from a donor-driven requirement to a user-driven tool for good management can be an asset toward better sector goals, better strategies to achieve them, and stronger external support for their achievement.

## A Question of Will

As shown, water supply and sanitation problems of the world are no longer technical or financial in nature. They are political, social and managerial.

Sustainability requires political will recognize water both as a human right and as an economic necessity and resource and of sanitation as a key to human wellbeing and dignity. Sustainability requires also that people be managers and not merely participants. The politician's task is to mobilise the problem-solving energies of millions, to harness them in new partnerships for change, and to support their efforts through enabling legislation and leadership.

Political will requires advocacy for changed attitudes and actions. Those who control the levers of power must be convinced that the consequences of giving higher priority to water and sanitation will be of value in political terms, and that their neglect will be politically damaging. This is not so difficult. Votes can be lost from poor services, from water disputes at the handpumps, from posts and wells not working. In contrast, rapid demonstrated progress can win votes.

Communication and mobilisation must now make this reality more immediate at levels of decision-making, acting as the lubricant to a process of change. Advocacy must make clear the choices and the consequences for all. It must offer concrete evidence to decision-makers that change is possible and that it will lead to real improvements in projects and programmes for the unserved, as well as in their own futures:

"We can build a world where water is secured for all, or a world where water is a cause for war..."[2/]

22 December 1997

---

[2/] Elias Diaz Peña of Paraguay, representing the NGO community at the Ministerial Conference, Noordwijk, March 1994.

**EXPERT GROUP MEETING**

**ON**

**STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT**

**27-30 January 1998**

**Harare, Zimbabwe**

# FRESHWATER: PRIVATE/PUBLIC PARTNERSHIP ARRANGEMENTS

**by**

**Jim Oatridge**
**Severn Trent Plc, England**

**Freshwater: Private/Public Partnership Arrangements**
**by**
**Jim Oatridge, Severn Trent Plc, England**

---

"Water has an economic value in all its competing uses and should be recognised as an economic good."

Dublin Principle

"Integrated water resources management is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization. To this end, water resources need to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resource, in order to satisfy and reconcile needs for water in human activities."

Chapter 18 from Agenda 21

---

## Introduction

There can be no other issue that the world community should put at the top of the international political agenda than water. It is the basis of all life and therefore vital if the projections that were in the Secretary General's Report to Earth Summit II are true, dealt with urgently. The CSD in April will be an important staging post for this.

## Foreword

This paper should be read in conjunction with the paper entitled "Why is Freshwater an Issue for Business" which was submitted, under the auspices of the World Business Council for Sustainable Development (WBCSD), for the Expert Group Meeting on Strategic Approaches to Freshwater Management, in Harare, January 1998.

The paper seeks to extend the general business discussion into the actions that water companies can take in partnership with international agencies, governments, public bodies, to facilitate the development and improvement of water and sanitation services. In doing so, the paper aims to go beyond "principles of water management", to practical issues of implementation and to address the "Blockers to Progress" referred to in the previous paper. The Blockers to Progress were seen to be:-

- There needs to be a willingness on all parties involved to make progress and to share a common view of what objectives should be achieved.

- There needs to exist a government framework capable of introducing, maintaining and enforcing a strong regulatory framework within which water resources are provided.

- The quantity and quality of fresh water use and sanitation have to be regulated and not open to manipulation.

- An appropriate legal system has to be in place for a variety of issues including transboundary water rights, water abstraction rights and land access.

- The charge/tariff/income issue must be addressed in order to attract investment. Investment will not take place unless this issue is addressed either through government (tax) or through direct customer payments (eg metering) or a mixture of both. This may include transferring responsibility from government to customers on a taper basis over a period of years.

**Economics and Finance - the "crunch" issue**

If governments, especially local municipal governments, set the correct framework conditions, it is possible that the economic and technical power of the private sector could be unleashed to address some of the most pressing water issues. **What exactly does that cryptic sentence mean?** In simplest terms, it means that the price for water must be set at a level which turns it into a valued commodity, one worth conserving, using wisely and, most importantly, one in which industry would be willing to invest its time, talent and cash. Fresh water can no longer be regarded as a free good. As the Comprehensive Assessment of the Freshwater Resources of the World stated:-

> **Water is an economic good. Its economic values should be given due attention when appropriating scarce water resources among competing uses, without infringing on the basic rights to water services for all people at affordable prices."**

Many municipal governments, especially in developing nations, lack the resources to build and operate essential water supply and sanitation facilities. Resources available from international lending institutions (eg., the World Bank) and overseas development assistance are unlikely to be sufficient to meet these needs. However, if local governments set appropriate water policies, industry could help fill this investment gap with "bankable" projects. Bankable implies a cash flow which repays the investment and generates a profit along with commercial, political and legal stability necessary to cover the risk. **What risk?** If there is instability, or legal and contractual uncertainty, the risk premium will be high. Stated more clearly, investors will require higher rates of return because of a perceived risk. Banks, private companies and individuals do not invest unless there are reasonable framework conditions.

However, it is not just a matter of price and profit. In return, industry should be held accountable. Industry should be required to meet specific performance standards - eg., delivery of safe water to designated service areas; increase water availability; eliminate water loss through leaking pipes; meet specified water quality parameters, or other goals. Water supply and treatment companies also should provide full monitoring and reporting to the public, meet specified deliverables, thereby delivering value for charges. Private sector providers have to demonstrate clear benefits to the public.

The primary need is to create a public and government commitment to act and to find creative financing mechanisms to carry out the tasks. These financing mechanisms could be a combination of international lending institutions, overseas development assistance, local government funding, private banking arrangements, and direct payments by customers and the combination might change over time eg., as the local economy grows, the proportion borne by customers might increase with, say, a reduction in local government funding.

**Partnership**

In the past the development, operation and maintenance of the provision of water and sanitation services has been seen as a "government" service. However the private sector has "always" had an involvement in this provision mainly through private sector engineering consulting and construction companies.

Over the last few years the adoption of private sector business practices in the management *operation and maintenance* of water and wastewater services has provided an impetus for efficiency and the catalyst for "change" in the delivery of these services.

But the private sector involvement will be enhanced the greater the recognition that is given to other stakeholder interests, not least:-

- Customers.
- Employees.
- Shareholders.
- Government.
- Regulators.
- Communities.

**Private Sector Involvement: A range of options**

There are many methods of private "involvement" in the delivery of these services and this can be seen as a continuum from a basic "consultancy" role through to full ownership and operation of assets.

The adoption of private sector business practices is something that enables change to take place and has the ability to fast track service expansion when compared with normal bureaucratic practices.

There are a number of forms that this concept embraces.

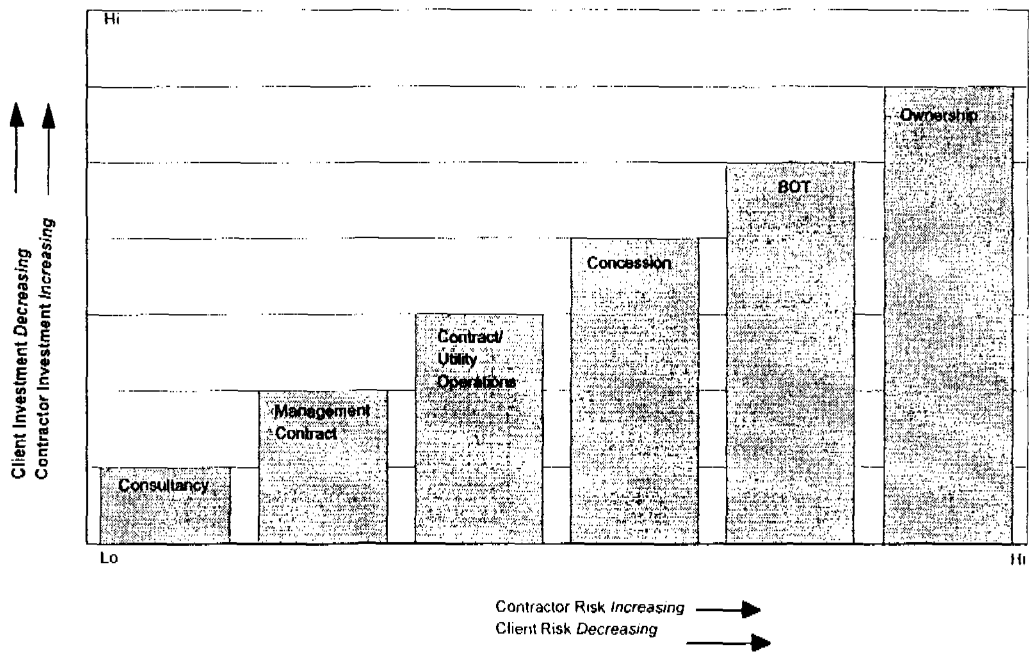
- Consultancy.
- Management contracts.
- Operating contracts.
- Concession type contracts.

- Build, Operate, Transfer (BOT).
- Full ownership and operation of infrastructure.

It is unlikely that many countries will adopt the "British" privatisation approach where the assets are sold, this has very strong political implications. However one of the other routes will certainly offer a tried and tested method of "bringing in" the private sector, the actual method will very much depend on the drivers for the process. It is however very important to select the right level of involvement for the situation.

Each of the conceptual models has different "risk" characteristics" as this diagram illustrates.

## Contract Models




This is not intended to be an exhaustive list, but serves to show key contract forms. Whilst all involve provision of management and operational expertise, the method of dealing with apportionment of risks and how investment is dealt with are key characteristics, as well as by an increasing level of investment. This diagram is drawn from the Operator's perspective for simplicity, showing an increasing level of risk and investment by the private operator, but it can be appreciated that the Clients' risks and investment reduce along the same axes.

**<u>What does the Private/Public Sector Partnership need to address</u>**

The private sector will look for a process that has the following attributes.

- A clear understanding of the drivers involved and the objectives to be achieved.

- A process, that is open and has a "level playing field" for the initial involvement either by negotiation or bidding.

- The political will to ensure the process is successful.

  *Ideally the regulatory mechanism for the utility business should be clearly established by Government via an external agency. If it is not, it needs to be defined within the contract itself. This is potentially one of the key areas of risk in the long term.*

- A "partnership" approach - where such an important service is being provided and where the risks of damage to personal health and the economic well being of a country are at stake there is very little mileage in having a contractor/client approach. There must be a partnership for the responsibility for the water and wastewater service is ultimately the "State's".

- Adequate levels of management control need to be clearly established to allow the Operator to manage effectively within a clearly defined framework.

- Resources to be provided by both the Operator and the Client have to be clearly defined, and control issues spelt out.

- A full appreciation of the risks involved and the guarantees of payment.

  *The funding needs for operation, maintenance, renewal and capital investment, along with methods and responsibilities for securing any necessary funding need to be established.*

  *Of key importance is the level and security of payment, the method of payment can vary according to contract type, and payment/earnings can be directly related to a basket of performance indicators for the business.*

- The ability to compare the delivery of services.

  *A strong customer service approach is the hallmark of effective modern utility management. It makes good business sense to develop a full range of measures of effectiveness for key aspects of the utility business, and an appropriate Management Information System.*

- The ability to link earnings to performance.

- A clear understanding of the information base that is currently available upon which to base financial decisions.

*Accurate information on the current status of the water services at the tender stage will help to reduce uncertainty, it will help increase the competitiveness of the bids received and increase the willingness of the operator to share a greater part of the risks. One idea that has worked in practice is that of a joint "pre-project preparation" study and data collection exercise during the negotiation stage. This improved the understanding of the business and led to a more rapid and effective contract start-up.*

These characteristics are very important to the private sector in that they encompass the process from bidding to operation and a good objective framework within which to work provides for efficiency and effectiveness and helps ensure each of the stakeholders in the process know what outcomes are to be achieved.

All of these must have the comfort that the delivery of such a monopolistic service is being carried out within a truly transparent regulatory framework.

## Conclusion

In recent years the numbers of contracts involving private management and operation of water and waste water utilities has increased from a trickle to a flood. In their turn, the form of contracts used has expanded from a few conventional models to a wide range of options and variants. It is hoped that this paper has been of assistance in illustrating some key issues to be addressed in the development of these new private/public sector partnership arrangements.

**Jim W Oatridge**
**Director of Environmental & Corporate Controls**
**Severn Trent Plc**
**2297 Coventry Road**
**Birmingham**
**B26 3PU**
**Tel: +44 (0) 121 722 4903**
**Fax: +44 (0) 121 722 4892**

WATER SUPPLY AND SANITATION COLLABORATIVE COUNCIL

=

*DRAFT*

# BACKGROUND DOCUMENT FOR MEETING OF 24TH MARCH 1998 ON VISION 21 FOR WATER SUPPLY AND SANITATION

=

## Introduction

The main purpose of this 24th March meeting is to consider and agree on next action steps for the development of a Vision, including a framework for action, for the water supply and sanitation sector. This follows the earlier development of the paper "Vision 21: Water, Sanitation and Global Wellbeing", tabled in Harare in January 1998.

Regarding action steps it needs to be realised at the outset that a distinction should be made between:
- actions to *arrive at* the vision
- actions to *fulfil* the vision

The discussion during this meeting will be focused on how to *arrive at* the vision, including sufficient discussion on the components of the vision to enable a good understanding of it. The vision itself and the actions to fulfil it, need to be developed jointly with as many partners in the water and sanitation sector as possible.

Clearly the vision must be a <u>shared</u> vision. It should be realised that the common ownership and the shared commitment to the vision, and the visionary and professional content are equally important. How the vision is prepared is as important as the final outcome of the work. To accomplish such a shared vision, an open, participatory process is needed to ensure agreement on the end product.

As a consequence, the development of the vision will be a complex process of dialogue, consultation, analysis, adaptation to regional and national circumstances, as well as communication and advocacy. It also includes broad co-operation with partner organisations.
The time duration will be in the range of at least one year and a half.

Why a Vision

Some may argue that the development of a vision takes a large amount of energy, time and money and that with its completion no one has yet one more drop to drink or a more appropriate place available for his or her sanitary needs. In other words: why a vision.

It is possible to have a long debate on this matter, but perhaps for this meeting it suffices to mark four major aspects:
(i) it is true that over the past three decades enormous progress has taken place, and the proportions with access to clean water and sanitation have risen considerably. But while in 1970 one and a half billion people had no safe drinking water and many more no sanitation facilities, to-day this is still the case.
In spite of placing water on the global agenda, accompanied by new initiatives in research and technology (1970s), in spite of the proclamation of a Decade, leading to increased implementation with community involvement in maintenance and cost recovery (1980s), and in spite of strong intentions and plans expressed and accepted at global meetings, complemented by greater community participation and management (1990s), millions are still suffering of the lack of water and sanitation.
Clearly, access to water and sanitation for all requires a change in perspective. The Ministerial Conference in Noordwijk (1994) agreed that full access will not happen in the course of "business as usual".
It is now time to re-think the sector's goals, strategies, commitments and levels of performance, and make them collective ones. That requires shared vision.

(ii) to act towards water supply and sanitation for the entire population, in a world that is changing more rapidly than ever before, we need the guidance of a vision. A vision that tells us in which expected societal context we will be working 25 years from now, and which wss future we want to be heading for. This will guide us in goals and strategies, and help us to be more effective and efficient in our endeavours.

(iii) water is becoming a scarce good. To ensure the availability of sufficient water for domestic purposes, we must have a vision with goals, so that we can convince partners in the larger water sector of our needs.

iv) to ensure a common vision among those dealing with water, co-operation in the vision development with the World Water Council is both an opportunity and a must.

Questions at the meeting

In developing a vision process, including next action steps, the agenda for the meeting contains four basic questions. The first two are of a fundamental, substantive nature. They need to be addressed at the meeting, and then emerge more fully gradually, in a shared fashion, through the various regions, over the coming months. These questions are:

**1. What sort of vision is needed**

**2. Which are the substantive components of a wss vision**

The second set of questions is of an operational nature; these questions need to be addressed in a more definitive way during the meeting and presented more widely to others later. These are:

**3.What are the process, next steps and timetable, to arrive at a common wss vision**

**4.How do we co-operate with the World Water Council**

On each of the four questions a few remarks are made in the following sections, for discussion and amplification.

1. ***What sort of vision is needed***

The experience at the recent vision meeting in Delft shows that it is essential to have common clarity on what is meant by vision.

Vision is not the same as mission and not the same as strategy. A vision is a tangible picture of the future we seek to create. It is seeing a future that can be achieved and is worth achieving. A statement of our vision shows where we want to go, and what it will be like when we get there. Because of its tangible and immediate quality, a vision gives shape and direction to our future. It helps people set goals to take us closer to that future.

(It needs to be realised that vision is part of a greater whole. Vision forms part of mission or purpose, to which it contributes. Purpose represents the fundamental reason for our efforts. It is the direction of the effort, its general heading. This purpose may be fulfilling the human right of water and sanitation for all, or contributing to human development, or poverty eradication, or health, or even all of these. (*This needs to be amplified further*). This purpose is translated into a specific vision. If purpose is the general heading, vision is a specific destiny.)

Putting vision as: "where we want to be", this immediately raises the question which changes are required to accomplish what is expressed in the vision.

These changes, in turn, are reached through time specific goals. These, in turn, form the basis for strategies, on which plans are based, in other words: "how to get there".

Schematically:

***purpose* > *vision* > *changes* > *goals* > *strategies* > *plans***

Taking the vision and the required changes as a basis framework for action, the challenge ahead is then reflected in our goals, strategies and plans. These must use past experiences, both positive and negative.

It is important to keep the vision fluid. Visions are evolving; as we work toward our vision, we learn more about our capacities, and other possibilities become clearer. Moreover the notions "where we want to be", "the changes required" and "how to get there" will vary from region to region and from country to country, even from locality to locality. Therefore the approach to the vision needs to be flexible.

*EXAMPLE:*
*Suppose there is common agreement in a given country that, in view of the demands in human development, water and sanitation should be available for all people. One major change required to reach this is that political commitment and societal support need to underscore this vision. Consequently time specific goals will be jointly established between partners, and political advocacy and social mobilisation strategies agreed upon. Plans will be put in place and actions on the ground will start (evidently, in reality many more actions will be needed).*

***The document to be established will need to address:***
***a) a shared vision, including changes required at the various regions and countries; and***
***b) a framework for action, including goals, sections on strategies and guidelines for mobilisation of action.***

## 2. ***Which are the substantive components of a wss vision***

### a. ***Societal trends***

Planning from a vision requires having a different mindset as compared to planning from to-day to to-morrow. Planning from a vision means "backcasting" instead of forecasting. It is like "wanting a man on the moon by then and then" and not yet knowing how to go about it. The only thing that is fixed is that vision, and the approximate time that that vision should be reality. This means that we must have a very clear idea how we want the wss situation to look like in say 2020.

If we want to have a **tangible** vision of the wss future (which the wss sector ***can*** influence) we need to know how **society** will look like in 2020 (which the sector can far less influence). We need to have an understanding of the future trends in global, regional and national developments, including political developments (political systems, conflicts), economic changes, lifestyles, environmental circumstances, issues of human rights, of equity and human development, of poverty, population pressures, migration patterns, travel and tourism, communication, etc. All this globally, in regions and countries, and more generally, in the cities, the peri-urban areas and towns, and the rural settlements. Existing scenario's should be used and supplemented or adapted where needed.

Clearly this involves a study area where the Collaborative Council should join forces with the World Water Council, which will have to undertake the same studies. (Regarding cities and rural settlements the paper Kalbermatten/ Middleton/Janssens: "Environmental Services - A Vision for the Year 2000" , prepared for the Delft vision meeting already presents a good example).
In view of the complexity of these issues, some of this work may benefit from the system of scenario planning, of the kind used by organisations like Shell.

### b. ***Water supply and Sanitation future***

With the societal circumstances in which the water and sanitation sector has to operate over the years better understood, the next question is "which future in water supply and sanitation we want to create" and which inherent components and implications are part of that vision.

Borrowing WaterAid's description, we may assume that the vision will be a world in which all people have access to safe water and sanitation. The inherent components and implications can be grouped under five categories, largely taken from the Ministerial Conference in Noordwijk (1994). These categories, which should be looked at as part and parcel of the vision, include:

1. **Political Commitment and Societal Change**
2. **The Institutional Basis**
3. **Water and the Environment**
4. **Economic and Financial Issues**
5. **International Co-operation**

These categories may be discussed during the meeting. Once well understood and defined, they form the framework within which goals, strategies and "a battle plan" can be developed and agreed upon. Action with the new focus can then start, building on ongoing activities and adding new ones where needed.

National and global action towards goals of universal access of water supply and sanitation then need to be mobilised. This will include the mobilisation of national and global resources, based on the 20/20 principle where possible, from both public and private sources.

**As one important goal in the vision, action should in the first instance focus on the availability of capacity in the countries, so that implementation can be carried out through own efforts as required. It should be further noted that the vision development should in no way delay ongoing activities, but instead help focus and accelerate them.**

=

In the following section the five categories are each listed with a number of major specific aspects. These listings specify the building stones of what needs to become a shared vision of the water supply and sanitation future, offering a framework for action in the years ahead. *These listings are neither balanced or exhaustive; they need further study and analysis.*

## 1. Political Commitment and Societal Support
(at target date)

- **Political commitment** to safeguard both water supply and sanitation as basic human rights for all, including poor sections of society
- **Equitable access** to basic water supply and sanitation for everyone, as a universal physical and social need, as part of human development, poverty alleviation and health improvement
- **Sanitation** regarded as indispensable component in human, social and economic development
- **Decentralised decision making and management** to levels close to the users
- **Empowered communities** in which **people** are seen as primary actors at the centre of action, working for their own self-reliance and exercising own responsibilities
- Stimulation of **local initiative and self-help action** for rehabilitation and upgrading of services
- A communication framework for **dialogue, involvement and participation** of and with the population
- Universal understanding of the role water and sanitation play in **health and hygiene,** *inter alia* through basic primary education
- **Gender consideration**, including the sharing of access to information, decision making, implementation and management, service control, training, and benefits between men and (empowered) women of all groups

## 2. The Institutional Basis
(at target date)

- **Government acting as facilitator and stimulator** of private sector, community and individual initiative
- **Institutional arrangement** which includes autonomy for public utilities, defined roles of the private sector (particularly in towns and cities), opportunities for mixed public-private roles and responsibilities
- Adequate **legal framework** and enforcement of water laws and regulations
- **Monitoring and evaluation** procedures at national and local levels to track further progress, mobilise support and ensure maintenance, rehabilitation and protection, as well as appropriate use of the facilities
- **Maintenance systems and partnerships in place at national and sub-national levels** between government departments and professional institutions to maintain the level of service reached
- Strategies to cope with newly developing **peri- urban and low-income urban settlements**
- **Institutional and managerial systems** geared to maintaining the level of service under severe circumstances, including rapid urbanisation, migration, disaster, etc.
- Availability of adequate **knowledge and research basis**

## 3. Water and the Environment
(at target date)

- Broad understanding among the population of water as a **finite resource**
- **Priority** for available safe **drinking water** of sufficient quantity, over other uses of water
- Full **conservation and protection** of available water resources
- **Sanitation facilities appropriate** and adequate in the given situation

## 4. Economic and Financial Issues
(at target date)

- Treatment of water as both an **economic and social good**
- **Economic resources** available from public and/or private sources (where needed supplemented with external resources) to sustain the continued provision of water supply and sanitation to all segments of society.
- General **awareness** that water and sanitation have a **cost** for the user
- **Full cost recovery**
- Temporary **subsidy arrangements** for those who can not pay
- Equitable and efficient **financial management** for wss systems

- **A variety of appropriate cost-effective technological systems**, applicable in different cultural, financial and physical conditions, including rapidly growing cities, and including technological options for self-help and community action

## 5. International Co-operation
(at target date)

- **Full international co-operation** in cases of severe circumstances, including rapid urbanisation, migration, disaster, etc.
- **Co-ordination of donor assistance**
- **Independence of policies** of external support agencies

***Further study is needed on each aspect on which adequate knowledge is not available.***
***Case studies of experiences which can support the attainment of the vision need to be undertaken.***
***The meeting may recommend suitable cases and discuss options for further work.***

## 3. *<u>What are the process, next steps and timetable, to arrive at a common wss vision</u>*

### *Process*

The process for the vision development should be organised such that it leads to a shared vision, ensure broad participation by the various regions, be transparent and inclusive and facilitate wide co-operation.

The Vision must be developed with the full participation of the leading international agencies in the sector, in full dialogue with the governments, with clear backing of the major donors, and using the expertise and experience of professional associations and NGO's, both national and international.

Linking with other sectors, both in the water fields and beyond, must be considered as appropriate.

At country level linkages should be established with local agencies and groups interested to help shape the vision and test it on the ground. A good example is the process started in with a group of NGO's in India, on the basis of the Harare paper.

A communication and advocacy action needs to accompany the vision development, so as to ensure a broad basis of endorsement and support.

*Next steps and Time table*

Action points as follow-up to the 24th March meeting can be grouped in four phases:

1. Preparation phase (March - May 1998):

= Establish a WSSCC team
= Confirm Vision Steering Committee for guidance
= Prepare work plan and timetable
= Secure funding
= Inform membership and others and arrange for available inputs
= Secure co-operation with major partners
= Enlist support and feed-back from various stakeholders during development phase
= Commission background papers and case studies

2. Development phase (June 1998 - May 1999)

= Prepare background papers and case studies
= Study and analyse trends and scenario's, in co-operation with WWC
= Arrange for inputs from a wide variety of partners and stakeholders, both institutional and individual
= Conduct first round of regional and other consultations on elements developed so far
= Conduct communications and advocacy programme

3. Consultation and Revision phase (June - October 1998)

= Develop first draft versions of Vision, both regional and global
= Arrange critique and feed-back through wide ranging consultations at global, regional and national level
= Prepare subsequent drafts, followed by further consultations and other feed-back mechanisms, regionally and globally
= Continue communications and advocacy programme

4. Finalisation phase (November 1999 - February 2000)

= Integrate inputs from different sources in final Vision
= Arrange for editing and printing
= Arrange for official publication, presentation and distribution

## *4. How do we co-operate with the World Water Council*

Dr. Jolly's proposal in his comment on the paper of Kalbermatten/Middleton/ Janssens is re-iterated here:

"Co-operation with the WWC in full and effective partnership, guided by a steering committee with members from both organisations and with an agreed work plan and timetable".

Decisions by the WWC on how to proceed, following the Paris Conference are yet to be made. The present meeting may recommend a strategy for discussion with the WWC.

*The question should not be whether the Collaborative Council and the World Water Council will co-operate, but how.*

=

***Relevant reference documents***

- Political Statement and Action Programme of the Ministerial Conference on Drinking Water and Environmental Sanitation, 1994, Noordwijk, Netherlands
- Water and Sanitation for All: A World Priority, Volume 1, 2 and 3 of Ministerial Conference, Noordwijk,
- Forward Looking Assessment on the Implementation of the Action Programme on Drinking Water and Sanitation, 1996
- Agenda 21, 1992
- The Dublin Statement, 1992
- The New Delhi Statement, 1990
- Report the Manila Global Forum of the WSS Collaborative Council, 1997
- Long Term Vision for Water, Life and the Environment: A proposed Framework, 1998
- Water Supply and Sanitation Sector Monitoring Report, 1996
- Human Development Report, 1997
- Vision 21 for Water and Sanitation, 1997
- Water Supply and Sanitation in Developing Countries, Sectoral Policy Document of Ministry of Foreign Affairs, 1998
- Memorandum of Population Council on Water and Sanitation in the 21st Century 1998

*More to follow*

WATER SUPPLY AND SANITATION COLLABORATIVE COUNCIL

CONSEIL DE CONCERTATION POUR L'APPROVISIONNEMENT EN EAU ET L'ASSAINISSEMENT

As per attached list

Dear Colleague,

VISION 21 FOR WATER SUPPLY AND SANITATION

I am very pleased that you will be able to be with us on 24th March, for the meeting on "Vision 21 for Water Supply and Sanitation". This meeting aims at defining the sort of common vision we need, including its substantive components, and at agreeing on the process, next steps and timetable.

The agenda for the meeting is attached, along with a background document discussing some of the aspects to be treated at the meeting.

The meeting will be held at the Ministry of Foreign Affairs in The Hague in room 1C25, starting at 9.30 a.m. The address of the Ministry is Bezuidenhoutseweg 67.
Mr. Willem Ankersmit from the Ministry has kindly agreed to act as host for the meeting. The Ministry is offering lunch and coffee/tea facilities. You are also invited to join the closing drinks offered by the Collaborative Council in room 1A06.

Most of you are staying in Hotel Mercure Den Haag Central which is at walking distance from the Ministry (approx. 10 - 15 min.). The address of the hotel is Spui 180. The telephone number of the hotel is +31 70 363 6700 (within the Netherlands: 070 363 6700).

Those of you who arrive in the Netherlands at Schiphol Airport, can best take the train to the Central Railway Station in The Hague and from there a taxi to the hotel.

In case you need further information, please contact Ms. Mary Brown, telephone +41 22 791 4513 (hotel information), or myself, telephone +31 252 422 560 (away from office from 18 - 22 March).

I wish you a good trip and a pleasant stay in The Netherlands.

Looking forward to seeing you there next week,

Hans van Damme

OFFICE OF HANS VAN DAMME-SPECIAL ADVISER TO THE WSS COLLABORATIVE COUNCIL
1e Poellaan 59, 2161 LA Lisse, Netherlands - Tel +31 252 422 560 - Fax +31 252 422 570 - E-mail: hansvandamme.wsscc@wxs.nl

Sent to the following (13 pages):

| Name | Fax |
|---|---|
| Richard Jolly | (1-212) 906 6661 |
| Willem Ankersmit | (31 70) 348 5956 |
| Joao G. Cardoso | (245) 20 11 37/25 30 26 |
| Lester Forde | (1-868) 662 3584 |
| Margaret Catley-Carlson | (1-212) 755 6052 |
| Ashoke Chatterjee | (91-79) 663 8465 |
| Hans van Damme | (31-252) 422 570 |
| Bert Diphoorn | (31-70) 348 4303 |
| Brian Grover | (1-202) 522 3228 |
| Jan Janssens | (1-202) 473 5123 |
| Raymond Jost | (1-514)849 2822 |
| Jon Lane | (44-171) 793 4545 |
| Roberto Lenton | (1-212) 906 6973 |
| Arienne Naber | (33-4) 91 99 4101 |
| Bindeshwar Pathak | (91-11) 555 6445 |
| Sekou Toure | (225) 32 21 92 |
| √ Christine van Wijk | (31-70) 358 9964 |
| Mario Vasconez | (593-2) 50 03 22 |
| Hannu Vikman | (358-9) 1341 6428 |
| Ranjith Wirasinha | (41-22) 791 4847 |



CvWijk
2h copy to
library (doc)

cc's to:

| | |
|---|---|
| David Collett | (44-1273) 77 21 21 |
| John Kalbermatten | (1-202) 337 8043 |

MEETING ON STRATEGIC APPROACHES ON
FRESH WATER MANAGEMENT
Harare, Zimbabwe January 27-30 1998

# WATER RESOURCES MANAGEMENT SOCIO ECONOMIC DEVELOPMENT AND CAPACITY BUILDING -----------
## A Ugandan Perspective

By Hon. Gerald M. Ssendaula
Minister of Natural Resources
Uganda

# UGANDA


UGANDA IS LOCATED IN EAST AFRICA, STRETCHING ACROSS THE EQUATOR BETWEEN 1° SOUTH AND 4° NORTH LONGITUDE, AND 29° AND 35° EAST LATITUDE.

UGANDA IS THREE HOURS AHEAD OF GMT. THE NATIONAL TERRITORY OF UGANDA COVERS 241,038 sq.km. OF WHICH FIVE-SIXTH IS LAND AND ONE-SIXTH CONSISTS OF LAKES, RIVERS AND WETLAND MARSHES.

AVERAGE ALTITUDE IS 1,312m.

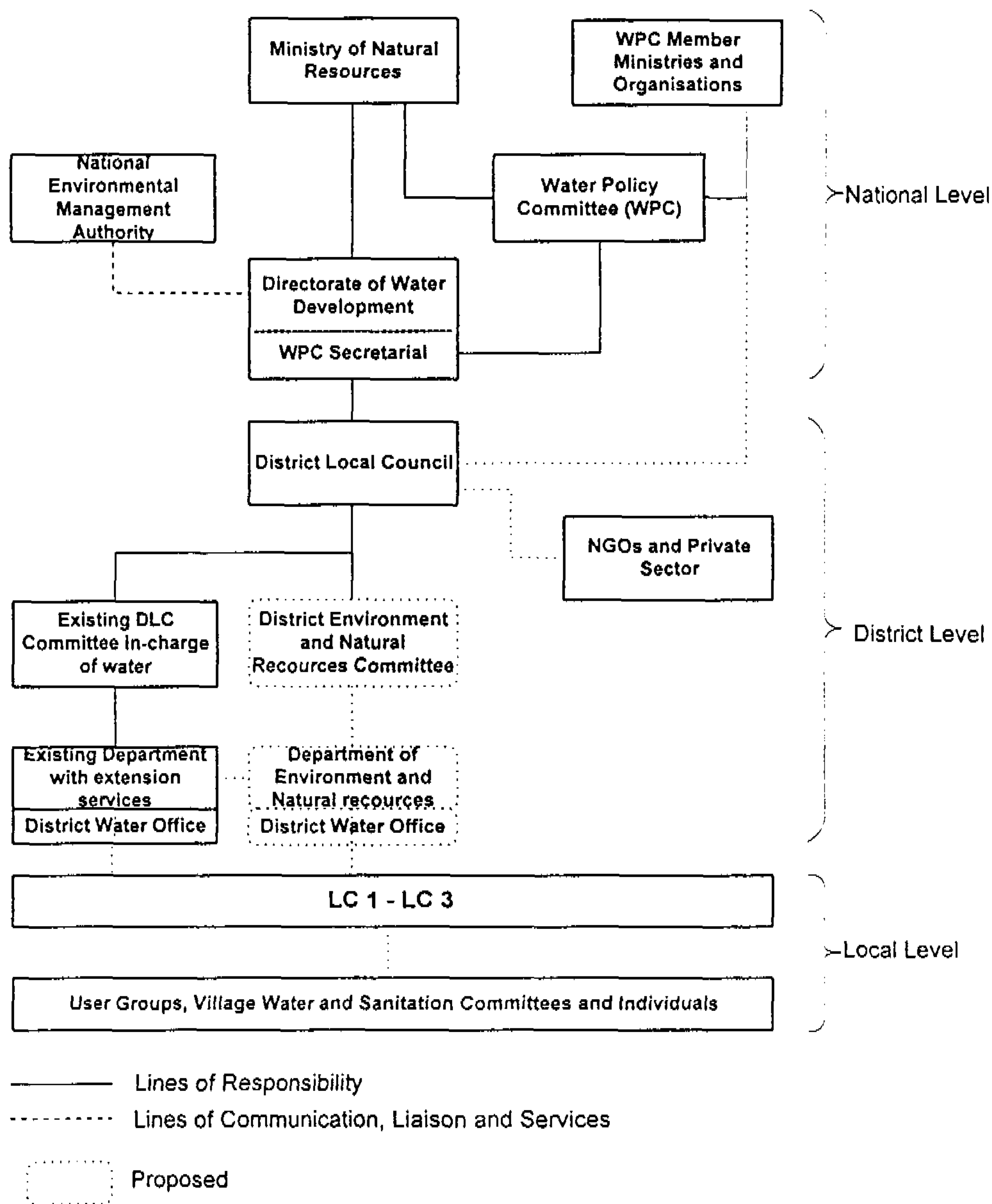



*Figure 1, Organisational Structure for Water Resources Management*

## ABBREVIATIONS

| | |
|---|---|
| DWD | Directorate of Water Development |
| LCs | Local Councils |
| WAP | Water Action Plan |
| WPC | Water Policy Committee |
| NEMA | National Environment Management Authority |
| UEB | Uganda Electricity Board |
| EIA | Environmental Impact Assessment |
| RTWSP | Rural Town Water Sanitation Programme |
| HRDSU | Human Resource Development Support Unit |
| NWSC | National Water and Sewerage Cupertino |
| GDP | Gross Domestic Product |
| FAO | Food Agricultural Organisation |
| MW | Mega Watts |
| DLC | District Local Council |
| DRC | District Resistance Councils (Now District Local Councils) |
| DWO | District Water Officer |
| RC | Resistance Council (Now Local Council) |

## 1. INTRODUCTION:

1.1 Uganda's total surface area is 241,038 sq km of which 15% is covered by fresh water. An additional 4% is covered by swamps. The fresh water is no doubt a strategic natural resource vital for life sustenance, socio-economic development and maintenance of the environment. The resource is finite and indeed vulnerable which population growth, increased agricultural and industrial development activities can endanger through depletion and degradation of its quality if not managed properly. This can be witnessed in many places all over the world and there are, already, worrying cases of pollution and degradation of our water resources afflicted by both natural and human factors.

1.2 Although Uganda is usually considered a country well endowed with water resources, their seasonal and spatial variability causes specific problems which necessitate proper planning for the development and use of the available resources.

1.3 Conflicts are emerging on the sharing of water resources between upstream and downstream users. Upstream riparians may use the water in ways making it either inadequate or its quality unsuitable for the downstream users. In the context of the Nile Basin, Lake Victoria and the River Nile are finite shared water resources and the projected demands of the riparian nations may well exceed the resource.

1.4 Viewed within this context there is a clear need for a framework for proper water resources management, through which priorities can be established and optimal use of the nation's water resources planned. I am pleased to report that Government, through preparation of the Water Action Plan now has provided major pillars of this framework.

## 2. WATER RESOURCES MANAGEMENT

2.1. The Water Statute 1995 and the Local Governments Act 1997 and their subsidiary Regulations specify the roles and responsibilities of the Central Government and the Local Governments in regard to Water Resources Management and water supply services.

Decentralisation has resulted in the districts being responsible for water supply services, subject to supervision and regulation by the Central Government, while the Central Government is responsible for water resources.

2.2 The policy objective of the Government for the water resources management is

*"To manage and develop the water resources of Uganda in an integrated and sustainable manner, so as to secure and provide water of adequate quantity and quality for all social and economic needs of the present and future generations with full participation of all stake holders".*

2.3 Uganda adopted and operationalised the guiding principles for water resources management as they emanated from the Dublin – Rio de Janeiro process and Agenda 21's Chapter 18 on Fresh Water Resources through its WATER ACTION PLAN which was prepared in 1993-1994.

2.4 The water Action Plan (WAP) identified the water resources management functions that were considered to be necessary in Uganda in the future, taking into account both water resources issues, the decentralisation process and the existing community management structures-as well as the requirements for overall environmental management through the National Environment Authority (NEMA). Considering the existing management capacity, it prioritised functions for immediate and later consideration and outlined a short-term strategy that placed some functions at the national level, which are designated later to be moved to district management.

The key water resources management functions identified are as follows:

2.4.1 **International Policy Making:**

It is recognized that Uganda needs a coordinated policy and strategy regarding international water resources issues: in particular, the utilization of the Nile Basin waters and the water quality of Lake Victoria. This is obviously seen as a function of immediate priority of the central government.

2.4.2 **Policy Making, planning and co-ordination:**

The integrated management of water resources and land-related issues requires policies and plans to be made both at the national and district levels. At the national level, policies will be formulated; standards set and project activities in the sector coordinated. A National Water Policy Committee is to be put in place. The districts are supposed to set local priorities, by-laws and annual action plans regarding the use of water resources such as wetlands, fishponds, irrigated areas, livestock watering, and rural and urban domestic water supplies.

The existing extension staff in the districts-who work in several sectors- will be coordinated in order to promote integrated and uniform information regarding the sustainable use of water and land resources.

Community level groups, within the framework of national and district policies, can manage the use of local resources, such as wetlands, and they will plan their use through local decision making bodies such as Village and Sub-county Local Committees.

### 2.4.3. Water abstraction regulations

The administration of permits for water abstraction will be determined by regulations that specify the types of uses that need to be regulated. In the long term, when the districts
have the capacity to make assessments of the impact of extraction and surface works within their district boundaries, they will administer the application and permit procedures. The central level (DWD) will carry out assessments of cross-boundary sources and then distribute block allocations of water rights to the districts concerned- who will then administer a permit system for the allocated amounts.

In the short term-while capacities are being built at District level-the DWD has embarked on the interim administration of permits for major water uses.

### 2.4.4. Wastewater discharge regulation

The management of wastewater discharge permit system will be a permanent national function because of the detailed technical expertise required, and because of the need to ensure adherence to international and national standards. The districts will comment on applications from their areas, organize public hearings and assist in monitoring that the rules governing permits are being followed.

### 2.4.5. Water resources monitoring

DWD will retain a national level role in: baseline monitoring of water flows and water quality, managing surface water, groundwater and water quality databanks; and disseminating data on water resources to relevant agencies and users. The on-going project on the rehabilitation of assessment and monitoring services will build capacity in this regard. The districts will check that by-laws, regulations and permits are being followed, monitor groundwater quality for domestic uses, and monitor groundwater abstractions in relation to recharge. Community groups and the Local Committees will monitor activities having impact on water resources, such as wetlands, forests and dumping of wastes- and they will report to the districts through LC system.

### 2.4.6. Enforcement

Enforcement of standards, regulations and by-laws will be undertaken by DWD and the district administrations through the imposition of stipulated penalties and use of the judicial system.

### 2.4.7. Mediation

The LC system, including the LC Courts, will be the first structures used for mediating disputes between individuals and groups regarding access to water resources and extractions that do not require permits.

The local government system will also be used when appropriate. All of these structures already function as mediators. Appeals can be handled administratively by the District committee responsible for water and judicially by Magistrates Courts. At the national level, the Water Policy Committee will be the final administrative appeal possibility; while the judicial system will also have an appeal channel.

#### 2.4.8. Training and information

Continuos public information activities will have to take place in order to ensure sustainable management of water resources. DWD has a role to play through its Training Unit, and at the district level the integrated extension staff will be trained and will spread information to the various users of water resources.

#### 2.4.9 Rural and urban water supply

Development of rural and urban water supply and sanitation of course remains one of the most important water resources management functions. The districts, under the new Local Governments Act 1997, will have responsibility for water supply services, except for towns supplied by NWSC. DWD will retain overall planning and supervision responsibility.

### 2.5 Management structure

The Water Action Plan and Water Statute seek to set up a management structure that is flexible and coherent with the management functions required to be performed both in the short term and taking longer term dynamics into account (fig 1)

## 3. WATER RESOURCES DEVELOPMENT AND USE

The consumptive uses in Uganda are for irrigation, water supply (rural, urban, industrial, livestock), while important non-consumptive uses comprise hydropower, fisheries, navigation, tourism and wildlife, and dilution of wastewater. These different uses, though in early stages of development, have diverse and often conflicting requirements on the water resources.

### 3.1 Domestic Water Supply

The situation within the domestic water supply in Uganda is characterised by a very low level of access to safe water within reasonable walking distance within both rural and urban areas. **Domestic water supply has been accorded priority No.1 in water resources allocation under the National Water Policy.**

**Access to safe water within urban areas**

The piped urban water supply coverage in the nine major towns (under NWSC) is estimated at 60% drawn from surface water sources. The rest of the population in these towns rely on springs, boreholes, wells, and polluted surface water sources. With the on-going expansion under the Second Water Supply Project, NWSC intends to supply 80% of its target population by the year 2000.

Water supply to (the rest of) estimated 250 small towns and rural growth centres falls under the responsibility of DWD. The total population in these centres is estimated to be approx. 860,000 people (1995) and is expected to increase to 1 million by the year 2000 and to 1.3 million by the year 2010 of these centres, 32 have existing water supply systems most of which are in a very poor state. In 60 priority towns under Rural Towns Water and Sanitation Programme (RTWSP), it is estimated that only 49% of the population have adequate improved water supply.

**Access to safe water within rural areas**

It is estimated that only 40% of rural population have access to safe water source within reasonable walking distance mainly from hand pumped boreholes and protected springs, and to a lesser extent from shallow wells and gravity flow systems. The rest of the population 60% has to carry water, sometimes over considerable distances, from unimproved polluted sources. The target is to increase the coverage to 75% by the year 2000. Considering the present level of investment in the sector and implementation capacity especially at district level, this target may not be achieved. A realistic service coverage may be 50% by the year 2000.

- The estimated 2010 urban demand is 222 mill. $m^3$/year or 7 $m^3$/sec, while the corresponding rural demand figure is 230 mill. $m^3$/year or 7.3 $m^3$/sec. The urban demand figure includes industrial demand.

- As depicted by the figures above, a larger portion of the population is still not served and millions of hours are lost each year on collection of unsafe water from distant sources. In addition, a large proportion of the facilities have persistently fallen into disrepair or disuse owing to inadequate central maintenance funds or sheer negligence by the community. In fact, the heart of the poverty trap rests in lack of access and utilization of safe water especially because it causes illness and lost opportunities to women and children.

- Uganda subscribes to the international efforts by collaborating with External Support agencies in understanding what approaches work and what does not work in the water supply sub-sector. The Dublin principle of water as an economic and social good to be managed at the lowest appropriate level is the benchmark for a new sector vision.

- At the national level, this vision is now implemented starting with the re-orientation of policies involving the definition of the role of Government, decentralization, community participation and incorporation of the private sector.

- The legal framework has been instituted including the Water Statute (1995) and the Local Governments Act (1997). The involvement of communities in management of the sector is now emphasized through the concept of Demand Responsive Approach. This approach recognizes the capacity of communities to take responsibility of identifying and solving their water supply problems. This is aimed at achieving user satisfaction, sustainability and resource mobilization at the lowest appropriate level.

- The Government has adopted a set of polices and rules that are designed to be followed by all sector development institutions and agencies. These can be summarized with the following key characteristics:

  (i) The communities are made aware of the available options

  (ii) The community makes a choice about the options that serve them best (preference)

  (iii) The community contributes to investment costs determined by the technology chosen;

  (iv) The community plays a key role on the control of these funds;

  (v) The community organizes itself into a legal body responsible for sustaining the facilities and thereof represent the ownership right, (the water user group);

  (vi) The capacity at community level to stimulate demand monitor and evaluate performance is constantly developed and maintained; and

(vii) Government to bear the facilitating role, sets national policies and strategies for an enabling environment to all actors and participating groups.

In order to ensure that disadvantaged and isolated communities are not left out, government recognizes the need to be flexible in service delivery. The government through development funds contributes over 95% of the investment cost and the community pay the remainder 2-5% within a specified period for basic water services. In urban areas, the policy emphasizes the need to set-up a mix of technology to include piped and point sources in order to meet domestic and equally industrial demand.

### 3.2 Industrial Water Supply

Uganda's industry is mainly engaged in processing of raw materials arising from agriculture, livestock and forestry with the aim to produce essential domestic requirements or prepare agricultural outputs for export.

The major activities consist of manufacture of textiles and garments, leather, sugar, foods, soft drinks, beer and flour milling. These activities are concentrated in the South of Uganda particularly, Kampala and Jinja at the shores of Lake Victoria and Victoria Nile. Uganda had a strong industrial base in the 1960s but this was rapidly destroyed during the 1970s. To date there are only about 5000 registered factories, many of them producing below capacity. Industry in total contributes 8% of the GDP.

Industries are generally connected to the urban water supply networks. However, individual industries with special requirements or isolated places not served by urban supplies may have their own water supplies. The state and requirements of these supplies are not properly documented.

### 3.3 Livestock Water Supply

Livestock water demand is a significant water use, especially in the semi-arid pastoral areas where surface water sources are seasonal and where long dry seasons are experienced. The semi-nomadic pastoralists who inhabit these areas often encroach on the nature reserves (e.g. L. Mburo National Park) and settled neighbouring communities in search of water and pasture.

The 1989 stock was estimated to be 4.5 million cattle, 1.2 million pigs and 5.5 million sheep and goats. Development of adequate livestock water supply in the pastoral areas is an important requisite for livestock development. Adequate supplies would also reduce the environmental degradation, associated social problems and competition for water and improve the health of the pastoralists.

In the past, about 1000 medium-sized dams (capacity 10,000 – 100,000$m^3$) and valley tanks (1,500 – 10,000$m^3$), were constructed by Government. The maintenance of these dams was the responsibility of government, which due to lack of financial resources, equipment and staff, has not been able to keep them in good condition. Most of the dams and valley tanks have therefore silted up or are dry due to poor siting, lack of maintenance, poor animal watering methods and soil erosion as a result of overstocking. A number of valley tanks and ponds have also been constructed by individuals especially, in the ranches.

The 1989 livestock demand was approximately 81 mill. $M^3$/year or 2.6 $m^3$/second, whereas the future (2010) demand amounts to 226 mill.$m^3$/year or 7.1$m^3$/second.

## 3.4 Irrigation development

Irrigation has over the recent years attracted increasing attention in Uganda. The failure of the usually reliable 1st season rainfall in year 1992 upset the food security of the country by causing crop failures and decrease in livestock production – underscoring the need for irrigated agriculture. The worst hit districts were Kasese, Kabale, Mbarara, Rakai, Bundibugyo, Masaka, Masindi, Mpigi, Mukono, Luwero, Moroto, Kumi, Soroti, Kotido and Rukungiri.

Today there exist plans to achieve higher agricultural production per unit area and improve food security through a more efficient use of land and water resources. Small-scale irrigation is planned to be supported by extension services and training as well as through planning and design.

The existing irrigated areas are predominantly located around Lake Kyoga and in the areas between Lake Kyoga and Mount Elgon. A total of 32,510 hectares of land was estimated as irrigated area in 1992. Current practices regarding water application indicate that a total of about 206 mill. $m^3$ of water is used annually for irrigation. Swamps presently largest areas with approx. 30,000 hectares of small-scale irrigation in Tororo, Iganga and Pallisa Districts. For comparison, the swamp area of Uganda is estimated to be approx. 3 mill. hectares.

An increasing interest in rice cultivation has been registered among the farmers. In areas surrounding the Doho rice scheme it was found that a total of 340 farmers grow rice outside the regular scheme. While in the Lake Victoria Crescent area many horticultural farmers have started small-scale irrigation.

In 1964 it was estimated that at an average annual crop water requirement of 10,000 m3/ha (single crop) the potential irrigation demand to be of 1868 mill.$m^3$/year or 59 $m^3$/s. While FAO in 1987estimated approx. 410,000 ha to have a potential for irrigated agriculture – corresponding roughly to 4,000 mill m3/year or 126 $m^3$/s for a single season. Two growing seasons would double the above estimates.

However, even a rather limited irrigation development will require substantial water resources which can only be supplied from surface water and which may create competition with other users in areas of scarce water resources.

## 3.5 Hydropower

The predominant energy used in Uganda is woodfuel which accounts for over 80% , followed by liquid fuel and electricity (less than 5%). Excessive dependency on wood, fuel is reported to be one of the major causes of deforestation leading to degradation, soil erosion and sedimentation. While use of imported petroleum products which accounts for over 80% of the imports is not economically sustainable, electricity is considered the most efficient and environmentally sustainable source but demands exceed supply. The present total generation capacity is 187 MW mostly from the Owen Falls Power Station compared to domestic demand of 211 MW and committed exports of 38 MW to Kenya, Tanzania and Rwanda. The demand is expected to increase to 374 MW (2002) and to 628 MW by the year 2010 (Uganda Hydropower Master Plan, 1996).

An extension programme intended to provide additional 200 MW of generating capacity at Owen Falls Dam is under construction and rehabilitation of the Maziba Mini-Hydro Power Station (IMW) is on-going, However, additional supply from these developments would have been outstripped by demand by the year 2005.

The country has enormous hydropower potential on the Nile between Lake Victoria and Lake Albert. The identified potential on selected sites is 2700 MW. Other mini-hydropower potential exists, for instance at Paidha (3.0MW), Ishasha (4.0MW) and Bisheruka (10MW). Therefore Uganda has adequate hydropower potential to meet the domestic and export demand in the foreseeable future.

Presently electricity generation and distribution is the monopoly of Uganda Electricity Board (UEB) which also regulates the sector.

In order to increase the generation capacity and in line with the government liberalisation policy, the industry is being opened up for private investment. A number of investors have expressed interest in hydropower generation, for instance the Nile Independent Power Ltd with whom Government has signed a development agreement for 290 MW at Bujagali on River Nile.

Hydropower generation is a non-consumptive use. Presently, there is no artificial storage on the Upper Nile and river flows are kept unchanged as compared to the situation before the construction of the Owen Falls Dam. However with the wide variations in Lake Victoria levels (and outflows) there would be urgent need to regulate the Lake levels (and outflows) in order to maximise the power produced. Concern has already been expressed on the reliability of the Lake Victoria outflows for operation of both existing 180 MW plant and the 200 MW extension at the Owen Falls Dam. The existing plant was designed to utilise fully the low flows under the present run-off river operation.

The mini-hydropower stations have small storage reservoirs and there is thus a slight tendency towards equalising of natural river flows.

### 3.6 Sewerage and Sanitation

There are 13 towns with public sewerage systems in Uganda, but it is estimated that only 15% of the population in these towns is served. Another 10% of the population is estimated to be served by septic tanks and 40% by pit latrines (with often very poor hygiene conditions); the rest of the urban population has no adequate sanitation facilities, relying on extremely un-hygienic communal facilities or defecate wherever they might find some privacy. The strategy of the RTWSP is to integrate water supply interventions with improvements in sanitation conditions and complimentary programme of hygiene education in order to improve the target communities overall health.. Within the rural areas the coverage of sanitation is estimated to be 50%.

The sewerage and sanitation sector's impact on the water resources comes from the discharge of domestic and industrial waste into the surface waters and from the possible impact of pit latrines on the ground water. Such threats to the water quality will follow the general growth in population and industrial activities. Of particular concern is the strategy under the RTWSP to promote on site sanitation (pit latrines) while at the same time advocating for low cost water supply schemes based on groundwater. The environmental and health impact of this strategy needs to be assessed.

### 3.7 Fisheries

The fisheries industry is increasing in importance with a total catch of 255,000 tonnes in 1991, a growth of 4% from 1990. The number of fish processing plants increased to seven and a significant part of the population is depending on this sector for their living. A catch of approx. 120,000 tonnes came from Lake Victoria, while the remaining catch was predominantly from Lake Kyoga and Lake Albert. In addition to the catch from lakes and rivers there are about, 2,000 man-made ponds for fish farming in the country. Restrictions are expected to be introduced to prevent overfishing of certain species, while fish farming could expand significantly. A further growth of total catch at 4% per annum could be well feasible (Ministry of Finance and Economic Planning, 1992).

Fisheries interact with the water resources through a requirement for a certain quality of the habitat for the fish stocks and through the possible pollution of small streams if intensive aquaculture is practised.

### 3.8 Navigation

Uganda relies on transport routes through Kenya and Tanzania for shipment of export goods. Parts of these routes include transport on Lake Victoria to Kisumu and Mwanza, respectively. Ferry services exist to a certain extent on Lake Kyoga as well and previously there was transport on L. Albert and navigable sections of the Nile.

The transport facilities include two ferry terminals on Lake Victoria including the recently completed Port Bell wagon ferry terminal. Three wagon ferries are part of the stock of the Uganda Railways Corporation. Passenger transport is also an important part of the navigation activities. The lake transport requires maintenance of lake levels within the design intervals for the ports and this is met by the present regulation of Lake Victoria. However, recurrence of high water levels of the early 1960s could have significant effect on the use of port facilities. The Port Bell wagon ferry line and terminal was flooded during the floods of 1960s and has just been rehabilitated.

Regulation of transport on the lake is the responsibility of Ministry of Works and Communications with Uganda Railways Corporation operating the present fleet on the Lake Victoria.

### 3.9 Tourism and wildlife

Uganda's policy in the tourism sector is to expand employment and incomes from tourism with the particular goal to increase incomes in foreign currency. This has become even more important with stagnation or decline in earnings from traditional export commodities, and the advantage of diversifying foreign trade.

Work has been concentrated on conservation and rehabilitation of facilities, with help from foreign technical assistance. Prospective investors have started to appear, and activity in the sector can be expected to grow steadily. The number of tourists arriving has increased from 25,000 in 1985 to 60,000 in 1991. An annual growth of 10% could be realistic in the future (Ministry of Finance and Economic Planning, 1992).

Requirements in relation to water resources lies in preservation of natural scenic spots, in particular water falls. Further, conflicts involving encroachment of cattle owners on wildlife parks due to scarcity of water has to be resolved.

## 4. INSTITUTIONAL CAPACITY BUILDING

4.1 It is of paramount importance that measures are put in place to strengthen the capacity of the Water Resources Management organisations both at national and lower levels for equitable and sustainable water resources management taking into account Government changing role as an outcome of the decentralisation process and economic policies which are in line with the Dublin and Rio declarations.

4.2 The Local Governments Act 1997 has designated water resources as a Central Government function. However the spirit of the Act and indeed the Water Statute 1995 as well as the Water Action Plan is that management should take place at the lowest appropriate level. Therefore, whereas the Central Government will continue to have over all responsibility for water resources including the formulation of policies, standards and management regulations, the lower levels of Government will have the responsibility for local decision making and management within the framework of national policies.

4.3 Although at Central level, human resources is not a major constraint, there are still major problems of inadequate financing, equipment, transport and management procedures to operationalise the contents of the several enabling policy documents that have been put in place. Capacity needs to be developed to enable national institutions carry out the following functions:

- International policy making;
- Policy formulation, planning and co-ordination;
- Water abstraction regulation;
- Waste water discharge regulations;
- Monitoring of water flows; and
- Mediation.

4.4 Presently, at District and lower levels, there is generally no co-ordination or planning of water resources management. The district staff have been almost exclusively concerned with water supply services and have no experience in other water resources management functions.

4.5 There is therefore need for training, education and information activities at both national,district and lower levels. These should be in addition to various projects and actions that will provide management and financial sunport to specific activities such as the on-going Water Resources Assessment Project.

4.6 The following activities therefore, have been identified as crucial for capacity building both at national, district and lower levels:

- orientation programmes for those politicians, officials and public representatives who become members of policy making and planning committees related to water resources management.

- re-orientation programmes for staff of DWD and other relevant ministries, and for district-based staff who have responsibility for carrying out water resources management functions within the decentralised structures of local government.

- in-service programmes on water resources management issues for members of the training section in DWD who have a responsibility for designing training activities and information materials for staff within the water and sanitation sector and for the general public

- in-service programmes for those extension workers who have a responsibility for giving information and facilitating discussion about water resources problems and issues

- awareness programmes on water resources management issues addressed to the general public, but particularly to members of LCs and members of water and sanitation committees operative within local communities.

## 4.7 National Level

Here, the immediate capacity-building concerns are to enhance the effectiveness of those bodies established for strategy formulation in the water sector, to foster co-ordination between key sector ministries, and to assist DWD in carrying out its retained role in water resources management – and in defining its advisory and supervisory relationship with staff working at the district level who also have responsibilities for water resources management. However, there should be a longer-term concern to influence relevant training institutions to put more emphasis on water resources management topics in the curricula designed for such professionals as civil engineers, community development workers, agriculture, fishery and forestry officers, public inspectors.

### 4.7.1 Water Policy Committee

Government is setting up a Water Policy Committee with the following mandate:

- coorditation of policy formulation regarding international water resources; liaison with regional organizations concerned with water resources; review and coordination of plans and projects that affect international water resources;

- initiation of the process of revision of the National Water Resources Policy, the Water Statute and the National Water and Sewerage Corporation Statute, when major revisions may be necessary;

- interpretation and revision, when necessary, of regulations concerning the implemention of the above Statutes;

- coordination of the preparation, implementation and revsion of the Water Action Plan, including determining the types of activites, developments or works that may not proceed prior to approval of the WPC or prior to amendment of the WAP;

- liaison with the National Environmental Management Authority regarding polices, guidelines, standards, monitoring and information concerning water resources;

- co-ordination of the formulation of national priorities for the use of water and related land resources;

- co-ordination of the formulation of national priorities for the use of water and related land resources;

- setting of national water quality standards, and setting procedures for the administration of wastewater discharge;

- setting procedures for administration of water abstraction permits, including application fees, water charges, penalties and compensation - procedures to be incorporated in current regulations;

- review and co-ordination of the formulation of national and development projects of related ministries that affect the protection and utilisation of water resources, and ensuring that the plans and projects adhere to the national environmental policies, guidelines and standards as well as the Water Action Plan - including the co-ordination of donor-sponsored projects to ensure a harmony of policies and practices and avoidance of overlaps;

- where it is not covered in legislation and regulations, advising the Minister on determination of the lowest appropriate levels of decision-making regarding the utilisation and monitoring of water resources - which powers the Minister would subsequently delegate;

- advising the Minister on settlement of appeals received regarding the administration of water abstraction permits and wastewater discharge permits;

- resolution of conflicts between government bodies regarding water resources that cannot be resolved at the district level;

As soon as possible after the Water Policy Committee is formed, an intensive orientation workshop will be held, in order to:

- appraise members of the range of water resources management issues with which they will be concerned;

- update them on the water sector legislative framework and management mechanisms currently in place at national, district and community levels;

- clarify the role and responsibilities of the Water Policy Committee, and its relationship with other bodies with similar functions – in particular, the National Environment Management Authority – and contact officers in member organisations; and

### 4.7.2 Co-ordination seminars

Following the restructuring of ministries and the decentralisation of government, in the interests of promoting cross-sectoral co-ordination in the management of land and water resources, immediate – and then occasional – seminars will be held for senior members of ministries and institutions concerned with agriculture, fisheries, forestry, energy and industry.

### 4.7.3 DWD: Re-orientation

Given that DWD has so recently been restructured, that all its staff previously deployed in the districts have new terms of service according to the decentralisation policy, that new legislation related to both water supplies and water resources has been passed, that the Water Action Plan will be in place – there will be a need for the directing staff of DWD to review the changes that are affecting the Directorate's operational, advisory and supervisory roles in relation to water resources management.

### 4.7.4 Curriculum development within environmental sector professional training institutions.

The effective management of water resources depends on the understanding of key environmental issues – and collaboration in planning and implementation of projects and extension programmes – by senior managers and field staff working in the following national ministries and local authority departments:

- Ministries responsible for natural resources; agriculture, animal husbandry, fisheries; health; local government;

- Departments responsible for community based services; construction and public works, health, environment and natural resources.

## 4.8 District level

The decentralisation process that is taking place in Uganda provides an opportunity for rationalisation of services as well as scope for greater democratisation of decision-making; and, of course, it calls for massive training initiatives in so many spheres. With respect to water resources management, there are needs parallel to those at the national level: orientation workshops for members of policy-making committees and local government officials; in-service training programmes for district water officers and extension workers who are concerned with the fairly wide range of environmental problems; and information dissemination to the public on water resources management issues.

### 4.8.1 Environment and Water Committees

Government has also put in place District Environment and Water Committees.

The Committees in relation to water resources management at the district level, will recommend policies, priorities, by-laws and standards to be adopted by the District Local Councils.

Membership to the Committees is determined by the DLC, and includes both political and relevant civil servant representatives to ensure that qualified social, technical and economic considerations are taken into account. NGOs that are active in water and related land management activities may also be co-opted as members.

In recognition of the important role that women play in the management of domestic water supply and in agriculture, the DRC should ensure that there is a strong representation of women on this commiittee.

As with the Water Policy Committee at the national level, the need for orientation workshops for these new committees at lower levels has been identified with the following similar objectives to:

- appraise members of the range of water resources management issue with which they will be concerned;

- update them on the water sector legislative framework and management mechanisms currently in place at national, district and community levels;

- review the scope and powers of the district authorities, in relation to both water supply and water resources;

- consider the specific roles and responsibilities of the Environment and Natural Resources Committee, or whichever committee is given the brief for water resources management;

- clarify the roles and functions of the various district staff working within the water sector, and their relationship with staff working in other sectors such as agriculture, community development and health

- clarify the relationship of community management of water resources and water supplies, and consider the applications of demand driven and community participation approaches in the particular districts.

#### 4.8.2 District Water Officers

The District Water Officers have a crucial role in water resources management in as much as within the decentralised government strategy, they have responsibilities for draft plans, designing and facilitating public awareness programmes, as well as carrying out water quality control activities at the district level.

Therefore, there is a need to not only update the DWOs on the water resources issues addressed in the Water Action Plan, but also to clarify their own water resources management functions – and to sharpen the skills required for carrying out these functions.

- In-service workshops are planned for DWOs, in order to increase their knowledge of:

- national policies, new statutes and regulations that apply to the management of water resources;

- available sources of water and the supply systems operative within their own districts;

- health and hygiene benefits of improved water and sanitation facilities; and

- detrimental environmental impacts that can be caused by ineffective management of water resources.

### 4.8.3 District Extension Staff

These are staff from the fields of agriculture and fisheries; community development; health; environment and natural resources. All these need training and/or re-orientation to be able to address the issues of water resources management adequately. The training is "situation-centred", in that it always focuses on actual characteristics and issues of the districts concerns.

The objectives of the training are:

- design an integrated extension strategy;

- explore experienced and interactive methods of promoting environmental awareness and of developing skills for effective management of water resources;

- increase understanding of the common range of problem areas, such as:

  - excessive irrigation
  - draining of wetland
  - competition between domestic and livestock use of water
  - overgrazing and land degradation
  - harmful wastewater discharges
  - other industrial pollution of water sources
  - water quality changes caused by fishponds
  - spread of water hyacinth
  - deforestation
  - soil erosion
  - lack of sanitation.

- identify the kinds of information materials that would be most useful in public education activities.

### 4.9 Community level

Training and information activities on water resources management issues should be promoted for local leaders, committee members, and for extension workers operating at below the district level. Here, it will be especially important to inform and activate the LC system, with its network of committees down to the LC1 level.

#### 4.9.1 LC Committee members

It is assumed that the extension services will ensure that their workers operating at lower levels will receive similar training on water resources management – provided by the district staff – so that they can incorporate the same range of topics in their interactions with farmers, say, or women's groups.

## CONCLUSION:

The paper gives an overview of the Water Resources Management issues in Uganda together with the measures that are being put in place to address them. The framework for integrated approach to the management of the water resources in ways that are sustainable and most beneficial to the people of Uganda consistent with the International Agenda and Guiding Principles is being put in place. The framework consists of the National Water Policy which has been developed on the basis of the Water Action Plan (1995) and presently under consideration by Cabinet, the Water Statute (1995) and the Local Governments Act (1997). To a large extent, the policies reflect the Socio-economic, development and financial fabric prevailing in present day Uganda, but with foresight to the future. The bulk of the work remaining is to operationalize the concepts and ideas articulated in the policy documents.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# IMPLEMENTATION OF SUSTAINABLE WATER MANAGEMENT IN FLANDERS

Paper presented by the Flemish Community of Belgium

*

# LA POLITIQUE DE L' EAU EN REGION WALONNE ET SON COUT

Par Michel Clignet,
Directeur à la division de l'eau.

Paper presented by the Walloon Region of Belgium

# Implementation of sustainable water management in Flanders

## Introduction

This memo is not intended to render an overview of the organisation and the outcome of water management in the Flemish Region. Just a few items will be highlighted which greatly contributed to improve sustainable water management and which are useful with regard to international consultation on sustainable growth and the implementation of Agenda 21.

## Challenge

The accelerated postwar economic growth in Belgium started to yield negative effects on water resources as from the end of the fifties. Many rivers became open sewers, vital groundwater reserves were polluted and reserves were overexploited compared to their replenishment capacity.

In 1971 two laws were passed in Belgium aiming at the protection of fresh water and of ground water. These laws laid the very base of sustainable water management.

The implementation of these two laws was difficult during the start-up period. However two events contributed to the positive outcome which we witness today :

1. The transfer of competences related to water management from the Belgian State to the three Regions, viz. the Flemish, Walloon and Brussels-Capitale Regions, which were created by the Constitutional change of 1970 ;
2. An increasing European and international co-operation.

## 1) Outcome of the Flemish water management

Since the Flemish Region acquired responsability for water management, a number of measures were taken which contributed to an accelerated improvement of sustainable water management.

These measures include legislation, vital capacity-building and finance.

Without entering into the whereabouts, the positive development related to water manangement can be attributed to following initiatives :

### 1. *Laying the legal basis in vital fields :*

- management of water resources in accordance with the principle of catchment areas or river basins ;

## III LES OUTILS FISCAUX

Des outils fiscaux ont été institués par les décrets suivants dits « décrets COOLS » en vue de dégager les moyens financiers destinés à couvrir les frais liés à la politique régionale de l'eau. Dès 1998, le total des recettes atteindra 4 milliards de francs par an.

a) Le décret du 30 avril 1990 instituant une taxe sur le déversement des eaux usées industrielles et domestiques qui permet de dégager annuellement une recette brute d'environ 2.800 millions de francs dont environ 2.200 millions proviennent de la taxe sur le déversement des eaux usées domestiques (18 F par $m^3$ depuis le 1er janvier 1996) et 600 millions de la taxe sur le déversement des eaux usées industrielles (380 F par unité de charge polluante). Les taxes alimentant le Fonds pour la protection des eaux de surface principalement destiné à financer la pose de collecteurs d'eaux usées et la construction de stations publiques d'épuration et couvrir les frais de fonctionnement de ces stations. Les redevables de la taxe sont les auteurs des déversements en application du principe « pollueur-payeur ».

b) Le décret du 30 avril 1990 sur la protection et l'exploitation des eaux souterraines et des eaux potabilisables qui a institué:

- une redevance (actuellement 3 F par $m^3$) appliquée aux prélèvements d'eaux souterraine et de surface potabilisables, c'est-à-dire destinées à être distribuées par réseau ou mises en récipients à des fins de consommation alimentaire. Ces prélèvements portent sur 400 millions de $m^3$ par an (320 millions en eau souterraine, 80 millions en eau de surface) et dégagent ainsi une recette annuelle d'environ 1.200 millions de francs. Cette taxe alimente le Fonds pour la protection des eaux potabilisables essentiellement destiné à financer, indemniser ou mettre en oeuvre des actions de protection dans les zones de prévention des captages, les zones de surveillance, les zones vulnérables (...) et les actions destinées à remédier à la surexploitation de certaines nappes aquifères (exemple: création de la Transhennuyère pour pallier la surexploitation de la nappe du calcaire carbonifère au nord-ouest de la Province du Hainaut).

- une contribution de prélèvement appliquée aux prises d'eau souterraine non potabilisable. Le taux de la taxe est compris entre 0 et 3 F par $m^3$ et varie en fonction de l'importance de la prise d'eau. Les prélèvements portent annuellement sur environ 60 millions de $m^3$. Compte tenu de certaines dispositions d'exonération, la recette annuelle brute espérée est d'environ 100 millions de francs. La taxe alimente le Fonds pour la protection des eaux souterraines essentiellement destiné à couvrir les frais liés à l'inventaire et la protection des ressources en eau souterraine, la surveillance et le contrôle de leur qualité et les actions entreprises en vue de récupérer les eaux d'exhaure des carrières.

Les redevables de la redevance et de la contribution de prélèvement sont les producteurs d'eau eux-mêmes.

Le Gouvernement wallon a marqué en 1995 un accord de principe sur la fusion des différents fonds mentionnés plus haut.

## IV L'EXPLOITATION DES RESSOURCES EN EAU

### A) LES PRELEVEMENTS D'EAU

L'homme prélève pour ses activités domestiques, industrielles, agricoles, ... une grande quantité d'eau dans le milieu naturel, c'est-à-dire:

1°) les nappes d'eau souterraine où environ 380 millions de $m^3$ sont prélevés annuellement (chiffres 1995):

- 320 millions de $m^3$ pour alimenter les réseaux publics de distribution d'eau ; un peu plus d'un tiers de ce volume (environ 127 millions de $m^3$) est exporté en Région flamande et en Région bruxelloise;

- 55 millions de $m^3$ prélevés à des fins industrielles ou pour l'exhaure des carrières (environ la moitié);

- 5 millions de $m^3$ prélevés à des fins agricoles (élevage, irrigation, ...).

2°) les eaux de surface, où près de 3.100 millions de $m^3$ sont prélevés annuellement, dont environ:

- 80 millions de $m^3$ pour alimenter les réseaux publics de distribution d'eau; les deux-tiers environ de ce volume sont exportés en Région flamande et en Région bruxelloise;

- 3.020 millions de $m^3$ prélevés à des fins industrielles dont environ 2.800 millions à des fins de refroidissement essentiellement pour la production d'énergie électrique.

Ces ressources en eau, souterraine ou de surface, doivent être protégées. Des outils fiscaux ont été institués par décrets, en vue de dégager les moyens financiers nécessaires ~~à cette protection. Cet aspect particulier sera évoqué au point 5 ci-dessous.~~

Les prises d'eau souterraine ou de surface potabilisable, c'est-à-dire destinée à être distribuée pour être bue et les prises d'eau souterraine non potabilisable sont soumises à autorisation préalable en vertu des dispositions du décret du 30 avril 1990 sur la protection et l'exploitation des eaux souterraines et des eaux potabilisables. Les demandes d'autorisation sont instruites par la Direction des Eaux souterraines de la Division de l'Eau. En ce qui concerne les eaux souterraines potabilisables, les autorisations sont notamment conditionnées par la délimitation de zones de prévention autour des captages. Indépendamment de l'existence des captages, des zones de surveillance peuvent aussi être délimitées ainsi que des zones vulnérables, c'est-à-dire des zones où la teneur en nitrates des eaux risque d'atteindre des valeurs-plafonds si des précautions ne sont pas prises.

### B) LE TRAITEMENT DES EAUX BRUTES ET LA DISTRIBUTION

La production d'eau souterraine potabilisable porte sur environ 320 millions de $m^3$ par an. Elle est assurée par:

* performs target and market oriented research and develops and demonstrates innovative and sustainable technologies and processes;
* performs highly specialised services including technological advice, analyses, monitoring and auditing in the field of non-nuclear energy and the environment including bio-technology, raw materials and new materials.

- The Flemish Water Supply Agency (VMW) :
  * studies, commissions the building and operates infrastructure necessary for public water supply;
  * enters into contracts on the matters of water production, water distribution and waste water treatment with other public bodies, municipalities, inter-communal ventures or private investors.

- The Environment and Nature Council for Flanders (MiNa-Council) :
  * is the advisory body to the Flemish Region for environmental policy. The MiNa-Council is made up of representatives of NGOs, trade unions, the corporate sector and agricultural organisations, etc.

- The Flemish Environmental Holding (VMH) :
  * focusses itself on investment in environmental projects or in partipations in utilies related to the environment. The most important participation of VMH in water policy is AQUAFIN, whose responsability it is to commission the construction and operate waste water collectors and waste water treatment plants.

## 3. *Financing environmental policy*

The successive reforms of the Belgian State have brought about increasing transfers of financial means from the federal budget to the Regions and the Communities.
Over the period between the 1980 and 1989 the budget of the Flemish Community increased from 40.5 billion to 92.8 billion BEF. A major transfer of responsibilities in 1989 entailed a substantial rise in funds to 342.5 billion BEF. Since 1989 (and up to 1996) an additional rise has been witnessed to 505.7 billion BEF. In a Belgian perspective the federal government has a policy budget of 800 billion BEF and a social security budget of 1498 billion BEF. The federal government also transfers annually 921 billion BEF to the Regions and Communities.

About 89% of the financial means of the budget of Flanders comes from transfers. The Flemish Region supplements it with regional taxes, with own non-fiscal revenues (sale of publications, sale of real property, ...) and with loans. The share of regional taxes remains rather modest. It grew from 20.9 billion BEF in 1990 to 30.1 billion in 1996, which is 5.9% of total revenue.

Funds for environmental policy are the odd one out when compared to the general size of Flemish financial means. The application of the 'polluter pays' principle reduces the share of transfered means from the general budget.

The total budget for environmental policy in the Flemish Region in 1996 amounted to 22,759 million BEF. As to the origin of these funds, levies account for 55%, the general budget of the Flemish Community for 21%, the transfered balance from the MINA-Fund for 16% and direct transfers from the budget to VMM and OVAM, together for 8%. As the balance of the MINA-Fund results also from levies and financial means of preceeding years the financing of environmental policy can be analysed from two main sources : levies and the general budget.

Environmental levies for 1996 include environmental taxes on waste disposal (BEF 4,448 million), on waste water discharges (BEF 7,985 million) and on manure production (BEF 140 million).

Allocations in the 1996 budget are :
- 14 % for waste management (BEF 3,180 million);
- 44,7 % for waste water management (BEF 10,180 million);
- 6 % for manure policy (BEF 1,372 million);
- 7,8 % for nature policy (BEF 1,768 million); and
- 27,5 % for general environmental policy (BEF 6,259 million).

The budget for municipal environmental expenditure and income was BEF 12,658 million in 1991 and has risen since by 75 %.

Municipalities can introduce taxes in order to contribute to the funding of municipal environmental policy. Most frequently applied are the tax on waste, the sewage tax and the general environmental tax. The Region contributes 13 % to the environmental budget of the municipalities, the other part (BEF 12,638 million or 57 %) is to be drawn from the general municipal budget.

The provinces do not have any direct financial responsibility for environmental policy but contribute to investments by municipalities and inter-communal ventures by a transfer of funds.

## 2) International co-operation

Together with the access to own responsability of the Flemish Region for the management of its water resources mid seventies, the European Community started to harmonise water policy among the Member States.

This harmonisation yielded a number of important directives, which the Flemish Region transposed in its legislation and which relate to :

- discharging toxic substances ;
- marketing of hazardous products (e.g. pesticides) which can get into the water ;
- quality standards for surface water aimed at special uses, such as bathing water, production of drinking water, shellfish water, fish water;
- collection and treatment of urban waste water ;
- nitrates in agriculture ;
- integrated environmental permitting for establishments.

# LA POLITIQUE DE L'EAU EN REGION WALLONNE ET SON COUT

Par Michel CLIGNET, Directeur
à la Division de l'Eau

## SOMMAIRE



1. US $ ≃ 37.5 BEF

## I LES OBJECTIFS DE BASE ET LE FINANCEMENT DE LA POLITIQUE DE L'EAU

Le décret du Conseil régional wallon du 21 avril 1994 relatif à la planification en matière d'environnement dans le cadre du développement durable assigne une triple mission au Gouvernement wallon:

- établir chaque année avant le dépôt du budget et au plus tard le 30 novembre un rapport sur l'état de l'environnement wallon;

- établir un programme d'action pour la qualité des eaux intégrant le programme pluriannuel de réduction de la pollution des eaux de surface visé par le décret du 7 octobre 1985 sur la protection des eaux de surface contre la pollution;

- établir tous les cinq ans un plan d'environnement pour le développement durable (PEDD) qui détermine les lignes directrices à suivre par les différents acteurs impliqués dans la politique de l'environnement.

La version définitive du PEDD a été approuvée par le Gouvernement wallon le 9 mars 1995. Les principales options retenues en matière d'eau et comportant une implication financière importante sont les suivantes:

- poursuivre l'assainissement des eaux urbaines résiduaires en conformité avec la directive européenne du 21 mai 1991 relative au traitement des eaux urbaines résiduaires et optimaliser la gestion des rejets d'eaux usées industrielles;

- mettre en place les mesures de protection des nappes d'eau souterraine et des captages et sécuriser l'approvisionnement en eau de distribution par le maintien ou le rétablissement d'un niveau d'exploitation durable des ressources en eau;

- développer une approche globale des cours d'eau en définissant une grille de qualité générale de ceux-ci, en dotant les zones inondables des rivières d'un statut spécifique et en revoyant la loi sur les cours d'eau de façon à y introduire l'orientation écologique qui lui fait actuellement défaut et à rendre la gestion et les aménagements plus cohérents dans le cadre d'une politique de bassin;

- mettre en oeuvre le coût-vérité de l'eau composé de 2 volets :

  a) un prix unique à la production d'eau potabilisable auquel s'ajoute un complément également unique couvrant les éléments pour lesquels la Région entend appliquer la solidarité régionale, à savoir le coût de la protection des eaux potabilisables, des grands travaux d'adduction, de la collecte et de l'épuration des eaux usées.

  b) un coût variable lié au service de la distribution d'eau qui relève de l'autonomie communale.

Pour financer cette politique, la Région recourt actuellement à deux moyens:

- les taxes à savoir:

  a) la taxe sur le déversement des eaux usées industrielles et domestiques instaurée en vue d'appliquer le principe pollueur-payeur et qui devrait dégager en régime de croisière une recette annuelle brute d'environ 2,8 milliards de francs dont 20 à 25 % sont liés au déversement des eaux usées industrielles et le reste au déversement des eaux usées domestiques et assimilées.

b) la redevance acquittée par les producteurs d'eau potabilisable et qui dégage une recette annuelle brute de 1,2 milliard de francs;

c) la contribution de prélèvement acquittée par les producteurs d'eau souterraine potabilisable et qui devrait progressivement dégager une recette annuelle brute d'environ 0,1 milliard de francs

- la dotation régionale dont l'origine est principalement constituée par des impôts ristournés dont le montant est fixé en fonction du pouvoir contributif des différents redevables et qui met davantage en oeuvre le principe de la solidarité régionale.

(N.B. : Tous les aspects évoqués plus haut sont examinés plus en détail dans les chapitres suivants)

## II LA DIVISION DE L'EAU ET SON BUDGET

La Division de l'Eau du Ministère de la Région wallonne comprend les services suivants:

- Direction des Cours d'Eau non navigables
- Direction des Eaux de Surface
- Direction des Eaux souterraines
- Direction de l'Epuration des eaux usées
- Direction Taxe et Redevance

La gestion de l'entreprise régionale de production et d'adduction d'eau est assurée depuis le 1er janvier 1992 par la S.W.D.E.

Les moyens d'action (crédits d'engagement) inscrits aux programmes 05 et 06 de la section 13 du budget 1997, peuvent être résumés comme suit (en millions de francs):

| | Frais généraux de fonctionnement, information, ... | Protection des prises d'eau et études des nappes | Traitement et distribution et adduction | Collecteurs et stations d'épuration | Gestion des cours d'eau y compris contrats de rivière, démergement et gestion des réseaux | Total des moyens d'action | Recettes fiscales nettes |
|---|---|---|---|---|---|---|---|
| - Direction CENN | | | | | 322 | 322 | |
| - Direction Eaux de Surface | 6 | | | | 30 (y comp. contrats de riv. 12.5 Mi) | 36 | |
| - Direction Eaux souterraines | | 1.065 | 349 | | | 1.414 | |
| - Direction Epuration | | 65 | | 8.425 * | 502 (démergement) | 8.992 | |
| - Direction Taxe et Redevance | | | | | | | 3.537 |
| - Administration générale | 17 | | | | | 17 | |
| | 23 | 1.130 | 349 | 8.425 | 854 | 10781 ** | 3.578 |

* 5.199 en 1996
** 7.663 en 1996

N. B. : 1. Il convient d'ajouter aux moyens d'action l'amortissement des charges d'emprunt de la SWDE et l'intervention dans les intérêts et amortissements d'emprunts contractés par les pouvoirs locaux en matière d'eau (respectivement 275 et 1.165 millions en 1996)

2. Ne sont pas repris dans le tableau, les moyens engagés par d'autres acteurs publics (Ministère wallon de l'Equipement et des Transports, Provinces, Communes, Division Nature et Forêts).

- 20 sociétés, compagnies, intercommunales, ... réalisant près de 90 % de cette production (la S.W.D.E., la CIBE et la CILE réalisent à elles seules 70 % de cette production);

- 70 administrations ou régies communales.

La production d'eau de surface potabilisable, qui doit être traitée avant distribution, porte sur environ 80 millions de m³ par an. Elle est assurée par:

- la CIBE à concurrence d'environ 45 millions de m³ prélevés en Meuse à Tailfer et destinés à alimenter la Région bruxelloise;

- l'ERPE (Entreprise régionale de production et d'adduction d'eau) à concurrence d'environ 35 millions de m³ prélevés dans divers réservoirs de barrages (Eupen, la Gileppe, Nisramont, Ry de Rome).

L'entreprise régionale a été créée par décret du 2 juillet 1987. Elle prend en charge le traitement des eaux de surface ainsi que la construction et l'entretien des grands travaux d'adduction d'eau tel que la Transhennuyère. Son budget de fonctionnement est assuré par la vente à divers distributeurs de l'eau produite (le prix de revient, amortissement compris, est actuellement d'environ 14 F par m³) et jusqu'en 1996 par une dotation du budget régional (400 millions de F en 1996) destinée à financer le volet « adduction ».

Au 1er janvier 1996, le prix moyen de vente de l'eau aux ménages raccordés à la distribution publique et consommant 120 m³ par an était, par m³, de 57,5 F, hors TVA et taxe sur le déversement des eaux usées. Un tiers environ de ce montant couvre les frais de production; les deux autres tiers couvrent les frais de distribution. Dans les frais de production est répercuté le coût de la redevance de 3 F par m³ supporté par le producteur; la répercussion moyenne à l'abonné est de 4 F par m³ pour tenir compte des pertes d'eau dans le réseau (un tiers de l'eau produite). A ce montant de 57 F par m³, s'ajoute la TVA de 6 % et la taxe régionale sur le déversement des eaux usées domestiques de 16 F par m³, perçue par le distributeur pour le compte de la Région moyennant indemnisation. Le prix moyen de l'Eau en Région wallonne pour une consommation de 120 m³ par ménage était ainsi de 76,9 F au 1er janvier 1996.

Comme déjà indiqué au chapitre I, le Gouvernement wallon a décidé, dans le cadre du PEDD de mettre en oeuvre le coût vérité de l'eau de façon à sensibiliser chaque consommateur au coût réel de cette ressource à protéger. Une comptabilité type devra permettre d'identifier pour chaque distributeur les éléments intervenant dans le coût de production de manière à établir au niveau régional un prix moyen unique à la production sur base d'une procédure et dans le cadre d'une structure administrative restant à définir. A ce prix moyen unique à la production, s'ajouterait le coût moyen également unique des mesures de protection des ressources de l'épuration des eaux usées et du grand transport de l'eau. A ce socle unique constitué de deux parties s'ajouterait alors le coût variable de la distribution proprement dite.

Il est à noter que la Région accordait des subventions couvrant une partie des investissements réalisés par la S.W.D.E. et prenait des participations dans le capital social de cette société en application du décret du 23 avril 1986 portant constitution de la S.W.D.E. La Région limite dorénavant ses interventions à régler la charge du passé et à financer ses investissements patrimoniaux.

## C) L'EVACUATION DES EAUX USEES

Les eaux usées produites par l'homme sont rangées dans deux catégories:

- les eaux usées domestiques définies comme étant des eaux sanitaires, de lessive, de nettoyage, de cuisine, ...;
- les eaux usées industrielles définies comme des eaux usées autres que domestiques.

Tout déversement d'eaux usées industrielles en eau de surface, égout public ou voie artificielle d'écoulement des eaux pluviales est soumis à autorisation préalable. Le déversement d'eaux usées domestiques en eau de surface est également soumis à autorisation préalable. Les demandes d'autorisation sont instruites par la Direction des Eaux de Surface de la Division de l'Eau.

En application de la directive européenne n° 91/271/CEE du 21 mai 1991, relative au traitement des eaux urbaines résiduaires, le Gouvernement wallon a prescrit pour le 31 décembre 1998, l'égouttage et l'épuration des agglomérations de plus de 10.000 équivalents-habitants situées dans les zones sensibles, sujettes à eutrophisation, pour le 31 décembre 2000, l'égouttage, l'épuration des agglomérations de plus de 15.000 équivalents-habitants et pour le 31 décembre 2005, l'égouttage et l'épuration des agglomération comprises entre 2.000 et 15.000 équivalents-habitants. Ces dispositions ont été transcrites dans le droit régional par l'arrêté du Gouvernement wallon du 8 décembre 1994 portant réglementation sur la collecte des eaux urbaines résiduaires.

Le Gouvernement wallon a imposé aux communes, par arrêté du 19 septembre 1991, la réalisation de plans communaux généraux d'égouttage et en a fixé les règles de présentation et d'élaboration. A partir du 31 décembre 1996, l'octroi de toute subvention régionale en matière d'égouttage sera subordonné à l'approbation du plan communal général d'égouttage (PCGE). Les travaux communaux généraux d'égouttage sont subsidiés par la Région wallonne à concurrence de 60 % de leur coût. Ces subsides émargent au budget des la Direction générale des Pouvoirs locaux. Ils portent actuellement sur un montant annuel global d'environ 1 milliard de francs.

En dehors des grandes villes égouttées à plus de 80 %, on estime que 35 % du réseau d'égouttage est réalisé en Région wallonne. 15 % du réseau régional actuellement constitué doit être réhabilité. Le coût global lié aux travaux d'égouttage restant à réaliser est évalué à 66 milliards de francs.

Par contre, la construction des collecteurs d'eaux usées, c'est-à-dire des conduites reliant les réseaux d'égouts aux emplacements prévus pour réaliser l'épuration des eaux usées, émarge au budget de la Direction générale des Ressources naturelles et de l'Environnement. Le Gouvernement wallon a approuvé le 18 mai 1995 un programme pluriannuel de réduction de la pollution des eaux de surface portant sur plus de 40 milliards de francs dont plus de 14 pour la construction de collecteurs. Le coût total lié au placement de collecteurs est évalué à quelque 29 milliards de francs.

## D) LE TRAITEMENT DES EAUX USEES

Le rejet des eaux usées est réglementé. Les autorisations de rejet délivrées en application du décret du 7 octobre 1985 sur la protection des eaux de surface contre la pollution peuvent imposer, sur base des objectifs de qualité préalablement définis, des conditions particulières qui renforcent les conditions fondées sur les normes générales et sectorielles fixées en application de la loi du 26 mars 1971 sur la protection des eaux de surface contre la

... eaux usées industrielles doivent veiller, notamment par un traitement préalable adéquat de ces eaux, au respect des conditions fixées dans les autorisations de déversement.

Le Gouvernement wallon a également fixé dans son arrêté du 23 mars 1995 relatif au traitement des eaux urbaines résiduaires les normes de qualité des eaux sortant des stations d'épuration publiques.

Le traitement des eaux usées urbaines déversées dans les égouts publics et qui comprennent une partie d'eaux usées industrielles est assuré en Région wallonne par 8 intercommunales d'épuration subsidiées à 100 % par la Région et couvrant l'ensemble du territoire. On compte actuellement près de 200 stations d'épuration publiques traitant plus de 1.000 EH. La charge contenue dans les eaux usées domestiques produites par la population correspond à 3.300.000 EH. Les trois quarts de cette charge sont déversés dans des égouts publics qui recueillent également une charge d'origine industrielle correspondant approximativement à 20 % de la charge globale d'origine domestique. Le potentiel théorique de traitement des stations d'épuration publiques est estimé à 1.800.000 EH mais la charge réellement traitée ne dépasse pas 1.000.000 EH. On peut évaluer à environ 1/3 la part de la charge déversée en égout public qui est réellement traitée en station d'épuration.

Le coût des investissements en épuration (hors renouvellement et modernisation) lié au respect des dispositions de la directive européenne du 21 mars 1991, relative au traitement des eaux urbaines résiduaires est évalué à quelque 31 milliards de francs. Le 4 novembre 1995, le Gouvernement wallon a décidé de garantir, sur la durée de la législature (4 ans) 16 milliards de francs en moyens d'action pour le programme d'épuration des eaux usées (construction et réhabilitation de stations, pose de collecteurs). Les dépenses consenties en 1995 pour couvrir les frais de fonctionnement des stations existantes se sont élevées à 759 millions.

Le programme pluriannuel de réduction de la pollution des eaux de surface approuvé le 18 [illegible] d'épuration les projets d'investissements en matière de stations d'épuration et de collecteurs:

| | |
|---|---|
| AIDE | 15,127 milliards |
| AIVE | 2,070 milliards |
| IBW | 2,745 milliards |
| IDEA | 2,801 milliards |
| IGRETEC | 9,079 milliards |
| INASEP | 5,097 milliards |
| INTERSUD | 0,635 milliard |
| IPALLE | 2,710 milliards |
| | 40,264 milliards |

## V LA GESTION DES COURS D'EAU

Un grand nombre d'acteurs publics sont concernés par la gestion des cours d'eau.

### L'ENTRETIEN ET L'AMENAGEMENT DES COURS D'EAU ET LA GESTION DES RESEAUX DE MESURE

En ce qui concerne les cours d'eau non navigables, la matière est régie par les dispositions de la loi du 28 décembre 1967 relative aux cours d'eau non navigables.

Les cours d'eau non navigables sont répartis en trois catégories.

Sont classés:

1. En première catégorie: les parties des cours d'eau non navigables, en aval du point où leur bassin hydrographique atteint au moins les 5.000 hectares;

2. En deuxième catégorie: les cours d'eau non navigables ou parties de ceux-ci qui ne sont classés ni en première ni en troisième catégorie;

3. En troisième catégorie: les cours d'eau non navigables ou partie de ceux-ci, en aval de leur origine, tant qu'ils n'ont pas atteint la limite de la commune où est située cette origine.

Les travaux de curage, d'entretien et de réparation à faire aux cours d'eaux de première catégorie sont exécutés par la Région et plus précisément par la Direction des Cours d'Eau non navigables de la Division de l'Eau. Les travaux relatifs aux cours d'eau de 2e catégorie sont exécutés par la province et les travaux relatifs aux cours d'eau de troisième catégorie par la commune sur le territoire de laquelle ces cours d'eau sont situés. La Région accorde également des subventions pour ce type de travaux.

La Direction des Cours d'Eau non navigables, héritière de l'ancienne Direction de l'Hydraulique agricole du Ministère de l'Agriculture, est également conseillère technique des wateringues (administrations publiques, chargées dans leur circonscription territoriale de réaliser l'ensemble des travaux d'assèchement et de drainage) et des agriculteurs pour le drainage des terres agricoles. Elle assure également la protection des berges contre les dégâts liés à la présence de rats musqués.

Il est à noter que les Directions des Eaux de Surface et des Cours d'Eau non navigables de la Division de l'Eau gèrent également des réseaux de mesures limnimétriques, physico-chimiques et hydrologiques dont les stations sont essentiellement implantées sur les cours d'eau non navigables.

La gestion des cours d'eau navigables est assurée par la Direction générale des Voies hydrauliques du Ministère wallon de l'Equipement et des Transports (MET). Les grands ouvrages d'art hydrauliques (barrages, canaux, ...) restent également dans les compétences de cette direction générale dont le service d'étude (SETHY) gère par ailleurs un réseau de mesures limnimétriques.

Ce département du MET joue évidemment un rôle primordial dans la lutte contre les inondations. Le Plan d'Environnement pour le développement durable (PEDD) prévoit à cet égard de mener une politique de bassin et de mettre au point un plan d'action à mener sur l'ensemble des bassins versants afin de diminuer l'amplitude et les effets des crues.

LE DEMERGEMENT

Dans certaines zones de l'agglomération liégeoise, du Borinage, du Centre et du bassin de Charleroi, l'exploitation de la houille sans procéder au remblayage des veines déhouillées a entraîné petit à petit l'effondrement des terrains de surface.

Les descentes du sol sur de vastes zones ont ainsi atteint plusieurs mètres selon l'importance des couches exploitées.

Ces affaissements ont désorganisé le réseau hydrographique et provoqué de graves problèmes d'évacuation des eaux usées et pluviales, nécessitant la construction et l'exploitation de réseaux complexes d'égouts, de collecteurs et de stations de pompage.

Cette opération très particulière de lutte contre les inondations s'appelle « DEMERGEMENT ».

Les intercommunales d'épuration AIDE, IDEA et IGRETEC sont habilitées à effectuer les études préparatoires, les travaux de démergement et l'entretien des ouvrages. Selon la nature des dépenses, le taux des subventions octroyées par la Région varie de 75 % à 100 %. Le solde est pris en charge par les communes et provinces concernées. En 1996, les moyens financiers dégagés à cette fin par la Région s'élèvent à 508 millions de francs dont 300 millions pour les études et investissements et 208 millions pour les frais d'exploitation. Les intercommunales concernées évaluent à environ 7 milliards de francs le montant des investissements restant encore à réaliser.

### LES CONTRATS DE RIVIERE

La Région wallonne encourage la conclusion de contrats de rivière et apporte son soutien financier à ces initiatives. Les contrats de rivière réunissant les différents acteurs concernés, utilisateurs et gestionnaires, ont déjà été mis en oeuvre dans 7 bassins hydrographiques. Ils conduisent à une amélioration et à une valorisation durables de la qualité des eaux. Le financement des conventions relatives aux contrats de rivière est assuré par la Région, la Province, les communes et tout autre partenaire désireux de soutenir le projet.

### LA PISCICULTURE

L'aspect particulier de la pisciculture est assuré par la Direction de la Chasse et de la Pêche de la Division Nature et Forêts.

L'action est amplifiée à travers les commissions provinciales piscicoles qui associent les pêcheurs et par une coordination qui s'affirme avec le service des cours d'eau non navigables de la Division de l'Eau. La Direction de la Chasse et de la Pêche assure également la gestion, le secrétariat et la comptabilité du Fonds piscicole. Ce fonds régionalisé est alimenté par une partie du produit des permis de pêche et réparti entre les sociétés de pêche par l'intermédiaire des commissions provinciales piscicoles en fonction de trois critères: nombre de permis, superficie des eaux pêchables et mécanisme de compensation des concentrations touristiques. Il a été constitué pour permettre le rempoissonnement et les travaux d'amélioration piscicole.

## VI PERSPECTIVES EN MATIERE D'INVESTISSEMENTS, DE PRIX DE L'EAU ET DE STRUCTURES

### BESOINS FINANCIERS

Une évaluation des moyens financiers à dégager au cours des 30 prochaines années a été réalisée. Elle porte tant sur les investissements que sur les frais de fonctionnement et distingue la part relative de la Région wallonne, des communes et des producteurs-distributeurs.

| | 15 premières années (milliards FB) | 15 années suivantes (milliards FB) | TOTAL (Milliards FB) |
|---|---|---|---|
| Protection des captages (+ divers) | 10 | 5 | 15 |
| Sécurisation et grandes | 8 | - | 8 |

« DIALOGUE ON WATER MANAGEMENT IN UNDERPRIVILEGED AREAS : WHICH SUPPORT TO SUSTAINABLE OPTIONS ? »

12-13 JANUARY, 1998 - N'DJAMENA (Chad)

# N'DJAMENA DECLARATION AND WORKSHOP RECOMMENDATIONS

DEPARTMENT OF ECONOMIC AND SOCIAL AFFAIRS OF THE UNITED NATIONS SECRETARIAT (UN/DESA)

DIVISION FOR SUSTAINABLE DEVELOPMENT

**The following declaration was unanimously adopted by participants :**

## 1. N'DJAMENA DECLARATION

The international workshop on « ***Dialogue on water management in underprivileged areas : which support to sustainable options ?*** » was held in N'Djaména, Chad, from January 12 to 13, 1998. This workshop was jointly organized by the Government of Chad and the Department of Economic and Social Affairs of the United Nations Secretariat (UN/DESA) - Division for Sustainable Development , in collaboration with UNDP - CHAD.

The workshop was inaugurated by the Minister of Livestock and the acting Minister of Environment and Water, with the participation of the acting UNDP Resident Representative, the Deputy Mayor of N'Djamena, and representatives of regional and international organizations. This workshop brought together technicians and experts involved in the implementation of water management programmes. They came from the following countries : Burkina-Faso, Cameroon, Canada, France, Great Britain, Guinea, Morocco, Mauritania, Niger, Senegal, Switzerland and Chad.

The workshop made **dialogue amongst various practitioners** possible, centreing around lessons drawn from real experiences. It also made clear **the critical points which need supports and the corresponding resources to be brought into play**. The workshop brought to light the diverse nature of situations, constraints, challenges and possible solutions for the sustainable management of water in less developed countries at several levels :

- that of **locally managing the uses of water** (affordable, equitable and efficient modes of exploiting drinking water in suburban zones, secondary towns, and rural areas as well as exploiting water for productive activities : the role of the State, of the Municipality , of users associations, as well as options for service delegation , with or without the intervention of the private sector.)

- that of **the planning and integrated management of resources at the level of the basin** : knowledge of water resources / long term water allocation / prevention and management of water shortages / protection of resources and ecosystems by considering their productive value / sensitization / training and financial mobilization.

Four general facts emerged from the discussions :

1). In underprivileged areas, the desire to foster the people's participation in order to aim at a real appropriation of their equiped water points, which is the only guarantee for sustainability, notably through the payment of water, calls for mobilization work at the base while respecting the pace of the population, giving the necessary time for learning and adapting the forms of organization to physical, economic, social and cultural specificities. This mobilization and local institutional support work, essential to sustainable investments, has a cost. This cost is largely under-estimated in all countries.

2). The administration no longer has the means to intervene in maintenance operations of thousands of rural water supply equipments in a country. However, rapidly handing over the management of these structures to poorly organized users or poorly trained private operators may lead to failure with serious consequences to health, and to removing responsibility from the State. Gradually, the State must strive to delegate maintenance management and concentrate on its role as regulator, monitor and incitator.

3). There are many forms and support organizations for the hydraulics of those underprivileged areas. But even when State policy exists, there often is no guarantee for sustainability in support initiatives, for the coherence of these supports nor for equipment programmes. It has become urgent for the sector to carry out minimum harmonization and regulation as part of a clear national policy reinforced by a political will of concrete monitoring of its implementation. Special support must be given to the training of users associations, the private sector and new water professions.

4). The monitoring of water resources, and the management of its uses, especially during crises, are generally abandoned when financial resources have not been mobilized. This service calls for new considerations from public authorities, because sustainable development is not possible without knowledge of water resources.

After an exchange of ideas in a plenary session participants in the workshop discussed in two working groups on the following themes :

- Strategic approaches, and actions, to sustainable and integrated management of water resources,

- Water as a key resource for economic and social development: actions for sustainable investments and local management of equipement in underprivileged areas.

The working groups made recommendations of concrete actions, presented herewith, on the support necessary for the setting up of sustainable options.

At the United Nations Conference on Environment and Development held in Rio-de-Janeiro (Agenda 21, Chapter 18, 1992) the international community defined the main strategic principles of water resources management and their associated ecosystems. Henceforth, the N'Djamena workshop considers it fundamental to determine, country by country and not globally, actions to be carried out within this strategic framework.

Innovative solutions, which have proved their worth, are to be implemented to meet the challenges and urgent needs in the underprivileged zones of developing countries.

The workshop feels that the international community should, as a matter of priority and respecting national autonomy, contribute (economically and technically) to the reinforcement of the capacities of various national actors (public and private) who effectively work for the implementation of sustainable solutions.

The international workshop has requested that the N'Djamena Declaration and the attached recommendations be presented as contribution to the Conference of Experts on Strategic approaches to Freshwater Management organized by the United Nations in Harare (January 1998), to the Conference on Water and Sustainable Development in Paris (March 1998) and to the Sixth Commission on Sustainable Development of the United Nations (April 1998).

N'DJAMENA, 13 January 1998

# II. RECOMMENDATIONS

## REPORT OF WORKING GROUP No. 1

Within the framework of the international workshop organized in N'Djamena on 12 and 13 January 1998 for *« **Dialogue on Water Management in Undeiprivileged Areas : Which support to Sustainable Options ?** »*, working group No 1, meeting on Tuesday 13 January 1998 in the LCBC Conference hall, pondered on the theme:

**THEME 1 :** « **Strategic Approaches to Sustainable and Integrated Management of Water Resources** ».

Discussions centred on 5 points which were the subject of constructive dialogue. The following recommendations were made :

**I- ACTIONS REQUIRED TO ENSURE SPATIAL AND TEMPORAL CONTINUITY IN THE INTEGRATED MANAGEMENT OF WATER RESOURCES**

1.1. Develop **a national water policy, with its operational Strategy**, comprising the drawing up of an incentive, legislative and statutory framework which provides for :
- participation by representatives of major public and private groups of actors.
- mobilization of financial resources.

1.2. Draw up, with all local, regional and central actors, **master sketches of the integrated use of water resources** per administrative district (local council / district), per Basin and per country, using :
- *reliable and detailed balance-sheet of the present situation of water resources and their uses ;*
- studies of options for the developement of sustainable hydraulic flows and of realistic financial flows, for a long term development scenario.

1.3. Set up exchange networks and **consultation frameworks** between the various contributors and actors at the level of the basins ;

1.4. Include these actions within the framework of the **sustainable management of the environment**.

**II- ACTIONS REQUIRED TO BETTER PREVENT AND MANAGE THE EFFECTS OF CLIMATIC CHANGE AND UNCERTAINTIES ON WATER RESOURCES**

2.1. Develop adapted means and methods of alert and forecast of floods and low flows.

2.2. Ensure the **dynamic mobilization of water resources** (surface and groundwater) and the rational management of the demand for water (for drinking water supply, agriculture and livestock) **in periods of water shortages**, in accordance with priorities and socio-economic criteria.

2.3. Develop models with a view to **simulating the functioning of strategic basin and aquifer systems following various long term climatic scenarios**, and taking into account water withdrawals for various uses (drinking water, agro-pastoral activities, industrial activities,...)

**III- ACTIONS REQUIRED FOR BETTER KNOWLEDGE OF WATER RESOURCES IN VIEW OF THE ACTIONS ABOVE**

3.1. Develop actions for the change of practices **induced by needs**, with a view to measuring, collecting and integrating the data on water resources, aquatic ecosystems and the socio-economic environment of users of water through :
- the re-inforcement and optimization of piezometrical, hydro-meteorological and hydrological networks ;
- the re-inforcement of capacities for the collection and dissemination of data.
- the training and motivation of technicians in charge of the collection.

3.2. Develop actions to identify, measure and monitor indicators of sustainability through :
- the creation, re-inforcement and organization of data bases.
- the exchange and dissemination of information amongst the actors and to users.

**IV- ACTIONS REQUIRED TO IMPROVE ON THE PARTICIPATION OF ALL THE ACTORS AND TO BUILD APPROPRIATE INSTITUTIONAL CAPACITIES (FROM LOCAL TO CENTRAL) IN VIEW OF THE ACTIONS ABOVE**

4.1. Harmonize approaches and **the role of various partners** : national institutions, local communities, NGOs, international organizations, donors.

4.2. Take into account **the criteria of professionalism** in the assignment of roles amongst various contributors.

4.3. Make the various **relay structures** (donors and international NGOs) to take into account the following :
- training and organization of beneficiaries into groups and associations ;
- training of relief structures in projects ;
- development of the capacities of local associations and NGOs.

**V- ACTIONS REQUIRED TO GENERATE ADEQUATE FINANCIAL RESSOURCES TO SUPPORT PRIORITY ACTIONS AND THEIR RECURRENT COSTS.**

5.1. Create **a water fund in the State Budget**, *including a management mechanism that will enable the main actors to participate ;*

5.2. At the level of external support, develop a partnership conforming to national and regional priorities with emphasis on **investments geared towards « projects upstream »** (enabling activities)

5.3. At the level of **local councils**, further the mobilization of compensatory financing for a real ownership of achievements by the beneficiaries.

# REPORT OF WORKING GROUP No. 2

**Theme 2 : « Water as a key resource for economic and social development : actions for sustainable investments and the local management of equipment in underprivileged areas »**
A constructive dialogue centred on five points and led to the following recommendations :

## GENERAL PRINCIPLES ADOPTED :

- **Necessity for precise definition of the water policy and responsibilities** *(project owner and project manager)*
- **Necessity to adopt consultation mechanisms involving various actors** *concerned with water at each level (local / national) and in each zone (Suburb / rural).*
- **Necessity to consider the social dimension of water in addition to its economic dimension.**

## RECOMMENDATIONS OF GROUP 2

### 1. ACCESS TO WATER IN UNDERPRIVILEGED AREAS

AT THE SUBURBS

- Consultation between the official water service, users representatives and private operators in the distribution of water.
- Negotiation on the pricing of water, the choice of the type of supply in accordance with the demand, and the financial capability of users.
- Support to water distribution operators with a view to improving on the quality and cost of their service.

AT SECONDARY CENTRES

- Consultation between users' representatives and the official water service.
- Negociation around technological choice and adequate mode of management. For example, a community mode of management for the smallest centres and an urban type of management (council-controlled or by private or moral person) for the biggest centres.
- Technical and socio-economic studies to help in the choice.

IN RURAL AREAS

- Recognition of the multiple uses of water (water for productive activities and for human consumption)
- Adapted technological choice in keeping with local realities such as financialcapability and maintenance procedures.

### 2) STRATEGY FOR PUBLIC SERVICES

- Associating the water supply issue with that of waste water disposal
- Fostering delegation of the exploitation and maintenance service of water points to the private sector through training, support advice, information, and agreement.

### 3) KNOWLEDGE OF WATER RESOURCES

- **To possess knowledge of water resources before further exploitation**
- To possess knowledge of specific needs for the **sustainability of small hydro-systems** (oasis...)
- Involve all actors in the data collection process
- Harmonize collection tools and centralize data processing

### 4) PARTICIPATION OF ACTORS

- Setting up operational mechanisms for **local consultation.**
- Involvement of all identified contributors
- Definition of the role of partners (NGO, donors etc)
- Support to local actors with :
  - **priority to local service providers,**
  - **training of animators in view of their autonomous organization as service providers,**
  - **decentralization of local skills of the capital in favour of the underprivileged zones.**

### 5) FINANCING

- **Define and disseminate pricing components to users** (calculation of the price of water). Search for adequate pricing methods in accordance with users capabilities (lump sum or volume payment)
- **Envisage a tax in the price of water in urban milieu for the benefit of hydraulic investments in the underprivileged milieu.**
- Tax exemption for equipment bought by users associations.
- The creation of **funds for the financing of water equipment management** may only be envisaged **at the local level** and through consultation.
- The technological choice for the waste water disposal and sanitation in small rural centres must be simple and adapted to the contribution capabilities of the populations.

- **Taxes should not be levied on the drinking water exploitation service in the underprivileged areas.**

*Comitato per la Vigilanza sull'uso delle Risorse Idriche*

**ALLOCUTION DU REPRESENTANT DE L'ITALIE**

**ET PRESIDENT DU COMITE DIRECTEUR DU SEMIDE**

WALTER MAZZITTI

*HARARE, LE 26 JANVIER 1998*

C'est avec le plus grand plaisir que l'Italie a accepté d'intervenir à cette réunion d'Experts du secteur de l'Eau du CIIS, en sa qualité de pays qui assure la présidence du "Système Euro-Méditerranéen d'Information sur le savoir-faire dans le Domaine de l'Eau",en abrégé *SEMIDE*. C'est une occasion qui donne l'opportunité d'informer les Experts des contenus et du potentiel de ce Système considéré, à juste titre, du plus haut intérêt dans le cadre de la coopération, dans le domaine de la gestion des ressources hydriques en Méditerranée.

Et cela, attendu comme il est désormais communément reconnu, qu'à la base de toute initiative ou projet, l'accès à l'information revêt un caractère prioritaire.

Les milieux où l'on prend maintenant conscience de la valeur de l'eau et de son importance pour le développement de l'homme et de son environnement commencent, heureusement, à se multiplier, atteignant

Comitato per la Vigilanza sull'uso delle Risorse Idriche

des couches de plus en plus étendues qui, partant du monde scientifique passent par celui des institutions pour parvenir, d'un côté, au coeur des processus décisionnels au niveau politico-gouvernemental et de l'autre à celui des usagers.

Cette prise de conscience n'est d'ailleurs pas sans se répercuter sur les objectifs de la coopération internationale au développement et, par là même, de façon plus particulière sur cet instrument de lutte contre la pauvreté qu'est le dialogue Nord-Sud.

En découlent des actions finalisées à orienter aussi efficacement que possible les investissements destinés à utiliser de nouvelles ressources hydriques, à gérer de façon plus rationnelle celles qui existent déjà, à remettre en état et/ou à conserver les éco-systèmes dans lesquels elles se situent.

Les pays méditerranéens réunis dans un premier temps à Alger, en 1990, ont promulgué à Rome (octobre 1992) la "Charte Méditerranéenne de l'Eau" dans le cadre de la Conférence de l'eau organisée par le Gouvernement Italien et par la Commission de la Communauté Européenne.

*Comitato per la Vigilanza sull'uso delle Risorse Idriche*

En adoptant la Charte de Rome, les 14 pays méditerranéens se sont engagés à effectuer des actions communes et concertées en matière de planification et de gestion de l'eau.

La constitution du "Réseau Méditerranéen de l'Eau", décidée dans le cadre de la Conférence de Rome et dont la structure organisative définie à l'initiative de l'Espagne a été approuvée lors de la Conférence de Valence, en 1993, constitue un support capable de promouvoir les actions prévues par la Charte de Rome.

La Conférence de Rome est en quelque sorte le point de départ de l'intérêt croissant que les Organismes Internationaux eux-mêmes manifestent envers la politique de l'eau, en Méditerranée.

La Banque Mondiale, la Banque Européenne des Investissements, la Commission Européenne, le Programme de Développement des Nations Unies ont pris une part active à ce processus par le biais du Programme METAP.

L'Union Européenne elle-même y participe, à travers le programme MEDA, approuvé à l'occasion de la Conférence Euro-Méditerranéenne de Barcelone (1995).

*Comitato per la Vigilanza sull'uso delle Risorse Idriche*

De même qu'y prend part le programme des Nations Unies pour l'environnement au moyen du Plan d'Action pour la Méditerranée.

*Tous ces organismes* financent un certain nombre de projets à travers des procédures bilatérales ou multilatérales.

Dans le même cadre, revêt une particulière importance l'initiative de la France d'approfondir *les conclusions et les principes sanctionnés par* la Charte de Rome en les limitant à la seule gestion locale de l'eau tout en *en élargissant, toutefois,* le contexte au Partenariat Euro-Méditerranéen tout entier, en d'autres termes aux 15 pays de l'Union Européenne et aux 12 autres, pays riverains de la Méditerranée.

Cet approfondissement a donné naissance à la *"Déclaration de* Marseille", adoptée par la Conférence Euro-Méditerranéenne qui s'est tenue *dans cette ville les 25-26 novembre* 1996, organisée par le Gouvernement Français et par la Commission de l'Union Européenne (programme MEDA).

De la Conférence de Marseille est né le projet d'un "Système Euro-Méditerranéen d'Information sur le savoir-faire dans le Domaine de l'Eau", ou SEMIDE, en tant que cadre de *référence d'ensemble en ce qui* concerne les initiatives sur l'eau en Méditerranée.

Un groupe de travail composé de 10 des 27 pays présents à la Conférence de Marseille (Algérie, Chypre, France, Jordanie, Italie, Malte, Maroc, Royaume - Uni, Espagne et l'Autorité Palestinienne) coordonné par la France, a conduit une étude préliminaire approfondie destinée à déterminer les contenus et les caractéristiques de la proposition SEMIDE.

L'étude qui a été faite entre janvier et novembre 1997 a compté une réunion du groupe de travail à Amman (avril) et une autre à Valence (octobre); les conclusions en ont été présentées aux représentants des 27 pays euro-méditerranéens et approuvées à l'occasion de la Conférence de Naples des 9-10 décembre derniers.

Toutes les initiatives internationales en matière d'eau ainsi que toutes celles qui en découlent au niveau national ont naturellement besoin d'une abondante quantité d'informations relatives à de très nombreux éléments au nombre desquels figurent certainement les informations sur les organismes et les opérateurs, les programmes, les projets et le matériel ainsi que les techniques et les méthodologies utilisées; toutes les informations sur les recherches et les experiences faites ainsi que sur leurs résultats, celle sur la documentation utilisée et le lieu où l'on peut la trouver; les *informations* sur les *possibilités* de formation spécialisée, et cetera.

*Et bien, tant* au *niveau* international qu'au niveau de chacun des pays, l'information disponible sur ces éléments comme sur beaucoup d'autres n'existe que de façon fragmentaire, dispersée, incomplète et hétérogène: le SEMIDE a pour *objectif principal de remédier* radicalement à ces lacunes.

"Documentation", "Formation", "Recherche-Développement", "Institu-tions" et "Administration des données (outils et méthodes)" ont été retenus comme thèmes d'échanges prioritaires susceptibles d'enrichir un dialogue euro-méditerranéen, d'autres thèmes devant pouvoir être intégrés ultérieurement à un *tel système*.

Le SEMIDE est un outil de coopération entre les pays euro-*méditerranéens qui vise à :*

.. Faciliter l'accès à l'information existante sur les savoir-faire dans le domaine de l'eau;

- Développer la mise en commun d'informations en permettant notamment à chacun de faire connaître ses responsabilités, ses activités, ses sujets d'intérêt;

- Développer des produits communs et des programmes de coopération permettant de valoriser les informations disponibles et de promouvoir la collecte des informations manquantes.

La structure du SEMIDE est fondée sur les Points Focaux Nationaux qui constituent le réseau de base à partir duquel les informations sont mises à disposition de tous les usagers qui auront accès au système.

Le travail des Points Focaux Nationaux est coordonné et assisté par un Comité de Coordination constitué à son tour par une représentation des Points Focaux Nationaux impliqués dans le projet et d'une Unité Technique.

La supervision générale du SEMIDE est assurée par un Comité Directeur qui délibère en matière d'orientation stratégique, évalue les résultats obtenus, approuve les plans d'action et le budget annuel du SEMIDE.

L'ensemble des Points Focaux Nationaux constitue donc le coeur du SEMIDE. Ces Points Focaux Nationaux sont reliés entre eux par un réseau informatique de communication à haute vitesse . Les informations sont assemblées, validées et mises à jour en temps réel par chaque Point Focal National qui demeure unique responsable et détenteur de ces informations.

Le Point Focal National est donc chargé d'inventorier et agréer les sources d'information disponibles au niveau du pays; organise dans les différents pays les procédures de communication et d'accès aux informations labélisées; s'assure que les protocoles d'accès à l'information soient traduits et disponibles dans les langues officielles du SEMIDE; développe, lorsqu'il le faut, tant les outils que les interfaces logiciels permettants d'accéder à des informations homogènes dans le pays; assure les relations avec les usagers du pays; contribue à l'élaboration du programme annuel de l'Unité Technique; participe aux réunions de coordination et d'information.

Le Comité de Coordination et l'Unité Technique proposent au Comité Directeur les orientation stratégiques principales ainsi que les plans d'action, animent et apportent un appui technique aux activités des Points Focaux Nationaux; assurent les fonctions de "Point Focal des Organismes Internationaux", inventorient les sources de données internationales, traduisent les protocoles d'accès à l'information dans les langues officielles du Semide; développe les accès aux sources d'informations internationales, développent et gèrent le serveur d'information.

Le Comité Directeur est constitué des représentants de 10 pays (1 représentant par pays avec possibilité de rotation des pays d'une année sur l'autre, à l'exception des pays membres de l'Unité Technique (voir ci-dessous) qui constituent le noyau dur du Comité de Direction) et d'un représentant de la Commission Européenne.

Il est chargé de :

- Définir les orientations stratégiques principales ;
- Valider les résultats obtenus à chaque étape;
- Valider le plan d'action et le budget annuel du SEMIDE proposé par le Comité de Coordination.

*Le Comité de Coordination* regroupe une Unité Technique et les représentants des Points Focaux Nationaux impliqués dans le projet.

L'Unité Technique est, elle-même, composée d'un consortium d'opérateurs de plusieurs pays. Ces opérateurs constituent une structure permanente qui assure l'exécution des actions définies avec les Points

Focaux Nationaux, tout en respectant les orientations générales définies par le Comité Directeur.

Cette Unité Technique est chargée de:

- Proposer au Comité Directeur les orientations stratégiques principales ainsi que les plans d'action et les budgets annuels, définis avec les Points Focaux Nationaux;
- Coordonner, animer et apporter, le cas échéant, un appui technique aux activités des *Points Focaux Nationaux* :
- Assurer les fonctions de "Point Focal des Organismes Internationaux"
- *Développer et gérer* le serveur d'information du Comité de Coordination :

Chaque pays est maître de l'organisation de son propre Point Focal National.

De manière générale, les Points Focaux Nationaux seront chargés de :

- Participer aux réunions de coordination et d'information organisées par le Comité de Coordination (participation physique ou par visio-conférence selon les cas);

*Comitato per la Vigilanza sull'uso delle Risorse Idriche*

- Inventorier et agréer, selon les orientations définies par le Comité de Coordination, les sources d'informations disponibles au niveau du pays qui seront accessibles à travers le SEMIDE;
- Organiser dans le pays, les procédures de communication et d'accès aux informations labélisées;
- S'assurer que les protocoles d'accès à l'information sont traduits et disponibles dans les langues officielles du SEMIDE;
- Développer, lorsque nécessaire, les outils et interfaces logiciels permettant d'accéder à des informations homogènes dans le pays, selon les normes définies par le Comité de Coordination;
- Assurer les relations avec les usagers du pays (analyses de satisfaction, identification des nouveaux besoins ...);
- Contribuer à l'élaboration du programme d'action annuel de l'Unité Technique du Comité de Coordination.

Nous sommes certains, quant à nous, que le projet euro-méditerranéen peut trouver sa place dans le cadre général de la discussion que nous allons entamer et plus particulièrement dans celui du quatrième atelier -Institutions et Participation-.

A notre avis, *les Institutions pourraient, en effet, s'adresser* directement à la population afin que celle-ci fasse preuve d'une plus *grande attention* en ce qui concerne les problèmes relatifs à ce bien précieux qu'est l'eau.

Ceci ne *pourra* avoir lieu que par l'intermédiaire d'une information correcte et capillaire*; de la sorte, les Institutions contribueront à éduquer* la population à la valeur économique de l'eau et aux devoirs et obligations que *comportent tant sa* sauvegarde que son équitable répartition.

il Presidente

*Walter Mazzitti*

# CSD FRESHWATER INITIATIVE

# EUROPEAN UNION

# PAPER ON OBJECTIVES FOR CSD

Expert Group meeting on Strategic Approaches to Freshwater Management: 27-30 January 1998

Harare, Zimbabwe

## CSD FRESHWATER INITIATIVE: EU PAPER ON OBJECTIVES FOR CSD

This paper sets out initial views on adding substance to the call in the Programme for the Further Implementation of Agenda 21, adopted by the Special Session of the General Assembly, 23-27 June 1997, for "..a dialogue under the aegis of the Commission on Sustainable Development, beginning at its sixth session, aimed at building a consensus on the necessary actions, and in particular, on the means of implementation and on tangible results, in order to consider initiating a strategic approach for the implementation of all aspects of the sustainable use of freshwater for social and economic purposes.." (para 35).

### *Objectives for CSD*

2. We consider that the Commission on Sustainable Development (CSD) in 1998 should adopt a programme of action - **"WATER 21"** - whose goal would be the achievement of long term economically, environmentally and socially sustainable use of all freshwater resources. This would include:

a. the general provision of safe drinking water and sanitation, the reduction of water-related diseases and the promotion of food security, through

b. the adoption of systems of managing water resources which bring together all relevant concerns, including both quantity and quality over time, the implications for all uses and applications, the interaction with uses of land, the problems associated with droughts and desertification, and links to biodiversity and climate change.

3. This programme of action "WATER 21" will require:

a. agreement on the principle that access to safe drinking water and sanitation is essential for satisfying basic human requirements;

b. agreement on a statement of the strategic approach necessary to meet the goals of "WATER 21" building on existing principles and instruments, all in accordance with Chapter 18 of Agenda 21;

c. co-operation and commitment by all States to develop and implement local, national or regional plans for the sustainable management of freshwater to address the above goals, supplemented where necessary with regional plans (this can be linked to the OECD Development Assistance Committee's target of implementation of national strategies in all countries by 2005). Such plans and management should be based on a participatory approach;

d. commitment by international organisations and donor States to promote the implementation of these plans, including in particular capacity building and considering the necessary resources;

e. development of a comprehensive picture of priorities and identification of improved mechanisms for monitoring and reporting on progress towards the aims of the programme, together with consideration on this basis of what further international action is required.

***Preparation for CSD***

4. A logical progression through a series of meetings identified before CSD is necessary to achieve a successful CSD outcome . The steps identified are:

a. a proposed international workshop (Harare, 27-30 January 1998) on Strategic Approaches to Freshwater Management. This must address the *role of water in poverty eradication and how to make the social adaptations* needed to achieve sustainable consumption patterns. We need to ensure that critical issues and gaps are tackled and that developing country experience is analysed and shared. A series of issues papers will be commissioned through the Division for Sustainable Development prior to the workshop. Resource material will also include a first draft of text setting out the strategic approach. It will be necessary for the workshop to bring together both water experts and policy makers, and build consensus. The workshop output must elaborate on the strategic approach necessary and provide a clear statement of priorities for implementation.

b. the CSD Intersessional (23 February - 5 March,1998) will make use of the workshop output to develop the text on the strategic approach necessary for sustainable freshwater management and the supporting programme of action "WATER 21".

c. the roundtable meeting in Bonn (3-5 March 1998) will be a high level round table, to be organised by Germany in collaboration with the World Bank to bring together about 40 decision-makers from developed and developing countries and international organisations; discussion is intended to cover the integration of environment and developmental aspects of water as well as security related issues against the background of transboundary water management.

d. the Ministerial and expert meeting in Paris (19-21 March, 1998) on "Water and Sustainable Development" will provide an important opportunity to build support for the programme of action and also bring in the views of a wide range of stakeholders. The purpose of the meeting will be to make a material contribution, with the participation of water decision makers, to the elaboration of strategies for improving the management of water, in 3 particular areas, which the CSD could adopt. These would be:

- improving knowledge of freshwater resources and use;
- *promoting suitable legislative and institutional and capacity building at* all levels; and
- promoting national strategies for sustainable water resource management and adequate sector financing.

e. the CSD VI (20 April - 1 May, 1998) sectoral theme review of freshwater management should aim to adopt this programme of action whose objectives are set out above.

***The framework***

5. The statement of the strategic approach to the sustainable use of freshwater must build on what has gone before (such as Dublin Principles, Chapter 18 of Agenda 21) and set out guidance on implementation. The conceptual framework should address all aspects of water including human uses and protecting the environment, promote a participatory approach involving all those affected, and take account of all economic and social factors. This framework is well known and accepted, and so the emphasis must be on addressing constraints and action.

6. Issues to be considered, and where the output from CSD ought to try to provide guidance, include:

a. the quantity of water of sufficient quality required to satisfy basic human needs in particular health and sanitation, together with equity and efficiency in water provision; this should link to the overarching CSD themes of poverty eradication and production/consumption patterns.

b. an integrated approach to management of water, the integration of water and land management which impacts on water, the promotion of sustainable agricultural practices and the control of discharges and monitoring quality including the effects of biological discharges;

c. food security (how to improve choice and promote access to entitlements, diversity in production and its intensification); stimulation of discussion on the role of water in adding value to agricultural produce (concept of virtual water);

d. protection of environment, biological diversity (including aquatic life), ecosystems and water quality;

e. demand management including control of water use - regulatory and financial aspects, experience in leakage control and increasing efficiency in water use;

f. strategic information management - information for informed decision making, emphasis on preventative rather than crisis management.

g. perspectives opened up by science and technology (and related initiatives such as education and training) to help resolve a range of problems concerning freshwater management and use.

h. issues relating to gender which should be discussed when developing the framework.

7. Particular issues which need to be considered in developing such guidance include:

a. within an approach based on river-basin management, the need for approaches to the management of international shared water resources to build on national strategies and the recently agreed UN Convention on Non-Navigational Uses of International Watercourses; assistance will be needed for states with less developed capacities;

b. the implications of customary water uses;

c. the implications of regarding water as both an economic and social good, and means of ensuring that its value is recognised, while ensuring the meeting of basic human needs in the short or longer term.

***Plan preparation and implementation***

8. To help with the national commitments to develop and implement local and national plans, the Programme of Action needs to give guidance on action to address the constraints on the preparation and implementation of such plans. This should include:

a. ways to facilitate the making of difficult political decisions (food and water issues are essentially political) and of applying an integrated approach to those decisions; we need to draw out examples of good policies that have been put into practice and the lessons that can be learnt on how this can be done;

b. ways to create incentives from better arrangements, possibly linked to technology transfer - we should highlight "win-win" situations (e.g. efficient production and use with better pollution control), and show how the right policy decisions can lead to effective action and thus to greater satisfaction for consumers/producers/voters;

c. ways to improve the data available for decision-making through improved availability, quality assurance, more focus on end-user needs and the promotion of concepts of water resource accounting both in terms of quantity and quality, and to cover both surface water and groundwater;

d. ways to ensure that future hot-spots and problems are identified, so that the approach is preventive, not crisis-management;

e. ways to improve sanitation and promote reuse of water resources;

f. need for national campaigns to increase awareness of water issues in both developed and developing countries, taking account of differing local circumstances (there may be a possibility of building on the World Water Day on 22 March to develop a publicity campaign throughout the EU);

g. ways of building more effective partnerships for the work to be done; greater public participation, and increased participation of women, together with exploration of partnerships between the public and private sectors, which have a potential for contributing to improved management, and promoting a balance between the interests of urban and rural areas;

h. ways of monitoring progress at the national level.

9. In all this, it is essential to recognise the importance of an integrated approach to water management and the consequent need for institutional development, creating a climate in which institutions can co-operate, build capacity, exchange experience, and develop the means of managing change to make policies work. Such development may need to be organised within an institutional framework structured on different principles. In implementing the plan, a framework should be defined to provide development pathways for countries of varying capacities to reflect their differing stages of development.

10. When setting goals for sustainable water management, the links to other important issues in Agenda 21 should be taken into account - such as climate change, integrated coastal zone management, and conservation of biological diversity.

***Action to promote implementation***

11. The Programme of Action needs to set out proposed actions, in the first place, to make best use of the resources already available. This involves trying to:

a. enhance the effectiveness of existing national actions *inter alia* by improving management information systems to guide reform and instituting a supporting legal framework and supporting administrative/fiscal systems for implementation.

b. co-ordinate international action with the aim of achieving mutual consistency of projects supported in a single country through different channels; responsibility for co-ordination at the country level rests with individual governments, but the international community can assist the development of more effective co-ordination;

c. reduce duplication of international effort between those who are supporting related projects, and make sure that all the crucial links in a system to be established are programmed in a logical sequence;

d. set clear roles and priorities for multilateral initiatives, and, as part of this, ensure complementary roles for both the Global Water Partnership and the World Water Council;

e. encourage better co-ordination between UN Agencies (the UN

Secretariat's report to ECOSOC will show the scope for this: the programme of action needs to identify the role of each agency and the timing of actions).

12. In the light of commitments on resources in relation to water made in the Beijing and Copenhagen declarations, a number of initiatives are possible to help identify more resources - human, technical (know-how) and financial:

a. in line with an enhanced priority for water, refocus existing training programmes to give higher priority to water policy analysis and formulation, public administration and management of water resources, and the strengthening of decentralised institutions;

b. stimulate research and development co-operation and technology transfer for sustainable water management, in line with approaches agreed in Agenda 21 and at UNGASS;

c. provide more effective technical assistance (there are strong resource bases in many EU states that could be better tapped); we need to stimulate a debate on how this can be done;

d. address the constraints that prevent greater private sector investment and establish an enabling framework that protects vulnerable sections of society and conserves the environment;

e. spread knowledge of innovative approaches to financing (especially micro-financing);

f. Promote the transfer of best practice in innovative management systems which effectively decentralise decision making, allow participation by all stakeholders and include affordable targeting mechanisms to protect the poorest segments of the population;

g. promote sustainable industrial and agricultural practices, possibly by demonstrating the contribution from high-value crops, cultivated under properly managed conditions, to developing economies;

h. explore the scope for focusing assistance on addressing the constraints to sustainable management of freshwater rather than funding new construction projects.

***Monitoring and reporting***

13. There will be a need to agree the appropriate indicators against which the progress towards the overall objectives of the programme of action can be measured and the success in providing support for implementation of the overall programme of action can be checked. National systems of monitoring and reporting may need support so that they can contribute to this process.

14. Therefore, there needs to be system of reporting which will provide the

information for compiling these indicators. The reporting system should not be judgmental but should encourage the exchange of experience and best practice.

EUROPEAN COMMISSION
DG VIII DIRECTORATE-GENERAL FOR DEVELOPMENT
DG IB DIRECTORATE-GENERAL FOR EXTERNAL RELATIONS

# A Strategic Approach for the Equitable, Efficient and Sustainable Management and Use of Freshwater

**A discussion paper,
based on the draft "Guidelines for Water Resources Development Co-operation"**

**Prepared by H.R. Wallingford**

**for the UNCSD Expert Group Meeting on Strategic Approaches to Freshwater Management, Harare, January 1998**

**January 1998**

HR Wallingford

# Building a strategic approach to the management and development of water resources

| | | | | |
|---|---|---|---|---|
| GOAL | **Water resources developed and managed in an integrated and sustainable way**<br>based on the Dublin Statement and EC guiding principles | | | |
| | NATIONAL/REGIONAL PROGRAMMING | | | |
| PURPOSE | Water Resources Assessment and Planning | Basic Water Supply and Sanitation Services | Municipal Water and Wastewater Services | Agricultural Water Use and Management |
| OUTPUTS | Projects; Decentralised co-operation; Programmes | Sector reviews; Policy studies; ETC | | |
| ACTIVITIES | Examples: | | | |

- Study Terms of Reference
- Stakeholder Analysis
- Capacity Building
- Participatory Appraisal
- Appropriate Modern Technology
- Environmental Assessment
- Financial & Economic Analysis

## Executive Summary

There is now widespread recognition at international level that the challenges posed by inadequate and inequitable water resources management and service delivery need to be actively addressed. A central core of principles concerning the need to protect the aquatic eco-system, and to extend the health-giving and productive properties of freshwater resources equitably and efficiently among humankind, has been agreed. Less progress has been made in developing a common approach to applying these principles or promoting action plans based upon them, bearing especially in mind the basic water resources difficulties faced by the poorest members of humanity.

In July 1997, UNGASS identified a need for "a strategic approach for the implementation of all aspects of the sustainable use of freshwater for social and economic purposes" (Programme for the Further Implementation of Agenda 21, paragraph 35). It happens that the European Commission is currently preparing Guidelines for development co-operation relating to water, in consultation with experts from EU member states. The centrepiece of the Guidelines is a "**strategic approach for the equitable, efficient and sustainable management of water resources**" based on internationally agreed core principles.

The strategic approach, which is summarised in this paper, identifies sets of **guiding principles** for policy development and practical action; and it clusters programmatic activity into four **Focus Areas**, within which the guiding principles are to be applied. The strategic approach is progressive, entailing the raising and resolving of issues throughout the programme process by systematic application of the principles. Its adoption will require emphasising certain types of programmatic action, especially those which expand or re-orient institutional capacity.

## Contents

## I. The need for a new water management regime

Freshwater is critical to the natural eco-system and to life on earth; all human activities depend on water in one way or another. But the world's supply of freshwater is finite, and is coming under increasing strain. Population growth, industrialisation, pressures on land and the food supply, and the rapid expansion of urban settlements have brought growing competition between uses -- and users -- of water. Progress in meeting the basic water resources needs of the poorest communities as part of a poverty elimination strategy has been all but overwhelmed by these trends. Unless action is taken to change the way freshwater resources are managed, competition over water could become explosive in the not too distant future.

Both the volume and the quality of the world's freshwater resources are at issue. Many countries in Sub-Saharan Africa and the Middle East are used to water scarcity, but rising demand from water-hungry populations and economies have increased the precariousness of their water resource situations. Many of the world's cities large and small, notably in Latin America and Asia, face serious water shortage and water pollution crises. At the same time, the potential role of technology in solving these problems has come to be viewed more modestly, with equal if not more importance attached to the social, economic and environmental context in which technology is applied. Mighty engineering projects -- dams and barrages -- for capturing water flows and enhancing supplies have brought major economic benefits; however, they can also cause social disruption, environmental damage, and inter-state tensions between upstream and downstream users.

Water's special character as critical to life itself has granted it a special status in belief systems and in public policy. Freshwater sources have traditionally been regarded as something in which all members of the human community have rights. Where systems for water supply are the product of engineering and construction, they have usually been provided from the public or administrative purse. And the use of water in public health, agricultural and industrial contexts has typically been unregulated and charges made for it well below operational costs. Water management regimes which continue in this fashion present serious problems in an age of water stress. They encourage water profligacy and waste. And they generate too few resources for managing, and further investing in, water systems.

*Changing international perceptions*

Until the 1990s, international concern with water largely focused on three distinct areas: harnessing surface water supplies (and controlling floods) by construction of major engineering works; irrigated agriculture; and public health engineering for domestic supplies and sanitation. Water was seen as one essential input to the meeting of basic human needs and the expansion of economic activity, and was handled as a service provision component of infrastructural development on a sector-by-sector basis.

During the 1980s, the UN's International Drinking Water Supply and Sanitation Decade drew attention to the vast numbers of people in the world still without a safe and reliable supply of drinking water or a sanitary means of waste disposal, and prominently associated international water-related concern with meeting basic human needs and improving standards of public health. During the 1990s, the framework within which water has been considered internationally has significantly broadened. Since the 1992 Earth Summit, concerns about the entire freshwater resource, and the threats posed by competition over its multiplicity of uses, have been taken up under the environmental banner. However, this strengthens rather than detracts from the role of water resources and supplies in defeating poverty, ill-health and poor quality of life; environmental sustainability is today seen as closely linked to gains in human development.

The view that water must be seen holistically as one finite resource with many competing social and economic demands upon it, and that any system for its management must take into account the need to moderate these demands, has gained considerable ground since that time. Acceptance of this view lies behind the promotion of the river basin as the logical entity for water resource management. But whatever the entity or institution accorded responsibility, 'integrated water resources management' is an idea whose time has come.

Integrated water resources management is an attractive concept, but an extremely complex one to put into practice. It requires simultaneous and comprehensive consideration of everything to do with water: equilibrium of the eco-system; potential and actual freshwater supplies; potential and actual levels of pollution; forecasts of demand in the various productive economic sectors, and for household supplies; costs and benefits of schemes for supply augmentation; water laws and regulations; institutional arrangements for water-related service administration; and so on. River basin management cannot provide a ready-made first step in all settings since river basins rarely conform to existing administrative structures and, in the developing world, most major rivers additionally cross at least one and sometimes several political (state or national) boundaries.

Even where river basin management is practicable, mediating between the needs of different users -- farmers, householders, manufacturers, urban authorities, public health authorities, private water suppliers, waterway users, and the eco-system itself -- and deploying the resource in an equitable, efficient and sustainable way is bound to be an immensely difficult task. This is especially the case in developing countries whose immediate priorities are overwhelmingly to do with supply development and provision and whose resources -- human, financial, institutional -- are over-stretched.

Yet other new characteristics of the policy-making climate further complicate the picture. Several decades of development experience have shown that universal formulae for programmes and projects do not exist; and that the most useful international contribution to development is rather to help establish common principles, share best practice, and offer appropriate expertise, than to propose universalist prescriptions which fail to respect social, economic, environmental and political diversity. In water-related activity, where there are wide variations within and between regions concerning the resource, water-related priorities, technical and economic capacity, and existing levels of service development, the need for flexibility is paramount. At regional level, 'water diplomacy' is also needed to resolve trans-boundary disputes over riverine resources.

*Institutional challenges*

Even before concern began to be expressed about environmental stresses, a long list of outstanding challenges already existed in relation to water resources management and use in developing countries. Many of these challenges stemmed directly or indirectly from lack of financial resources and weak institutional incapacity. They included: failure to keep pace with service delivery needs for drinking water supplies and sanitation, especially in urban areas and among low-income communities; problems of salinisation and water-logging accompanying many major irrigation schemes; the inefficiency of many publicly-administered water authorities, and lack of participation by consumers and other stakeholders; lack of public health impact of many water-related schemes; failure of the authorities to charge realistic fees to cover operations and maintenance costs for services; investment in technologies inappropriate to the social and economic environment and therefore unsustainable; escalating costs; and declining development co-operation resources.

Stresses on freshwater enhance the importance of many of these issues since almost all in one way or another have a bearing on squandering or polluting the resource or failing to derive maximum benefit from it. To counteract these tendencies and underline the value of water, international fora have recently been calling for water to be regarded as an economic good with a realistic price-tag. But the notion of treating water as a commodity to be bought and sold, in whom the community and especially its poorer members might thereby lose their rights, cuts across deeply held beliefs and long-established ideologies in many parts of the world. Before such ideas can be accepted, confidence is needed that putting a price on water will ultimately facilitate fairer distribution of a scarce commodity, including to the poor.

Similarly, in the drive for efficiency, calls have been made for some devolution of responsibility to the private sector according to a range of possible models of partnership, and to other partners (NGOs, for example) by water authorities. A facilitating and regulatory, rather than a 'do-everything', role for public bodies is envisaged. But in countries where systems of regulation are embryonic or unenforceable, and where low-income consumers are often marginalised from mainstream political and economic life, water resource management may still need to be vested primarily in public bodies in order to achieve greater equity in service access, effective environmental controls, and genuine prospects of 'integrated management'. Again, flexibility is vital. Monetising or commercialising water cannot be seen as a universal panacea, any more than technology transfer or other types of generic 'fix'. The model for new-style water management regimes needs to be adaptable to widely diverse physical, economic, and socio-cultural circumstances.

The call for integrated water resources management has also pointed up the very dispersed system of service administration which characterises current regimes. Responsibilities for the construction of installations -- dams, drains, sewerage systems, treatment plants, basic services -- and for their operation and maintenance, are distributed around a variety of administrative departments. There is no such thing as a 'water sector' although the term is often misleadingly used. Water-related activities are positioned within specific sectors and managed by sector-based institutions. Their priorities are not associated with the resource itself, but with sectoral concerns such as irrigated crop yield or disease control. All sectoral strands need to be brought together within a cross-cutting framework. But because water pervades social and economic life, this cannot be done by consolidation. Co-ordination across sectors, taking into account the total environmental picture, is the key.

New water management regimes which face these many challenges comprehensively and systematically are clearly needed. The core principles governing such regimes have been reiterated in various international fora, since the 1992 Earth Summit; but their translation into policy development and programming processes has been slow to follow. It is for this reason that the recent work undertaken by European Commission Directorates-General IB (External Relations) and VIII (Development) in developing new Guidelines for European Commission development co-operation in water is timely.

The centrepiece of the new European Commission Guidelines is "**a strategic approach for the equitable, efficient and sustainable management of water resources**". This approach is deeply grounded in recent international thinking and takes as its starting point the need to find ways whereby the multiplicity of 'old' and 'new' issues surrounding integrated water resource management and service delivery can be systematically addressed within programme and project activity. It also gives due priority to the three 'horizontal guiding principles' -- institutional development, gender equity and environmental protection -- set out in the policy guidelines for relations with ACP countries proposed for the follow-up agreement to Lome IV[1].

The evolution of the approach comes at a time when, following the call by UNGASS, UN donors and their partners are themselves advancing down the path of articulating a common strategic approach and programme of action. In the hope that there may well be a convergence between the approach sought by UNGASS, and that in the process of being articulated by the European Commission, this paper sets out the European Commission's proposed approach in summary form.

---

[1] See Communication to the Council and the European Parliament on Policy Guidelines for future EU-ACP Relations, 29 October 1997.

## II. The strategic approach: guiding principles

The hallmark of new international thinking about water is the need to view the resource holistically. Nonetheless, it is essential to disaggregate component parts of what is to be done in order to make the task of planning and carrying out water-related activity manageable. The strategic approach now being developed by the European Commission is based on sets of **Guiding Principles** for water-related decision-making; a division of programmatic activity into **Focus Areas** in which these principles are to be systematically applied; and a framework for applying principles to activities within Focus Areas at appropriate stages of the programming process. (Application of the strategic approach is covered in part III.)

The **guiding principles** should be seen as a next generation of principles based on core principles already discussed in a number of international fora (q.v. Dublin 1992, Rio de Janeiro 1992, Noordwijk 1994, New York 1997). Consensus has developed around these core principles[2] -- a consensus in which EU member states concur. Although the process of discussion continues and ideas evolve, the European Commission's strategic approach is based on the assumption that these core principles are unlikely to change in the near future.

The problem with these principles from the field perspective is that they are remote from practitioner realities and offer no guidance for resolving dilemmas confronted during the process of programme activity. To aid intellectual management of the principles and provide a framework for their practical application, the European Commission's strategic approach has elaborated sub-sets of principles under the following headings: **institutional and management principles**; **social principles**; **economic and financial principles**; **environmental principles**; **information, education and communications principles**; and **technological principles**. Many principles and categories are inter-related.

The compartmentalisation of principles into groups broadens the framework within which water-related policy can be addressed in an organised fashion. It also allows concerns outside the immediate programming and project environment to be taken into account -- concerns such as sustainability of the resource over the long term, protection of water-dependent eco-systems, and sustainability of service. Activities at the macro-level (development of integrated water management regimes, water policies, legislation, institutional change) and at the micro-level (user group participation, community-level operation and maintenance) are given more weight for the purposes of programming than in the past. Technological issues and construction, which previously dominated programme formats, are regarded as one set of important considerations among many.

---

[2] The paper assumes that these core principles are familiar to the reader; but for reference purposes, see The Dublin Statement and Report of the International Conference on Water and the Environment: Development Issues for the 21st Century, January 1992, Ireland.

Although compartmentalised, the principles are cross-cutting and universal, applicable to all types and aspects of water-related activities -- from surveys, to human resources development, to construction of installations -- whatever their physical, social or economic setting. Such principles should be seen as the bedrock of the European Commission's strategic approach. Their application is supposed to aid clear thinking about objectives and actions at all stages of the programming process.

A full exposition of the policy principles is too long to present in a summary paper; instead they are synopsised below.

### *A. Institutional and management principles*

This group of principles concerns all the key issues relating to the role of government and public or private sector agencies in establishing the institutional, management, legal and regulatory framework for water-related policy and practice. Since national policy development is the starting point for everything else, including institutional responsibilities and capacity-building, this group of principles is placed first. 'Integrated water resources management' can only begin to be put into effect if it is established by national policy, along with the necessary co-ordinating structures between sectors and other institutional arrangements.

The principles emphasise the need for government to move towards becoming a facilitator and regulator, rather than the exclusive provider of services; the need to establish participatory mechanisms to bring all stakeholders into the institutional and management picture, including the private sector and NGOs; the need to improve the knowledge base and expand capacity in all contexts and among all concerned institutions; and the need for both flexibility and accountability to build confidence in the system.

The following are the principles in this group:

***1 Roles of government and official bodies at all levels should be defined and areas of responsibility clearly established***

***2 Involvement of the private sector should be encouraged***

***3 The structures and systems of management should be designed in such a way as to facilitate the participation of different stakeholders***

***4 Ongoing capacity-building is needed within institutions and for participant groups at all levels***

***5 Management systems should be transparent and accountable and appropriate management information systems should be established***

### *B. Social principles*

This group of principles concerns the over-riding need to meet humanity's basic requirements of water and sanitation for the support of life and health, and to do so in ways that respect existing community values and livelihood strategies. Because of water's fundamental role in human survival and well-being, and in farming systems, certain key social principles which support poverty reduction, quality of life and equity considerations, need to be taken into account in the conceptualisation and planning of activities. Many past basic water supply schemes and environmental sanitation programmes have failed to produce public health and other intended benefits because social considerations and cultural values were ignored.

The principles also emphasise the role of users of water supply and waste disposal services in service management, especially in the case of basic services among low-income communities. These facilities tend to be dispersed and free-standing, and without the participation through community mechanisms of their users, sustained operation and maintenance cannot be assured. The central role of women in the provision, management and husbandry of water, especially in the household context including family food production, also needs to be recognised; without women's full participation, services cannot be equitably managed, nor are they likely to yield looked-for benefits in terms of improved family well-being.

The principles in this group are as follows:

> ***1 A sufficient supply of water and an adequate means of waste disposal are basic human needs to which everyone should have access***
> ***2 Users have an important role to play and user group involvement should be fostered via a participatory approach***
> ***3 Gender implications should be examined and taken into account at all stages of the planning and implementation process***

### *C. Economic and financial principles*

This group of principles concerns the many issues stemming from the new importance attached to the idea that water is a precious commodity and its economic value should be recognised in the way that it is managed. In order to avoid the implication that the new sense of its economic value should over-ride the social imperative of providing a basic supply of safe water to every human being, the principles suggest that high-value uses -- such as public health -- should be distinguished from low-value uses -- such as recreation and leisure. Thus, in situations of scarcity, water resources can be re-allocated to high-value uses.

The principles emphasise, therefore, the need to maximise the usage of given volumes of water by 'demand management': curbing inessential or low-value uses through price or non-price measures. In countries where supply-led solutions (indefinite expansion of services without regard for over-consumption of the resource) have been the norm up to now, political support will be needed for the new approach. Water tariffs (and other charges, for example for pollution) are an important component of any strategy for the sustainability of services; this principle needs to be recognised although the way it is acted upon needs to take into account other principles, especially social principles, equity considerations, and high-and low-value water uses.

The following are the principles in this group:

> ***1 Water has an economic value and should be recognised as an economic good***
> ***2 'Demand management' should be used in conjunction with supply provision***
> ***3 Charging tariffs for water services is an important component of any strategy for sustainability***

***D. Environmental principles***

This group of principles underlines the new realisation that all water-related activities should be planned and implemented with due regard for their environmental implications. In the past, programmes and projects requiring the disruption of water flows or other modifications of the natural environment have given inadequate attention to their potential effects on aquatic eco-systems, grazing lands, wetlands, and the natural environment generally. Their environmental impacts should be systematically assessed and factored into the range of considerations governing the decision-making process. Environmental costs should form part of the overall economic and financial analysis.

The principles also cover the need to protect aquifers from pollution and over-exploitation and to avoid the use of fossil groundwater. The fact that the eco-system itself has a need for water is underlined; and the need to respect the 'in-stream' value of water where it is used for fisheries, recreation, transport, and the maintenance of environmental well-being. Environmental impacts of water-related activities need to be monitored, alongside changing patterns of land use which may affect water flows or soil quality and other areas of environmental resource management.

The environmental principles are as follows:

> ***1 Water-related activity should aim to enhance or to cause least effect on the natural environment and its health and life-giving properties***
> ***2 The allocation and consumption of water for environmental purposes should be recognised and given appropriate emphasis***
> ***3 Environmental change should be monitored so that improvements can be encouraged and detrimental impacts controlled***

### *E. Information, education and communications principles*

This group of principles has been identified to underscore the importance attached to information, education and communications (IEC) as critical components of 'integrated water resources management'. A well-developed knowledge base is regarded as essential for any effective water resources management regime, and the need to improve data collection systems and carry out appropriate surveys and studies is underlined.

The IEC principles also register the need for education as a vital component of water and sanitation basic services schemes, especially where the population is poorly educated. Users in low-income communities tend to welcome services for their survival, convenience and livelihood benefits without understanding the linkages between unsafe water, inadequate excreta disposal and disease; lack of hygienic usage means that public health impacts can be disappointing. Awareness-building at every level is needed to combat prevailing complacency regarding the state of water supplies and efficacy of water-related policies.

IEC principles are as follows:

***1 A sound information and knowledge base is needed for effective actions within all water-related activities***

***2 Education is a vital component of water-related schemes if health and life enhancement benefits are to be achieved and sustained***

***3 Communication and awareness-building are an essential ingredient in all forms of water resources development***

### *F. Technological principles*

This group of principles covers technological issues, underlining the need for balanced attention to 'hardware' and 'software' considerations. Technological innovation and adaptation is critical to the system improvements urgently needed to maximise use of the resource, and to equitable spread of services. Choice of technology often determines costs. There has been far too much tendency in the past to end up in a cycle of 'build, neglect, rebuild' because too little thought has been given to maintenance and sustainability.

A common problem in many infrastructure projects has been the importation of technology unsuited to the physical, economic and social conditions in which the system is located. The desired approach is summarised by the term 'appropriate modern technology', indicating that whether the technology selected is high-tech or low-tech, it should be the most up-to-date and cost-effective available. Use of 'clean' technologies to reduce waste disposal problems is favoured, as is the use of upgrading technologies that permit staged development. These can be developed on the basis of indigenous technologies, and on scaled-down versions of more elaborate systems.

The technological principles are as follows:

***1 A balanced approach towards 'hardware' and 'software' components of projects should be adopted***
***2 Choice of technology should be governed by considerations of its efficiency, appropriateness, cost, and suitability for local conditions***

## III. The strategic approach: application

There are two frameworks for the application of guiding principles in water-related activity, according to the European Commission strategic approach. One answers the question "To what?"; the other answers the question "When?" (Some answers to the question "How? are provided in IV, **Implications for action**.)

The first framework, which the European Commission regards as an important and original contribution to water-related work, is the grouping of programme-related activity, including studies and assessments, into four **Focus Areas**. These Focus Areas accommodate sectoral responsibilities but are not delineated by them; they allow programmatic activity with similar technological, socio-economic and administrative characteristics to be addressed in tandem.

One other framework is needed: a framework which indicates when and in what order to apply the elements of the Approach. This is described as the **programme process** framework.

### i) Focus Areas

The term 'Focus Areas' has been used for the proposed grouping of programme-related activity in keeping with terminology adopted in Agenda 21. The Focus Areas are as follows: **Water resources assessment and planning**; **Basic water supply and sanitation services**; **Municipal water and wastewater services**; and **Agricultural water use and management**. More detailed descriptions are provided below.

The organisation of programme activity represented by the four Focus Areas aims to accomplish a number of objectives. First, it reflects the broader range of activity necessitated by the new thinking about water. Second, it allows programme activities with similar social, economic and technological characteristics to be grouped together: **Basic water supply and sanitation services**, for example, includes both rural and poor urban settings where small-scale, differentiated installations managed and operated on a local basis are likely to be the norm. Third, it allows the integration of major works for drinking water supplies with those for wastewater management and sewerage. And finally, it transcends technical categories such as 'irrigation' in favour of larger concepts such as **Agricultural water use and management**, which includes land-water management and environmental protection.

The application of principles to the Focus Areas is intended to be carried out in such a way that all principles are applied in all contexts. This should pre-empt the possibility that any one Focus Area could be treated in isolation from any other; work directed towards provision of basic water supplies, for example, cannot omit to consider agricultural water management activity, or vice versa. The grouping of activities is intended to assist the organisation of practical action; it should not detract from the need to view water holistically and integrate management across activities and sectors.

The Focus Areas offer a framework broadly matched to sectors, although not precisely. The variety of administrative arrangements for water-related activity, both between sectors and at different levels of national, local and municipal authority, makes it easier to distinguish between categories of activity than classify water activity by sector. Even in countries where there is a separate Ministry of Water Resources, water-related policy will need to be examined in relation to, and integrated with, the work of other sectors and administrative departments: industry, agriculture, or public health for example. The concept of Focus Areas for programming activity suggests, but does not prescribe, the most appropriate administrative aegis for any given programme or project.

**Focus Area 1: Water resources assessment and planning**

The lack of an integrated approach to the management of water resources has led in the past to isolated investments in water-related activity, some of which have inadvertently resulted in negative consequences on other users or on the environment. This Focus Area is designed to allow for special attention to be given to macro-planning of water resources management, giving due respect to its environmental importance.

The particular character of water makes it extremely complex to manage. Rivers often originate outside national and state boundaries; even where there are no trans-boundary problems, river basins rarely correspond to existing internal administrative boundaries. Similarly, groundwater extraction does not occur tidily: its beneath- and above-ground impacts are not administratively convenient. There are other geo-political anomalies associated with the resource and its situation vis a vis human settlements; for example, water use is closely linked to land use, and freshwater outflows can have significant impact on a coastal zone.

Activities within this Focus Area are therefore mainly associated with the development of a co-ordinated strategy on the use of water resources, at national level but also as part of regional, district and area development plans. Uses to be considered include non-consumptive uses such as flood control, hydropower and navigation. An overall perspective is envisaged which takes in protection of the environment and ecological needs, and sets limits for activities which may otherwise neglect the broader view.

The types of projects (studies) which fall into this category include support for policy or strategy development, institutional strengthening including the improvement of organisational structures, hydrological assessment and establishing management information systems. Issues to be addressed include: policy and legislation regarding ground and surface water, trans-boundary planning and negotiation, river basin planning and management (including the interaction between water and land use), environmental protection and conservation, distribution of responsibilities for management of the resource and management of water-related installations within the framework of public services reforms, regulation of service providers both public and private, the systematic co-ordination of, and conflict resolution between, sectors involved in water use, and between the many actors and partners involved in water-related activity -- public bodies, private companies, donors and NGOs.

**Focus Area 2: Basic water supply and sanitation services**

This Focus Area covers the extension and management of basic water supply and sanitation services, especially to low-income communities. These usually consist of low-technology, community managed schemes, in which local and municipal authorities play a facilitating and/or supervisory role. Sanitation services, in the form of household latrine installations, are frequently neglected in comparison to basic water supplies, and targeted effort is needed to promote both demand and supply.

Basic services in both rural areas and poor urban areas are included. Poor urban areas have previously suffered from serious water- and waste-related neglect. The major public works with which municipal authorities are pre-occupied rarely provide service outreach to slum and shantytown areas. As a population group, the urban poor is the fastest growing in the world and their crowded and insanitary habitat poses high risks to their own health as well as risks of spreading epidemic disease to other neighbourhoods. Sanitary excreta disposal is particularly important.

Basic services providing drinking water and human waste disposal in poor communities, whether rural or urban, are different in concept from conventional mains connections and standard sewerage and drainage. They usually consist of low-technology installations: for water supply, handpump-tubewells, rainwater catchment tanks, gravity flow from capped springs and small dams; for human waste disposal, pit latrines, and where practicable, modified sewerage systems and septic tanks.

Most such systems are much cheaper to install than standard public health engineering; but they are unconnected to a central operating system. Thus, their operation and maintenance requires very different arrangements from centrally-run systems, as does any system of charges to customers. The importance of gaining community participation and ownership to ensure O&M and cost recovery has recently led to innovatory approaches, often with close participation from NGOs. This Focus Area therefore covers schemes which have these common technological, management, financing, social and economic characteristics, and can profit from the body of recent experience associated with such schemes.

**Focus Area 3: Municipal water and wastewater services**

This Focus Area covers major water-related activities undertaken within the municipal area, usually under the auspices of municipal authorities. Although these authorities have a role, if only a regulatory one, in basic services for low-income urban areas covered in the previous Focus Area, their main area of concern will be with capital-intensive, high-technology type of programmes and projects. They will also be responsible for operations and maintenance of existing mains water supplies, sewerage and wastewater treatment systems, and for setting and collecting user dues.

Programmes and projects in the Focus Area therefore include water supplies, sewerage and drainage, and pollution control for a range of industrial and domestic consumers. Given the rapid rate of urbanisation in developing countries, one area of concentration will be the development of additional water sources; although currently these may be given less emphasis than schemes for rehabilitation and repair of existing systems to increase water savings and efficiency. Water quality, wastewater treatment, and control of upstream and downstream pollution will also be a focus in many countries. Cost recovery, regulation and demand management will be key elements of programme and project design.

Institutional responsibilities of public bodies and their systems of management are likely to come under scrutiny, with attention given to increasing the involvement by private sector companies in the management of services, recognising that the form of this involvement will vary according to prevailing circumstances especially the state of development and degree of regulation enjoyed by the private commercial sector. Many activities are likely to address efficiency savings, pollution charges, and tariff reforms, some of which are bound to confront vested interests of powerful and articulate stakeholders. Sophisticated and costly schemes may be indicated; but all potential solutions will need to be tested against efficiency and 'appropriateness' criteria.

**Focus Area 4: Agricultural water use and management**

In many developing countries, agricultural water use and management is virtually synonymous with irrigation: dams and other measures for water catchment, the efficient use of water in agriculture, and the prevention of soil erosion, are the principal water-related activities. Food security is closely linked to water resource availability, and many countries are interested in expanding their cultivable areas due to population pressure.

This Focus Area is intended to cover schemes relating to agricultural water use and management at all levels, from small-scale, community-based schemes to large-scale formal schemes requiring sophisticated engineering. Irrigated agriculture is a complex activity, and the water volumes and flows it necessitates cannot be addressed in isolation from questions relating to land use, cultivation methods, and such environmentally significant issues as water-logging and salinity, and public health.

As competition between water users increases, there will be pressure to reduce the volumes absorbed by irrigation, at least for crops of relatively low social and economic value. At the same time, demand for foodstuffs and higher agricultural yields will continue to rise. Thus the challenge is raise crop production while consuming less water and operating within a more restrictive financial and economic regime. Measures to reduce water consumption, achieve cost recovery and manage demand are therefore important concerns in this Focus Area. The need for re-orienting or restructuring Government agencies involved in agricultural water use and management is likely to be a major issue, as is the involvement of the private sector, and the role in management and financing of water user groups and farmers associations.

Many community development programmes which include small livestock development, horticulture, and manufacture of food or craft products necessarily include water-related components. Irrigated agriculture is often regarded as a motor for rural development, and often includes non-water components such as feeder roads, electrification, and schools construction. All such projects -- as far as their water-related components are concerned -- fall into this Focus Area, as do those for prevention of desertification, water harvesting, soil erosion control and flood control of agricultural land.

**ii) The programme process**

In order to be in a position to apply the guiding principles systematically, a framework is needed which provides the user with a guide to the application of the principles at different stages in the programme process. Partners in development -- donors, government authorities, NGOs, and other stakeholders -- have a responsibility to build into a scheme, service or study maximum potential for its outcome to be equitable, efficient, and sustainable. There are different issues to be raised, questions to be asked and possible responses to make at different stages. All projects and programmes, at least theoretically, contribute to a larger development process and need to be analysed and assessed accordingly.

Within European Commission development co-operation, a programme process known as Project Cycle Management is used which defines specific stages of project development, funding and evaluation. Therefore, the European Commission Guidelines for co-operation in water pre-suppose that users will be operating within this framework. However, the approach is adaptable to any phased process of planning, preparation, implementation and evaluation of activities. The stages identified in Project Cycle Management fall broadly into these categories.

The application of the strategic approach therefore envisages that a systematic analytic exercise will take place at all stages of the programme process. A large number of issues need to be raised at the planning and preparation stages; others are appropriate during implementation or evaluation. The European Commission Guidelines therefore sets out checklists of questions under given principles, and possible responses to those questions, for all stages of the programme process, across all Focus Areas.

At the initial programming stage, the key issue envisaged is the selection of Focus Areas in which activity is to be undertaken. As individual activities (or projects) are devised for the various Focus Areas, critical issues of viability, management, appropriateness, public demand, and environmental impact arise. At the planning and preparation stage, the issues which need to be addressed vary significantly according to Focus Area. However, once the implementation and evaluation phases are reached, the issues and possible responses become similar in all Focus Areas.

The European Commission's strategic approach is not a prescriptive system, applied uniformly. The checklists provided for use act as pointers. Each situation, each set of problems faced in any given Focus Area, at any given stage in the programme process, is subject to so many variables that to produce a definitive set of problems and responses would be inappropriate. The emphasis instead is to facilitate an open and flexible programme process in which sensitivity to changing trends, local economic, social and environmental circumstance, and inputs derived from stakeholder and user participation, can be reflected. The approach is intended to provide managers and operators with the means of identifying within the considerable array of potential problems and issues those which are of key importance to the effectiveness of a given scheme, and to identify the appropriate responses quickly and smoothly. Thus by a systematic process of problem identification and solution in all areas and phases of the programming process, maximum benefits of the scheme can be achieved and sustained.

## IV. The strategic approach: implications for action

The adoption of the strategic approach leads to decisions concerning actions. These actions will usually be carried out by governments, often with the support of donors; but many actions will require partnership approaches, in which government agencies, the private sector, NGOs, community-based organisations, research organisations, and international, bilateral or NGO donors all have a part to play. The building of partnerships is an inherent characteristic of the strategic approach, and one of its modalities.

The application of the strategic approach, as already explained, entails identifying problem areas and appropriate responses at every stage of the programme process. During the course of developing checklists for this purpose, a number of commonly repeated core activities emerged. It became clear that the successful application of the strategic approach requires that these activities need to be given a high priority. Many are cross-cutting, both with regard to the guiding principles and between Focus Areas; almost all relate in some way to management and institutional strengthening and/or redirection.

It is fashionable to distinguish between the 'hardware' -- technological, construction and engineering -- components of water-related programmes, and 'software': information gathering, partnership development, capacity-building, health education, social mobilisation and so on. In fact, 'hardware' and 'software' are interlinked, and it is a feature of 'integrated management' systems that they should not be separate aspects of programmes, undertaken by separate specialists in separate domains. All the themes for action described below are 'software' themes. But it is worth noting that almost all water-related programmes (except in Water Resources Assessment and Planning) include engineering of some kind, and that 'hardware' will almost certainly continue to consume the lion's share of water-related investment.

The core activities identified below can therefore be seen as antidotes to over-confidence in technologically-driven responses, not as a substitute for investment in installations. Their purpose is to make the design, management and sustainability of constructed installations more cost-effective and efficient. They may be carried out in the context of traditional infrastructural projects; alternatively, special 'software' activities may be undertaken as special exercises. They have been grouped under six themes as follows:

- institutional development and capacity-building;
- participatory structures and gender equity;
- natural resource management;
- expansion of the knowledge base;
- demand management and pricing;
- awareness-building and communications.

**1. Institutional development and capacity-building**

The success of policies, programmes and services depends heavily on the resources, skills and technical expertise of the responsible institutions. These bodies need to be appropriately structured and provided with a legislative and administrative framework which favours efficiency. Devolution of some part of service delivery to the private sector may be one appropriate form of institutional development, along with the establishment of a suitable regulatory framework and implementation mechanisms. Capacity-building is the process of institutional upgrading, usually by means of human resources development and training, which facilitates the effective operation of programmes or services. The process should be continuous, and applies as much to formal bodies as informal bodies, such as community groups.

Actions include:
- policy review and reformulation to meet requirements for 'integrated water resources management';
- review of existing laws and customary practices related to water, with a view to establishing a rational legal regime and enforcement mechanisms, including over private sector service providers;
- establishment of mechanisms for inter-sectoral liaison and co-ordination, to ensure equitable allocation between competing users;
- advocating/supporting the reorientation of public water authorities towards adopting a facilitating and regulatory rather than a 'do everything' role;
- introduction of concepts and techniques associated with up-to-date thinking, such as environmental assessment, stakeholder analysis, participatory appraisal, etc.

- setting up of river basin organisations where appropriate;
- setting up, or strengthening where they exist, transboundary organisations to settle issues arising from the use of waters from shared rivers/river basins; regional co-operation in this context;
- training of managers (and trainers for lower administrative tiers) to undertake water resources management rather than service delivery; provide support for facilitating mechanisms, consultative committees, and information activity;
- help in establishing community-level bodies, including user associations and local authority water committees, to play a role in the installation, management and maintenance of local facilities.

**2. Building participatory structures and gender equity**

Participation by stakeholders in a given programme or activity is not only desirable as a matter of democratic right, but to ensure that investments of money and resources correspond to demand for services, and to enable those services to be equitably managed in the interests of all. A participatory process allows stakeholders to take part in decision-making relating to policies and actions undertaken by formal bodies on their behalf, whereby they also accept a degree of responsibility for those decisions. Thus, mechanisms for the expressions of stakeholders' views, especially those of users, and -- especially in basic services schemes -- for their managerial contributions are needed. Within participatory management structures, the role of women in household water and food security needs to be recognised, and special attention paid to involving them at all decision-making levels.

Actions include:
- establishment of user groups, farmers associations, water and sanitation committees, and other expressions of civil society to participate in water resources management at local level; ensure that there are female as well as male members, and that they play a full part in decision-making;
- provision of funds and networking support for NGOs involved at local level in community water and sanitation service schemes and small-scale irrigation; include a wide range of NGOs, including women's groups, market associations, co-operatives and teachers' groups which may be needy or influential in some way related to water;
- leadership training for functionaries at the lower tiers of responsibility for water-related public health and community development schemes; training of trainers employed by government and NGOs;
- gender-awareness training for personnel at all levels; build women's participation into institutional structures where possible, by gender-sensitive recruitment and promotion;
- research activities targeted on meeting needs and demands of poorest users, ensuring that they have the opportunity to express their views and equitable access to service provision;

- basic education and technical training at the lowest stakeholder levels so as to develop demand for health- and livelihood-promoting water and sanitation services and participation in management;
- micro-project funds to enable community-based organisations and small NGOs to undertake local clean-up campaigns, establish artisanal enterprises and build small community installations (e.g. public latrines);
- surveys of local indigenous water management techniques and enterprises; develop ways to build on and legitimise sound local practice.

### 3. Natural resource management

The protection of the eco-system and the natural resources upon which all forms of life on earth are dependent should be regarded as a national and global obligation. Water, as a key natural resource, is a strategic national asset and all policies related to it should be consistent and comply with environmental protection aims. Activities in this context have not, in the past, been given priority; since the 1992 Earth Summit, they are beginning to be given their due.

Actions include:
- advocacy on behalf of water as an essential natural resource, whose potential for scarcity and/or pollution, and therefore whose value, needs to be appreciated; advocacy of policies and pricing regimes that discourage water wastage and pollution;
- introduction of environmental assessment practices through training and incentives; establishment of environmental data collection and monitoring procedures to ensure compliance with regulations;
- investments in environmental protection of vulnerable areas such as wetlands, coastal zones and fisheries, marginal farming lands, deserts, and areas vulnerable to flooding and/or soil erosion;
- promotion of irrigation policies and schemes which emphasise water savings, and give equivalent importance to wastewater disposal and treatment and agricultural drainage as to supply provision;
- provide support for measures which prevent or reduce environmental pollution by excreta-related bacteria or chemical contamination; couple environmental sanitation and pollution control to water supplies provision;
- promotion of clean technology to prevent pollution, reduce water consumption and encourage recycling;
- training and material support to strengthen environmental agencies; support their role as watchdog to ensure that 'polluters pay';
- research studies into the needs of aquatic eco-systems;
- environmental impact assessments to measure the potential or actual effects of water-related projects on the eco-system;
- awareness-raising campaigns to educate government officials, professionals, communities and NGOs on the importance of natural resource management; ensure the incorporation of water-related environmental issues into education curricula.

### 4. Expansion of the knowledge base

Water resources development and management and delivery of water-related services can only be carried out effectively on the basis of real knowledge and information, including:

- Knowledge of water resources availability: surface and groundwater,
- Information on water quality and its impact on users and the environment,
- Knowledge of water and water-related demands and needs of households, of different productive sectors, and of society as a whole;
- Water requirements of the eco-system, including the aquatic eco-system;
- Knowledge of the good, bad or indifferent performance of water-related services, and their costs relative to water values.

Actions include:

- supply of equipment, instruments and training in hydrological, hydrometric and hydrogeological data collection, storage and analysis;
- surveys of water and wastewater service usage and potential demands, including willingness-to-pay and knowledge-attitude-practice surveys among potential users; capacity-building in conducting the surveys;
- equipment and training for baseline studies into ecological needs and for monitoring ongoing changes in the water-related environment;
- promotion of water quality testing, including provision of laboratory equipment and training; the establishment of local water quality standards;
- mechanisms for sharing information between different administrative levels and between sectors, agencies and stakeholders involved in water resources management; advocacy and support for the principle of information-sharing via newsletters, seminars, etc.;
- establishment of monitoring and evaluation systems for water-related programmes and services in all sectors.

### 5. Demand management and pricing

Demand management of water resources is the alternative to indefinite expansion of supplies -- a policy option not available in countries or regions facing implacable hydrological limits. Demand management implies some form of water pricing which, above a basic subsistence supply, is correlated with high and low water values, creating conditions in which the available supply is more efficiently used. The implication of demand management is that maximum use is made of existing services and systems, and the cycle of 'build, neglect, rebuild' is broken. Actions under this theme are closely inter-linked with those relating to institutional development and capacity-building, as well as with advocacy for a better understanding of water's importance as an environmental resource.

Actions include:

- advocacy and awareness-building activities to create the necessary political climate to accept the principle that water is an economic good and -- at levels above subsistence -- should be subject to realistic pricing;

- studies and surveys to assess demand and willingness-to pay; support for the introduction of tariff reform and appropriate pricing regimes;
- feasibility studies to determine the system and levels of charges needed for financial viability;
- campaigns to reduce pollution and enable regulations to be introduced to penalise and fine polluters;
- the establishment of a regulatory framework to monitor prices set by service providers (including autonomous public sector agencies) and protect the poor from exploitation;
- advocacy of reduction of subsidies, except where equity considerations justify service provision to low-income communities and other clearly identifiable 'public good' considerations;
- introduction of the concept of demand management to agricultural irrigation, and development of system of water charges for users;
- promotion of economic analysis, including environmental economic analysis, ensuring that criteria of financial viability reflect true values of the resource and its amenity, environmental and health benefits;
- introduction of water saving technologies, leakage control, rehabilitation and repair of existing systems.

**6. Awareness-building and communications**

Building political and public awareness of the need to value water as an economic good, so that available scarce resources can be equitably shared and efficiently managed, is very important. This is especially the case in countries where large numbers of people are without adequate supplies, and where there has been a political tradition of promoting free or heavily subsidised services and systems. The point needs to be put across that indefinite expansion of highly subsided services tends to enhance, rather than reduce, inequities because it leads to wastage. The role of communications for advocacy, and within programmes and projects as a pre-condition of successful implementation, is now widely recognised. Communications techniques and methods of all kinds should be used to build awareness, provide two-way channels between users, suppliers, and other stakeholders. Without good communications, the development and performance of strong participatory structures is likely to remain elusive.

Actions include:

- workshops, seminars and 'events' which offer opportunities to promote the concept of water as a valuable resource, which must be carefully and equitably managed, to political leaders and senior administrators;
- social mobilisation, involving all types of stakeholders, all sectors and all levels of administration, in action to improve sanitation and public health, including the use of publicly-declared national 'Days' and 'Weeks';
- introduction of environmental and water-related components into education curricula in both primary and secondary schools; programmes of sanitation and hygiene education in schools to support awareness-building;

- educational campaigns on sanitary behaviour, water storage and use, directed at the public, especially women; campaigns directed at men to enhance respect for women's role in household water management;
- studies into existing knowledge, attitudes and practice regarding water collection, use and management and waste disposal, as a preliminary to hygiene education efforts at community level;
- production of communications aids, and the use of TV, radio, advertising and other media for communication of public health messages;
- exchange of experience, project models and best practice among managers and operators in different countries and localities, by visits, newsletters and other means;
- fostering inter-state and inter-country collaborative mechanisms where a river basin is shared and there are potential tensions over water usage.

# WATER AND TECHNOLOGY

## BACKGROUND PAPER FOR THE CSD EXPERT GROUP MEETING ON FRESHWATER MANAGEMENT

**HARARE, ZIMBABWE**
**27 - 30 JANUARY, 1998**

INTERNATIONAL ENVIRONMENTAL
TECHNOLOGY CENTRE (IETC),
UNITED NATIONS ENVIRONMENT
PROGRAM
OSAKA, JAPAN.

JANUARY 15, 1998

# WATER AND TECHNOLOGY

## TABLE OF CONTENTS

# 1.0 INTRODUCTION

This background paper has been prepared by the International Environmental Technology Centre (IETC) of the United Nations Environment Program (UNEP) for consideration at the CSD Expert Group Meeting on Freshwater Management in Harare, Zimbabwe, January 27-30, 1998.

The paper provides a brief overview of some important policy considerations related to water and technology. It then reviews current trends and future challenges in developing environmentally sound technologies for managing freshwater resources and facilitating their adoption and use.

IETC is particularly interested in the application of environmentally sound technologies which consider social and cultural values, as well as opportunities to utilize endogenous approaches. An overview of water and environmentally sound technologies is available on the aESTro database administered by IETC/UNEP. Readers can obtain more information by contacting the IETC in Osaka, Japan (http://www.unep.or.jp).

# 2.0 POLICY CONSIDERATIONS

Throughout the world, over a billion people lack access to adequate supplies of water , and close to two billion people suffer from the consequences of poor sanitation; millions of people, especially children, die each year from contaminated water.

Water is a collective good and a social necessity. Its market continues to be shaped by politics. It is virtually impossible to isolate water issues from the broader issues of public policy. Furthermore, it is difficult to produce either a market or a regulatory system that can allocate water rights with efficiency and equity.

Governments have a continuing interest in ensuring that water resources are available for the benefit of their constituencies. They must balance the often competing interests for present and future supplies, while maintaining a system which will ensure an adequate flow and quality of water for society in a sustainable manner.

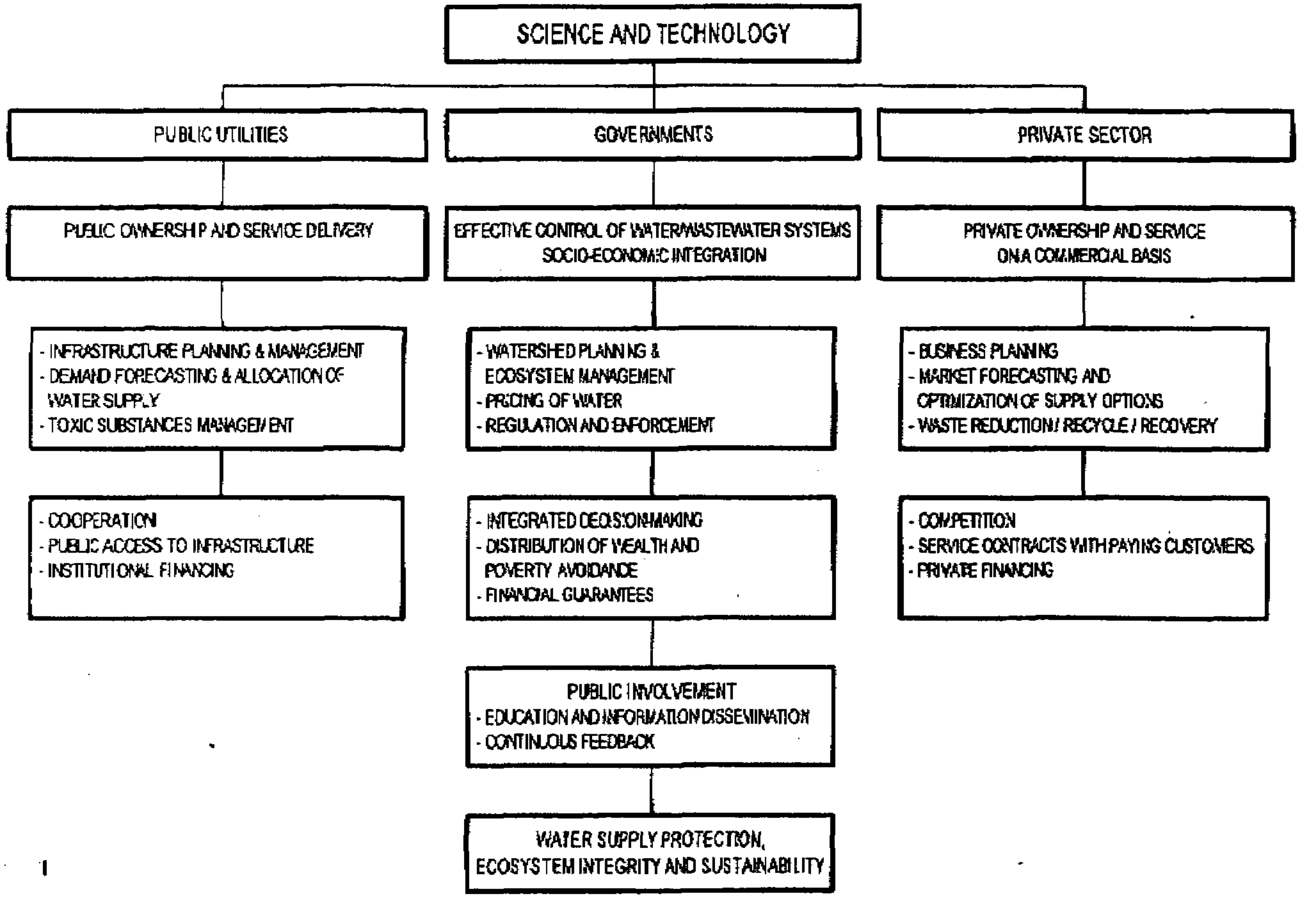
Public utilities and the private sector both play important roles in the provision of water sector products and services, including the design, construction and operation of facilities and associated infrastructure.

Public involvement and support are essential to success in the preservation of water resources, the development of water-related capital works projects and the maintenance of associated infrastructure. It is better to involve and educate the public as part of an integrated decision making process, rather than wait for a disaster or system failure.

The inter-relationships amongst stakeholders within the water sector are summarized in Figure 1. Science and technology, appropriately utilized, serve to guide sound decision-making.

FIGURE 1

WATER AND TECHNOLOGY: WORKING TOWARDS SUSTAINABILITY



## 2.1 INTEGRATED SYSTEMS MANAGEMENT AND CAPACITY BUILDING

Physical and political constraints in the management of water supply and disposal make regional planning and policy processes essential. This is particularly important where fragmentation of water management responsibilities exists among a host of government agencies and where competition exists among users for unappropriated surface water and groundwater supplies.

The development of water solutions and the alleviation of poverty requires the mobilization of financial and human resources. In some cases, international financial assistance may be necessary; however, the effective deployment of these resources requires the capacity to understand local needs and assess technological options. Where such capacity is lacking, education, training and institutional development should be structured in a manner which is strategically linked to higher level organizational and societal goals.

While the approaches to capacity development vary, the following characteristics are shared:

- an understanding of the context in which capacity development occurs, including the political, social and cultural processes which are often different than those prescribed by the donor organizations
- participation by stakeholders at all levels of planning, implementation and evaluation, taking into account the dynamics among various stakeholders and interrelationships between projects, programs and organizations.
- local commitment and control, incorporating an iterative approach which is responsive to changing needs and perceptions; greater sharing of responsibilities and accountability ensures local involvement and ongoing support
- incorporation of facilitative approaches which go beyond supply-driven objectives and consider the needs and priorities of developing countries; implementation of development assistance programs should be based on collaboration and teaming, allowing local stakeholders to learn by doing
- realistic expectations about the size, scope and scheduling of projects and programs relative to local capabilities; starting small is often most effective, with growth taking place as learning occurs and as local resources and structures acquire the capacity to absorb and manage change.

By adopting an integrated approach to regional planning, resource management and capacity building, water, environmental and health objectives are more likely to be realized.

## 2.2 FINANCING WATER INFRASTRUCTURE

In developing countries, as governments find it increasingly difficult to secure adequate financing for water infrastructure, water users are becoming the likely source of future funding; this means pricing water closer to its market value. Where the costs of tapping new water supplies are too high, legislation to conserve water and to protect the quality of existing supplies is often more cost effective. In some cases, it is necessary to underwrite water projects through the pooling of higher user fees and pollution taxes.

In the developing world, many countries rely on technical and financial assistance programs to acquire technologies and establish infrastructure. A number of mechanisms can be used to support water technology and infrastructure financing, including:

- regional and international environmental and economic development funds
- grants, donations and debt conversions
- economic development ffsets tied to procurement
- risk management insurance and performance guarantees
- tradable permits
- taxation and tax rebates
- market mechanisms targeted at consumers and investors.

Often, the lack of integrated policies and planning, combined with donor-tied conditions to aid, gives rise to technological incompatibility relative to local environmental and socio-economic priorities and management capacity. Infrastructure expenditure should be carefully considered with respect to technological and financial issues, including debt dependence. Mechanisms to promote technology cooperation and the adoption and use of environmentally sound technologies should include the development of local capacity to support the implementation and continuous management of sustainable options.

## *2.3 PRICING OF WATER*

Water is a basic need, upon which humans and ecosystems depend for survival. In spite of this universal requirement, there are fundamentally different socio-economic realities amongst nations; where poverty exists, certain options that would otherwise be desirable are either reduced or eliminated.

The pricing of water must take into account the fulfillment of basic needs as well as the requirement for appropriate infrastructure and supporting mechanisms. Once the capacity to address basic human survival is established, resource managers and decision makers can then consider the implementation of incremental pricing strategies to ensure water supply protection and ecosystem preservation.

Rationing of water may be an effective management strategy during a drought or a disaster, but over the longer term market-based strategies may work better. Raising the price per cubic meter of water provides an incentive to conserve. The challenge is to achieve a price that is high enough to induce conservation while at the same time low enough to avoid political and social upheaval.

In evolving towards an appropriate user-pays pricing mechanism, a two-component structure should be considered:

(i) An affordable level of pricing that takes into account issues of poverty and the basic requirement of water for survival

(ii) An incremental level of pricing tied to water consumption above the level required to meet basic needs.

Across this broad spectrum, there must also be a recognition of the costs of water supply protection and ecosystem preservation in order to meet sustainable development objectives. Once basic needs are met, marginal cost pricing can be used to support incremental system expansion by conferring most of the costs on those who directly benefit. As the system evolves, marginal cost pricing can also serve as a mechanism to account for the costs of maintaining and modernizing the system at a level which is sufficient to achieve ongoing quality and reliability of service.

## *2.4 SCIENCE AND TECHNOLOGY*

Science and technology play a key role in resolving many water issues. The growing scale of cultural and technological developments which pose new threats to water quality and availability requires that water science be widely accessible and integrated with economic policy and planning.

Science can contribute to water policy by clarifying how much water there is, where it is, at what rate it is replenished and purified, the sources of its pollution, and how it can be cleaned up. Scientific research and new technologies, effectively applied, provide a means to help preserve our environment and protect water resources against abuse.

Researchers are actively developing water and wastewater treatment technologies. These include the means to deal with synthetic organics, biological processes to treat contaminants, and plant automation. Such developments are in response to more stringent regulatory requirements, the need to manage an expanding range of complex contaminants, and an increasing emphasis on product recycling and energy recovery. In addition, the adoption and use of technologies endogenous to developing countries can facilitate the acceptance and long term success of environmentally sustainable options.

## *2.5 TRENDS*

Beyond the policy issues outlined above, future decisions related to water and technology must give consideration to the following trends:

- continuing urbanization
- increasing domestic and industrial consumption of water
- continued pollution of surface and groundwater through human activity and chemical processes
- climate changes that may alter water supply and use patterns in some regions.
- chronic under-financing of infrastructure and technology
- growing costs of water projects and declining fiscal capacities of governments
- growing public awareness and expectations, with associated political and legal entanglements.

FIGURE 2

## PRIORITIES FOR WATER SCIENCE AND TECHNOLOGY

| ACTIVITY | OFT TECHNOLOGIES | ARD TECHNOLOGIES |
|---|---|---|
| **3.1** Watershed Planning and Management | • Geographic Information Systems<br>• Ecosystems and Watershed Modelling<br>• Economic Development and Business Planning | • Information Technology Hardware |
| **3.2** Water and Wastewater Infrastructure, Facility Operations, Monitoring and Reporting | • Water Supply Forecasting<br>• Optimization Tools<br>• Monitoring & Reporting Software | • Enhanced Process Technologies<br>• Instrumentation<br>• Information Technology Hardware |
| **3.3** Toxic Substances Management and Pollution Prevention | • Predictive Models<br>• Risk Assessment<br>• Regulatory Instruments | • Point of Use / Point of Discharge Technologies for Waste Reduction, Recycle and Reuse, and for Water / Wastewater Treatment |
| **3.4** Effective Communication Amongst Stakeholders on Water Issues, Including Financing | • Decision Support Software<br>• Integrated Databases and mart Search Engines<br>• Educational and Organizational Tools<br>• Financial Management and Accounting Models | • Information Technology Hardware |

# 3.0 PRIORITIES FOR WATER SCIENCE AND TECHNOLOGY

Figure 2 outlines four broad activity areas within the water sector and some of the science and technology priorities facing water resource managers, scientists and engineers. A discussion of these priority areas follows below.

## *3.1 WATERSHED PLANNING AND MANAGEMENT*

Leading causes of surface and ground water pollution include silt, sewage, disease-causing organisms, fertilizers, toxic chemicals, oil and grease. In an effort to eliminate these pollution sources, some jurisdictions are developing watershed planning and management strategies within hydrologically-defined geographic areas.

A watershed planning and management strategy provides a coordinating framework for pollution prevention, environmental protection and ecosystem preservation. Although watershed strategies vary in terms of specific priorities, timing and resources, the main objective is to achieve and sustain environmental improvements and meet other community goals by incorporating three important elements:

*Stakeholder involvement--* By involving stakeholders most affected by management decisions, environmental objectives can be integrated with economic, social and cultural goals. Because stakeholders work together, actions are based upon shared information and a common understanding of the roles, priorities and responsibilities of all parties.

*Geographic focus* – Activities are directed within specific geographic areas that drain to surface water bodies or groundwater.

*Science-based management techniques* – Watershed planning and management employs sound scientific data, tools and techniques to:

- assess and characterize the natural resources and the communities that depend upon them
- set goals and identify environmental objectives based on the condition or vulnerability of resources, the needs of the ecosystem and the requirements of the human community
- identify priority problems
- develop specific management options and appropriate technologies
- implement action plans
- evaluate effectiveness.

### 3.1.1 Assessment and Characterization

Watershed planning and management require the establishment of multi-year monitoring programs which provide information on physical, chemical, biological and habitat conditions. An effective monitoring program should include:

- an inventory of existing information on water resources, including groundwater, sources of drinking water, habitat, wetlands and restoration areas
- the capacity to update existing information, fill in gaps and report trends
- reference conditions for biological monitoring programs to provide baseline data for water quality assessments as well as biological and nutrient criteria

- data collection incorporating geographic references and comparable methods to allow for aggregation of data at various scales using Geographical Information Systems (GIS) technology
- information on the condition and quality of waters and causes of impairment
- coordination with stakeholders to share information.

### 3.1.2 Goal Setting

Water quality standards provide a logical starting point in establishing watershed goals. Water quality standards also include appropriate chemical, physical and biological criteria to characterize, protect and preserve the uses of water. Actions to establish watershed management goals and objectives include:

- consulting with stakeholders
- reviewing and, revising water quality standards as appropriate
- defining uses based on the chemical, physical and biological characteristics of the watershed
- applying a suite of tools to address cumulative impacts on human health, aquatic life, wildlife and sediment-dwelling organisms, as well as methodologies for toxicity testing and risk evaluation.

### 3.1.3 Problem Prioritization

Identification of priority problems within the context of watershed planning and management should consider other programs and initiatives that may impact:

- drinking water protection for both surface and groundwater sources
- wetlands and habitat protection
- point source and nonpoint source pollution control
- agricultural and industrial withdrawals
- water diversions
- other issues, such as waste management and air pollution.

### 3.1.4 Management Options

The development of management options and action plans should build upon environmental objectives that are consistent with national standards and regulations for water quality, taking into account the needs and concerns of the watershed stakeholders. Where possible, environmental indicators should be identified for monitoring and reporting the attainment of environmental objectives. Action plans should include voluntary, mandatory and educational measures to help achieve and maintain these goals. Where specific technologies might be considered, an assessment of benefits, risks and life cycle costs should be undertaken prior to implementation.

### 3.1.5 Implementation

All stakeholders should support the implementation of watershed plans through their activities pertaining to water quality protection, pesticide management, waste management, air pollution control, natural resources protection, agriculture, water supply, transportation and other related programs. Stakeholder actions should support water quality permitting, nonpoint source pollution control, habitat protection and other water resource protection and restoration activities on a watershed basis in accordance with appropriate national regulations and watershed management priorities. Implementation should also include nonpoint source management programs to reduce potential impacts on groundwater, surface water and wetlands.

### 3.1.6 Monitoring and Evaluation

Watershed planning and management should include monitoring and verification of implementation and, where necessary, enforcement of certain management actions. Progress should be reported and the results of monitoring should be used to ascertain the environmental and socioeconomic impacts of the actions that are implemented and to guide decisions about continued implementation and future actions.

## *3.2 INFRASTRUCTURE AND FACILITY OPERATIONS*

Technologies for treating water and wastewater are generally categorized in terms of water treatment (for both groundwater and surface water supply), water distribution, wastewater collection and wastewater treatment (primary, secondary, tertiary). From a policy perspective however, water/wastewater technologies and processes are better presented in terms of infrastructure, water supply, facility optimization and stormwater management.

### 3.2.1 Infrastructure

In many parts of the world, urbanization has caused progressive occupation and development of open land and attendant changes in ecology and hydrology; continued heavy consumption of water in older cities, taxing aged resources and facilities; suburban sprawl and growth with the accompanying technical, political and economic challenges of meeting water demands; and growing pressure on public financing to build in new areas and maintain older systems, often in the face of a declining tax base.

Traditionally, rural or low density suburban areas outside cities have developed water supply and other facilities on a house-by-house basis. Individual domestic wells are drilled at the beginning of development, and septic tanks are employed for the disposal of domestic sewage. As density increases, small water systems are usually built, often based on pumping groundwater by a town authority or a private firm. In some cases, the dangers of groundwater contamination from septic tanks have induced growing communities to build sewage treatment plants.

Another level of infrastructure development occurs when rapid population buildup makes limited water, sewer and waste treatment systems inadequate. Large withdrawals of water from groundwater aquifers can lower the water table at an extremely rapid rate, forcing communities to search elsewhere for water supplies. In many cases, water quality standards make small, technically unsophisticated treatment plants unacceptable, and towns are often forced to consider building larger facilities or seek cooperative agreements with adjacent communities to build regional water and wastewater systems.

For some communities, decentralized water and wastewater systems can offer an attractive alternative. This is done by treating the water or wastewater at or near the location where it is used or generated.. This eliminates the need for piping systems, while employing technologies that are appropriate to particular users.

Even so, the high capital and operating costs of conventional wastewater treatment systems are often too onerous for many communities and much of the world wastewater is discharged untreated. As a result, there is growing interest in the development of lower cost natural systems which combine wastewater purification and nutrient recycling. While these systems are often not suitable for densely populated cities, they do offer a more affordable solution for many suburban and rural areas.

### 3.2.2 Water Supply

Serious problems face water supply, both in developing and developed countries. In developing countries, the major difficulty is providing sufficient volumes of safe water to meet basic human needs; in developed countries, water suppliers are struggling with treatment modifications and upgrades made necessary by an ever-increasing number of water quality goals and regulations.

*Inadequate supply*
Many countries do not have an adequate supply of potable water. The lack of potable water exacts a high economic and social cost in these countries. Areas without adequate municipal water supply tend to remain underdeveloped because of widespread disease and unsanitary living conditions.

Historically, the problems of poor water supply have persisted because of limited resources and funding. Even when funding has been available, the conventional response has been to build large, centralized water treatment plants, often without sufficient consideration of existing supply infrastructure. In cases where high quality water from treatment plants is compromised by a sub-standard distribution network, the problem is often exacerbated, since when water reaches the consumer, it is no longer safe for consumption. It is also not unusual for poor distribution systems to leak 50% or more of the water pumped from a treatment plant. This represents a poor use of resources, since the cost of treatment and pumping this water is wasted.

Many developing countries cannot afford the high costs of water supply based on procurement, treatment and distribution. Increasingly, point-of-use treatment alternatives are being considered based on endogenous technologies.

*Water quality standards and regulations*
Over the past 20 years, the water treatment industry has been subjected to an ever-increasing number of more stringent water quality guidelines and objectives. Current areas of concern include:

- the presence, survivability and risks of waterborne infectious pathogens
- the fate and persistence of disinfection by-products
- control strategies and technologies for minimizing health risks.

Emerging user expectations and increasingly more stringent standards force operators to balance treatment improvement costs against higher quality goals. Furthermore, because of the increasing complexity of treatment requirements, many treatment plant operators do not have in-house knowledge to identify and meet all the required standards, especially when this entails substantial modifications to facility operations.

*Water consumption*
Water consumption is a function of many factors, including climate, standard of living and supply availability. While the per capita consumption of water is generally lower in developing countries than in the more industrial nations, this is most often the result of lack of supply; when water availability becomes unrestricted, demand rises to levels similar to those of developed nations. Water consumption can be tempered by programs for water source management, conservation, reuse and recycling. This requires a certain level of organization, computerization and record keeping not usually found in developing municipal utilities.

Water supply modelling is a valuable tool for forecasting demand as well as for implementing water efficiency and conservation programs, including:

- planning the expansion of system capacity
- preparing contingency plans for water shortages caused by drought or contamination
- performing sensitivity analyses with various assumptions about pricing and use
- assessing revenues and financing requirements
- calculating net benefits and costs.

Technologies such as high level leak detection can also be used to conserve water resources and reduce costs.

### 3.2.3 Water and Wastewater Facility Optimization

Provision of water and wastewater treatment facilities and infrastructure is one of the largest budget expenditures of governments. As financial resources to meet growing demands become increasingly difficult to find, and as effluent standards become more stringent, a more systematic approach to the operation and optimization of water and wastewater facilities makes sense. Experience has shown that in many cases, the capacity of existing water and wastewater treatment infrastructure can be extended significantly by using sensor-based monitoring, automated process control and sophisticated software systems as operational tools.

Some optimization opportunities can be implemented easily at reasonable cost, while others may require more detailed analysis to evaluate potential savings for specific facilities. Technologies and procedures with significant potential for resource use reduction and cost savings within water and wastewater facilities include:
- use of energy efficient motors and variable speed drives
- optimization and off-peak operation of pumps and blowers
- optimization of aeration processes
- instrumentation and control technologies and procedures to monitor ongoing conditions and adjust chemical addition
- reduced frequency and duration of filter backwashing to provide significant water use savings
- use of effluent water (instead of potable water) for foam control, chemical handling and other applications in wastewater facilities
- energy recovery through cogeneration and heat exchangers.

In addition to these optimization approaches, a number of other technologies are gaining wider acceptance, including:
- on-line measurement
- high velocity mixing systems
- biological nutrient removal (BNR)
- membrane bioreactors (MBR)
- membrane filtration
- advanced oxidation and disinfection
- autothermal thermophilic aerobic digestion (ATAD).

Work is also being done to control industrial discharges and to fully utilize the capabilities of treatment plants to reduce toxic contaminant loadings to receiving waters.

### 3.2.4 Stormwater Management

The focus of urban stormwater management is shifting from quantity to quality. In meeting water quality standards, cities and regional governments must consider a mix of structural and nonstructural solutions to stormwater management.

The limitations of combined sewer systems are significant. While such systems may be initially cost efficient, and financially attractive compared to separate systems, they often cannot process the water produced by heavy storms. Consequently, some of the runoff is diverted without treatment into streams, contaminating them with nonpoint source pollutants, while at the same time reducing the replenishment of groundwater aquifers.

Historically, urban stormwater management has focused on quantity issues such as flooding, and local governments have constructed thousands of miles of curb, gutter, roadside ditches and storm sewers to convey stormwaters as quickly and as efficiently as possible to the nearest stream. In some cases, government agencies have chanellized streams and rivers and constructed flood control dams to reduce damage from flooding.

Because land development results in higher runoff rates compared to "green field" conditions, it is not uncommon for local governments to attempt to mitigate the impact of urbanization on stormwater flows by requiring developers to construct stormwater detention facilities. This involves the retention of runoff for short periods in small ponds, on parking lots, or wherever space is available to temporarily store the water. However, stormwater quality criteria vary considerably from community to community and the long term impacts and maintenance requirements of randomly-placed on-site detention facilities are uncertain. An alternative to developer-constructed on-site detention facilities is the use of regional detention sites, which, if properly planned and maintained, can be more cost effective.

Strategies and technologies for the alleviation of problems caused by combined sewer overflow and stormwater discharges are being developed in some jurisdictions. Specific projects have been initiated to demonstrate combined sewer overflow and stormwater treatment and control options within the context of broader watershed management and pollution control plans.

## *3.3 TOXIC SUBSTANCES AND POLLUTION PREVENTION*

### 3.3.1 Toxic Substances

Toxic substances pose a challenge to the way resource management, pollution control and human health programs are structured. These substances enter the environment via aqueous discharges from pipes and landfill sites, smoke stack emissions and direct volatilization. Once in the environment, they move through water, air and land, contaminating plants, animals and humans.

Traditionally, institutions have been structured around these separate phenomena; the challenge is to implement interdisciplinary approaches to measure the risks of exposure, rank the sources of contamination, assess the impacts, model cause and effect relationships, analyze the costs and benefits of risk reduction and implement appropriate prevention and control options.

A number of technologies are required for the virtual elimination of toxic substances. Analytical techniques are required to isolate problem compounds; follow-up evaluations, using both chemical and biological analysis, further define sources and the scope of potential impacts. In addition, screening methods and predictive techniques are used to evaluate the characteristics of new substances.

Treatment and control technologies can be used to limit the release of toxic substances into the environment. Pollution prevention technologies however, have the greatest potential to virtually eliminate the formation of toxic substances. Where past practices have contributed to the creation of contaminated deposits, remediation technologies may also be required.

Typically, wastewater treatment processes have been designed to remove conventional pollutants such as BOD and suspended solids, and in some cases, nitrogen and phosphorus. Some jurisdictions now require the removal of volatile organic compounds (VOCs), priority pollutants and organics and inorganics which are toxic to aquatic life. Some of these organic compounds are refractory or generated as biological treatment process by-products. Physical-chemical treatment technologies are often required for those compounds that are toxic to biological wastewater treatment processes and to aquatic organisms.

The most common technologies for addressing these problems include source treatment for specific pollutants, tertiary treatment following biological treatment, and modifications to biological treatment processes such as the addition of activated carbon or the use of chemical oxidants. Where non-degradable, toxic wastewater can be segregated, high-strength treatment at source is often the most cost effective solution.

The virtual elimination of toxic substances is a long term commitment which requires an understanding of the practical limitations, risks and potential for success.

### 3.3.2 Pollution Prevention

The long term goal of environmental protection is to prevent the creation of pollutants and waste and to produce durable, recyclable, less hazardous goods. As awareness has grown regarding the ecological impacts and economic costs of environmental damage, emphasis has shifted from controlling pollutants and wastes once they have been created to preventing their creation in the first place. Avoiding or minimizing pollutants and waste can reduce the necessity for costly control and cleanup efforts, the loss of raw materials and the impacts of waste processing activities. While all environmental protection activities produce some benefit, opportunities for reducing environmental and health risks, and their associated costs, are greater through pollution prevention, reuse and recycling.

Pollution prevention seeks to eliminate the causes of pollution rather than treating the symptoms. It encourages the kinds of changes that are likely to lead to lower production costs, increased efficiencies and longer term protection of the environment. Pollution prevention reduces problems associated with the handling and storage of toxic materials and wastes, dependency on markets for recycled materials, and the health risk exposure of workers and the public at large.

## 3.4 MOBILIZING STAKEHOLDERS USING INTEGRATED INFORMATION SYSTEMS

Global markets are rapidly integrating within countries in different ways. Only those with appropriate institutional and information systems are likely to move towards integration and gain from the benefits of doing so.

The effective adoption and use of water-related science and technology in support of environmental and economic goals requires good communication and cooperation amongst stakeholders.

- Governments must educate, regulate, encourage research and support appropriate pricing of water.
- Infrastructure companies must provide integrated services and be willing to apply new technologies in innovative ways.
- Water professionals must support integrated watershed planning and management.
- The public must be involved.

A proactive strategy for mobilizing stakeholders in support of environmental solutions requires a variety of communications and decision support tools including:
- integrated databases and intelligent search engines
- educational and organizational software
- financial management and accounting systems.

## 4.0 POLICY ACTIONS

There are a number of areas where policy makers can act.

### *4.1 RAISING AWARENESS*

An important role exists to facilitate the sharing of information for the development and application of environmental technologies. Actions to educate stakeholders, build capacity and establish integrated databases and information networks should be targeted. This will enhance the adoption and use of appropriate technologies.

To protect water supply, public health and ecosystem integrity, emphasis should be given to watershed planning and management, the establishment of ecosystem objectives and the implementation of appropriate management options. Efforts should also be made to better understand the application of endogenous approaches in achieving sustainable solutions.

### *4.2 FINANCIAL CONSIDERATIONS*

Policy makers should take steps to strengthen the development and implementation of more efficient, resource-conserving practices and technologies. Pollution prevention and environmentally-driven process modifications can offer economic advantages while minimizing pollution.

Actions should be directed towards the appropriate pricing of water to encourage conservation and efficient use while ensuring continuous quality and reliability of supply. A transparent process should be in place for establishing policies and implementing decisions for financing water and wastewater infrastructure, taking into account issues of poverty and the basic needs for survival. Emphasis should be given to strategies which encourage self-reliance and debt avoidance.

### 4.3 REGULATIONS

Governments have the capacity to establish programs which support environmental standards and regulations. They are also responsible for the development and implementation of enforcement and compliance. Another regulatory tool is the application of assessment protocols for analyzing the environmental and socio-economic impacts of decision-making.

Policy actions should support full accounting of economic and environmental costs and the consistent and fair application of environmental regulations. Stakeholder participation and commitment to this process is essential.

### 4.4 SCIENCE AND TECHNOLOGY

When policy makers look to science and technology, they must recognize the complexity of acquiring information and the process through which knowledge must flow to support the adoption and use of sustainable technology. Technology choices should consider overall life cycle costs, benefits and risks, as well as the mix of human and capital resources required.

Actions by all stakeholders should draw upon sound science and technology as a fundamental prerequisite for effective decision making. Two-way information flow should be encouraged, recognizing the particular needs of both developed and developing countries and the contributions that each can make in achieving environmentally sustainable objectives.

## INTERNATIONAL ENVIRONMENTAL TECHNOLOGY CENTRE

In 1991, UNEP Governing Council further strengthened UNEP role in the management of large cities and freshwater resources by establishing an International Environmental Technology Centre (IETC). The Centre was inaugurated in October 1992 in Japan and its offices in Osaka and Shiga officially opened in April 1994.

In meeting its role as facilitator for the transfer of environmentally sound technologies, IETC is focusing on solutions for urban problems and the management of freshwater lake and reservoir basins. Current IETC efforts to promote environmental technology transfer include:

- establishing an information base on environmentally sound technologies
- strengthening local capacity within developing countries
- supporting technology cooperation.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# THE FINANCING OF HYDROPOWER, IRRIGATION AND WATER SUPPLY INFRASTRUCTURE IN DEVELOPING COUNTRIES

by
John Briscoe

Paper No. 1

Prepared for the
Department of Economic and Social Affairs
United Nations

# THE FINANCING OF HYDROPOWER, IRRIGATION AND WATER SUPPLY INFRASTRUCTURE IN DEVELOPING COUNTRIES

A background paper for the **UN Commission on Sustainable Development**, January 1998

John Briscoe, Senior Water Advisor, The World Bank

**Caveats and Qualifiers**:

This paper is produced as an input into the UN Commission on Sustainable Development's assessment of the water sector. Surprisingly, I could find no recent, credible effort to cover this terrain, some parts of which are changing rapidly. There are formidable conceptual and data problems in attempting to compose a picture of the magnitudes, sources and trends in financing. There are glaring problems with data consistency and definition across countries and across sectors, and many problems of inappropriate inclusions and exclusions from the data. The approach taken in this paper was to make estimates from a variety of different persepctives -- macro estimates based on percentages of GDP; ratios between well-defined numbers, such as World Bank spending, and public spending: private flows from transactions data bases, and "bottoms-up" estimates based on country-level data for specific sectors; etc. etc. To my considerable surprise (and even vague suspicion!), there was a remarkable degree of convergence in the aggregate sub-sectoral numbers which emerged!

This paper draws on a wide variety of sources. In many instances I have (shamelessly and often directly) appropriated the material of World Bank colleagues who have addressed specific parts of the problem. The most egregious cases involve the most useful and insightful work --that of Greg Ingram and his team who produced the Bank's World Development Report on Infrastructure, and Barry Trembath and his internal and external collaborators in the hydro sector, and Mike Garn on the water and sanitation sector.

Even more so than usual, the standard qualifiers apply --the views represented in this paper are attributable solely to the author and are not necessarily the views of those who provided help (including Tor Ziegler and Monica Scastasa), of the World Bank (for whom the author works) or the United Nations Commission on Sustainable Development (on whose behalf this paper was produced).

## SUMMARY

This paper deals with the financing of major infrastructure in the water-related sectors – hydropower, water supply and sanitation, irrigation, and overall water resources management (including the environment). The overall level of investment in water-related infrastructure in developing countries is of the order of $65 billion annually, with the respective shares about $15 billion for hydro, $25 billion for water and sanitation and $25 billion for irrigation and drainage.

These massive investments have been made because water infrastructure plays such a central role in economic and social well-being. It is simply not possible to imagine social and economic well-being without protecting people and property from floods and droughts; without cheap and accessible electricity; without clean and accessible water and adequate sanitation; and without the central contribution which irrigated agriculture makes to global food security. *In addition to extending and maintaining this traditional infrastructure*, it is also increasingly clear that there has been underinvestment for too long in maintaining the quality of the environment, both terrestrial and aquatic.

With rapid population growth and growing needs for flood protection, clean energy, food security, water and sanitation and environmental quality, there is no question about the need for improved water resource management and no question about the need for continuing large investments in water-related infrastructure. What is in question is what has been bought and how it has been paid for and supplied -- is the infrastructure that which best serves these needs? Are the limited resources used most efficiently? Are environmental impacts adequately addressed? And is it possible to develop a healthier balance between private and public financing, to produce the right services in the right way? This papaer assesses these questions in light of current standard practice, and emerging best practice within the water business and in other infrastructure areas.

About 90% of investments in water-related infrastructure comes from domestic sources, and primarily from the public sector. Water-related infrastructure accounts for a large chunk -- about 15% -- of all movement spending. This heavy dependence on the public sector means that the global "winds of change" in perceived roles for government and in what constitutes legitimate government spending have major implications for the financing and structure of the water economy.

There is substantial variation in the culture of the different "water infrastructure industries" — at one extreme there is a long history of relatively "business-like practices" in the hydro-electric industry; at the other extreme irrigation in most countries has been synonymous with a politicized grab for public subsidies; urban water supply typically falls somewhere in between. The industrial and financing structure for each sub-sector is quite specific, as is the prognosis (and the availability and quality of data).

At first glance, **the hydropower industry** would appear to face a rosy suture in developing countries. Potential in developing countries is huge and only a small fraction (less than 10% in Asia, Latin America and Africa, versus about 70% in Europe and North America) has been tapped. The relatively simple technology is well-suited to operating conditions in many countries, and the technology has major environmental advantages in a "warming world". The dams constructed for hydro purposes also fulfill a number of other vital roles -- in ensuring the water supplies necessary for growing populations and the growing demand for food, in flood protection, etc. The hydropower industry however, faces huge challenges due to changes in the way in which energy supplies are financed, and due to concerns about the environmental and social impacts of dams. Financing of energy supply infrastructure is increasingly being turned over to the private sector. To private investors thermal power plants often look more attractive than hydro plants, for a variety of reasons. For thermal plants, project preparation is cheaper and more predictable, risks are more definable, limited and manageable, export credits provide a ready source of financing for these equipment-intensive plants, and pay-back periods are relatively short. For hydro plants the situation is quite different. The history of hydro construction is replete with the cost overruns and delays deriving, in part, from the public sector domination in this sector. More fundamentally, each and every plant has to be tailored to the particular hydrological, geological, environmental and social conditions; risks are substantial and not always best borne by a private party; financing from official development assistance, which has played a vital role in the

past, is "drying up"; there is well-organized opposition to many dams; and there are frequently substantial infrastructural and institutional costs in linking hydro supplies to their often-distant markets. The prognosis is that the private sector will invest in relatively small hydro plants where risks are low. But large plants are another story. Multilateral and bilateral financers play a vital role, but appear to be withdrawing from the sector, partially because of the political pressures from those who oppose dams, partially because of the poor performance of many public-dominated hydropower projects and partially because of a (mistaken) view that this is an industry which can simply be turned over to the private sector and is thus "a sunset sector" for external support agencies. There would appear to be a major need for external support agencies to review their (implicit) position, and to formulate a new, more affirmative approach to partnerships with governments and the private sector in the hydropower industry.

**The water supply and sanitation industry** is also deeply affected by the changing economic paradigm. The sector has long been undergirded by publicly-financed, government-run utilities which have (with some important exceptions) performed poorly in terms of efficiency, quality of services, coverage and environmental impact. Recent years has witnessed a surge in private sector activity in the sector. Where the private sector has been engaged, the results have generally been encouraging -- accountability, efficiency, quality and coverage have improved markedly. As experience has accumulated, one consistent theme emerges -- this is not a sector from which the public sector can "withdraw". Just like hydropower, this should not be considered a "sunset industry" for the public sector (and external support agencies). Rather, the entrance of the private sector means that the public sector has a different, but still vital, complementary role to play, primarily in terms of regulation, but also in terms of financing. The stark reality is that, as currently structured in most developing countries, the water supply sector will attract little private capital. The sector is bedeviled by a long history of underpricing, and by a politicized debate about "basic needs" and the moral imperative of subsidies, by high capital intensity and therefore long payback periods and associated risk. Developments to date show that there are a variety of innovative ways of addressing these problems. But this experience also shows that this takes time, that it requires attention both to long-term vision and to transition processes. And, above all, it shows that it requires innovative new forms of public-private partnership if private expertise and financing are to be attracted into the sector. There is no doubt that the international community has a central role to play in this sector for many years -- in working with governments on developing better legal and regulatory frameworks, in helping to manage the difficult processes of transition from the "old model" to the "new model", and in both direct and indirect (via appropriately-structured guarantees) financing of water and sanitation infrastructure.

**The irrigation and drainage sector** is a composite of a broad set of different sub-sectors. Most visible are the surface irrigation schemes which have been publicly-financed throughout the world. In industrialized countries and developing countries alike, this is a classic "pork-barrel politics" sector. The results are broad and consistent. The positive effect is that irrigation has been the well-spring of the extraordinary era of food security (and associated low food prices, to the enormous benefit of the urban poor). The negatives, however, have become all too apparent throughout the world -- overbuilding and wasteful use of money, water, fertilizers and pesticides, with serious fiscal, economic and environmental impacts. There are manifest benefits of this system to three principal parties -- the bureaucracies, politicians and private beneficiaries, known as "the iron triangle" in the United States. Rent-seeking behavior is deeply embedded in the social and political fabric of all major irrigating countries and thus changes only slowly and usually because of major exogenous threats. That said, there has been striking change in recent years in a number of major irrigating parts of the world -- Australia, the United States, and much of Latin America -- driven by the idea of the market economy, and by the forces of fiscal austerity, environmental change and participative democracy. Where these forces have matured, the changes have been profound and "the impossible" has happened -- irrigation has become like any other utility, in which accountable agencies provide users the services the users want. In many instances, farmers have become responsible for the costs of operating and maintaining their systems; in some instances they are responsible for meeting the full costs of replacement, rehabilitation and new investments. Where these changes have taken place, there have not only been sharp swings in the relative proportion of private and public spending, but there have been dramatic improvements in the efficiency of investment and operation and, in most cases, major positive environmental impacts. The long-term future is clear; but getting there is not easy, and is a process which has barely started in many of the major irrigation societies in the developing world. For these societies there is both bad news and good. The "bad news" for those looking to the past is that broader economic forces are going to make a return to "the good old days" of massive public funding impossible. The "good news" is that reforming irrigation systems throughout the world have shown that private investment (mostly farmers investing their own resources) can be mobilized, and that the results can, remarkably, mean better agriculture, better economy and a better environment.

In summary, the considerable heterogeneity in "the water sector" notwithstanding, there are a number of commonalities—all water sub-sectors (hydro, water and sanitation and irrigation) perform poorly from many perspectives (in terms of returns on investments, of service to customers, and impact on the environment) and all face imminent reductions in public spending and substantial difficulties in attracting private investment. A review of global experience, however, provides both a sense of hope, and a sense that only a few, small steps have been taken down the long and necessary road of reform. This paper describes some of these "beacons of light" -- where governments have become partners with communities, businesses and investors in attracting private investment and in producing services accountably and efficiently. What is striking about all of these positive cases (drawn from all water sub-sectors) is that they have made much greater use of private actors and market forces; that issues of environmental quality have been central; and that government attention and capacity has been re-focused away from the direct provision of services, and towards the structuring of an enabling legal and regulatory framework. What is distressing is that movement towards this new approach has been so slow, patchy and uneven. The challenge to people in developing countries, their governments, investors and the private sector is clear. There are terrific examples of progress in all sectors, throughout the developing world. The vision of public-private partnerships which provide quality services to people and which respect the environment is not a utopian dream. But it does require courage and vision, most of all from governments in developing countries. And it requires that the multilateral and bilateral international financing agencies not shy away from the difficult issues involved, and not dream of greener pastures away from the infrastructure sectors, and not declare premature "sunsets" in sectors where they still have such a central role to play.

## PART 1: THE CHANGING FACE OF INFRASTRUCTURE FINANCE IN DEVELOPING COUNTRIES

For decades the financing of water-related infrastructure was a sleepy backwater -- the financing of hydro-power plants, water supply and irrigation systems all depended heavily on government financing. In recent years, the sweeping changes affecting most economies in the world -- changing roles of government, increasing involvement of the private sector, globalization -- have had a profound effect on how infrastructure is provided and financed. Since financing of water-related infrastructure is subject to all of the same currents, it is useful to set the stage by providing an overview of the changing face of infrastructure financing in developing countries.

*Infrastructure is costly . . .*

Even when efficiently provided, infrastructure is costly. About 20% of all investment in developing countries is for new and rehabilitated infrastructure (a total of about $250 billion a year). Of this, about $65 billion is for the financing of water sector infrastructure -- hydropower (about $15 billion), water and sanitation (about $25 billion) and irrigation and drainage (about $25 billion). All countries—especially those with rapid economic growth— have struggled to meet the infrastructure investment needed to support new economic activities.

*. . . and often performs poorly*

Recent reviews show inefficiencies in the investment and operation of publicly-provided infrastructure services. In the water sector, for instance, half of water leaving a treatment plant is unaccounted for in most developing country cities. Worse, many people are unserved: more than one billion lack access to safe water and two billion to electricity or adequate sanitation. Unreliable services, lack of coverage, and sporadic maintenance reflect inefficiencies, unresponsiveness to demand, and poor management. The underlying causes are many and common: lack of managerial accountability, shortage of hard-budget constraints, and the absence of commercial practices in many public infrastructure agencies.

*Most infrastructure financing comes from public domestic sources*

Developing countries now spend around $250 billion a year on infrastructure investment, with some 90% derived from government tax revenues or intermediated by governments. The burden on public finances is enormous, accounting, on average, for about one half of government spending for all infrastructure, and about 30% of this for water-related infrastructure. Governments have relied to varying degrees on foreign financing for infrastructure. Official development financing (including concessional and non-concessional funds from both multilateral and bilateral sources) has remained about constant in recent years, providing about 10% of total resources for investment in infrastructure.

*Limitations of the present system*:

The logic behind the present system is that in most countries the government is the most creditworthy entity and is able to borrow at the lowest rates, making possible infrastructure projects that might not otherwise be financially viable. Balanced against this advantage has been the difficulty of maintaining accountability, and consequent inflated costs and poor quality of service. Moreover, being creditworthy does not imply that governments have unlimited access to resources. Furthermore, where budgets have been tightened for macroeconomic reasons, the large share that infrastructure represents in government investment has led to proportionately sharper reductions in spending.

*There has been a dramatic shift in the relative roles of private and public flows to developing countries*

As shown in Figure 1, in the 1990s there has been a dramatic shift in the relative roles of private and official capital flows to developing countries. While the current crisis in the East Asian economies makes it clear that there will be many ups and downs (most obviously in foreign private flows, but also in domestic private and public investments), the long-term prognosis remains one of major private financing of infrastructure.

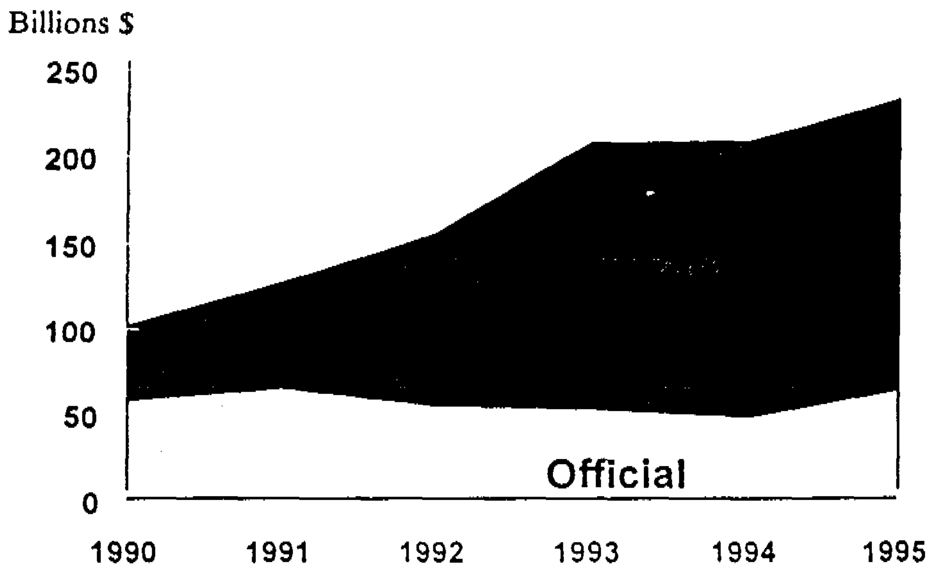


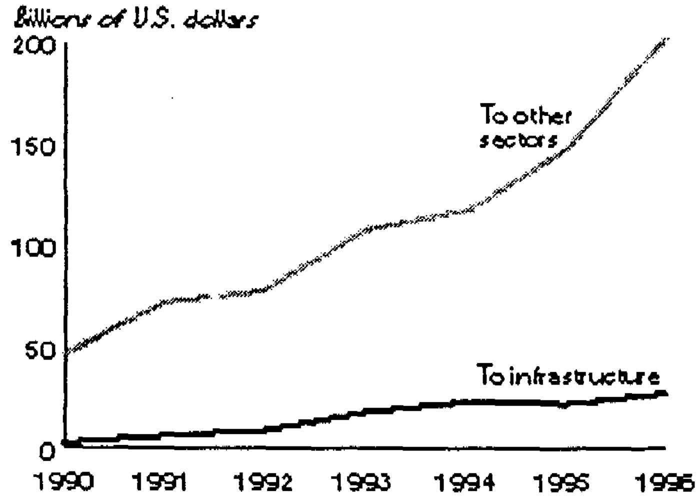

Figure 1: Private capital flows to developing countries have increased dramatically

*Private involvement can improve performance and provide financing*

The desire for greater efficiency and better service and the need for additional sources of finance have led many developing countries to turn to the private sector. Experience shows that having private providers compete in the market for customers improves service and increases coverage for a range of infrastructure services. A recent study of privatizations of eleven infrastructure enterprises found that divestiture was good for the economy as a whole and led to higher productivity and faster growth in all but one case. Gains stemmed from higher investment to serve unmet demand (the Chilean telephone company doubled its capacity in the four years after its sale), higher productivity from smaller workforces and better management (the Mexican phone company reduced its per-unit labor costs sharply), and prices that covered costs within the context of regulation. Where direct competition for customers is not possible, competition among firms for the right to serve the market is a strong incentive for efficient investment and operation. With the proper policy and regulatory framework, private investors will provide capital for new investment in many infrastructure sectors, reducing the demand for public funds and providing fiscal space for investments in public goods (such as sewage treatment, salinity control and other environmental improvements).

*Recent trends in private involvement*

One partial measure of global activity based on gross private international financial flows (bank loans, bonds, and portfolio equity, but excluding foreign direct investment) shows rapid growth in flows to infrastructure to developing countries up to 1993 and then a modest increase to $27 billion in 1996 (Figure 2). Developing countries thus account for about a half of the global private infrastructure industry, a $60 billion a year industry . The number of infrastructure privatizations expanded tenfold from 6 in 1988 to 61 in 1992, and then increased to 85 in 1995. Revenues from these privatizations grew from $800 million in 1988 to $9.8 billion in 1992, the peak, and then flattened at $9.4 billion in both 1994 and 1995.

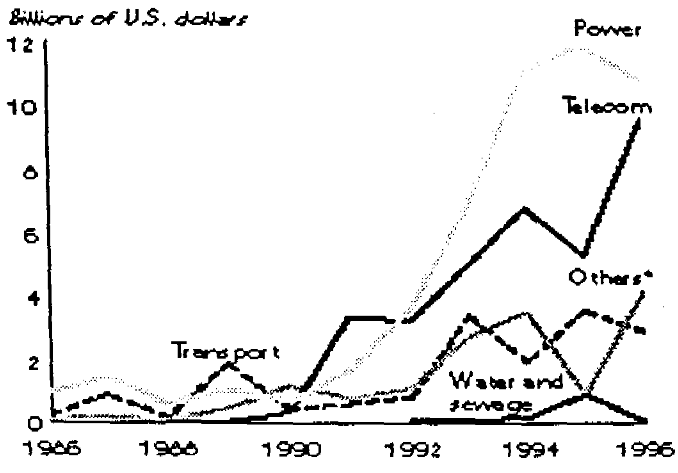



Source: Global Development Finance 1997.

Figure 2: Private international financial flows to infrastructure have grown rapidly

*Private participation varies by sector . . .*

Private provision and financing of infrastructure in developing countries, essentially nonexistent a decade ago, has blossomed. This happened most (see Figure 3) in telecommunications—helped by technological change, few environmental spillovers, and a strong revenue base with some foreign exchange earnings. The power sector has seen more extensive use of concessions and build-operate-transfer arrangements, particularly for the construction and financing of generation plants. Concessions and BOTs (which bring investments) as well as leases and management contracts (which bring only private management skills) are now expanding in water supply, ports, airports, and highways.

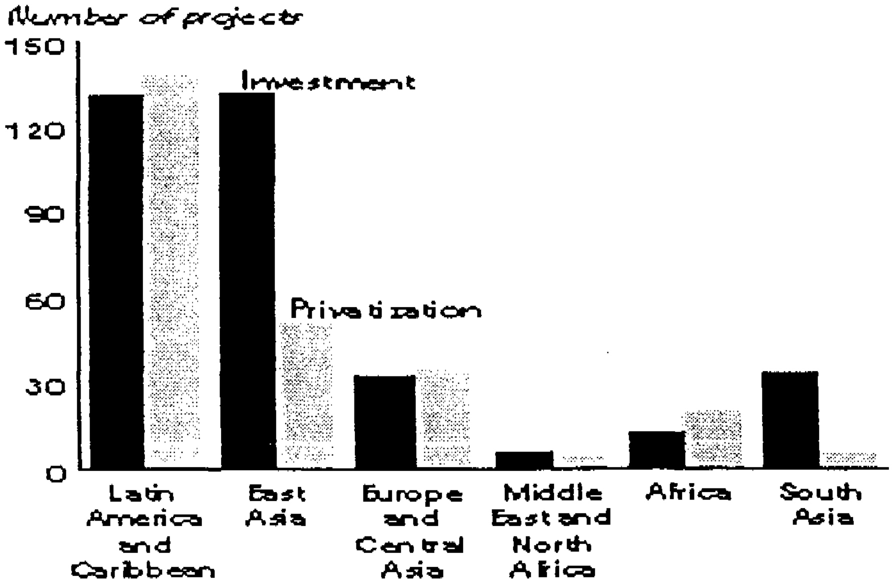



a. Public works construction and heavy engineering.
Source: Euromoney, Loanware, Bondware, and IECF staff estimates.

Figure 3: Private investment in different infrastructure in developing countries

*. . . but is broadening*

Private activity in infrastructure, previously concentrated in East Asia and Latin America, is now expanding in Eastern Europe and Central Asia, South Asia, and Sub-Saharan Africa (Figure 4). In Latin America, however, countries are privatizing infrastructure enterprises to a much greater extent than are East Asian countries, which tend to rely more on concessions and leases. Private investment also varies with country income and is concentrated in a few countries. Information on net private international flows (including foreign direct investment) to all sectors illustrates this pattern. About three-quarters of net private flows go to middle-income developing. The concentration of financial flows is being diluted as other countries develop attractive environments for private participation. The top twelve recipients of international flows from 1990 through 1996 (the ten top middle - income countries plus India and China) received 80 percent of net flows in 1990 and 71 percent in 1996. Net private flows per capita in 1996 reflect differences in country income level and country policy environments. The top ten middle-income countries receive roughly twice as much per capita as other middle-income countries; India and China receive roughly three times as much per capita as other low-income countries.




Note: Number of actual projects or transactions, 1994–96
Source: Private Infrastructure Project Database, World Bank 1997.

Figure 4: The number of private investment projects and privatizations varies widely by region

*The financing mix is changing.*

Bank loans predominated through 1990, when both bond financing and portfolio equity flows began to grow (Figure 5). Bond and portfolio equity financing have now emerged as major components of infrastructure finance. Roughly two-thirds of infra-structure bond finance has been issued by Latin American enterprises, much by privatized infrastructure corporations. Thus corporate finance (both bond and equity) is increasing relative to project finance. The sectoral composition of financial flows to infrastructure has also been shifting (Figure 3). Power and transport predominated in the late 1980s; telecommunication began to grow after 1990. Now power and telecommunications absorb three-fourths of private international financial flows to infrastructure. Inadequate availability of long-term debt finance continues to delay many projects, and infrastructure financing must be used to foster the development of domestic capital markets (as it did in industrialized countries).

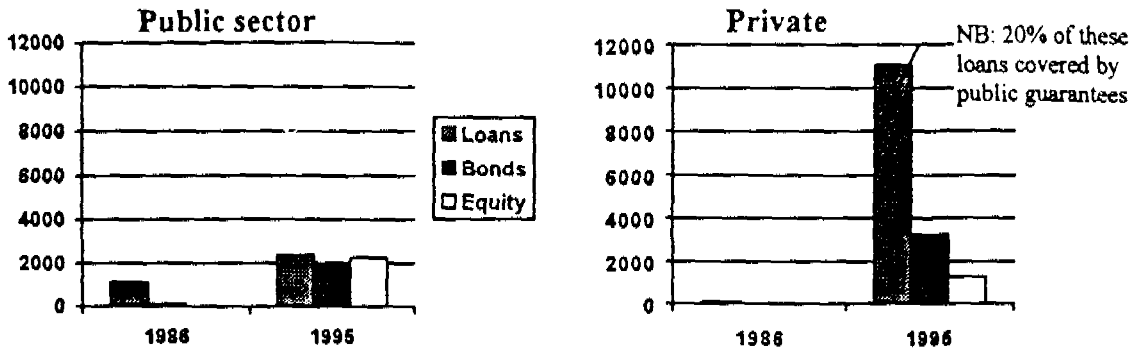



Figure 5: <u>Infrastructure financing raised by developing countries by type of borrower and instrument</u>

*The supply side is changing, too*

The private infrastructure industry has grown rapidly and become global over the past fifteen years, attracting over 2,000 major companies. The most successful companies have benefited from experience with deregulation and privatization in their home markets and established reputations for expertise within a sector or region—which has helped them increase their market share. Current estimates indicate that the top 20 companies participate in almost one third of all infrastructure projects. Many companies have broadened their scope. Equipment supply companies, engineering companies, and contractors have become project developers, offering financing packages along with their technical expertise.

As the markets mature, the players are changing. The water supply business, for example, was long dominated by a few French companies. While they still play a major role, the privatized British water industry now competes, as, increasingly, do utilities from Spain, Germany and other European countries. Equally important, there is now evidence of the emergence of domestic private operators in countries such as Brazil and Chile, often lead by large construction companies.

*Private infrastructure investment can grow much more*

In 1996, private investment accounted for about 15 percent of all investment in infrastructure in developing countries. This is both a lot and a little. Across countries the private share of infrastructure investment varies from less than 10 percent to over 70 per cent (Box 1). As a result of policy choices and budgetary decisions the range will continue to be wide in both developing and industrial countries. But the average for developing countries could easily approach a third. So there is plenty of scope to increase the existing private investment share and to reap substantial benefits from private participation.

*And the future will surely not be like the present....*

A striking feature of the above picture is the rapid change in virtually every dimension -- in the amount of private investment, in the countries and sectors it goes to, and in the forms in which it becomes available. It is certain that the rapidly-changing economic situation in East Asia will give rise to further substantial changes. What does seem certain, such volatility notwithstanding, is that the fundamental factors underlying the expanded role of the private sector -- the need for services, the inability of governments to finance these, the greater accountability of privately-financed and provided services -- are here to stay.

Box 1. How extensive is private investment in infrastructure?

Private investment in infrastructure varies considerably across countries—even among the most industrialized OECD nations (see Table 1 below). The wide range of private interests (from 9 percent to 76 percent) indicates that countries are at very different points on the path to private involvement in infrastructure. Private investment is concentrated in the telecommunication and power sectors. Countries with the highest shares of private investment in infrastructure have man-aged to widen private investment to include transport and water and sanitation. For example, England and Wales fully privatized the assets and operations of its ten regional water boards in 1989. But the broadening of private investment from telecom and power to transport and water and sanitation normally includes increased involvement with state and local governments. In the United States and Germany state and local governments carry the lion's share of public investments for transportation and water/sewerage infrastructure. In France almost half the public investment in water is from state and local authorities, while in Hungary, municipalities are increasingly responsible for infrastructure services (particularly in urban areas). Shrinking public budgets will force local governments to seek private financing, providing a strong case for improved municipal financing instruments and opportunities. Developing countries can raise private investment in infrastructure from the current 10–15 percent to 25–35 percent of the total by allowing substantial private participation in telecommunications and power generation alone. Hungary, Chile, the Philippines, and others have already seen extensive private investment in both telecommunications and power generation. With some privatization in transport (usually railroads, airports, ports, and toll roads) or water supply, developing countries could reach an average level of 40–50 percent.

| | Telecom | Power | Transport | Water/sewer | Weighted private share |
|---|---|---|---|---|---|
| OECD-high income countries | | | | | |
| France | 0 | 0 | 10 | 36 | 13 |
| Germany | 0 | 67 | 0 | 20 | 9 |
| Japan | 35 | 96 | 3 | 0 | 14 |
| Netherlands | 100 | 23 | 8 | 54 | 46 |
| United Kingdom | 100 | 100 | 21 | 100 | 71 |
| United States | 100 | 81 | 13 | 22 | 47 |
| Middle- and low income countries | | | | | |
| Chile | 100 | 99 | 7 | 4 | 54 |
| Cote d'Ivoire | 0 | 30 | 0 | 25 | 10 |
| Hungary | 98 | 100 | 53 | 0 | 76 |
| Philippines | 87 | 49 | 25 | 0 | 42 |
| Thailand | 31 | 30 | 20 | 0 | 17 |
| Average | 59 | 61 | 15 | 24 | 36 |

*Source: World Bank staff estimates 1997*

Table 1: Private investment in infrastructure, in selected countries as % of total infrastructure investment

## PART 2: AN OVERVIEW OF THE FINANCING OF WATER-RELATED INFRASTRUCTURE

*Investments in this sector are very large....*

It is not a simple task to estimate the overall levels of investment in different water-related infrastructure sectors. There are glaring problems with data consistency and definition across countries and across sectors, and many problems of inappropriate inclusions and exclusions from the data. The approach taken in this paper was to "let a thousand flowers bloom" – to make estimates from a variety of different directions, including macro estimates based on percentages of GDP; ratios between well-defined numbers, such as World Bank spending and public spending; reviews of private sector transactions data bases; making "bottoms-up" estimates based on country-level data for specific sectors; etc. etc. There was a surprising degree of convergence in the global numbers which emerged, suggesting that the overall level of spending on water-related infrastructure in developing countries amounts to about $65 billion a year, with hydropower accounting for about $15 billion, water and sanitation about $25 billion, and irrigation and drainage about $25 billion.

The domestic/external mix for water-related infrastructure is broadly consistent with the overall infrastructure financing pattern described earlier -- about 90% of investment is from domestic sources and 10% from external sources. The World Bank, which provides about 50% of this external funding, typically provides about half of the funding for projects it is involved in. The Bank's current portfolio of water-related investments provides about $20 billion for projects costing a total of about $50 billion. The World Bank's contribution to current water projects, by sub-sector, is presented in Figure 6. Figure 7 shows how the World Bank's investments in water-related infrastructure have changed in recent years.

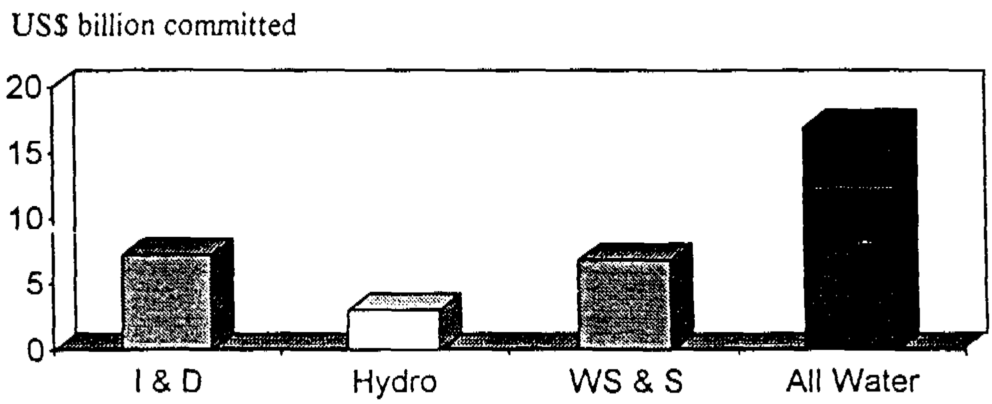



Figure 6: The World Bank's Water Infrastructure Portfolio

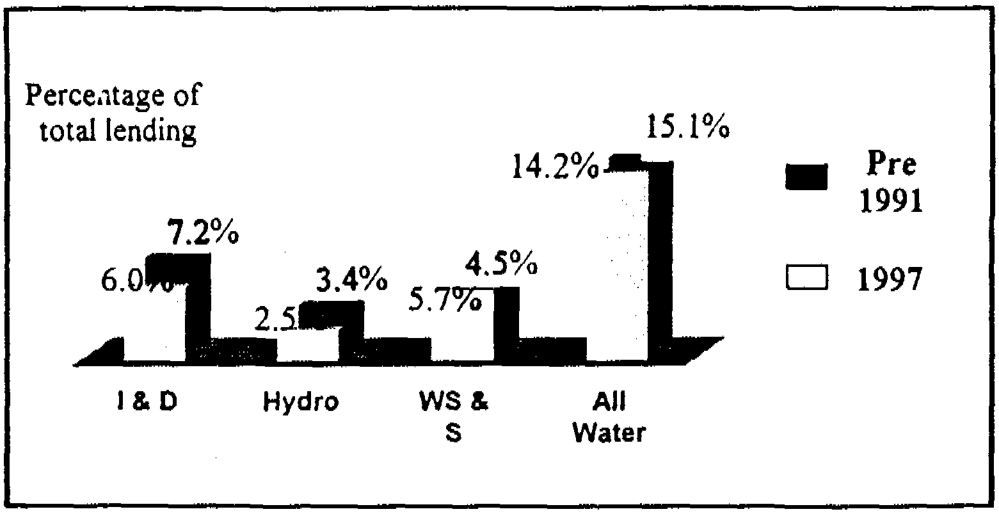



Figure 7: How the World Bank's Water Infrastructure Portfolio is changing

*The context is changing rapidly...*

In recent years the water-related infrastructure business has been subject to the wave of changes affecting all of infrastructure financing. In some cases this has simply been that the same forces have affected water infrastructure: in other cases major technological changes in other parts of an industry have changed the competitive position (and financing prospects) of a water-related sub-sector. Hydropower is the most dramatic example, where associated technical and institutional changes have been profound. Technical advances in natural gas turbines have opened a field which is attractive to investors. Coupled with deregulation and the emergence of competitive electricity markets, this has meant that investments in long-return, risky hydropower have become less attractive. Concomitant with these sweeping changes in the role of government have been equally broad concerns about the environment -- in some cases (such as hydropower) making financing more difficult to attract; in other cases (such as sewage treatment) leading to substantially increased levels of investment.

*The "water infrastructure sector" comprises quite different sub-sectoral "cultures"...*

Before examining the financing trends in each of the major water-related infrastructure sectors (as is done in the following sections) it is also important to note that there are sharply differing "cultures" in each of these infrastructure sectors.

- The power sector is "business-like" (and increasingly so as competitive forces become widespread), with rapid technological change, complex financial engineering and a lot of financial information available;
- Surface irrigation is the classic government-driven public works and rent-seeking operation. The public irrigation sector is characterized by simple financial arrangements, without much demand for, and consequently poor-quality, information;
- Groundwater irrigation is usually "out of sight" in the informal, small-scale private sector. There are some dynamic and modern elements, with changed technology playing an important role in recent decades. The financing arrangements are generally simple and often informal;
- Water and sanitation is historically dominated by public sector financers and providers. But partial commercialization has meant that it is somewhere in between hydro and irrigation on this spectrum (in terms of "business-like-ness", financing complexity and quality of information available).

## PART 3: THE FINANCING OF HYDROPOWER

*Participating in the electricity economy is fundamental for the poor...*

Increases in the quantity and efficiency of energy used is a sine qua non of development. Electricity, in particular, has a critical role in improving efficiency not only of energy use, but of capital, labor and natural resources. There is a clear relationship between energy and human capacity and an inevitable corollary -- the availability of abundant electricity is a fundamental for development.

*The poor pay more for useful energy*

The lives of the poor are unlikely to improve unless they participate in the modern energy economy.
Poor urban households in developing countries spend a significant proportion of their limited cash incomes on energy -- often as much as 15 to 22%. The poor often pay higher prices for energy than more wealthy households. This is partly the result of both the heat content of the fuels used and the conversion efficiencies of the technologies used to produce useful energy. Appliances fueled by wood, charcoal, and kerosene are often very inefficient. Conversely, appliances designed for electricity or LPG, purchased mainly by wealthier households, use energy more efficiently. A few examples illustrate the general situation: In the Philippines, where energy prices generally reflect economic costs, the urban poor pay US$1.80 per kilogram of oil equivalent (KGOE) for their cooking needs, whereas the rich pay only US$0.70 per mainly because the poor use woodfuels and the rich use LPG. In Cape Verde, the poorest households pay about US$1.40 per kilolumen hour, compared with US$0.80 paid by the highest income groups.

*Subsidized services do not work, but efficient, commercially-based services do meet the needs of the poor.*

Attempts to make energy services more accessible and affordable to the urban poor by targeting subsidies for certain fuels have largely failed, resulting in restricted access by the poor and diversion of subsidies to other economic groups. Furthermore, the benefits of taxing modern fuels to conserve energy, raise government revenues, and lower foreign exchange expenditures are often offset by the indirect harm that they cause the urban poor.

This does not mean that governments should abandon efforts to assist the urban poor through energy policies. Many studies, including an extensive recent global survey, confirm that the urban poor are better served by pricing energy along commercial lines and facilitating access to fuels. Energy that is neither heavily subsidized nor heavily taxed, and
that is free of import restrictions, has the best chance of reaching the urban poor. Such policies help households that can afford electricity, LPG and kerosene; they also help the poor by keeping the prices of traditional fuels, used mainly by the poor, at affordable levels.

*Hydroelectric potential is unevenly distributed, but there is vast untapped potential in many developing countries*

As shown in Figure 8 below: developing countries have more than double the hydropower potential of industrialized countries. But whereas about 70% of that potential has been tapped in industrialized countries, only about 10% of that potential has been tapped in the developing world.

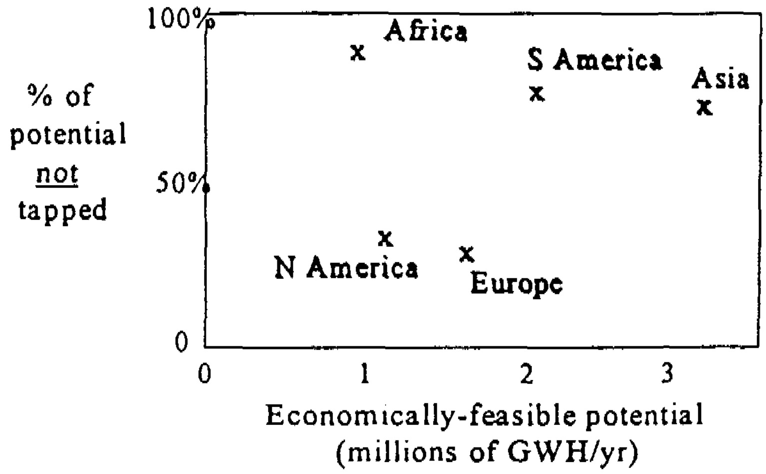



Figure 8: Potential and actual hydropower generation in different regions

Since the demand for elecricity in developing countries is expected to triple over the next 30 years, the outlook for hydropower would appear to be rosy. Most estimates agree that by 2020, installed hydro capacity will triple, from about the current 10% of technical usable potential to some 30%. A closer look at the industry, however, unearths deep problems, and many challenges.

*How much, and how, is hydro currently financed?*

Historically, hydroelectricity in the developing world has been financed predominantly from public or guaranteed funding. For instance, during the last three decades, the World Bank has financed about 110 hydroelectric power projects in 50 developing countries. These projects range from 6.6 MW to 2,460 MW, with a combined generating capacity of about 35,000 MW. Between 1990 and 1995 the Bank approved 12 hydropower projects, accounting for about $600 million a year of the total estimated investment in hydropower in developing countries of about $15 billion a year.

Reliable global data on trends in hydro financing are not available. As usual, World Bank data provide some pointers. As shown earlier, there has been a marked decline in World Bank lending for hydro -- over the course of the 1990s, hydro has fallen by about 25% as a share of (approximately constant) Bank lending -- from 3.4% to 2.5% of the approximately $20 billion lent annually. There is no doubt that environmental pressures on the Bank (and other multilateral agencies) account for some of this decline; accordingly, it is not clear whether this decline mirrors a parallel shift in spending on hydro by developing countries. What seems more likely (and for which there is ample anecdotal evidence) is that, since money is fungible, developing countries have simply taken "the path of least resistance", using their own resources for these controversial investments, and submitting projects to the World Bank (and other external support agencies) which are more politically palatable in the West.

Whatever the actual numbers on current (mostly public) spending on hydro, it is obvious that capacity expansion will require the mobilization of both public and private finance and the forging of new partnerships between the two.

The private sector has shown some interest in funding hydroelectricity. The International Finance Corporation (the private sector arm of the World Bank) approved financing for 7 private hydroelectric power projects, between 1990 and early 1995; 6 of these were relatively small (10 MW to 73 MW), and one was a large (450 MW) run-of-river project. Besides development of new capacity, the private sector has also shown considerable interest in buying, retrofitting, rehabilitating, and operating existing hydroelectric plant, with this process particularly active in Brazil and other Latin American countries.

*Hydro projects have frequently suffered from delays and cost overruns*

World Bank data show that power generation projects have not always performed well -- schedule slippage has averaged about 38% for thermal projects and 35% for hydroelectric projects. Cost overruns have averaged about 11% for thermal plants but 30% for hydroelectric projects.

Some of this poor performance can be attributed to the generic "public works hazard", in which there is little sanction for high costs and poor performance. But as the difference between public thermal and hydro plants suggests, there are also a much larger variety of risk factors -- hydrologic, geologic and environmental – associated with hydro plants. The allocation and assignment of risk is a central topic to which we return later; here it is only pertinent to note that it is possible to structure private sector projects to specifically address the problems of cost overruns and delays. In recent independent hydropower projects in Colombia, India and Guatemala, for example, a major portion of the project developers' return on equity comes from delivering the project on time and within budget.

*The characteristics of "the new energy economy", and the consequences for hydro financing*

Hydropower advocates (reasonably) portray hydropower as an indigenous, renewable, non-polluting and long-lived peak energy resource more deserving of foreign investment than many thermal projects which, in the words of one observer, *"when based on imported equipment and fuel,... are no more than a long-term contract for the import of electricity".*

The reality, however, is that hydro, in the words of an influential energy analyst "stands at a cross roads". " *On the one hand, project owners face increasing economic, environmental and financial challenges. There are the vocal and visible attacks by environmental interest groups on hydro projects, particularly those with large dams. There is competition from alternative energy sources. In only a few years, the natural gas-fueled combustion engine has become a dominant technology for producing electricity. Its physical and economic characteristics are almost the opposite of those of hydro -- project capital costs are relatively low and predictable with a high degree of accuracy; construction times are short; and fuel/operating costs are high. And there is the drying up of inexpensive public financing for energy projects."*

*Financing from the private sector*

There is no doubt that private financing will play a major role in the future of the power sector – Percy Barnevik, a leading energy thinker, suggests that in the future 90% of power financing will come from the private sector.

How does the private sector view investments in hydro? The short answer is "warily", because of a number of substantial risks, many of which are inherent in the degree to which each and every hydro project has (unlike thermal projects) to be tailored to specific hydrological, geographical and geological conditions. When a private financier looks at hydro, he sees the following:

- substantial market growth, in contrast to the situation in industrialized countries; but
- a wide variety of legal and regulatory environments, with some markets better structured and less risky than others;
- there is a lot of work (and associated high costs) in preparing a project to the stage where it can be costed by a prospective developer within a reasonable degree of certainty;
- a necessity (see Figure 9) below, for a complex set of partnerships, even in relatively simple projects;
- even at the bid stage there is typically considerable cost estimate risk from geological and hydrological uncertainties, as well as uncertainties (and often shifting goalposts) due to costs of environmental mitigation and resettlement;
- costs are recovered from these capital-intensive projects over a design life typically two or three times longer than a thermal plant, with consequent exposure to greater uncertainty (not least due to political changes);
- a dearth of the long-maturity financial instruments which are necessary for hydro;
- little ability to attract export credits, the major source of financing for thermal plants, which have about four times more dollars of equipment than a hydro plant per megawatt of capacity and, therefore, greater dependence

on multilateral agencies sources, who are subject to a variety of political pressures and have become less than reliable partners, for financing or guarantees;

- the considerable hydro resources located in poorer countries or regions are often far in excess of their needs. While there is often demand in adjacent countries or regions, there is considerable friction in cross-border marketing due to both lack of infrastructure and lack of well-established purchase rules.

The net effect is that the private sector correctly sees hydro projects, relative to thermal power projects, as fraught with risks. With countries and utilities increasingly turning to the private sector to fund and build such projects, that perceived high financial risk will discourage investment.

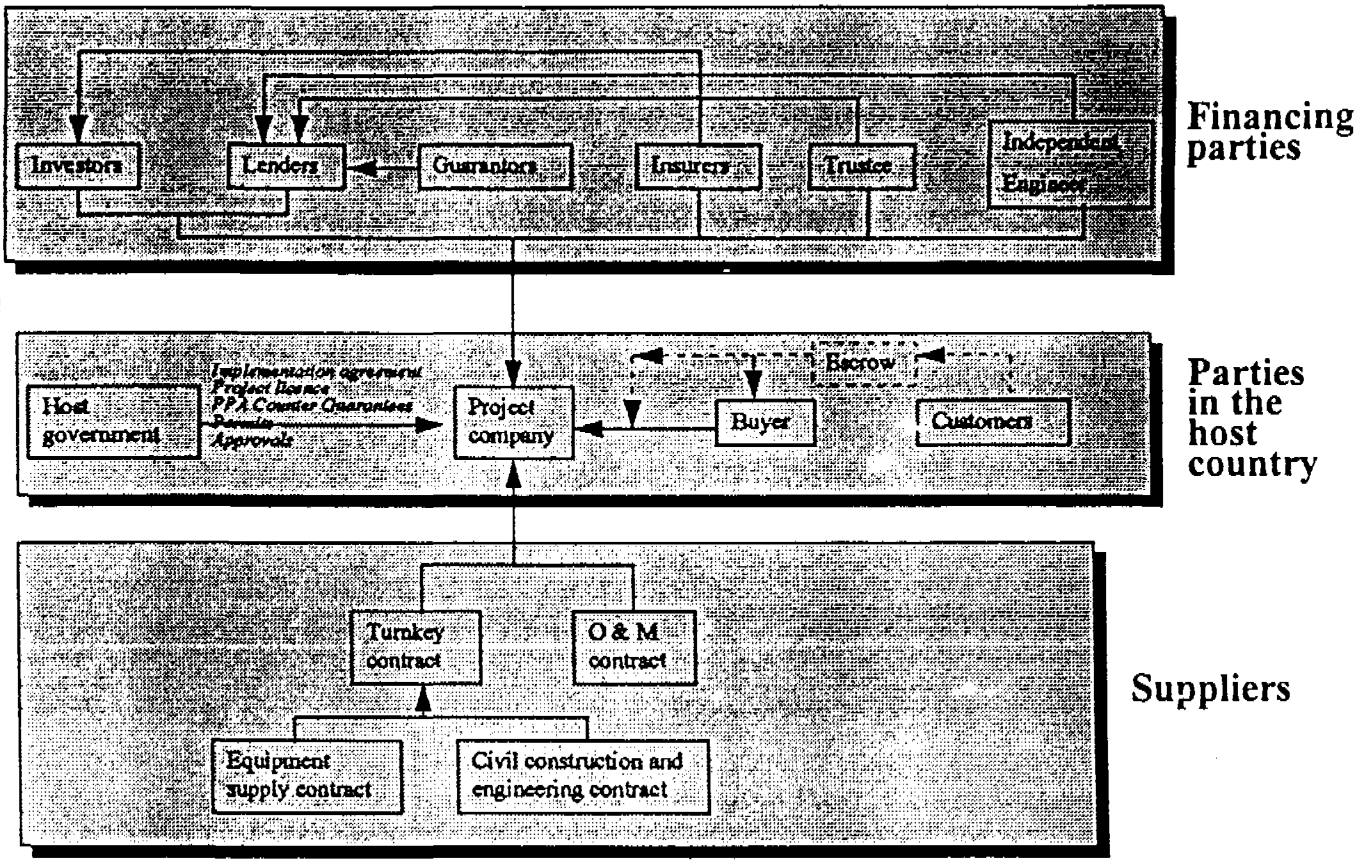



Figure 9: Structure of parties in a typical project- financed power project

An important reality is that these risks are typically quite different in smaller and larger projects. It is relatively easy to involve the private sector in smaller projects, specifically chosen to have minimal geological, hydrological and environmental risks. Consequently, the typical private sector hydropower plant is an environmentally benign, high head, run-of-river plant between 40 and 400 MW located on the tributaries to the big rivers. For larger projects there has been, and will be, little private sector financing unless there is substantial involvement of governments and bilateral and multilateral agencies in co-financing such projects and in assuming some of the risks (by, for instance, funding upstream sector planning and project preparation activities, and by providing partial risk guarantees). It should be noted that traditional financing by governments and through bilateral and multilateral banks addressed most of these difficulties. Development costs were financed through technical assistance loans and credits and through project preparation facilities. Construction uncertainties were addressed by the "schedule of rates" form of contract and price variation clauses which passed as much as possible of the risk of unknown conditions to the project owner. Owners, usually with the backing of their governments, shouldered the responsibility for cost overruns. While there were certainly moral hazards abounding in such arrangements, in many cases this made sense since the risks were borne by the party best able to diversify the risk, which in the case of hydro development was the (usually public) owner. Grace periods and maturities accommodated the longer construction period and pay-back periods.

What, then, needs to be done to harness the immense potential for hydropower as a source of socially-sensitive and environmentally-benign electricity generation in developing countries? The development of hydropower will, to be sure, require much greater participation of the private sector in project development, management and operation. But it will also require substantial, continued involvement of official development assistance -- in helping set internationally-accepted standards on when dams are appropriate investments and how to plan, design, build and operate them (as is being done through the World Conservation Union/World Bank sponsored "World Commission on Dams"); in financing construction-intensive plants; in providing private investors comfort with regard to political risk through partial-risk guarantees; in facilitating cross-border power sharing and sale agreements. Although official development assistance still provides substantial financing to the power sector, the prognosis is not good. The World Bank's lending -- often a "leading indicator" in the development business -- shows hydropower's share declining by 25% over the past five years. And agencies like the UK's Department for International Development has a policy of "avoiding large capital projects". There is a general perception that official development assistance for power generation is a "sunset sector", and that responsibility can be handed over to the private sector. The realities of global environmental politics (to which development agencies are highly susceptible) also play an important role. There is an effective and vociferous "anti-dam lobby", which focuses only on the environmental and social costs of dam-related projects. And there is a curious absence of environmental defenders of what, in many circumstances, can (relative to the realistic current alternatives of thermal and nuclear power) an environmentally-benign source of power. For this combination of reasons there is an implicit belief that a "phased withdrawal" of official development assistance from the hydropower sector has started. If this trend is sustained, then the private sector of its own volition will confine its activities primarily to the small, low-risk niche of the hydro spectrum and will concentrate of "private-sector-friendly" thermal power instead. . This will mean that the overall low level of development of hydro potential in developing countries will persist.

## PART 3: THE FINANCING OF WATER SUPPLY AND SANITATION

*There have been huge increases in coverage...*

A great deal has been accomplished since the start of the UN International Drinking Water Supply and Sanitation Decade. Between 1980 and 1994, about 2,000 million more people have obtained access to an improved water supply, and 400 million more urban people have access to sanitation facilities. The glass is, however, also half empty -- about 1 billion people still do not have access to an adequate supply of water, and 2 billion do not have access to sanitation facilities. In fact sanitation coverage has actually declined over this period, from 67% to 63% in urban areas, and from 33% to 18% in rural areas.

*But the costs of supplying raw water are rising...*

This challenge is made more daunting by the fact that the cost of raw water is rising, due to three main factors. First is the Malthusian arithmetic, which pits growing populations and increasing economic activity against a finite water resource base. Second, in all countries it is taking time and political will to change existing allocation patterns in the face of rising scarcity and, in particular, to re-allocating water from irrigation to urban uses. And third, as cities grow, so do the "pollution halos" around the city. This often requires relocating water intakes at substantial costs (over $350 million in the case of Shanghai, for instance). The net effect of these factors is substantial, with the cost of raw water increasing by a factor of 2 to 3 each time a new water source is tapped (as shown in Figure 10).

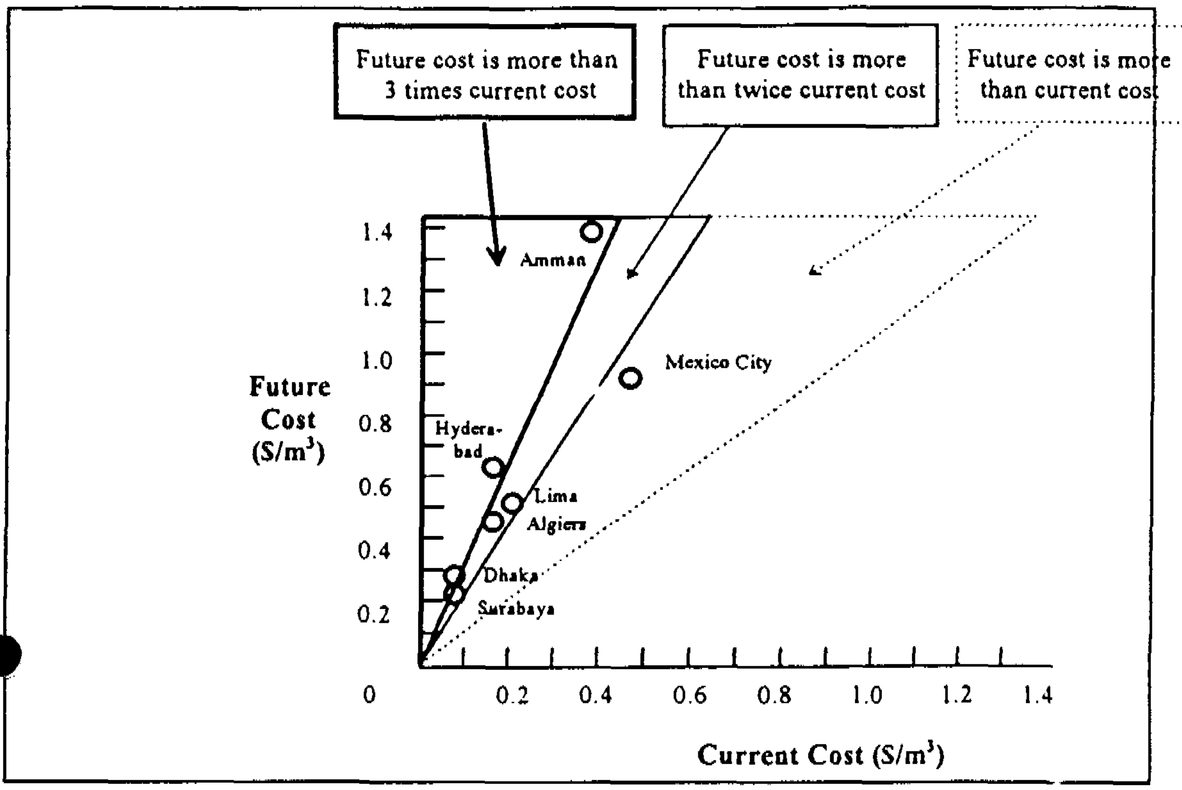



Figure 10: The rising cost of raw water for cities

*Most water utilities in developing countries are inefficient..*

Further aggravating the cost problem is the fact that most water and sewerage supply organizations in developing countries are very inefficient. For example, whereas the level of unaccounted-for-water is about 8% in Singapore, it is 45% in Bogota, Colombia, and 58% in Manila. Throughout the Indian sub-continent the situation is so bad that losses are "controlled" by having water in the distribution system for only a couple of hours a day, and for keeping pressures very low. In Madras, for example, it is estimated that if supply was to increase from the current levels (of about 2 hours supply a day at 2 meters of pressure) to a reasonable level (say 12 hours a day at 10 meters of pressure) leaks would account for about 900 MLD, which is about 3 times the current supply in the city!

*Should public spending be increased?*

An obvious response to the supply deficit is that public spending on the water and sanitation sector should be increased. It is also frequently asserted that spending on the sector has declined in recent decades. In fact, this is not true. A World Bank review of public expenditures in developing countries shows that public investment in the water and sanitation sector increased from under 0.3% of GDP in the 1960s and 1970s, to over 0.4% of GDP in the 1980s.

*There is a lot of private financing in the informal water economy*

Whatever the state of public facilities, people have to have water to live, and have to deal with their sanitation needs. Accordingly, where there are deficits in formal supplies, households have to devise other ways of meeting these needs, generally at very high costs. Water vendors are ubiquitous in developing countries, and typically charge around $3 per cubic meter of water, which is ten or more times the cost of water through the formal system. The magnitude of this "black economy" is huge. In the city of Onitsha in Nigeria, for example, aggregate annual payments to water vendors are 10 times the annual revenues of the water utility. In Jakarta, 54% of households rely on private wells and 32% on street vendors, and household investments in septic tanks are estimated at about $400 million. Throughout the developing world this "hidden water economy" represents an immense source of financing which could be "attracted in" if the formal systems were available to all and of reasonable quality.

*What do users pay and what are the implications?*

Few developing countries charge users the cost of the water services provided. Figure 11 shows the sources of financing for World Bank-financed water projects, and shows that payments from users are particularly low in the poorer parts of the developing world.

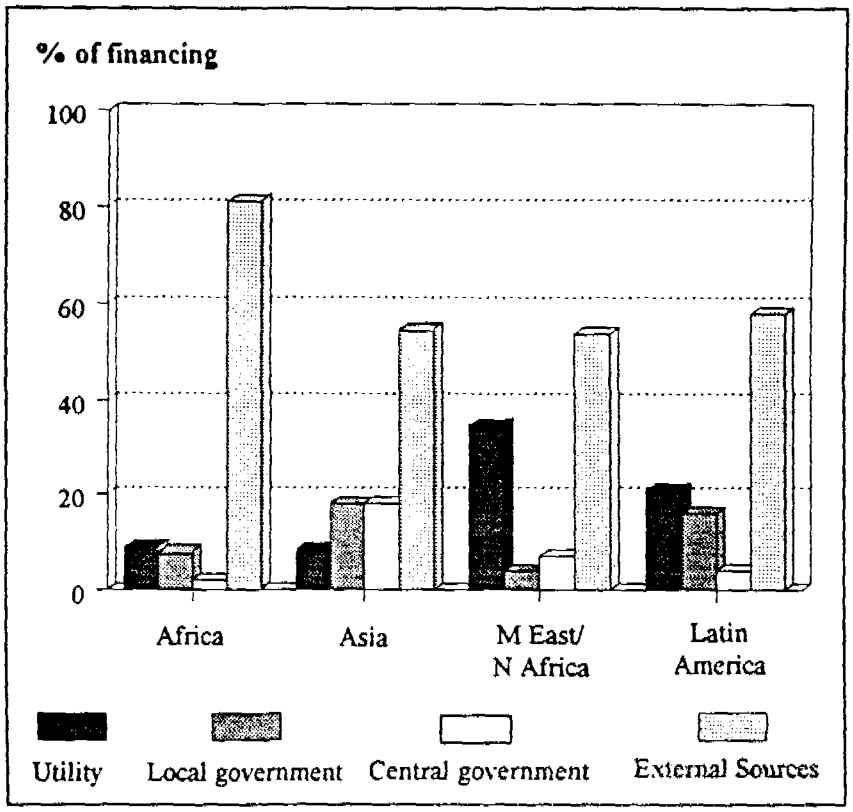



Figure 11: <u>How World Bank-supported water utilities in developing countries are financed</u>

*The implications of current financing arrangements*

There are many pernicious results from this distorted financing picture. First, fine-sounding statements notwithstanding, he who pays the piper will always call the tune. Consequently, utility managers correctly see government as their most important stakeholder -- there is little accountability to the users of the services. Second, because government is a fickle client, there is seldom sufficient reliable financing to cover the costs of maintenance and to extend coverage. For some the result is no services at all, for others the services are of poor quality. Third is the vital and paradoxical issue of equity. The universal stated rationale for subsidizing services is that "water is a basic human need, for which the poor cannot afford to pay". In virtually every situation, however, the story is the same -- when services are rationed, it is always those with access to political power, namely the rich and middle classes -- who get served, and it is always the poor who do not get services and who have to rely on the "black market". In city after city in the developing world the consequence of "social tariffs" is that the rich are heavily subsidized, while the poor pay very high prices for "black market" water. The "hydraulic law of subsidies" always pertains -- water flows towards influence and power, which the poor never have. Figure 12, which shows who benefits from public sanitation subsidies, illustrates another general point -- the poorer the country, the greater the rationing and the greater the negative impact of "social subsidies" on the poor. The bottom line is clear -- what the poor need is not charity, but opportunity, inclusion and even-handedness.

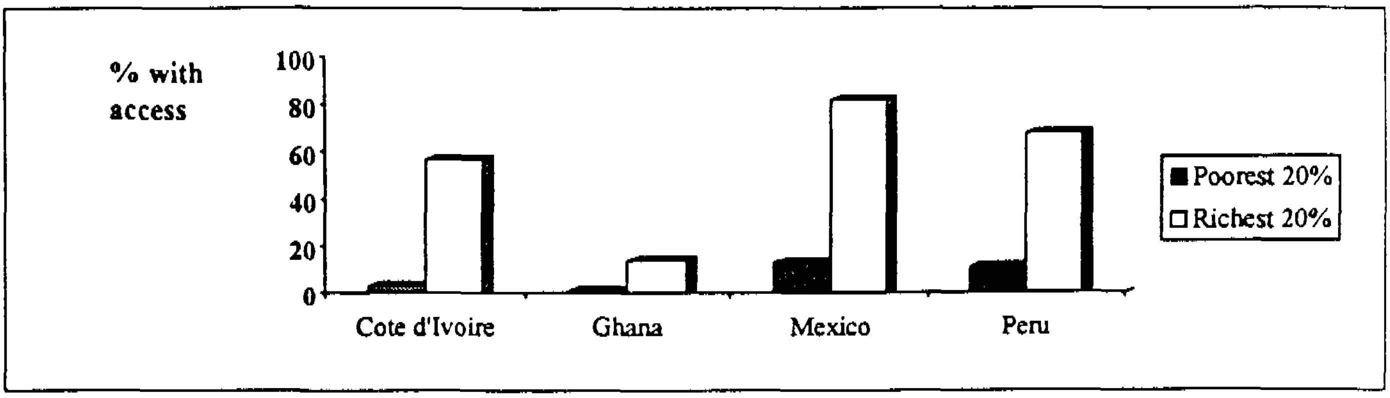



Figure 12: Who benefits when services are rationed?

*Innovative, equitable, approaches to financing of water and sanitation services*

In recent years a number of innovative approaches to dealing with the issue of cost recovery have emerged. In rural Bangladesh, the renowned Grameen Bank makes unsubsidized loans available to groups of organized poor women. While the bulk of such loans have been used for directly economically-productive activities, in recent years about $15 million a year is lent for private tubewells and handpumps. As with all other Grameen projects, repayment rates are high (98%).

At the other end of the development spectrum, Chile has developed an equally innovative and effective approach. Until the late 1980s water utilities in Chile (like most developing countries) used cross-subsidies to address the needs of the poor. What was observed was that this introduced several distortions. First, it meant that each poor person served meant a financial loss for the utility, which, consequently, had a disincentive to actually serve the poor. Second, it meant that utility managers were diverted from their primary focus, which was running their company efficiently. The essence of the new approach was to separate the welfare and business functions, by introducing the idea of "water stamps", which are provided by the government to means-tested poor people, and which are used by the recipients to pay part of their water bills. This has worked very well for the past five years. It has meant that utility managers are now out of the welfare business, and it has meant that subsidies are visible and transparent.

A very common problem for water utilities in developing countries (including Eastern Europe and the former Soviet Union) is that of how to make a transition out of a "low-level equilibrium trap", in which the quantity and quality of services are poor, which means willingness to pay is low, which means revenues are low, which means services are poor, and so on. An innovative approach in the city of Conakry in the West African state of Guinea shows how creative financing can help break out of this vicious cycle. In 1987, the government water utility functioned very poorly, and the quality of services in Conakry was abysmal. The government of Guinea decided that they wanted to attract the private sector in, an approach which had worked well in the Ivory Coast and other countries in the region. The problem was an obvious one -- no private company would be interested in a contract when revenues were only a fraction of the costs! The solution which was devised is illustrated in Figure 13. The private operator was assured of sufficient revenues by a combination of (initially low, but rising) revenues from users and (initially high, but declining) subsidies from the government (largely paid out of a World Bank credit). The trick was to use a time-bound, transparent "transition subsidy" to improve services, and then raising tariffs for the improved service. The vicious cycle was replaced by a virtuous cycle of good service and reliable revenues.

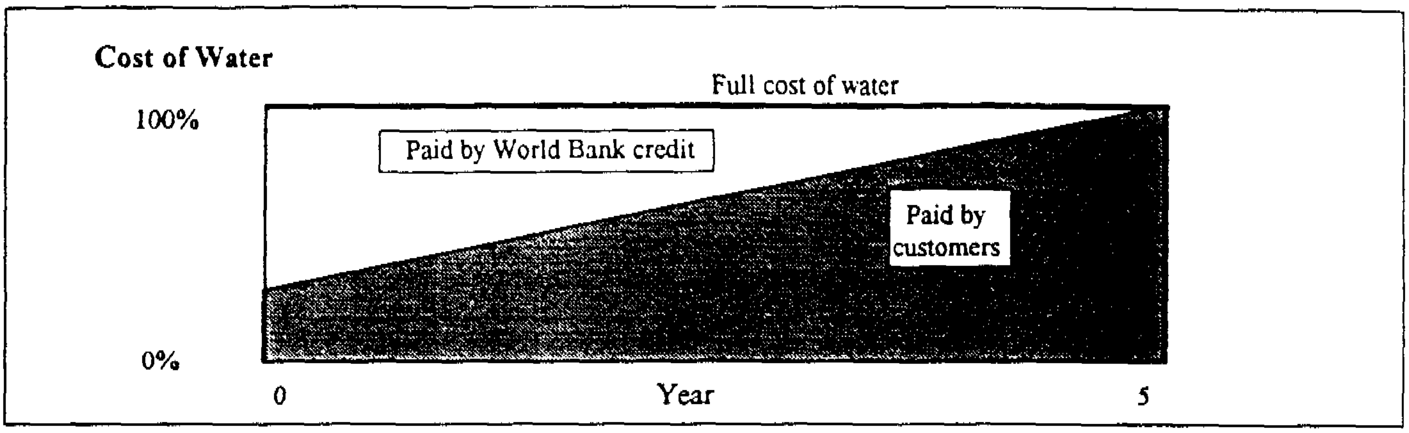



Figure 13: Breaking the "vicious cycle" in Guinea, Conakry

*Serving the poor -- the Orangi Pilot Project example*

These general lessons on how to provide services to poor people in developing countries are well illustrated by the Orangi Pilot Project in Karachi. In the early 1980s, Akhter Hameed Khan, a renowned community organizer, began working in the slums of Karachi. He asked what problem he could help resolve. People in this area had a relatively satisfactory supply of water but now faced "streets that were filled with excreta and waste water, making movement difficult and creating enormous health hazards". What did the people want, and how did they intend to get it, he asked. What they wanted was clear -- "people aspired to a traditional sewerage system... it would be difficult to get them to pay for anything else." And how they would get it, too, was clear to them -- they would have Dr. Khan persuade the Karachi Development Authority (KDA) to provide it for free as it did (or so they perceived) to the richer areas of the city.

Dr. Khan then spent months going with representatives from the community petitioning the KDA to provide the service. Once it was clear that this would never happen, Dr. Khan was ready to work with the community in finding alternatives. (He would later describe this first step as the most important thing he did in Orangi -- liberating, as he put it, the people from the demobilizing myths of government promises.)

With a small amount of core external funding the Orangi Pilot Project (OPP) was started. The services that people wanted were clear; the task was to reduce the costs so that these were affordable and to develop organizations that could provide and operate the systems. On the technical side, the achievements of the OPP architects and engineers were remarkable and innovative. Coupled with an elimination of corruption, and the provision of labor by community members, the costs (in-house sanitary latrine and house sewer on the plot, and underground sewers in the lanes and streets) are less than $100 per household.

The (related) organizational achievements are equally impressive. The OPP staff has played a catalytic role -- they explain the benefits of sanitation and the technical possibilities to residents and conduct research and provide technical assistance. The OPP staff never handled the community's money. (The total costs of OPP's operations amounted, even in the project's early years, to less than 15 percent of the amount invested by the community.) The households' responsibilities include financing their share of the costs, participating in construction, and election of a "lane manager" (who typically represents about fifteen households). The lane committees, in turn, elect members of neighborhood committees (typically around 600 houses) who manage the secondary sewers. The early successes achieved by the Project created a "snowball" effect, in part because of increases in the value of property where lanes had installed a sewerage system. As the power of the OPP-related organizations increased, so they were able to bring pressure on the municipality to provide municipal funds for the construction of secondary and primary sewers.

The Orangi Pilot Project has led to the provision of sewerage to over 600,000 poor people in Karachi and to attempts by at least one progressive municipal development authority in Pakistan to follow the OPP method and, in the words of the project director Arif Hasan "to have government behave like an NGO." Even in Karachi, the mayor has now formally accepted the principle of "internal" development by the residents and "external" development (including the trunk sewers and treatment) by the municipality.

*Developing efficient formal institutions*

It is obvious that there can never be good services for people in developing countries unless the formal utilities which serve them function well. The ingredients for successful utility performance are universal, simple and clear -- managerial autonomy, a commercial orientation and a strong voice for consumers. Throughout the developing world (and substantial parts of the developed world!) water and sewerage utilities are run as a direct agent of government. As a rule, these utilities are politicized, bureaucratic and inefficient, with the result that coverage is low, and services are costly and of poor quality.

Many approaches have been tried in developing more efficient and accountable water utilities. "Corporatization" describes an approach in which service delivery remains public, but in which managers are given greater responsibility and an arms'-length relationship to government. In many cases (Indian "Water Boards" are a good case in point) the independence is paper-thin. In some cases – New Zealand and Chile are two examples -- this model has been implemented with conviction. While substantial efficiency gains are possible (and have been achieved) these gains turn out to be difficult to sustain over time. (In the face of these difficulties, Chile is now starting to divest its public utilities.)

Many utilities (water and other) are involving the private sector to an increasing extent. The simplest form of private sector participation (PSP) is for a utility to subcontract out various activities (such as billing and collecting). Once again, efficiency gains are possible, but only if the contracting utility is well run (which is often the real cause for concern!). Another drawback is that this form of private sector participation does not stimulate private investment.

Somewhat greater private sector involvement can be obtained via a management contract, whereby a private company is paid a fee for operating water and sewerage services (typically for about a five-year period). Such contracts are being implemented in Gdansk in Poland, and Mexico City. This is an obvious approach when public agencies are performing very poorly, and can be a first step in initiating a process of deeper private sector involvement. However, the arrangement offers few incentives for the private sector. Furthermore, administrative demands are substantial, and the city remains responsible for investment.

Throughout the world there is now much greater use of "stronger" instruments for involving the private sector. A common approach is the lease or "affermage" contract, in which a private company leases the water and sewerage assets for a period of 10 - 15 years, and operates them in return for the right to revenues from the customers. These contracts are common in France (as the name implies!). In recent years affermage contracts have been concluded in Guinea, Senegal and Australia (Adelaide). The two main advantages of the approach are that the private operator has clear performance incentives and that the operator provides the necessary working capital. The arrangement remains administratively demanding for the public sector, which also remains responsible for investments.

The second common "French" approach is the concession contract. As in the affermage contract, the city owns the assets, and a private operator operates and maintains the facilities. In this case, however, the private operator is also responsible for new investments. Accordingly, these contracts are much longer, typically 25 to 30 years. This is a popular model in France. The city of Abidjan in the Ivory Coast has moved gradually from an affermage to a concession contract. Macao, Limeira in Brazil, and Buenos Aires are other well-known recent cases of concession contracts. These contracts offer potential for high, sustainable efficiency gains in both operations and investment. The case of Buenos Aires illustrates what is possible. In the three years following the concession contract, water production increased by 27%, coverage for water supply and sewerage increased by 9% and 6% respectively, response time was down by 73%, and labor productivity increased by 43%. However, sustaining these improvements and providing incentives for new investment by the private sector depends on the public sector's ability to establish good regulatory frameworks and to implement adequate tariff regimes and subsidy mechanisms.

Build-operate-transfer (BOT) contracts are similar in some respects to concession contracts. Here the private sector is given a contract to build and operate bulk facilities. This form of private sector participation is particularly popular in Asia, with major recent contracts in Malaysia, China and Australia (Sydney). This is a good way of getting efficient construction and delivery of bulk services, and of mobilizing private financing for this purpose. But it is not a good solution in the situation where distribution systems and operating companies are in bad shape, a situation which is, unfortunately, both the norm and the fundamental problem in many developing countries.

Finally, the most complete form of private sector involvement is that of asset sale. The best-known case of this approach is England and Wales. Chile has now decided to sell the assets of several of its corporatized water utilities. While the potential for efficiency gains is high with this approach, it requires sophisticated regulatory capacity and great commitment from the government.

It is instructive -- Figure 14 -- to depict the various forms of private sector participation in terms of increasing levels of deregulation, private sector investment, and contract duration.

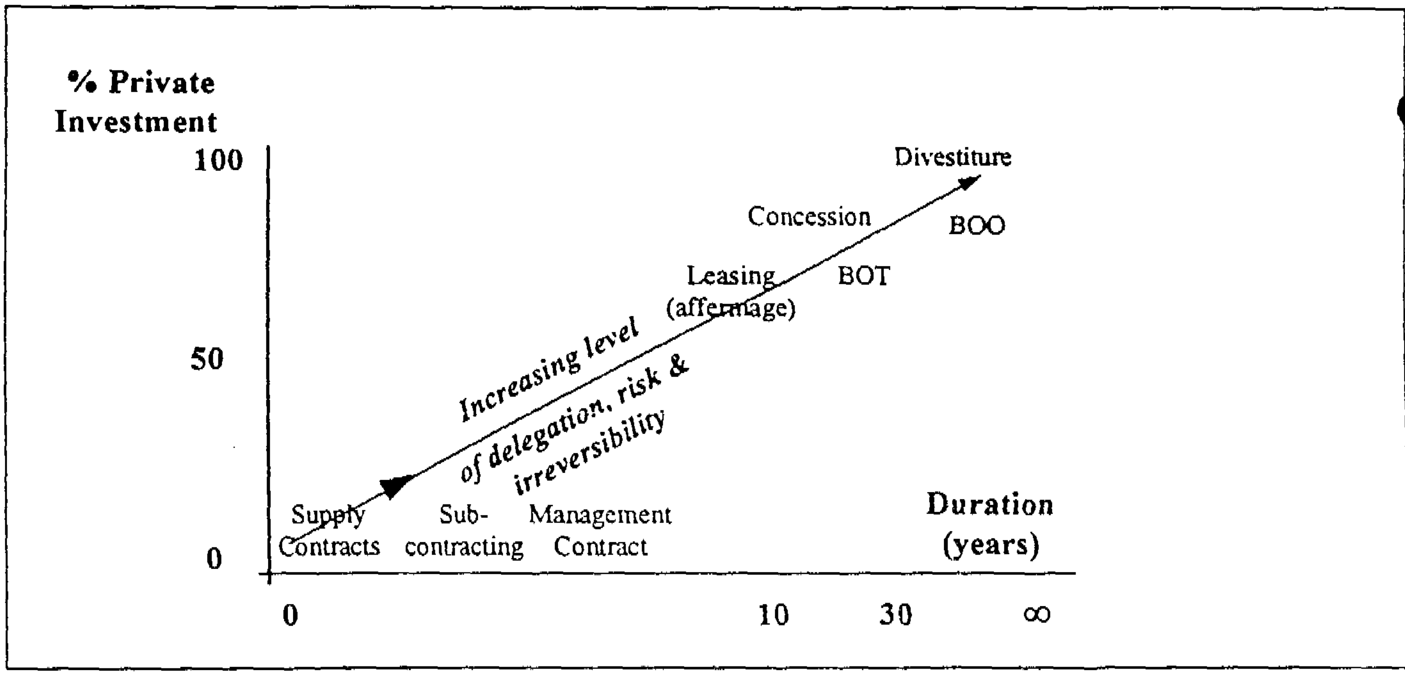



Figure 14: <u>Forms of private sector participation</u>

*The prospects for private sector investment in the water sector in developing countries*

The prospects for private sector investment in the water sector in developing countries are conditioned by several factors. First, there is the nature of the water industry itself. As shown in Figure 15, in industrialized countries the water industry has the following characteristics: (a) high capital intensity; (b) the low profitability associated with a relatively competitive industry; and (c) the low return on assets associated with a mature, low-risk industry. Financial leverage is a direct consequence of the interplay of (a) through (c) -- as shown in (d), debt-equity ratios are inevitably high for the water sector. The implication is that private sector financing in developing countries is going to depend (as it does in industrialized countries) heavily on the availability of debt financing.

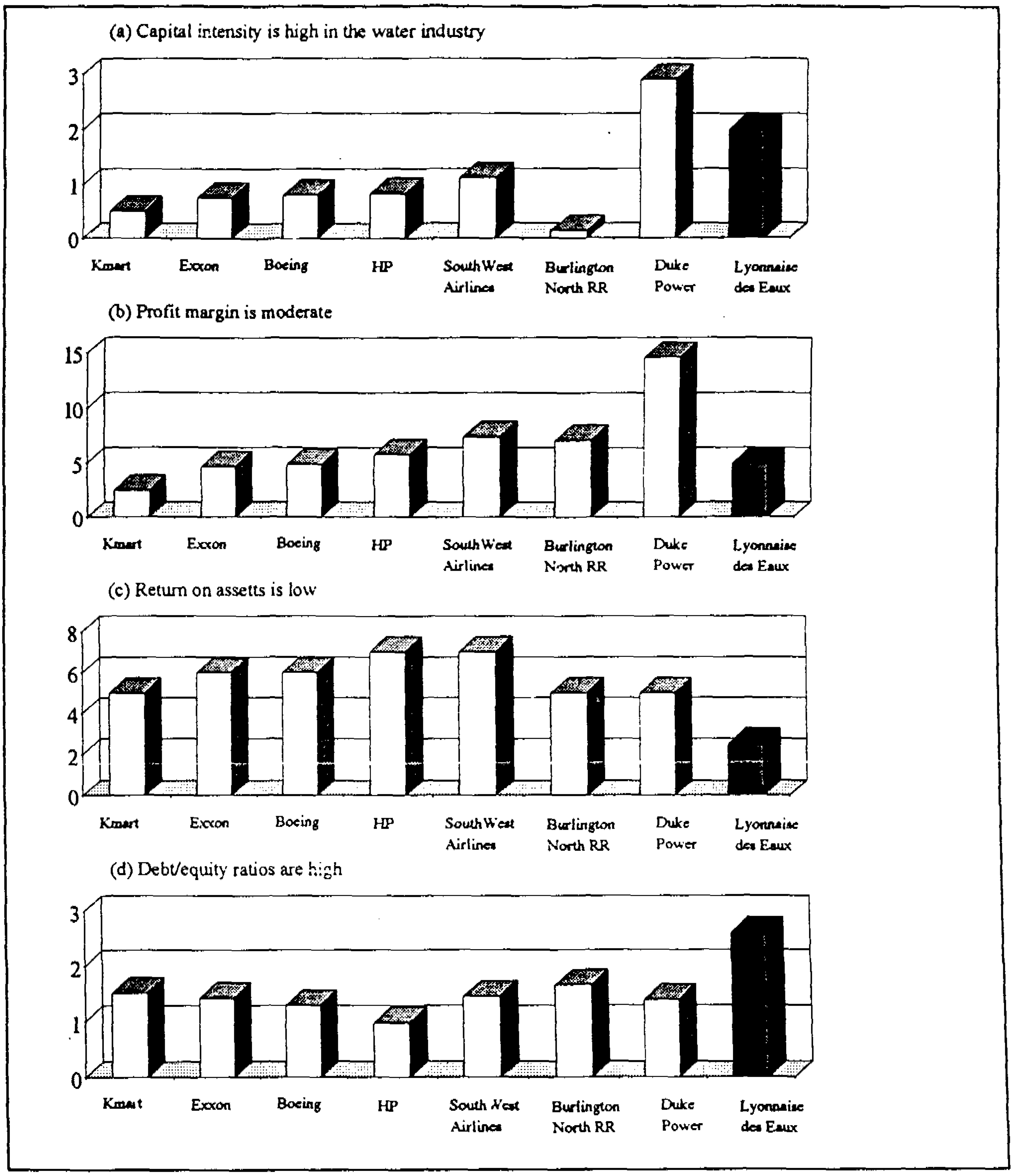



Figure 15: The financial performance of water utilities and other companies.

As described earlier, while official sources of development assistance have stagnated in the 1990s, there have been huge increases in private sources of financing. Over this period about $150 billion of private sector investment has gone into infrastructure in developing countries. As shown in Figure 16, however, very little of this investment has gone into the poorer parts of the world (Africa and South Asia), and very little has gone into the water sector.

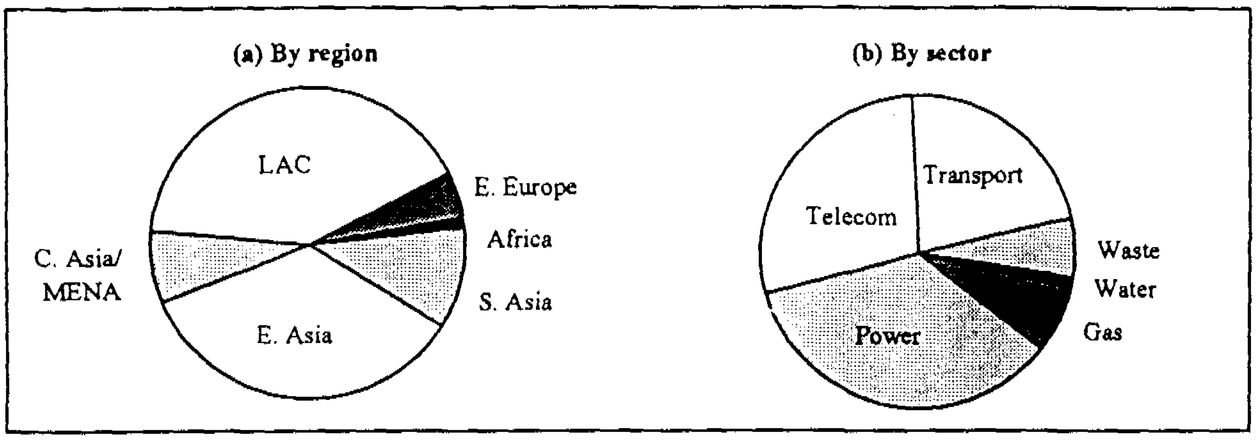



Figure 16: $150 billion of private investment in infrastructure in developing countries: Where it went and what it went for

There are two fundamental reasons why so little of this private investment has gone into water supply and sanitation. First, because the level of cost recovery in the water sector is so much lower (see Figure 17) than it is for other infrastructure. And, second, because the capital intensity of the water industry means that pay-back periods (and hence vulnerability to political risk) is particularly high.

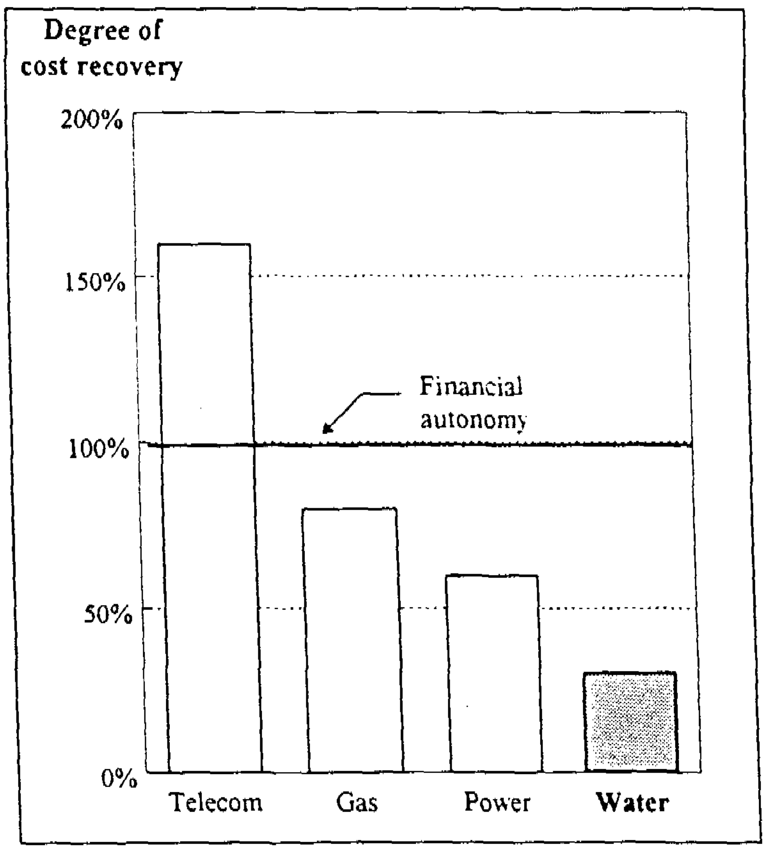



Figure 17: Cost recovery in infrastructure in developing countries

### *The bottom line for water and sewerage financing*

Recent years have seen a sea change in the role of the private sector in operating and financing water and sanitation facilities throughout the world. It is obvious that this process has only just begun, and that it will deepen and mature in coming years. But it is equally clear that there is a vital role for other actors. As the Orangi case illustrated, there is a need for creative partnerships between formal providers (who provide the bulk infrastructure) and informal providers (who deal with the feeder infrastructure) in many poor areas. And, as illustrated by the successful Chilean experiment with "water stamps", there will remain a vital role for the public sector in ensuring that the poor have access to services. It is also apparent that, for a very long time, the public sector will have an important role in partial financing of water supply services (even when they are publicly-provided) and, even more so in financing sewerage services. (It should be noted that after many decades of heavy private involvement in the water sector in France, about 50% of financing still comes from local and regional governments). Finally, it is obvious that governments have a vital role, most of all in providing an appropriate legal and regulatory framework which will provide the incentives and checks and balances for all providers -- public and private -- to provide efficient, accountable services.

## PART 4: THE FINANCING OF IRRIGATION AND DRAINAGE

### *What is "irrigation" and how is it financed?*

The word "irrigation" refers to an extraordinarily large variety of activities. Many think of irrigation as a storage dam on a river with off-take structures and a network of canals and drains. For others, it is a well equipped with a pumped linked by water channels to nearby fields, or a shaduf or shipa to lift stream water by hand. This diversity makes it difficult to analyze "irrigation". And when the subject is financing, the difficulty is greater still. To most in the public irrigation world, "financing" falls into two categories. The most common perception is that "financing" is synonymous with "budget allocations" and therefore of little systemic interest (aside for lobbying for larger allocations). With some exceptions, private irrigation in the developing world is a family affair, again with no systematic public policy attention to financing issues. To illustrate just how complete this neglect of financing is, a recent major review of the World Bank experience in irrigation has this, and not a word more, to say about irrigation financing: *"There are no reliable statistics on global irrigation investment"*. The subject is of so little interest (including, presumably to reviewers and the audience in the irrigation community) that the subject is not mentioned again in this 140-page report. Similarly, a policy review for the UK Department for International Development does not mention the issue of financing, save for a report on official development assistance flows to the irrigation sector.

In this "data desert", estimates of aggregate levels of investment on irrigation are little more than partially-informed guesses. The most common figure in circulation is "$10-$15 billion per year". Since the perspective of the international irrigation community is so firmly on public irrigation, the existing estimates appear to capture only public expenditures. This ignores, among other things, the fact that a large amount of irrigation is privately provided – 70% in Pakistan, 40% in the Philippines and India. A variety of perspectives (ranging from ratios of World Bank spending to national expenditures, and from country-level data from India, Morocco, Colombia, Egypt, Mexico, Ethiopia, Nigeria, Laos, Vietnam and Bangladesh) give a surprisingly consistent picture, suggesting that about $25 billion a year is invested in irrigation in developing countries.

### *Does cost recovery matter?*

The one area where the irrigation community has paid some attention to financing-related issues is that of cost recovery. As is well known (and sometimes derided) the World Bank has made something of a religion of the virtues of cost recovery in general, and has preached the virtues of cost recovery for irrigation, too. What are the performance of the large irrigation agencies in terms of cost recovery? Estimates of the ratio between receipts and fiscal costs of irrigation systems include: Pakistan - 13%; China - 25%; and Philippines - 10%. In some particularly egregious cases (such as the state of Bihar in India) revenues do not even cover the cost of collection. Even in World Bank-financed projects, where so much attention is paid to this, cost recovery (modestly defined as covering operation and maintenance costs) is successful in only about 30% of projects. Why is this so?

The answer is usually that receipts from irrigation in many instances go into general revenues. For the irrigators the moral hazard is clear – whether or not I pay, I still get the same service, so why pay? The corollary is also true -- experience has shown that cost recovery in and of itself achieves little, unless the money collected is used efficiently to improve the quality of services provided. The experience of Mexico in this regard is salutary. In recent years, as a component of overall economic restructuring, the operation of irrigation districts throughout Mexico have been turned over to farmers. One (of many) consequences is that there has been a dramatic increase in cost recovery -- from about 30% to 80%. For now the farmers know what the charges are for, and they apply the revenues to improving the maintenance and operation of their systems.

The case of Victoria, Australia, provides a fascinating example of what can happen when the challenges of structural reform and fiscal austerity are faced creatively. Over a relatively short period irrigated agriculture moved from being a heavily-subsidized sector into one in which market principles play a dominant role – water markets are used to ensure that the resource is used efficiently, and farmers now are accountable for the full costs of their infrastructure. When this happened (see Box 2), Victorian farmers made sure that nothing was spent frivolously (and succeeded in cutting the costs of an already quite efficient delivery organization by about 40%), and ensured that all receiving services paid their fair share. The key, then, as indicated in several illuminating studies by the International Irrigation Management Institute, is not "cost recovery" per se, but rather financial autonomy and accountability to users.

Box 3: Cost recovery and financing in Victorian irrigation systems

Until recently, irrigation financing in Australia has followed the familiar world-wide pattern -- government pays for investments and a substantial part of the operating costs. In recent years this pattern has undergone a fundamental reform, which provides important insights into likely future evolutions in many irrigation systems.

The key turning point came through a confluence of external influences in the early 1990s. The general context was that the Australian economy was in serious difficulties, losing its ability to compete successfully on international markets. The upshot was that a series of national and state governments decided that a change of tack was necessary – Australia decided to liberalize its economy, putting an emphasis on removing distortions in both input and output markets, and opening the economy up to domestic and international competition. In the specific case of the state of Victoria, this general liberalization coincided with a crisis in the state fiscus.

As part of the overall liberalization process, the Coalition of Australian Governments initiated a Water Reform process, designed to bring market forces to bear (both through reductions of subsidies and through the broadening and deepening of the use of tradeable permits for both water and salinity). In the State of Victoria, this coincided with a crisis in state fiscal affairs, and a decision by the State government to withdraw all subsidies from, inter alia, the irrigation sector.

The result was predictable and colorful, in an era when Australian farmers watch CNN and see how their French colleagues take their tractors to Paris when the EU considers reducing agricultural subsidies. And so the Victorian irrigators took their cows (and other things) to Melbourne to protest. Unusually, this tactic did not work. The consensus on economic reform was deep, the state financial crisis was very serious, and the government would not back down.

Once the farmers realized that there was no "return to the good old days", then they focused their attention on dealing with the new reality. The first thing that became clear was that if it was they who paid, then the irrigation agencies in the state would be accountable to them (the farmers) not the government. And if they were to pay, they were going to make absolutely certain that they would pay only for things that were absolutely necessary, and that the irrigation services business would be run efficiently. This launched a new era for the (already sophisticated and quite efficient and effective) water agencies in the State. Now these agencies were, de facto, accountable to the farmers, not to the government. The result is remarkable. There was a strong imperative to drive down costs – and costs of water management have fallen by about 40% (with, if anything, an improvement in the quality of services). And there has been a revolution in management of assets and financing of rehabilitation and new investments. The water agencies have devised a sophisticated asset management scheme, in which the condition of all assets is assessed and judged, in which requirements for rehabilitation and new infrastructure are determined, and in which a financing plan is developed (jointly with the farmers) for financing of these investment costs. The result, of course, is that every single item is scrutinized, with farmers constantly asking the critical "what if" questions, and often deciding that particular elements of the infrastructure are not worth preserving. This has resulted in a sharp fall in rehabilitation and investment needs, with little negative impact on the quality of service.

The story in Victoria is not yet over, with the government and the irrigators still wrangling over what "payment of full costs" means. (For the government it means that the farmers would pay for past investments; the farmers argue that they will not pay for past investments, many of which were overtly political in intent.) To an outside observer a likely and reasonable outcome would be the farmers' position – that they will pay the full costs of operation and maintenance, the full costs of rehabilitation and replacement of existing infrastructure, and the full costs of any new infrastructure.

The Victoria example is instructive in many ways. It shows that reform of deeply-entrenched patronage-based financing systems will come only when there is a broad overall context of economic reform, and only when there is a fiscal crisis so serious that it cannot be avoided. But it also shows that there is great potential in critical elements of the institutional structure -- the farmers and the service agencies -- to change from the past patterns to ones in which efficiency, customer service and quality matter. And the Victoria experience shows that irrigated agriculture can -- the dire early prognostications notwithstanding -- flourish in this new environment.

It is instructive, too, to note that the same broad set of social forces – the adoption of the tenets of a market economy, greater discipline in public spending, greater participation by users, and greater attention to the environment -- have induced quite similar changes in irrigation practices elsewhere. Water markets are now instruments being used in the Western United States, Chile and Mexico; users' associations play a huge role in operating systems (and increasing cost recovery) in Argentina, Mexico, Brazil, Chile, and Turkey; etc.

*What is so special about irrigation?*

A fundamental question (and one which raises the hackles of the irrigation community), is "what is special about irrigation vis a vis other utility-type services"? The answer is a combination of the legitimate and the disingenous. In many countries there has been a reasonable claim that government-controlled food prices (designed to keep prices down for the urban poor) have been a massive tax on agriculture, which has to be redressed through distortions in the factor markets, and thus subsidies for fertilizers, pesticides, energy and water. What is striking is that when such distortions operate in the opposite direction (in the Western US, for example), the "irrigation is special" plea finds other arguments ("culture", "multipliers", "a way of life", "sovereignty" etc.). Several things ARE clear -- this privileged "special" place of agriculture (and irrigation) respects few boundaries -- it is as difficult to remove the subsidies from French farmers as it is to charge irrigators in Tamil Nadu a paise for the electricity used for their tubewells. The easy path -- and the path much taken by politicians everywhere in the world -- has been to avoid this political hot potato. The beneficiaries of this -- the "pork barrel" politicians, the irrigation bureaucracies, and the farmers themselves -- have played their roles, claiming a "special place for agriculture". Critics of the activities of governments and agencies such as the World Bank have put it as follows: "*World Bank policy objectives in irrigation differ substantially from those applied to other sectors, such as energy, telecommunications and even urban water supply. There, World Bank policies put considerable emphasis on creating autonomous, financially viable entities capable of making rational investment decisions and mobilizing the funds needed o service debt and contribute to future investments. The borrowers are expected to levy tariffs and charges related to the costs of* *providing services so as to discourage excess consumption and waste. Why these objectives and policies are not equally applicable to public sector irrigation lending is not clear."*

### *What will happen to irrigation in a market-driven world?*

What is clear today is that the aggregate impact of these distortions have been highly uneconomic, inequitable and environmentally destructive. And it is equally clear that the future will be quite different from the past. The world is rapidly becoming one where output and factor markets are liberalized, and where there is heightened concern with the extensive environmental destruction caused by profligate use of irrigation water becomes a public issue. Where this has happened (to varying degrees in many developed countries and in parts of the developing world -- much of Latin America, and South Africa, for example) there are radical changes in store or irrigated agriculture. Water then becomes a resource which will find its highest value. This means that formal water markets emerge, and farmers have to decide whether they will use their allocation or sell it to another farmer who values the water more highly, or to a city, or even for environmental purposes. The era of fiscal restraint which is similarly a part of the emerging economic landscape also means that subsidized irrigation (which accounts for over half of all investments in agriculture in developing countries) will come under fiscal pressure. Although the initial response of irrigators and irrigation agencies is to claim that this is "the end of the world", the experience of countries as diverse as Mexico and Australia shows that it will mean that users finally exert control, and that the impossible happens -- costs come down, cost recovery goes up and water services are greatly improved.

It is also clear that, just as in the peri-urban sanitation examples described earlier, "co-production" between the private and public sectors will become more common. In Colombia, for example, although the public sector is still involved in major investments, the private sector is increasingly taking over investments in secondary and tertiary irrigation-water conveyance systems, and in farm-level investment.

Finally, it should not be concluded that the dismal state of information on, and perspective about, irrigation financing necessarily means that the huge public investments in irrigation have been a waste or that the era of irrigation is over. On the contrary, they have made a great contribution to welfare, food security, poverty alleviation and the economy. As documented in a recent World Bank review, the benefits of most irrigation investment have also directly reached the poor. Large numbers of poor farmers have benefited directly. But equally important, since irrigation increases farming intensity, it greatly increases labor demand. A typical example of the aggregate impact on poverty comes from India -- districts with little irrigation had an incidence of poverty 2.5 times greater than in districts which had substantial irrigation. And irrigation projects -- at least those financed by the World Bank -- have substantial economic returns -- the average rate of return of World Bank-financed irrigation projects is 15%.

It is also apparent that the developing world faces immense challenges in coming decades in producing sufficient food. The International Food Policy Research Institute estimates that "the food gap" (the difference between consumption and production) in developing countries will grow from about 90 million tons in 1993 to about 230 million tons in 2020. The FAO estimates that 60% of future gains in food production will have to come from irrigation. It is evident that the era of meeting these growing needs through expanding the irrigated area is over, and equally evident that a modernized, efficient, intensive irrigated agriculture will have to play a central role.

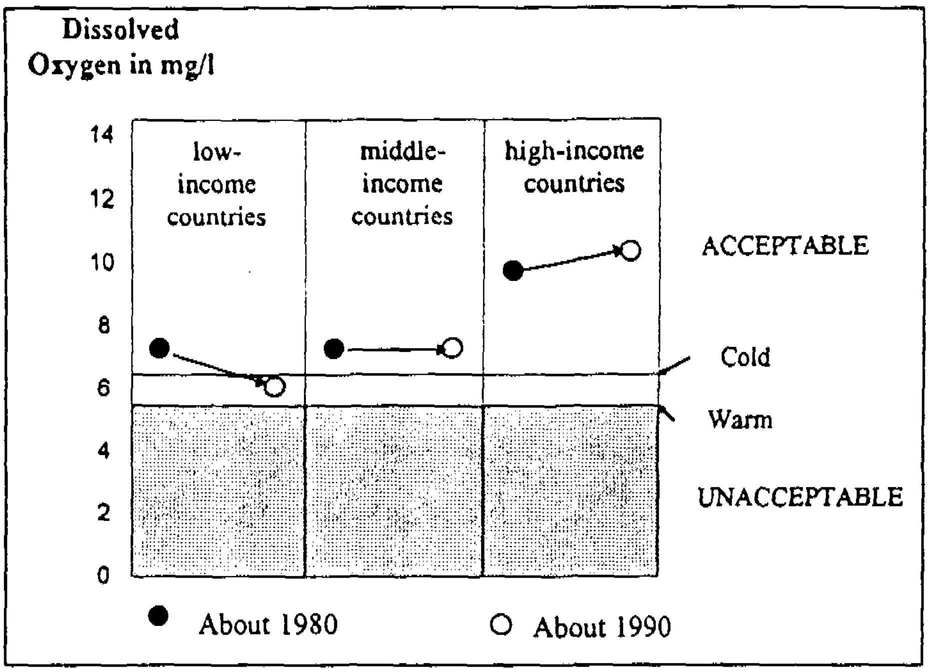



Figure 18: Surface water quality in developed and developed countries

*What does it cost, and how can investments be financed?*

At the risk of some simplification, one can discern two major approaches to dealing with environmental standards and the costs required to achieve those standards. The first approach can be characterized as the "set-the-standards-and-then-raise-the-money" approach. The prime example of this approach is the European Union, where the magnitude of investments required to meet standards is staggering. Germany, for example, needs to invest an estimated $300 billion if existing water quality standards are to be met. At current (high) investment levels this would take 40 years to achieve. (A European parliamentarian and bureaucrat was once asked how issues of cost were factored into the discussions of standards -- "Simple", he replied, "we never discussed costs"!) And if this is impossible for Germany, what about Portugal? The ingenious (and disingenuous) European solution is now to talk about "common standards but different time-tables"!

The second approach is one in which environmental quality and the required financing are considered simultaneously. The origin of this approach was in the Ruhr basin in Germany at the time of the First World War; the approach was subsequently (in 1960) adapted by France on a national scale, and it is now being used in several developing countries. The new Brazilian Water Law, for example, incorporates many of the lessons of the Ruhr/French experience.

The Ruhr-French approach is based on a coherent set of institutional and instrument principles. The "institutional principles" are those of participation, subsidiarity and technical efficiency. With respect to participation, the French River Basin Financing Agencies provide a good model -- 60 - 120 parliamentarians, representing all users and interested parties, choose the vector of water quality and cost appropriate for their basin, and decide on the assignment of costs among the public and private parties involved. With respect to subsidiarity, the basin agencies are careful never to do anything which can and should be done at a "lower" level (such as a municipality or irrigation district). Thus, while the basin agency decides on abstraction and pollution charges, it has nothing to say about whether a city chooses to have a public or private agency operate its water supply. With respect to technical efficiency, this model depends heavily on strong technical basin agencies, which ensure that basin management is scientifically and technically sound, and which advise the water parliament on the tradeoffs between standards and costs, and on how best to deploy available resources.

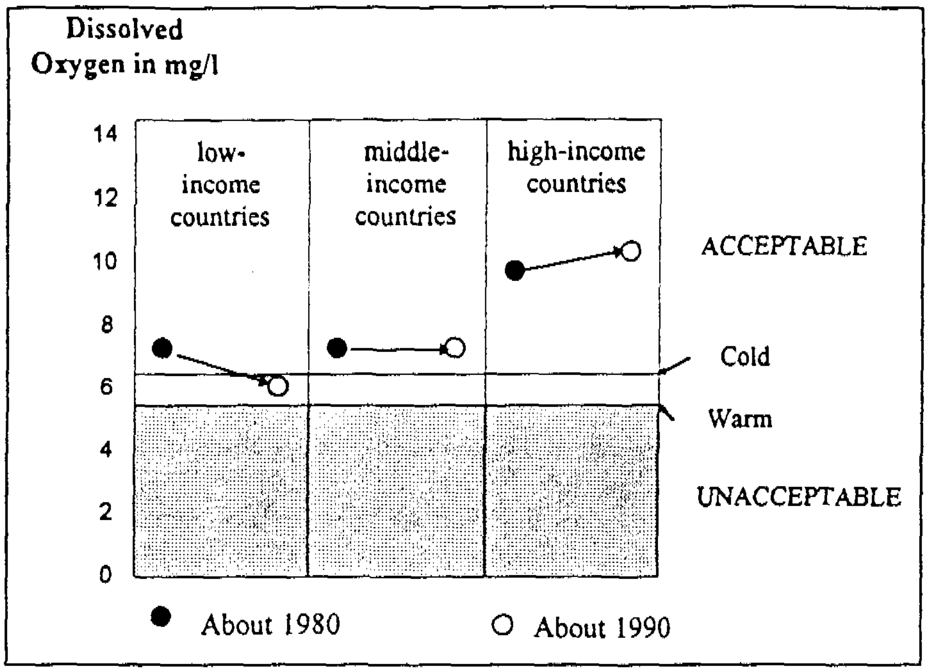



Figure 18: Surface water quality in developed and developed countries

*What does it cost, and how can investments be financed?*

At the risk of some simplification, one can discern two major approaches to dealing with environmental standards and the costs required to achieve those standards. The first approach can be characterized as the "set-the-standards-and-then-raise-the-money" approach. The prime example of this approach is the European Union, where the magnitude of investments required to meet standards is staggering. Germany, for example, needs to invest an estimated $300 billion if existing water quality standards are to be met. At current (high) investment levels this would take 40 years to achieve. (A European parliamentarian and bureaucrat was once asked how issues of cost were factored into the discussions of standards -- "Simple", he replied, "we never discussed costs"!) And if this is impossible for Germany, what about Portugal? The ingenious (and disingenuous) European solution is now to talk about "common standards but different time-tables"!

The second approach is one in which environmental quality and the required financing are considered simultaneously. The origin of this approach was in the Ruhr basin in Germany at the time of the First World War; the approach was subsequently (in 1960) adapted by France on a national scale, and it is now being used in several developing countries. The new Brazilian Water Law, for example, incorporates many of the lessons of the Ruhr/French experience.

The Ruhr-French approach is based on a coherent set of institutional and instrument principles. The "institutional principles" are those of participation, subsidiarity and technical efficiency. With respect to participation, the French River Basin Financing Agencies provide a good model -- 60 - 120 parliamentarians, representing all users and interested parties, choose the vector of water quality and cost appropriate for their basin, and decide on the assignment of costs among the public and private parties involved. With respect to subsidiarity, the basin agencies are careful never to do anything which can and should be done at a "lower" level (such as a municipality or irrigation district). Thus, while the basin agency decides on abstraction and pollution charges, it has nothing to say about whether a city chooses to have a public or private agency operate its water supply. With respect to technical efficiency, this model depends heavily on strong technical basin agencies, which ensure that basin management is scientifically and technically sound, and which advise the water parliament on the tradeoffs between standards and costs, and on how best to deploy available resources.

The instrument principle is simple, namely to use instruments which give users and polluters of water an incentive to change their behavior. There is, accordingly, maximum use of market-based instruments, with users paying for the water they abstract, and polluters paying according to the pollution they impose.

In the past, many industrialized countries financed much of their water quality investments through general taxation. For example, under the US Clean Water Act, passed in 1992, the Federal Government paid 75% of the capital costs of wastewater treatment plants. While public financing will always play a role in financing such public goods, the trend is towards more local or regional financing, and recovering a greater proportion of the costs from the direct beneficiaries.

Similar practices are now starting to emerge for non-point sources of pollution. In the Murray-Darling Basin in Australia, for instance, the major water quality problem is the high levels of irrigation-induced salinity. The Murray-Darling Basin Commission has now specified maximum salinity fluxes from its different member states. Salinity control measures are required to stay within these limits, with the costs of these control measures being passed on to irrigators in their water bills. (These costs are considerable. In the state of Victoria, for instance, irrigators pay roughly equivalent amounts -- about 1 US cent per cubic meter for water and a similar amount as a salinity levy. In the Colorado Basin it costs, on average, about $70 to remove a ton of salt. For a program which aims to reduce salinity levels by 200 ppm, this equates to a cost of about 1.5 cents per cubic meter. This is a very substantial amount -- it compares to typical irrigation water levies of about 0.4 cents per cubic meter.)

*The emergence of market-friendly management arrangements in developing countries and the contribution they can make...*

The Ruhr-French approach was developed in areas where water quality management was the major water resource management issue. Arid areas of the world present a somewhat different water resources management problem, one where efficient water allocation becomes an issue of over-riding environmental and economic importance. While the Ruhr-French principles (participation, subsidiarity, technical efficiency and use of market-based instruments) remain valid, arid areas have had to be more imaginative than simply charging users for water abstractions.

An instrument of rising importance throughout the arid world is that of "water markets". A market for water is not, of course, a new phenomenon. Informal water markets have probably existed wherever water is scarce. These markets can often be very sophisticated. -- as has been documented in the case of Gujarat in India, for example. Formal water markets have also existed on a limited scale in Spain for centuries. In recent decades, however, the scope and importance of these markets has grown substantially. Water markets now play a prominent role in all the arid Western states of the United States. Since each state has it own history and legal and institutional structure, there is wide variation in the operation of these markets -- in some water rights are separated from land rights, in others this is not the case; in some permanent sales are prominent, in others short-term leases are the only form of transaction. In Australia, too, each state has developed water markets along different lines. Since 1981 Chile separated water and land rights, and enshrined formal water markets as a central element for ensuring that water moves towards high-valued agricultural, municipal and industrial uses.

What is critical from the point of view of environmental quality, is that the environmental impact of water markets are almost all positive -- markets have meant a turning away from supply augmentation alternatives as the method of choice for meeting rising demands. They have meant that, in Australia, for example, the water has moved off of low-productivity, high-salinity areas to more productive, less destructive environments. Furthermore, water is used more judiciously, and environmental groups (including the government) are able to purchase water rights and assign these to environmental purposes (as is happening in the western United States).

*The bottom line on financing of better water quality...*

There is no global estimate of the costs developing countries now. or will, incur in financing improvements in water quality. But it is apparent that relatively little is currently spent, and virtually an infinite amount could be spent without "solving the problem". Financing of improved water quality in developing countries is going to be a long and uphill battle. Experience shows that people have a (legitimate) hierarchy of needs. When billions of people do not have access to a reasonable supply of water and do not have adequate in-house sanitation facilities, they do not want to invest in sewage treatment. And when primary treatment costs $400 per household, and people live on a few dollars a day, the problem becomes more difficult, still. In economic jargon "water quality is a luxury good", the demand for it growing as income grows.

What this means is that while economic growth can play a fundamental and positive role (in generating resources and in stimulating demand for environmental quality) developing countries are going to face their large, and mounting, water resource management and quality problems with great discipline and ingenuity. It is clear that preventive strategies (such as the use of economic instruments to stimulate careful resource use) can play a major role in reducing required investments. It means that they will have to ensure that they rigorously prioritize their needs for investments to improve water quality, and spend their limited resources only where the return is greatest.

## Bibliography

This paper draws heavily, and often directly, on work of colleagues both in the World Bank and the wider development community. The interested reader is referred to these references for details and primary sources of information. Among the major references used in this paper are


Aqua-Media International Ltd., 1997. "The status of dams and hydropower development in 1997." Reproduced in The International Journal of Hydropower & Dams.

Barnes, Douglas 1995. Consequences of Energy Policies for the Urban Poor. The World Bank Group, FPD Energy Note No. 7, on the internet at: http://www.worldbank.org/html/fpd/energy/energynotes.

Barnevik, Percy, 1997. Energy and Environment. Paper presented at the World Bank's Energy Week, Washington DC, March 13-14, 1997.

Besant-Jones, John, 1995. Attracting Finance for Hydroelectric Power. The World Bank Group, FPD Energy Note No. 3, on the internet at: http://www.worldbank.org/html/fpd/energy/energynotes.

Briscoe, John, 1995. "The German water and sewerage sector: How well it works and what this means for developing countries", World Bank Report TWU 21, Washington DC, 1995.

Briscoe, John and Mike Garn, 1995. "Financing water supply and sanitation under Agenda 21", Natural Resources Forum, 19 (1), 1-12.

Briscoe, John, 1996. "Financing water and sanitation services: the old and new challenges." Water Supply, Vol. 14, Nos. 3/4, Durban, pp.1-17.

Briscoe, John. 1996. "Water as an economic good: The idea and what it means in practice", Proceedings of the World Congress of the International Commission on Irrigation and Drainage, Cairo, 1996.

Briscoe, John. 1997. "Managing water as an economic good: Rules for reformers", Water Supply, Vol 15, No 4, pp 153-177, 1997.

Churchill, Anthony A., 1997. "Meeting Hydro's Financing and Development Challenges." In Large Dams: Learning from the Past, Looking at the Future. Proceeding of a workshop held in Gland, Switzerland, April 11-12, 1997

Churchill, Anthony A., 1997. "Hydropower: A New Business or an Obsolete Industry?" In Large Dams: Learning from the Past, Looking at the Future. Proceeding of a workshop held in Gland, Switzerland, April 11-12, 1997

Department for International Development, 1997. Priorities for Irrigated Agriculture. Water Resources Occasional Paper No. 1, London, UK: Department for International Development.

Dinar, Ariel, and Andrew Keck, 1997. "Private irrigation investment in Colombia: effects of violence, macroeconomic policy, and environmental conditions." Agricultural Economics 16(1997): 1-15.

Food and Agriculture Organization, 1997. FAOSTAT Statistics Database. On the internet at: http://apps.fao.org. Rome, Italy: FAO.

Garn, Harvey A, 1990, "Financing Water Supply and Sanitation Services", a paper prepared for the Collaborative Council As a Background Paper for the Delhi Conference, Water Supply and Sanitation Division, World Bank, Washington DC.

Garn, Harvey A, 1987, "Patterns in the Data Reported on Completed Water Supply Projects", Water Supply and Sanitation Division, World Bank, Washington DC

Hasan, Arif, 1986, "Innovative Sewerage in a Karachi Squatter Settlement: The Low-cost Sanitation Programme of the Orangi Pilot Project and the Process of Change in Orangi", Orangi Pilot Project, Karachi.

Hasan, Arif:, 1990, "Community Groups and NGOs in the Urban Field in Pakistan," Environment and Urbanization 2.

Lenton, Roberto L., and Carlos Garcés-Restrepo, 1995. "Institutional, Managerial and technological Innovation in Latin America Irrigation: Relevance to Global Irrigation Improvement." Water Resources Development, Vol. 11, No. 4.

Repetto, Robert, 1986. Skimming the Water: Rent-seeking and the Performance of Public Irrigation Systems. Research report # 4, Washington, DC: World Resources Institute.

Serageldin, Ismail, 1994, Water Supply, Sanitation and Environmental Sustainability: The Financing Challenge", Directions in Development Series, World Bank.

So, Jae, and Ben Shin, 1995. "The Private Infrastructure Industry - A Global Market of US$60 Billion a Year." In Public Policy for the Private Sector, on the internet at: http://www.worldbank.org/html/fpd/notes.

Trembath, Barry, 1997. Constraints to Hydropower Development in a Privatizing Sector. Paper presented at the World Bank's Energy Week, Washington DC, March 13-14, 1997.

Ulfsby, Oyvind, 1997. Project Financing of Hydropower Projects in Developing Countries: Some Issues Worth Discussion. Paper presented at the World Bank's Energy Week, Washington DC, March 13-14, 1997.

World Bank, 1992c, Water Supply and Sanitation Projects, The Bank's Experience - 1967 - 1989, Operations Evaluation Department, Washington, D.C.

World Bank, 1992d, World Development Report 1992, Development and the Environment, Washington, D.C.

World Bank, 1993. Water Resources Management: A World Bank Policy Paper. Washington, DC: The World Bank.

World Bank, 1994. A Review of World Bank experience in Irrigation. Operations Evaluation Department, Report No. 13676, Washington, DC: The World Bank.

World Bank, 1993. Arab Republic of Egypt:Public Sector Investment Review. Country Department II, Country Operations Division, Middle East and North Africa Region. Washington, DC: The World Bank.

World Bank, 1996. Bangladesh: Public Expenditure Review. Country Operations Division/Resident Mission, Dhaka. South Asia Region. Washington, DC: The World Bank.

World Bank, 1997. Ethiopia: Public Expenditure Review. Resident Mission in Ethiopia, Country Department 6: Ethiopia, Eritrea, Somalia, Sudan, Africa Region. Washington, DC: The World Ban.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# *Financing of Freshwater for All - A Rights Based Approach*

by

Ashok Nigam and Sadig Rasheed

Paper No. 2

Prepared for the
Department of Economic and Social Affairs
United Nations

# Financing of Fresh Water for All - A Rights Based Approach

by

Ashok Nigam and Sadig Rasheed *
UNICEF, New York

*"All people have a right to have access to drinking water..."* Mar del Plata, 1977
*"Some for all rather than more for some"* New Delhi Declaration, 1990
*"Water is an economic good"* Dublin Declaration, 1992
*"Satisfy the freshwater needs of all countries."* Agenda 21, Rio Earth Summit, 1992
*"Efficient and effective use of the available funds"* Ministerial Conference, Noordwijk, 1994

The international declarations in water supply and sanitation in the last two decades have emphasized the right to water and covered a range of criteria for the mobilisation and allocation of financial resources. Yet, by the year 2000, it is projected that almost 750 million people will not have access to safe water supply and 3.3 billion will not have access to environmental sanitation.

More alarming still are the predictions of water scarcity. The United Nations estimates that "..some 80 countries, comprising 40 per cent of the world's population, are already suffering from serious water shortages and that, in many cases, the scarcity of water resources has become the limiting factor to economic and social development". Further, "ever increasing water pollution has become a major problem throughout the world, including coastal zones" (United Nations, 1997). In this paper we argue that fresh water for all is achievable early in the next millennium if a rights based approach is adopted by governments for the mobilisation and allocation of financial resources.

The challenges in fresh water for all are twofold: ensuring sustainable financing and environmentally sound use of water resources. In this paper the term fresh water will refer to the availability of water resources for all its competing and conjunctive uses - agriculture, industry and domestic - with primacy for the latter, and for the maintenance of the ecosystem taking account of future generations. The rate of abstraction of water resources and its utilisation must recognize the limitations of the resource base in specific locations at specific times and ensure sustainability of the eco-system. The "fresh water environment" includes environmental sanitation because of its impact on health through pollution and water borne diseases.

---

* Sadig Rasheed is Director, Programme Division, and Ashok Nigam is Policy Analyst, Division of Evaluation, Policy & Planning, UNICEF, New York. The authors are grateful to Marta Santos Pais, Gourisankar Ghosh, Alfredo Missar and Jan Vandemoortele for their support and comments. The paper reflects the views of the authors and not necessarily those of UNICEF.

Fresh water is a renewable but finite resource in a given environment. Ninety seven per cent of all water on earth is salt water - unsuitable for drinking or growing crops. Of the remaining 3 per cent most is locked away in the polar ice caps. Only 0.3 per cent of the total fresh water reserves on earth are found in rivers and lakes which along with ground water forms the bulk of the water for drinking (10 per cent), industry (21 per cent) and agriculture (69 per cent) (Gleick, 1993; Shiklomanov, 1993).

While fresh water is a renewable resource following the hydrological cycle, it is not evenly distributed. Adequate quantity and quality of water is not available when and where it is needed and pollution and unsustainable abstraction of water resources has enormous environmental, socio-economic and health implications. The global fresh water crisis is in actual fact a local level crisis. It is a crisis in time (particular periods during the year) and in space (particular locations) as shown by a number of case studies (Nigam et. al. 1997; IUCN & PRB 1997).

## Water as a human right

The Universal Declaration of Human Rights (1948), Article 25 states that *"Everyone has the right to a standard of living adequate for the health and well-being of himself and of his family, including food, clothing, housing and medical care and necessary social services.."* Article 22 of the Declaration confers on everyone *"..economic, social and cultural rights indispensable for his dignity and the free development of his personality"*. The Vienna Declaration and Plan of Action on Human Rights 1993, further reaffirms the ***right to development*** as a "universal and inalienable right and an integral part of fundamental human rights". Fulfilment of this right requires "effective development policies at the national level, as well as equitable economic relations and a favourable economic environment at the international level. The right to development should be fulfilled so as to meet equitably the developmental and environmental needs of present and future generations".

Water is essential for life and development. It fulfills all of the criteria to qualify as a fundamental human right. The Vienna Declaration calls for policies and strategies which take full cognizance of the needs of future generations. This is no where more true than in fresh water management because of the implication for water availability if the 'water environment' is degraded. Deforestation, soil erosion, agro and industrial pollution of water sources, and declining water tables, as a result of over-exploitation for irrigation, have now become major problems in many parts of the world.

This right to survival, protection and development has been further reinforced for children in the Convention on the Rights of the Child (CRC). Article 24 of the CRC calls on State Parties to recognize the right of the child to the enjoyment of the highest attainable standard of health and in implementation of this right through ".... inter alia, the application of readily available technology and through the provision of ...clean drinking water, taking into consideration the dangers and risks of environmental pollution". The State must also ensure hygiene and environmental sanitation. This implies that fresh water use must take full account of the costs of environmental protection.

The welfare of future generations can often be compromised in strategies to meet the challenges of the present.

## Role of the state, NGO's and civil society

The role of the state in ensuring access to water for all and environmental sanitation must be interpreted in the context of both human rights - political, civil, economic and social - and child rights, both of which call for the satisfaction of basic needs. Access to safe water, environmental protection and sanitation are economic and social rights. All human beings are entitled to basic levels (as defined in the national context) of drinking water supply and environmental sanitation with environmental protection for the welfare of present and future generations. State Parties are urged under both the Vienna Declaration and the CRC to undertake measures to meet these rights to the maximum extent of their available resources.

### *The congruity between rights and economic efficiency*

In the allocation of scarce resources, national governments are often faced with difficult choices. The economic criteria governing the allocation of scarce resources has been derived from theories of Pareto optimality, second-best and where market failures exist, compensation of the losers by the gainers. The role of the state becomes increasingly important in cases of market failure. The market is also inefficient in taking account of equity and inter-generational considerations.

In arriving at the conditions for efficiency, the market allocation mechanism takes as a given the initial resource endowment across individuals and households. But the efficiency frontier depends very much on the distribution of the initial endowment of resources. This is to say that if the initial endowment of resources and capabilities is changed to ensure that rights are met, then alternate but efficient outcomes can still be achieved. These outcomes can be both more equitable and efficient. But the inequities that prevail in the initial conditions - endowments and capabilities - are not the primary considerations of the market. Moreover, to the extent that it is political economy rather than purely market forces that drives the decision-making on the allocation of resources, the role of rights in influencing those decisions is of fundamental importance.

The allocation criteria based on rights would ensure the fulfilment of basic needs and compensate to some extent for the inequity in the initial endowments and capabilities. The rights based approach is not at odds with that based on economic efficiency. Decisions in political economy must be informed by the overarching framework of human and child rights.

One can find a formidable ally for a rights-based approach in Sen (1987) who acknowledges the shortcomings of a pure economists way of analysis: "moral rights and freedom are not, in fact, concepts for which modern economics has much time. In fact, in economic analysis rights are seen typically as purely legal entities with instrumental use rather than any intrinsic value".

Sen argues for the role of freedom and rights in achieving well-being as well as offering choices on which much of economic reasoning is based.

The rights based approach to development, within which meeting of fresh water for all is one challenge, provides the political, moral, ethical and legal imperative for more equitable allocation of resources. Thereafter, the criteria for economic efficiency can be postulated. The rights based approach to financing fresh water for all, therefore, calls for ensuring that the fundamental right to basic levels of service[1] is met. If these initial conditions for the distribution of resources and enhancement of capabilities are achieved, then the market mechanism can reach an efficiency frontier which is more equitable and just.

### *Public and private goods from a rights perspective - who should pay?*

The role of the state in public finance has often been looked at in the context of public and private goods in order to determine who should pay for what type of services. It is argued that because the benefits from water supply such as time savings, amenity and health benefits accrue to the household, the public finance principle dictates that the bulk of the costs should be borne by the households themselves. By the same principle, because there are strong positive exernalities in sanitation whereby the benefits accrue to the community as a whole from safe excreta disposal, the costs outside the household should be borne by successive levels from block to district, state and national (Serageldin, 1995; Briscoe and Garn, 1995).

In the case of water and sanitation the distinctions between public and private goods is not easy. Water borne diseases in many parts of the world are a health hazard. The positive externalities mean that the nation as a whole will benefit from improved access to safe water and sanitation through productivity gains and reduction of the cost of health care.

The public-private criterion for the allocation of resources must not obviate the state's responsibility to ensure that basic levels of services are provided. While the state has primary responsibility to ensure access to water and sanitation, it cannot even with its best efforts shoulder the sole responsibility for its provision and operations of maintenance of the facilities. Non-governmental organizations and civil society have historically played a major role. The example of Orangi in Pakistan (Box 1) shows the scope and impact of such partnerships.

The lesson from Orangi suggests that not only do NGO's and civil society play a critical role in ensuring fresh water for all but if actions by the state are motivated from the rights perspective there can be powerful strategic alliances between the state and civil society. The major change in

[1] Basic level of service must be defined in the national context. In general, safe water supply should be available throughout the year within a reasonable distance from the home in rural areas. For urban areas, the criteria may be defined as accessibility within the home or through a yard tap. The determination of reasonable distance is important because of the time spent by women and girls in fetching water which impacts on health and school attendance.

the policies of the state in the case of Orangi was the granting the residents title to the land that they had been living on which provided civil society the motivation for action. The community was able to design cost-efficient financing mechanisms on its own without profit-seeking intermediaries. The key constraint was not lack of financial resources but the political decision by the state to confer rights to people.

**Orangi Sanitation Project**

About 40 per cent of Karachi's population lives in squatter communities, called *katchi abadis*. These are dynamic new neighbourhoods developed on the edge of the city over the past 25 years by enterprising migrants from rural areas. The rich in Karachi have modern sanitation with flush toilets in the homes and underground sewers. Most of those in the *katchi abadis* had only bucket latrines and open sewers. In the 1970s the municipal government made a major shift in policy by accepting that these settlements were here to stay. This was a key step because it enabled people to buy titles to their homesite, giving them a sense of permanency and the incentive to invest in improvements. In 1980, Akhtar Hameed Khan formed an organization called Organi Pilot Project to tackle the sanitation menace in one of these *abadis*.

Orangi is home to about 1 million working-class people - skilled labourers, clerks, shopkeepers - with family incomes averaging about 1000 rupees (US$30) per month. The residents had formed numerous community associations that relentlessly pressed their demands with the authorities, but they were getting nowhere. OPP was set up to help them develop a sanitation system themselves after repeated requests to the municipal authorities was getting them nowhere.

Seventeen years later virtually every home in Orangi has a pour flush toilet connected to an underground sewage line. OPP provided technical advice and plans for a simplified design, which reduced the cost by a factor of 10. Each family invested about a month's income to buy materials and hire labour. Government contractors who often pad their costs were avoided. Significant improvements are now seen in school attendance, loans for small businesses, and health. The key Organi lessons are that adequate sanitation is fundamental to improving living standards; that people are willing and able to pay for sanitation if costs can be controlled through community initiatives; that ownership of land and houses in urban areas is an essential prerequisite for private investments in sanitation; and that collective efforts of ordinary people can push aside roadblocks of bureaucrats.

*Source: "The sanitation gap: Development's deadly menace" by Akhtar Hameed Khan, UNICEF, Progress of Nations 1997.*

Recognizing some of the lessons learned in the sector the New Delhi Declaration (UNDP 1990) envisaged the role of the government to transform from that of provider to that of promoter and facilitator. At the Dublin International Conference on Water and the Environment (1992), the lessons learned suggested that water should be treated as an 'economic good'. While no clear interpretation of this term was provided, it is generally interpreted that water should have a 'price'.

Pricing of water is seen primarily with respect to its domestic and manufacturing use not so much for agriculture. With the exception of surface water supply which can be controlled and regulated, legislation and control of ground water varies from country to country. For example, In India, the owner of the land has right to the water beneath it under common law. By contrast, in Mexico, the landowner has no such rights. In the context of competitive use of the resource, which has resulted in water scarcity for domestic purposes as a result of over-extraction for irrigation, there is an increasing need to consider pricing of water for agricultural use also. In the absence of the price mechanism covering all the uses of water and protection of the environment, the emerging problems of scarcity will be difficult to tackle. Needless to say, pricing of water for agriculture is a much more difficult task, politically and operationally because of the system of water rights such as in India and the difficulty to monitor and control the amount of ground water extracted.

The nature of the fresh water sector suggests that market forces alone will not be able to address the problems of water scarcity, access to safe drinking water, competitive and conjunctive uses of water between domestic, agriculture and industry, sanitation and environmental protection. The state has an important role to play in setting the standards to be met in the extraction and use of water resources, including regulating and monitoring compliance regardless of whether services are government owned or privatized. Unfortunately, most developing countries do not have appropriate regulatory frameworks. The difficulty in setting up such frameworks is the lack of experience, relevant skills and expertise. Moreover, because of the political sensitivity of the sector, the issues are highly charged and many governments in developing countries lack credibility as a regulator.

### *Willingness and ability to pay*

The growing trend towards market-based approaches for meeting basic needs has gathered momentum in the water supply and sanitation sector. Through a number of studies it has been contended that people are willing to pay for water supply. Willingness to pay studies became a major justification for instituting charges for water supply in rural and urban studies. Since the principle of payment for urban services was generally accepted although recovery was low, the chief focus was on payment for rural water supply and in particular by the poor. The evidence cited was derived from contingent valuation surveys and from what people already pay for often inferior services. Thus, for example, it has been shown that in many peri-urban areas the poor are often paying up to 20-30 per cent of their income for water (Briscoe and Garn, 1995).

In a study in five cities in Morocco it was found that households are willing to pay more than the 5 per cent of total household expenditure - an unofficial norm in the sector - for individual water services (Mcphail 1993). Such evidence in conjunction with the need to ensure a demand based approach for sustainable operation and maintenance of services has been used to justify cost-recovery in water supply.

The willingness to pay approach suffers from a number of inherent weaknesses as pointed out by Reddy & Vandemoortele (1996) in the context of social sectors. Water being life, it is not surprising the people would be willing to pay for it. In December 1997 the New York Times reported on the willingness of people in Indonesia to sell their precious gold for water in the wake of the massive forest fires that engulfed the nation. Willingness to pay analysis in water supply fails to pay adequate emphasis on the ability or capability of poor households to pay for basic levels of services when they have to pay for all the other basic needs such as health and education (Ghosh and Nigam 1995).

Second, although women are the main fetchers of water, their willingness to pay may not be matched by ability, because of their lack of control over household income. The dynamics of household decision-making, control over material and non-material assets and the overall economic and social burden needs to be built into the analysis (Cleaver and Elson, 1995, Cleaver and Lomas 1995).

Finally, from a rights and public good perspective, the public health argument to justify widespread provision of these services by the state is being replaced under the guise of economic efficiency criteria with calls for individual valuation of the benefits. By equating the monetary payment that individuals are willing to make or already make, the willingness to pay technique suggests that the preferences that people express in such a manner to meet what is after all a basic need for survival is equivalent to welfare. (Cleaver and Lomas 1995, Sen 1979).

Recognizing the centrality of rights to basic levels of service, willingness and ability to pay and the resource constraint faced by national governments, UNICEF's strategy calls for ensuring that basic levels of service are met through community cost-sharing of capital and recurrent costs while the full capital and recurrent costs of higher levels of services is to be recovered in order to generate additional resources to extend basic services and ensure their sustainability (UNICEF, 1995). Such a strategy recognizes the need to ensure that the provision of higher levels of services does not hinder the achievement of the right to at least the basic levels of service for all as defined in the national context. Equally, it does not preclude cost-sharing by communities for even basic levels of service.

### *Investments in water and sanitation*

Investments in water supply and sanitation and allocation of government budgets have been difficult to track. In part, this is because a number of sectoral ministries from health, water resources, agriculture, and infrastructure development are engaged in the provision of domestic water supply and sanitation and hence the data is dispersed. Moreover, no distinction is made between low-medium and high cost investments.

An estimated $134 billion was spent in the water supply and sanitation sector in developing countries in the 1980s - the International Drinking Water Supply and Sanitation Decade (WHO 1990) - three-quarters of which was on high cost urban systems. In relation to the estimated total require ment of US$5-9 billion a year (UNICEF 1994) for universal water supply and sanitation coverage in rural and peri-urban areas using low-cost technologies, there is a need to at least double the investments from the level of the 1980s of about US$3 billion a year on such systems.

Increasing populations in urban areas have severely strained the already low levels of services in many cities of developing countries. Lack of proper urban sanitation facilities is having a dramatic impact on health as witnessed by the plague and dengue fever in parts of India and cholera outbreaks in Chile. A $13 billion annual investment in water supply and sanitation in 1990's is less than 8 percent of the $170 billion spent on health in 1992 in developing countries (World Development Report 1993) and the estimated $200 billion per annum spent on total infrastructure (including power, telecommunications, roads, water supply and sanitation) (World Development Report 1994). Of the total investment in infrastructure only about 6.5 percent is in water supply and sanitation.

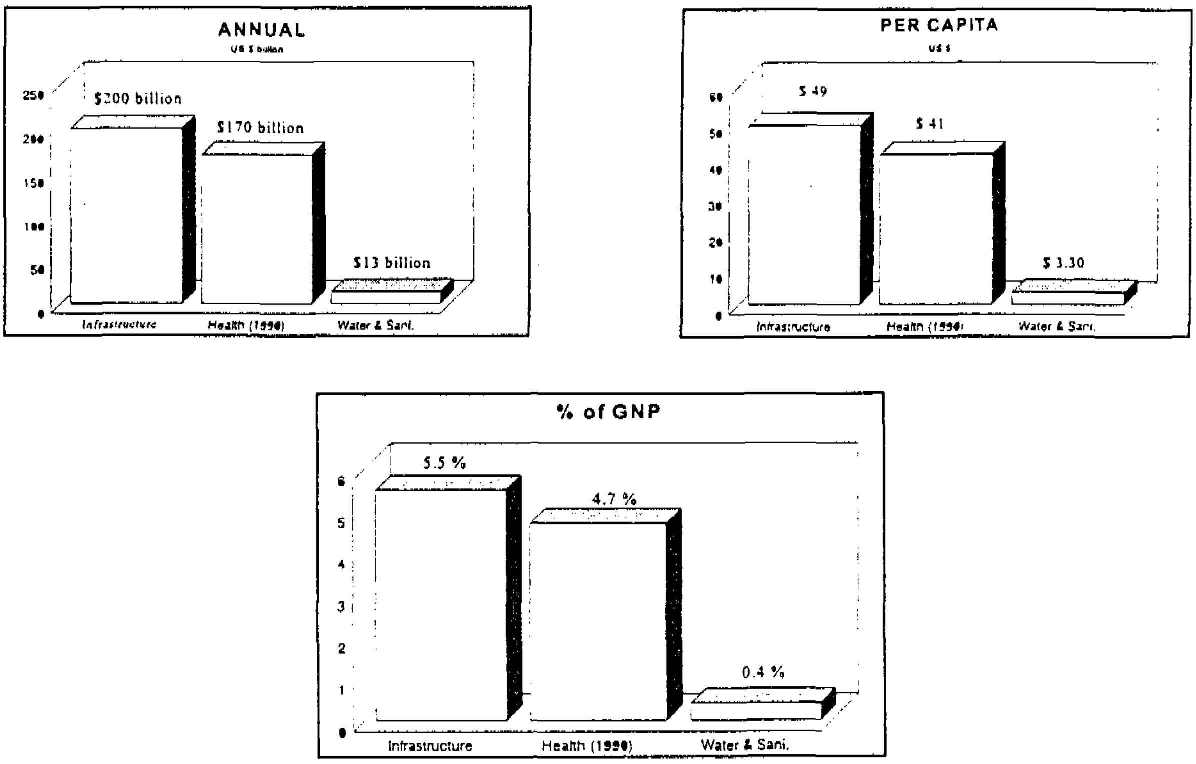
Investment in water supply amounts to about 0.4 percent of the GNP of developing countries (WDR 1994) compared to 4.7 percent for health and 5.5 percent for infrastructure. This represents only about $3 per capita for water supply and sanitation; compared to $41 for health and $49 for infrastructure as a whole (Figure 1). Investments in the water and sanitation sector have been woefully inadequate. Public investment must be complemented by greater private investment in the future, both of which must be guided by the rights based approach to ensure basic levels of services for all.

### *The 20/20 Initiative*

Article 4 of the Convention on the Rights of the Child calls for State Parties to meet the rights of children to the "maximum extent of their available resources". It would be true to say that most developing countries can do more. The 20/20 initiative agreed upon at the World Social Summit in Copenhagen calls for an agreement on a mutual commitment between interested developed and developing country partners to allocate, on average, 20 per cent of Overseas Development Assistance (ODA) and 20 per cent of the national budget, respectively, to basic social programmes including low-cost water supply and sanitation, basic education, primary health care, nutrition and reproductive health (UNICEF, 1994; United Nations, 1995).

Current estimates suggests that developing countries on average are spending only about 13 per cent of government budgets and about 10 per cent of ODA is spent on basic social services. The attached note on 20/20 for Water and Sanitation prepared by IRC, Netherlands Ministry of Foreign Affairs and UNICEF examines in depth the scope of this initiative for this sector and the efforts underway for its implementation. Clearly, more can be done through public finance, including the re-structuring of inter and intra-sectoral expenditures in favour of basic social services. In addition, the efficiency and effectiveness of current investments can be enhanced.

Figure 1
**ESTIMATED ANNUAL INVESTMENT IN DEVELOPING COUNTRIES**




*Reaping the efficiency dividend for fulfilling rights of fresh water for all*

It has been argued that the goal of universal access to water supply and sanitation cannot be met without efficiency and effectiveness in resource use; additional resource allocation; and the use of alternate financing mechanisms (Nigam & Ghosh, 1995). The water supply and sanitation sector is highly inefficient with significant water loss from leakages in urban areas and inefficiency in utilisation of water for agriculture. It is estimated that China's network of 600,000 km of underground pipes waste US$360 million worth of water each year. A saving of 1 per cent could supply 6.5 million people with water for one year (Financial Times, July 30, 1996). In an environment of water scarcity where there are competing users of fresh water wastage by other sectors also constitutes a significant loss. In India, it is estimated that 60 per cent of irrigation water is wasted by seepage through unlined field channels and due to over application (TERI, 1997).

There are a number of other examples of inefficient utilization of funds in the sector. In Kerala State of India for example, during the period 1977/78 to 1989/90, while water supply coverage has doubled, real investment in the sector increased sixfold indicating that real unit costs more than trebled (Pushpangadan et. al. 1995). Inefficiencies and subsidies for the rich work against the fulfilment of rights of all because they take away scarce financial resources for meeting the rights of those who do not have access to basic levels of services. Cost recovery in urban water supply in many developing countries is only about 30 per cent - the rich in urban areas benefit from government finances and subsidies (Briscoe & Garn, 1995). Increasing this percentage will depend very much on improvements in the *quality* of services provided, *quantity* of water available to the household in relation to the total volume of water pumped and *reliability* of services - QQR principle (Nigam, 1996). Failure to improve efficiency of services impinges on the rights of those that do not have access to basic levels of services.

## Privatisation and private sector financing within a rights-based approach

Quite apart from considerations of whether water and sanitation are public or private or economic goods, the inability of the state to meet the basic levels of services in rural and urban areas due to political, financial and institutional constraints and the high degree of inefficiency that has prevailed in the sector has led to a growing recognition that the private sector can play a major role in achieving the fundamental right of all to safe water and enviornmental sanitation .

A wide range of possibilities have been suggested in private financing of public infrastructure from NGOs, to contractual arrangements for service delivery and operations and maintenance by the private sector, to franchising and ultimately the sale of public property to private investors with the rights to engage and manage all aspects of service delivery and operations and maintenance.

The domestic private sector will be an important source for both capital and service delivery. Thus, for example, a number of country experiences now show that services can often be delivered more cheaply and efficiently by private contractors than by the government. The expansion of the handpump programme in India testifies to this. The costs of boreholes has been halved in the case of Zambia by the use of private contractors. Similarly, incentives for the private sector for the production and sale of sanitary latrines and imparting health messages through rural sanitary marts in India has been shown to be a cost-effective strategy. Provision of household sanitation facilities should be based on the principle of effective demand. (Nigam and Ghosh, 1995).

The role of the state is also increasingly being called into question in the context of growing liberalisation and globalisation of economies. In such an environment, privatisation of water utilities and private sector financing is increasingly being looked at as a major market-based approach for sustainable financing of water supply and sanitation. Experiences in privatisation in developed countries such as the United Kingdom, private sector financing of the public sector such as in France through concessions (a contractual arrangement between the public authority and private enterprise which is generally accompanied by subsidies and risk sharing whereby the public sector contracts the private to act in its stead through the delegation of specific authority) and in developing countries such as South Africa have provided models such as Umgeni Water Board (Box 2) for other countries.

Liberalisation, privatisation and globalisation of markets is also affecting the direction of flow of natural water resources across national borders. In such an environment, water becomes yet another resource that can be bought and sold on international markets. It is now not uncommon to think of tanker loads of water being transported from water abundant regions to water scarce regions. This issue gained prominence in the aftermath of the North American Free Trade Agreement (NAFTA) which opened up the possibility of large scale transfer of water resources from Canada to California. In the case of developing countries which are severely strapped for resources, it may not be uncommon for them to enter into agreements for the shipment of water to scarce regions. The long-term implications, including environmental impacts of such large scale transfers in the exporting country have yet to be analysed systematically since this is a relatively new phenomenon. But globalisation of international markets has introduced trading in water as a distinct possibility with its consequent and as yet uncertain implications for livelihoods and the environment in relatively water abundant regions.

Despite the trend towards privatisation of water utilities, it is perhaps worth noting that in most of the developed countries provision of water supply and sanitation had until recently been considered to be primarily a 'state' responsibility and continues to be so in many of them. Those that have privatized have done so only after the basic infrastructure had been well developed. Privatisation of water and sanitation services in developed countries did not come about until full coverage had been assured by the state. Indeed, under the principle that the market would not be interested in 'lame ducks', water utilities have to be profitable ventures in order to be candidates for privatisation. The private sector has been willing to fund public infrastructure but whole sale privatisation of public water utilities is a relatively new phenomenon.

There is an important distinction between using the private sector for service delivery, promoting private sector investment in the sector, both in principle to be encouraged, and private sector ownership and management of the water supply and sanitation utilities or privatisation.

A key consideration from a rights perspective is whether privatisation can ensure access by all to at least basic levels of services in a non-discriminatory manner; or whether privatisation will lead to a balkanization of the market with the profitable sectors being passed in to the hands of private shareholders and the poor and marginalised groups being forced to purchase water at much higher rates than in the privatized sector - or left to the state which, having lost the profitable sector to cross-subsidize the disadvantaged segments of society, finds it increasingly difficult to finance the provision of services to marginalised groups.

These questions are, however, often pressed aside in the rush to encourage private capital flows - domestic and foreign - for infrastructure development. The conditions necessary for private sector flows, particularly external - sound macroeconomic environment, and consistent and 'friendly' economic and regulatory policies towards private sector utilities - become the primary objective of government actions. Only a handful of developing countries are presently beneficiaries from foreign direct investment in general and to the water sector in particular.

Although, private sector flows can compensate for inadequate and inefficient public investments, without adequate regulatory mechanisms they cannot guarantee access by all and ensure environmental sustainability. Privatisation must also not compromise accountability - both to the market and society. Calls for privatisation must be mindful that the efficiency of such institutions assumes the existence of corporate governance - an assumption which may not always hold in some developing countries. Hence privatisation must be accompanied by corporate governance.

There may be reasons for optimism in privatisation if companies operate in a socially responsible manner as in the case of Umgeni Water Board (Box 2). Their reason for doing so arises not from being welfarist, but the realization that the long-term growth of the private sector in water supply and sanitation depends very much on ensuring environmental sustainability. Lack of basic services for the poor can impact on the environment of the basin on which the private company is dependent for its revenues. It is in its interest to bring communities within its basin into the ambit of improved services. But this will not happen automatically. The state will need to play the role of guarantor of services to the poor, protecting them from the inequity of the market, and regulator of private utilities in the sector.

**Box 2. Umgeni Water Board: Expanding access to improved levels of services through the private sector.**

Umgeni Water, the largest water utility in the province of Natal, South Africa takes a long-term view in the provision of water supply to a catchment of 24,000 Km. and a population of 5.5 million people of which 1.5 million are rural. Development and growth has put the water resources under stress. The utility identified a major source of pollution to be from the discharge of raw and untreated sewage into the basin resulting from increased urbanisation and informal settlements. In addition, soil erosion in the headwaters was causing increasing silt loads in rivers and reservoirs. As a result the cost of water supply to urban users was increasing due to expensive treatment processes.

To counter these long-term effect, the utility started providing water supply to rural areas also demonstrating that services could be provided jointly to rural, peri-urban and urban areas in a cost-effective manner with full cost recovery for the operations and maintenance cost. The utility covered the capital cost by a capital subsidy from the urban to the rural areas which, when a broader perspective is taken of the environment and long-term cost price relationships, is essentially seen to be of benefit to the urban dwellers. The utility charges households the full capital cost for house connections and recovers the full recurrent costs. Umgeni Water is a parastatal which receives no subsidy. It is triple A rated on the stock market and issues its own bonds.

*Source: Nigam and Ghosh (1995)*

## Micro-finance and other credit mechanisms

A key aspect in treating domestic water supply and sanitation as economic and social goods is to enhance the capabilities of households to pay for these services. Participatory rural appraisals in a number of countries have shown that water is a priority and people may well be willing to pay for these services. But for the reasons noted above, their ability to pay for these services should also be enhanced. Microfinance, small loans for the purpose of income generating activities and support for other business services along with savings mechanisms, can play a crucial role in increasing access to fresh water for all.

There are now a number of experiences in microfinance which indicate its potential for meeting the domestic water and sanitation needs. Grameen Bank in Bangladesh, is by now a well known provider of credit to over two million of the poor and landless, mainly women. It provides small loans for income generating activities. Since 1992, it has also provided loans for tube well and sanitary latrines. Within a period of one year these loans tripled to US$18 million. The income generated from self-employment loans has allowed families to both improve their water and sanitation facilities and to repay the loans taken specifically for water and sanitation. When loans are made to women, one of the first benefit for households is improved water supply and sanitation. In the Family Development Fund microfinance scheme in Egypt supported by UNICEF, one of the first uses of the net income from their self-employment activities is to pay for the capital cost of water connections to the house.

Other models have consisted of a revolving fund for covering capital costs. The capital costs are recovered over a period of time with regular recovery of the recurrent costs. In such approaches the community has to mobilise and manage the resources themselves. The model of Tegucigalpa in Hondurus is now well known (Box 3).

There is considerable scope for using microfinance and alternate credit mechanisms for financing water supply and sanitation services. In microfinance schemes which are based on groups and require group meetings there is also scope for imparting health, hygiene and environmental protection messages. Both microfinance and revolving credit schemes

**Box 3. The Tegucigalpa Model**

Prior to the start of the programme in Tegucigalpa, most of the peri-urban communities had difficult access or totally lacked water and had to buy it from private vendors at high commercial prices and/or collect rainwater in the wet season. Families used up to 30% of their already low income to purchase water.

The programme set up a revolving fund for construction of water supply facilities. The community actively participates by providing manual labour and purchase of part of the construction material. The contributions to the cost are approximately 40%, the national water and sewage authority 25% and UNICEF 35%. The cost recovery system recovers fully the operations and maintenance and capital costs of the investments. The community decides the speed with which to pay back the revolving fund.

By the end of 1996, approximately 150,000 people in 80 communities will have benefitted from the water supply programme and about 5,000 in four communities from the sanitation component.

*Source: Torres X and A.M. Mooijman, Waterfront, 1996.*

require a long-term commitment and building national capacity.

## Community initiatives and public-private partnerships

One of the important lessons in the water and sanitation sector in the 1980s and 1990s is the fundamental role that communities play in any sustainable financing strategy. Many of the communities are not ripe for private sector initiatives. Placing undue reliance on private capital to finance public infrastructure runs the danger of marginalizing many poor people unless this investment is also socially responsible. But, community initiatives have in many instances shown potential for sustainability and replication.

The motivation for community initiatives arises from the shared nature of the resource base, whether ground or surface water and the implications of unhygienic conditions as a result of improper sanitary practices. Even for the protection of the fresh water environment success can be achieved only when the community participates in decision-making and sees a stake for itself in the protection of the environment. The latter goes beyond the rhetoric of stakeholder participation. The greater the control that the community has in the management of the fresh water environment and benefits from it, the higher the probability of success. For this purpose the community must be aware and appreciate the consequences of actions that impact on its environment. This is true for example for the promotion of sanitation and control of deforestation.

In Guatemala city, the El Mezquital squatter slum, with 9,400 families has been able through community initiatives to ensure improved water supply and sanitation facilities for its residents. Like many squatter settlements the families did not have rights to the land that they had invaded and as a result received no help from either national or local government agencies. However, the community and children living there were still subject to health risks. After an outbreak of typhoid UNICEF was approached to improve water supplies in the settlement. As an initial step UNICEF in co-operation with NGOs and the community provided 13 community water taps and health care to the residents. This small step which was brought to the attention of the government provided the basis for a dialogue in the form of the creation of a Commission to look into the issues and the alternatives, including linking of the local community to other agencies and resources.

The important innovation of the programmes was the recruitment and training of community volunteers called *reproinsas* to develop a health care and monitoring programme. The *reproinsas* save the community money and reduce pressures on costs within the hospital system by providing preventive care facilities. The initial water and health intervention was expanded to develop income generating activities through credit programmes. In turn, this allowed for improving water supply and sanitation facilities in the settlement which were not priorities for he municipality but very much so for the communities, even over health services.

The Commission helped the community to approach the municipal water enterprise for the installation of a 'corporate' or single source water tank in the neighbourhood. From this single source the community created a supply network to reach individual residences. Each family carried out and paid for the work for its own connection. The local community association received one large bill from the water company and then collects fees from residents according to usage measured by individual meters.

Although, the cost of water paid by households in El Mezquital is more than that paid by those in the city connected to the city's water supply, it is far less than the exorbitant rates that had previously been charged by private tanker water supply firms. In another scheme, residents constructed a 305 meter community well which now provides 80 liters of water per person per day for each of the 2000 families connected to it at a cost that is 25 to 60 per cent lower than that from other sources. The project also improved the sanitation facilities: 500 dry latrines installed, 3,000 existing latrines improved (Espinosa and Lopez, 1994).

Community initiatives also play a critical role in rural settings where the dynamics of water use for domestic and agricultural purposes often puts considerable stress on water resources. In Narsipur village, Gujarat State in India, the community has taken initiatives to ensure drinking water supply even in the face of competition by the agriculture in which the same community is involved (Nigam et. al. 1997). The introduction of energized borewells led to a rapid over-extraction of water for the irrigation of cash crops in this relatively water scarce region of India.

Despite the fact that this over-extraction in Narsipur has led to the decline in the ground water table, it has not affected domestic water demands of the community. This is because in the 1970s the community, through the local institution called *Panchyat*, constructed a waterworks with a 30 meter borewell and storage tank with a capacity of 85,000 liters, a pumphouse and distribution pipe lines. Water is provided to each household by the pipeline at an average of 165 liters per capita in the peak summer months when demand is highest. The community has financed the costs on its own, managed its water source and also safeguard its domestic water supply from the competing uses.

But it is increasingly recognized that continued pressure from cash cropping will not abet and they will need to take additional steps to ensure sustainable utilisation of the fresh water resource. Already the tank that used to take two hours to fill now takes seven. This suggests that sustainable financing mechanisms must be accompanied by sustainable resource utilisation - the twin challenges noted above.

## Conclusions

The number of lessons in financing fresh water for all suggest that there is no blue print for all countries, regions or communities. Private sector financing should be seen to be complementary and in no way a substitute for the state's responsibility in ensuring basic levels of services for all.

Some of the key considerations in arriving at strategies and plans of action for financing fresh water for all are:

- Ensuring that the fundamental right of access to safe water and sanitation with environmental protection as enshrined in the Declaration on Human Rights and the Convention on the Rights of the Child is met. The trends towards local water scarcity creates a further imperative for urgent actions. The key constraint is not lack of financial resources but the political decision by the state to implement the rights already conferred on individuals.

- The market cannot be expected to safeguard and allocate the freshwater resources equitably across income groups and across competing uses. The pressure on domestic water supply as a result of over-extraction for agriculture calls for examination of 'pricing' of water in its competing uses.

- There is no incongruity between achieving efficiency in resource allocation through the market mechanism and the rights based approach to financing. This approach suggests that efficiency with equity can be achieved if basic levels of services for all are guaranteed by the state. There needs to be the political will to ensure that these rights are met.

- Privatisation and public sector financing can be complementary, but the former should not be expected to substitute for the state responsibility for ensuring basic levels of service especially to the most disadvantaged groups in society. Private sector financing, however, will be needed for mobilising resources for meeting the challenge of fresh water for all and the private sector can be useful for delivery of services. But reliance on capital from the private sector alone for water supply and sanitation risks marginalizing the poor.

- Privatisation of water supply and sanitation services in urban areas must be accompanied by effective regulation. Regulating profit taking by private companies, ensuring coverage of marginalized groups to adequate and acceptable levels of service and protection of the environment must be part of the regulatory framework. Many developing countries as yet lack the expertise and skills in effective water and sanitation utility regulation.

- Microfinance and revolving credit schemes must be promoted along side water supply and sanitation. Operations and maintenance of the services by the community has been a key lesson in the sector. But this must be accompanied by efforts to enhance the capacity of the community to pay and manage the fresh water resources. Enhancing the income generating capabilities of the poor provides them with the ability to pay and maintain their services.

- Community based management as a strategy for service delivery and financing fresh water for all has been shown to be effective. Private sector delivery and privatisation of water utilities cannot serve as the solution, particularly in ensuring services for the poor. Moreover, communities will need to play a central role regardless of whether the state or private sector are the principal institutional mode of service delivery. Communities need to be in charge and particpate in all aspects of management if they are to be the custodians of their "fresh water envionment". There are no blue prints for community initiatives. But communities are capable through the implementation of their rights and with financial and capacity building support from governments, NGOs, and donor agencies to transform Samuel Taylor Coleridge's (1772-1834) phrase "Water, water everywhere, nor any drop to drink", in the poem "The Rime of the Ancient Mariner" into the slogan and reality of "fresh water for all".

**References:**

Briscoe J. and Harvey A.Garn (1995) *Financing water supply and sanitation under Agenda 21*, Natural Resources Forum Vol. 19, No. 1 pp. 59-70.

Cleaver F. and D. Elson (1995) *Women and Water Resources: Continued Marginalisation and New Policies*, International Institute for Environment and Development Gatekeeper Series No.49.

Cleaver F. and I. Lomas (1996) *The 5% 'Rule" Fact or Fiction?* Development Policy Review, Vol 14 pp. 1-11.

Espinosa L. and O.A. Lopez Rivera (1994) *UNICEF's urban basic services programme in illegal settlements in Guatemala City*, Environment and Urbanization, Vol 6, October .

Ghosh G. (1996) Keynote Address, *Proceedings of the 22nd WEDC Conference, Reaching the Unreached: Challenges for the 21st Century: 9-13 September, New Delhi, Edited by John Pickford and others.* Loughborough University, Leicestershire, U.K.

Ghosh G. and A. Nigam (1995) *Comments on 'Financing water supply and sanitation under Agenda 21' by John Briscoe and Mike Garn*, Natural Resources Forum, Vol 19, No. 2 pp161-165.

Gleick P. (1993) "An introduction to global fresh water issues" in P.H. Gleick edited *Water in Crisis - A Guide to the World's Fresh Water Resources*, Oxford University Press, Oxford.

IUCN and PRB (1996) *Water and Population Dynamics - Local Approaches to a Global Challenge*, Report on a collaborative initiative and workshop at IUCN' World Conservation Congress, The World Conservation Union and Population Reference Bureau, Montreal Canada.

Mcphail A.A. (1993) *The "Five Percent Rule" For Improved Water Service: Can Households Afford More*, World Development, Vol 21, No.6, pp 963-973.

Ministerial Conference on Drinking Water and Environmental Sanitation, Noordwijk (1994)

Nigam A. (1996) Sustainable Financing of Water and Sanitation, *Proceedings of the 22nd WEDC Conference, Reaching the Unreached: Challenges for the 21st Century: 9-13 September, New Delhi, Edited by John Pickford and others.* Loughborough University, (Leicestershire, U.K.).

Nigam A., B. Gujja, J. Bandyopadhyay and R. Talbot (1997) *Fresh Water for India's Children and Nature - Learning from local-level approaches*, UNICEF and WWF

Nigam A. and G. Ghosh (1995) *A model of costs and resources for rural and peri-urban water supply and sanitation in the 1990s*, Natural Resources Forum, Vol. 19 No. 3 pp.193-202.

Pushpangadan, K., G. Murugan and K. Navaneetham (1995) *Status Report on Rural Water Supply in Kerala State,* Centre for Development Studies, Thiruvananthapuram, Kerala.

Reddy S. and J. Vandemoortele (1996) *User Financing of Basic Social Services: A review of theoretical arguments and empirical evidence*, Working Paper, Office of Evaluation, Policy & Planning, UNICEF, New York.

Sen A. (1979) 'Rational Fools' n F. Hahn and M. Halls (eds) Philosophy and Economic Theory, Oxford University Press, Oxford.

Sen A. (1987) On Ethics & Economics, Blackwell, Oxford U.K.

Serageldin I (1995) *Water Supply, Sanitation and Environmental Sustainability: The Financing Challenge*. World Bank. Washington D.C.

Shiklomanov I. (1993) *World Fresh Water Resources* in Water in Crisis: A Guide to the World's Fresh Water Resources edited by P.H. Gleick, Oxford University Press, Oxford.

Tata Energy Research Institute (TERI) 1997 *Looking Back to Think Ahead - Green India 2047, Growth with Resource Enhancement of Environment and Nature.*

Torres Xiomara and A.M. Mooijman (1996) *Update on the Tegucigalpa Model*, Waterfront, Issue 9, UNICEF December 1996.

United Nations (1977) *Report of the United Nations Water Conference*, Mar del Plata, 14-25 March 1977.

------------------- (1989) Convention on the Rights of the Child

------------------- (1992) Earth Summit Agenda 21, The United Nations Programme of Action from Rio.

------------------- (1993) World Conference on Human Rights: The Vienna Declaration and Programme of Action.

------------------- (1995) The Copenhagen Declaration and Programme of Action, World Summit for Social Development, 6-12 March 1995.

------------------- (1997) *Comprehensive Assessment of the Freshwater Resources of the World*, Report of the Secretary General, Commission on Sustainable Development, Economic and Social Council E/CN.17/1997/9.

UNDP (1990) *Report of the Global Consultations on Safe Water and Sanitation for the 1990s*, 10-14 September, New Delhi, India

UNICEF (1995) Strategies in Water and Environmental Sanitation,

---------- (1997) Progress of Nations.

UNICEF, UNDP, UNFPA & UNESCO (1994) *The 20/20 Initiative*

WHO, (1992) International Drinking Water Supply and Sanitation Decade, End of Decade Review as at December 1990.

World Bank (1993) World Development Report, Investing in Health. Washington D.C.

--------------- (1994) World Development Report, Infrastructure for Development. Washington D.C.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# *Towards Water and Sanitation as Sustainable Basic Social Services for All*

by

by François Brikké, Jan Teun Visscher and Willem Ankersmit

Paper No. 3

Prepared for the
Department of Economic and Social Affairs
United Nations

# *"Towards Water and Sanitation as Sustainable Basic Social Services for All"*

by François Brikké, Jan Teun Visscher and Willem Ankersmit *

This paper embraces the 20/20 initiative as it supports the development of safe drinking water and sanitation services, basic social services many people still lack. It stresses the need to improve sector efficiency and to set clear objectives and establish key indicators to measure the outcome of efforts that are undertaken. It highlights the need to emphasize the sustainability of basic services and emphasizes the growing challenge to do things differently in the sector.

## 1. Introduction

The International Community met in 1977 at the United Nations Water Conference of Mar del Plata, and made the following appeal : "All people, whatever their stage of development and their social and economic conditions, have the right to have access to drinking water in quantities and of quality equal to their basic needs"[1]. Twenty years later we still need to accomplish this challenge. The same goes for adequate sanitation which is considered to be one of the foundations of a healthy human development. It thus seems that at the end of the millennium, our collective and individual conscience needs to be revived. "We will need to change our way of thinking and our operations, improving coordination[2] ", enhancing accountability and adopting human-centered and demand based approaches.

Lack of supply of safe water and of adequate means of sanitation is blamed, at least in part, for as much as 80% of all disease in developing countries[3]. A decent sanitary facility is an unknown luxury for half of the people on earth (2.9 billion people lack access to adequate sanitation in 1997, up from 2.6 billion in 1990 [4]). It is widely recognized that the percentage of people with access to sanitation has fallen in the developing world, because of population growth and declining investments. Furthermore, there are important disparities between water and sanitation coverage, showing that the attention given to sanitation is still lagging far behind the one given to water. Different from sanitation, in 1996 it is estimated that 3.3 billion people can count with safe water supplies against a 2.5 billion in 1990[5].

Still the coverage is far from being satisfactory, with important disparities between urban and rural, and within urban areas between the "poor" and "better-of". The poor have benefited least and some people living in low-income urban areas are paying as much as 35-40 percent of their income to buy water.

---

* François Brikké and Jan Teun Visscher are staff members of IRC, International Water and Sanitation Centre, The Netherlands; Willem Ankersmit is a staff menber of DGIS, Dutch Ministry of Foreign Affairs. The paper reflects the views of the authors and not necessarily those of IRC or the Dutch Ministry of Foreign Affairs.

The rich pay less and consume more. Many households purchase water at considerable cost from local water vendors. Often this water involves a high sanitary risk, being contaminated at the source or during collection or transport[6] .

OECD global figures indicate that ODA funding has decreased from US$ 43.2 billion in 1991 to US$ 39.1 billion in 1996[7]. This decrease in funding stems mainly from the lower contributions from the United States, Spain, Italy and Finland, whereas the other countries maintained there funding level. Nevertheless according to the Chairman of the Development Assistance Committee (DAC) of the OECD : "It is hard to imagine that the volume of ODA will increase dramatically in the near future"[8].

## 2. Lessons learnt

While **coverage** figures for water supply seem to have increased over the past years, it is false to conclude that we are on the right track. Particularly in the low-income areas coverage figures have not been able to keep up with the pace of **population growth**. The **poor are still marginalized** when it comes to benefiting from sector investments and present approaches do not allow to solve the problem efficiently. Also the coverage figures do provide a rosy picture as many installed systems provide neither the **continuity** nor the water **quantity** or **quality** that is needed[9] . This is partly because the organizations responsible for providing the service have limited management capacity, hardly any back-up support and do not succeed to cover even the cost of operation and maintenance[10]. This leads to inadequate functioning and eventually to abandoning of systems, representing a considerable loss of investments. Still the emphasis in the sector seem to remain on enhancing the coverage through the **construction** of new systems, because of political pressure and because doing things as usual is convenient. This approach generates short term results, but does not consider the negative impact of the resulting failures, and the deception of the communities involved.

On the positive side we see that more and more governments and institutions are gradually initiating a **process of change** in which they adopt a more integrated and demand responsive approach to problem solving, and become willing to place more emphasis on **sustainable functioning and effective use** of the systems. We see increasing interest of public sector agencies in **participatory approaches** involving the community in their attempt to do more with less financial resources. Government agencies are searching for alternatives as they begin to accept that "blue print" development strategies have been shown to be ineffective in meeting the basic needs of large numbers of marginalized, vulnerable people [11].

It is obvious that this shift is needed and that it is essential to look at the sector in a **holistic** manner, integrating issues of sustainable water and sanitation, waste disposal, water resources management, land and water use, health and nutrition and hygiene behavior.

## 3. Water supply and sanitation a basic services for all

Originally, basic social services were defined as those services that are a fundamental prerequisite for the sustainable achievement of social development. They encompass : *population programmes and reproductive health; health care; nutrition; environmental health including water supply and sanitation; basic education; and shelter.* Basic social services are of particular importance in reducing the worst aspects of absolute poverty. They yield high returns and are associated with strong positive externalities. Finally, basic social services are characterized by strong complementarities[12] .

In October 1995, the United Nations Administrative Committee on Coordination (ACC) established the Task Force on Basic Social Services for All to help coordinate the response of the United Nations System and galvanize the system around priority goals and objectives emerging from the recent United Nations Conferences.[13]

Considering water and sanitation as a basic social service has helped to give this sector a high priority. It underscores the importance of the sector for economic and social development and for poverty reduction as a whole. This however can only be achieved if the services that are established can be sustained.

## 4. What does the 20/20 Initiative imply for sector financing ?

The 20/20 Initiative was initially conceived in 1994, by UNDP, UNESCO, UNFPA, UNICEF and WHO, as a pragmatic way of accelerating the mobilization of resources from national and external sources, in favour of basic social services, by reallocating 20% of the total government budget and 20% of ODA to these services. This idea as developed so far entails important and very positive implications but also some limitations. Some of the more important ones include:

***The initiative may generate additional funding for the sector.*** The present global ratio is approximately 13/10, which means that an average of 13 percent of national budgets and an average of 10 percent of ODA are used for the financial, human and institutional capacity to deliver basic social services[14] . Increasing this ratio to 20/20 would mean generating an important additional source of funding. On the ESA side, in theory there is room for increased funding because the commitment of OECD countries to devote 0.7% of the GNP to ODA is far from being reached for most of them. The economic development however makes this expectation less realistic so as an alternative a reallocation of ODA funds could be strived for. Governments face similar limitations, and some of them are confronted with drastic measures (Structural adjustment policies), which put their spending under pressure. So in this case also a reallocation of national funds needs to be explored perhaps at the expense of military expenditure (see box);

***Alternative funding is needed.*** The 20/20 Initiative does not insist on the need to develop jointly or in parallel the use of local resources, especially at community level, where micro-credit systems could be introduced; a public/private partnership can very much help to generate additional resources and enhance long term financial sustainability. The idea to draw heavier on private sector funding that is reclaimed though users contributions is quickly gaining ground. User contributions can be increased, provided that reliable services are being provided and users get a better say in the development of the services. Actually it is only fair that users and particularly the better off pay for the services as in the past a lot of subsidized systems have primarily benefited them and not the poor. This is an important addition to the initiative because it would help to redress this balance. This does not imply that the poor should not pay at all. They may not be in a position to pay the full price and particularly the investment cost, but running cost need to be met by the users in order to sustain the service.

If private capital will not cater for the needs of the poor, because of a possible negative rate of return , public and donor funds have to be mobilised for low-cost water supply and sanitation in rural and peri-urban areas, where cost-recovery from users is not (yet) possible, and this is exactly the aim of the 20/20 initiative.

- ***Efficiency, effectiveness and sustainability of investments needs to be increased***. Increasing resources does not guarantee efficiency and effectiveness and here a lot of efforts are needed (see box). Whereas the 20/20 initiative indicates the need for human resource development that may help to enhance efficiency, it does not sufficiently stress the need to enhance the sustainability of sector investment. This is perhaps the most important challenge ahead where ESAs can be acting as catalysts and facilitators and implementing organizations should be held accountable for the sustainability of their achievements.

## 5. Searching for sustainable solutions

So we need to include the search for sustainability in the 20/20 initiative. For the WSS sector the following definition helps to clarify this.

*A water supply system is sustainable when it:*

- *continuous to provide an efficient and reliable service, at a level which is desired*
- *can be financed or co-financed by the users*
- *can be maintained with limited but feasible external support and technical assistance, and*
- *is being used in an efficient way, without negatively affecting the environment, conserving it for the generations to come* [15].

The search for sustainability implies that a match is needed between four dimensions, the community, the environment, the technology and the legal and institutional context.

In this **the community dimension** includes its capacity to manage, operate and maintain a system; the availability of skills; its capacity and willingness to pay, its cultural and social structure, its health awareness and hygiene behaviour; and its gender balance. The **environmental dimension** includes the availability of fresh water resources (in quantity and quality), its proper management, protection and conservation. The **technology dimension** *includes, the available technology, the capacity to respond to present and* future demands and consumption patterns; its capital and maintenance costs; its impact on environment; its complexity and the availability and cost of spare parts.

**Putting the bill for sustained water supply and sanitation coverage in perspective**
(Extracts from The sanitation Gap : Development's deadly menace by Akhtar Hameed Khan, in : The Progress of Nations, 1997, UNICEF)

So far in this decade, governments in Africa, Asia and Latin America have invested roughly US$ 2.1 billion a year in water and sanitation services for rural and under-served urban areas - and still they fell behind. The cost for achieving universal coverage would be an additional US$ 4.7 billion a year (in 1994 dollars) for a decade, bringing the total investment required to US$ 6.8 billion per year. The figure also includes $300 million a year for hygiene education programmes, which are just as important as latrines...Operating and maintaining sanitation systems adds another 5-20 percent to the bill.

A bill of US$ 68 billion over 10 years may sound high. But it is only 1 per cent of what the world will spend on military expenditures in the same period. Given the cost to human health of failing to provide proper water and sanitation facilities, it is hard to understand how a humane society can say no...

Water systems are notoriously leaky in developing countries, where 30 to 60 per cent of the water treated and pumped never makes it to the consumer, because of leaks, illegal tapping (and inappropriate administration of bills). Such losses cost Latin Americans, for example, between US$ 1 billion and US$ 1.5 billion each year - the amount needed annually to provide water and sanitation services to all the region's currently underserved citizens by the year 2000.

These dimensions are set within an overall **legal and institutional context** of regulations and availability of technical/financial assistance and support that can best accessed through a partnership between the community and public or private institutions[16]; most of the developing countries today are going through important institutional changes, transferring responsibilities to decentralized and deconcentrated levels. The role of the central government changes *from provider to facilitator and regulator*; this means devolving responsibility for management of water supply and sanitation services to the lowest possible level, while government remain responsible for policy development and the establishment and enforcing of the legislation. This institutional "change", concerns also the involvement of the "formal" or "informal" *private sector*. It may be questioned whether privatization is the universal solution, particularly because the private sector is weak in many countries. Also it is not clear if privatization caters for the needs of the urban and rural poor where profit margins may be small.

Searching for sustainable solutions requires therefore to integrate all the consequences that these institutional changes are inducing, in terms of roles, responsibilities, and capacity. Through an informed **dialogue** with the stakeholders sustainable solutions can be found that are based on a clear understanding of the different perceptions of the problems and demands that exists and the possible solutions that are available, prerequisites of a **demand-driven** approach.

## 6. Strengthening the 20/20 initiative

The WSS sector can benefit from the 20/20 initiative and can help to make it happen by drawing on some of the lessons learnt. What is particularly needed is to:

- ***Put stronger emphasis on sustainibility of investments.*** This will very much help to reorient the thinking and the action, shifting the focus to longer term objectives instead of short term results. This is crucial as it will place much more emphasis on adequate water resources management, prevention of pollution and ensuring the development of good quality facilities that provide a continuous and adequate service that is effectively used. This will have an additional benefit in that it makes sector investments more attractive.

***Setting objectives and indicators*** together with the stakeholders to clarify expected results and make it possible to enhance accountability. Objectives and indicators need to move away from input and output and focus on sustained outcome. So not just number of people reached with new projects (coverage) but number of people having access to water supply and sanitation systems that are functioning and are effectively used (sustained coverage). Governments and ESA's adopting this approach will be in a position to guide their agencies and make them accountable for results.

- ***Adopting a learning perspective in capacity building and technology sharing,*** as blue print approaches do not work. It is essential that the different perceptions of problems and solutions are shared in a learning environment in which academic knowledge and community experience are equally valued and shared in a dialogue that allows the adaptation of technologies and methodologies to the local environment[17].

***Create or strengthen platforms for decision making and resource negotiation*** to establish the dialogue between stakeholders and ensure a better management and distribution of resources and benefits. This requires access to information for all and strengthening the bargaining powers of men and women in communities, to make them a better match in the discussion with the other stakeholders.

***Enhance community and individual access to local resources and private funding.*** It is positive that the commercial value of water supply is being recognized and that users are expected to pay a reasonable price for it. If those who can afford and have access to loans coming from private banking, in order to improve their facilities, these costs could not longer be part of government programmes, hence freeing up resources for the poor. This implies that the bottleneck of access to funding needs to be overcome, by establishing banking facilities, micro-credit schemes, revolving funds, national/international guarantee funds and leasing.

***Focusing the subsidies to the poor***. At the end of 1995, 1.3 billion people were estimated to live in absolute poverty and if current trends persist this number will be growing. So subsidies will remain necessary but they need to be better targeted to the poor and should be more easily accessed by them. Governments need to develop guidelines for investments giving priority in using public and donor funds to meeting the needs of the rural and urban poor.

## Notes

1. United Nations, 1977, Report of the UN Water Conference, Mar del Plata, p.2
2. OECD, 1996, DAC Report, p.4
3. WHO, UNDP, 1995, The healthy route to a sustainable world, p.4
4. UNICEF, 1997, The progress of nations, p.5
5. UNICEF, 1997, opus citae, p.12
6. Gosh,G. And Nigam,A., 1995. Comments on 'Financing water supply and sanitation under Agenda 21', in : Natural Resources Forum 1995 Volume 19 Number 2.
7. OECD, 1997, DAC Report, ODA funds annexes
8. OECD, 1996, DAC Report 1995.
9. Visscher, J.T ed, 1997, IRC Technical Paper 32.
10. IRC, 1996, 1997, Country reports in Courses held in Colombia, Mozambique and Vietnam
11. Thomson,J. , 1995, Participatory approaches in government bureaucracies : Facilitating the process of institutional change.
12. UNCTAD, UNDP, UNFPA and UNICEF, 1996, Implementing the 20/20 Initiative, Oslo meeting.
13. United Nations, 1997, Basic Social Services for All . Web site : http://www.undp.org/popin/wdtrends/bss
14. Oslo meeting 1996. Implementing the 20/20 Initiative
15. Visscher, JT, 1997, IRC Technical paper n.32
16. IRC - CINARA, 1997, "Management for Sustainability of water supply and sanitation programmes" Training Course package.

17. Garcia, M. and Visscher, J.T. (1996). Formación de actores del desarollo en el marco de proyectos de transferencia para el aprendizaje en equipo. CINARA, Cali, Colombia.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# MAINTAINING FUNCTIONING OF FRESHWATER ECOSYSTEMS: THE KEY TO SUSTAINABLE MANAGEMENT OF WATER RESOURCES

by

MARK W. ROSEGRANT, CLAUDIA RINGLER
INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

Paper No. 4

Prepared for the
Department of Economic and Social Affairs
United Nations

# IMPACT ON FOOD SECURITY AND RURAL DEVELOPMENT OF REALLOCATING WATER FROM AGRICULTURE FOR OTHER USES

MARK W. ROSEGRANT, CLAUDIA RINGLER
INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

## ABSTRACT

Water in its multiple uses--for irrigation, household, industrial, and environmental uses--is essential to a healthy and productive life, as well as for the expansion of economic opportunity. The competition for limited water resources between agriculture and more highly valued domestic and industrial water demands is rapidly increasing, however, and will likely require a reallocation of water from agricultural uses to meet these demands. This paper examines the impact of the shift of water resources from agricultural to other uses on the household, on local, national and global food production scenarios, and on global food security. National and global impacts are explored using the IMPACT global food model to create alternative scenarios. The baseline scenario shows that effective food demand in 2020 will be met with slowly declining food prices and significantly increased food imports from developed to developing countries, as well as little improvement in food security in poorer regions. An alternative scenario, simulating a large reallocation of water from agricultural uses *without* countervailing gains in water use efficiency and productivity, demonstrates the potentially dramatic macro-level impacts of water reallocation on national and global food markets. Under this scenario--in contrast with the baseline scenario--prices of staple foods increase sharply, consumption is depressed in low-income regions, and malnutrition increases.

The reallocation of water from agriculture can also negatively impact rural economies, causing loss of income, decreased food production and overall social disruption. On closer examination, however, the actual impacts are mixed. Reallocation tends to have negative impacts for rural communities in particular circumstances: when the transfers are so large that they eliminate farming or other economic opportunities in the area of origin, when farmers have no incentive to sell but water resources are transferred anyway, and when institutions and secure legislation to adequately compensate sellers or third parties are absent. Conversely, the reallocation of water from agricultural uses can have positive impacts. Such water transfers can stimulate economic growth in both rural and urban areas, especially under certain scenarios: when farmers sell only a portion of their water, when sellers are compensated for the water resources sold, when sellers have a stake in the economic development of the urban area, or when sellers' water rights are adequately protected by institutions and organizations.

Appropriate policies to sustain food security and agricultural productivity growth, especially in local economies losing water resources through such reallocation, will vary from region to region. Important elements of policy reform will therefore include the establishment of secure water rights, the decentralization and privatization of water management functions to appropriate levels, the use of incentives for water conservation including reduction in water subsidies and establishment of markets in tradable property rights, and the introduction of appropriate water-saving technologies. In addition, specific compensatory measures should be taken for the poorest water users in the rural communities, those who would be the most harshly affected by water transfers.

# 1. Introduction

Population and economic growth in developing countries will pose serious challenges for humanity in simultaneously meeting food requirements and water demands. Competition for limited water resources increasingly occurs between different stakeholders and at different levels: between farmers within an irrigation system; between irrigation systems in the same river basin; between the agricultural sector and other rural uses, such as fisheries or domestic water supply and drinking water; and more and more between agricultural and urban and industrial users and uses; and environmental uses (for example, instream flows and recreation). Agriculture still accounts for the majority of global water withdrawals, and is often responsible for 80 percent or more of total withdrawals for consumptive uses in developing countries, but, as this paper will show, it is likely that significant amounts of water will be reallocated from agricultural uses to higher valued domestic and industrial water demands. The impacts of the shift of water from agricultural to other uses on household, local, national, regional, and global food production and food security have not been studied in an integrated manner; this paper reviews and synthesizes the available evidence.

The paper focuses on the implications of water reallocation at the sectoral level, in particular, on the transfer of water out of agriculture to meet urban and industrial demands, to provide an overview of the issues involved in water reallocation and to assess the potential local, sectoral, and global impacts. The following sections examine recent food supply and demand trends as well as projections of global food production based on IFPRI's global food model; describe the role of irrigation in global food production; and examine recent trends and projections in water demand. The paper then addresses the potential for meeting future water demands through expansion of water supplies; provides an account of the potential impacts of reallocation on global food production and on local and regional rural economies; and examines the potential for water policy reform and demand management to save water and minimize adverse impacts when water is reallocated from agriculture, followed by some concluding observations.

# 2. Recent Trends in and Projections of Global Food Supply and Demand

## *2.1. Recent Trends in Global Food Supply and Demand*

The world population is expected to grow to 7.7 billion in 2020, from 5.3 billion in 1993 (UN, 1996), raising serious concerns about how food demand will be met in the next decades. In addition, the global urban population is expected to increase to about 5.1 billion by 2025, from 1.5 billion in 1975, and 2.6 billion in 1995. The majority of the population is projected to live in urban areas by 2025 (61 percent), up from 38 percent in 1975 and 45 percent in 1995. Almost all urban population growth, about 90 percent, will occur in developing countries, where roughly 150,000 people are added to the urban population every day (WRI, 1996). These developments will have serious impacts on global food supply and on the structure of water demand.

*2.2. Projections of Global Food Supply and Demand to 2020*

Projections of global food supply and demand have been made using an updated version of IFPRI's International Model for Policy Analysis of Commodities and Trade (IMPACT). The model covers 37 countries and regions and 17 commodities, including cereals, roots and tubers, soybeans, and meats, and is specified as a set of country-level supply and demand equations, with each country model linked to the rest of the world through trade. Food demand is a function of prices, demand elasticities, income and population growth. Growth in commodity production in each country is determined by prices and the rate of productivity growth, which in turn is influenced by advancements in public and private agricultural research and development, extension and education, markets, infrastructure and irrigation. Irrigation expansion directly affects area harvested and yields. The world price of each commodity is determined as the price that clears world markets. A full description of the model is beyond the scope of this paper, but see Rosegrant, Agcaoili-Sombilla and Perez (1995) for the detailed model structure; and Rosegrant et al. (1997) for a detailed presentation of the baseline results summarized below.

The baseline analysis using IMPACT projects that real world prices of food will decline, but more slowly than in the past two decades. Cereal prices on average are projected to drop by about 10 percent by 2020, and meat prices by 6 percent. Projected real prices of cereals will be nearly constant through 2010, but the continued slowdown in the population growth rate after 2010, together with declining income elasticities of demand for cereals, will reduce demand growth enough to cause cereal prices to fall. The tighter future price scenario implies that shortfalls in meeting water demand for agriculture could put serious upward pressure on food prices. This issue will be explored below.

In developing countries, especially in Asia, rising incomes and rapid urbanization will change the composition of cereal demand. Per capita food consumption of maize and coarse grains will decline as consumers shift to wheat and rice, livestock products, fruits and vegetables, and processed foods. The projected strong growth in meat consumption, in turn, will substantially increase cereal consumption as animal feed, particularly maize. Growth in cereal and meat consumption will be much slower in developed countries. These trends will lead to an extraordinary increase in the importance of developing countries in global food markets: 82 percent of the projected increase in global cereal consumption, and nearly 90 percent of the increase in global meat demand between 1993 and 2020 will come from developing countries. Developing Asia will account for 48 percent of the increase in cereal consumption, and 63 percent of the increase in meat consumption. The composition of food demand growth across commodities will change dramatically. Total cereal demand is projected to grow by 717 million metric tons (mt), or by 40 percent, of which 35 percent will be maize; 31 percent, wheat; 18 percent, rice; and 16 percent, other coarse grains.

How will the expanding cereal demand be met? Expansion in area will contribute very little to future production growth, with a total increase in cereal crop area of only

39 million hectares (ha) by 2020, from 700 million ha in 1993, 88 percent of which will originate in developing countries. The projected crop area growth represents the net effect of slow expansion in irrigated area (see section 3.3); slowly increasing crop intensity on existing irrigated areas; declining commodity prices that limit the profitability of investment in land expansion; and gradual loss of land to soli degradation and urbanization. The slow growth in crop area places the burden to meet future cereal demand on crop yield growth. Although yield growth will vary considerably by commodity and country, in the aggregate and in most countries it will continue to slow down. The global yield growth rate for all cereals is expected to decline from 1.5 percent per year in 1982-94 to 1.1 percent per year in 1993-2020; in developing countries, average crop yield growth will decline from 1.9 percent per year to 1.2 percent per year; and in developed countries from 1.3 percent per year to 0.9 percent per year. Even with these reduced growth rates, yield growth will account for 80 percent of growth in cereal production in developing countries, and for 94 percent in developed countries.

### *2.3. Food Demand and Supply Gaps and World Trade in Food*

Two types of food gaps can be identified. The most devastating is the gap between actual food consumption and the quantity and quality of food required to sustain a healthy and productive life. By this measure, there will be little improvement in food security for the poor in many regions. Sub-Saharan Africa will have only small increases in per capita calorie availability as income growth will be only slightly in excess of population growth, and the number of malnourished children is projected to increase by 12 million in 1993-2020. Thus, even with relatively abundant food in the world, there will not be enough growth in effective per capita demand for food in Sub-Saharan Africa to improve the food supply situation. More progress can be seen for South Asia, home to more than one-half of the world's malnourished children, but nearly 70 million children will still be malnourished in the region in 2020.

The second type of food gap is the difference at the national level between food production and food demand as reflected in food imports. Growing imports are not a problem if they are the result of strong economic growth generating the necessary foreign exchange to pay for the food imports. In the case of some Middle Eastern countries facing extreme water scarcity and sharp population increases, the strategy of substituting food imports for irrigated agricultural production paid for by (water-based) urban and commercial growth has been called imports of "virtual water" (Allan, 1996). However, even when rapidly growing food imports are primarily a result of rapid income growth, they often act as a warning signal to national policymakers concerned with heavy reliance on world markets, and can induce pressures for trade restrictions that would damage growth and food security in the longer term. More serious food security problems arise when high food imports are the result of slow agricultural and economic development that fails to keep pace with basic food demand growth driven by population growth. Under these conditions, it may be impossible to finance the required imports on a continuing basis, causing a further deterioration in food in the ability to bridge the gap between food consumption and food required for basic livelihood.

World trade in food is projected to increase rapidly, with trade in cereals projected to increase from 186 million mt in 1993 to 349 million mt in 2020, and trade in meat products to increase from 8 million mt to 23 million mt. Expanding trade will be driven by the increasing import demand from the developing world: net cereal imports in developing countries are projected to rise by nearly 150 percent, from 94 million mt in 1993 to 229 million mt in 2020, and net meat imports are expected to increase from less than 1 million mt in 1993 to 11 million mt in 2020. Trouble spots for food trade gaps are Sub-Saharan Africa, and potentially West Asia and North Africa (WANA). Cereal imports in Sub-Saharan Africa are projected to increase from 12 million mt in 1993 to 29 million mt in 2020. It is highly unlikely that this level of imports could be financed internally, but instead would require international financial or food aid. Failure to finance these imports would further increase malnourishment in this region. In WANA, cereal imports are projected to increase from 38 million mt in 1993 to 65 million mt in 2020, with most of this increase expected to occur in the nonoil-producing countries.

## 3. The Role of Irrigated Agriculture in Global Food Production

### *3.1. Contribution of Irrigation to Global Food Production*

Worldwide, the agriculture sector is the largest consumer of water. During the 1950s to the 1980s, irrigation expanded rapidly and currently accounts for about 72 percent of global water withdrawals, and about 90 percent of water use in the lowest-income developing countries. Such a major role for irrigation had been justified by the contribution of irrigation systems to stabilizing, then expanding national and world food supplies during the Green Revolution, especially in Asia (Svendsen and Rosegrant, 1994). Dramatic increases in yield during and after the Green Revolution were largely based on the introduction and successful adoption of high-yielding varieties of wheat and rice that depend heavily on timely nutrient and pest control management as well as irrigation applications to secure and control soil moisture (FAO, 1996). Irrigated agriculture was a major factor in achieving the yield growth rates described above.

In the mid-1990s, irrigated agriculture contributed nearly 40 percent of world food production on 17 percent of the cultivated land. In India, for example, irrigated areas (one third of total cropped area) account for more than 60 percent of total production. Over the next 30 years, as much as 80 percent of the additional food supplies required to feed the world may depend on irrigation (IIMI, 1992). Irrigation also furthers stability through greater control over production and scope for crop diversification. In many developing countries, irrigation constitutes an important element of rural development policies, as it provides higher rural incomes and employment and allows for increased agricultural and rural diversification through secondary economic activities derived from extended and more varied agricultural production (as compared to rain-fed agriculture). In addition, in arid and semi-arid areas, alternatives to irrigated agriculture are rare, and water reallocation can lead to rural-urban migration and abandonment of plots (Fereres and Ceña, 1997; Raskin, Hansen and Margolis, 1995; Wolter, 1997). Thus, irrigation plays a vital role in achieving food security and sustainable livelihoods in developing countries, both locally, through increased income and improved health and nutrition, and nationally, through bridging the gap between production and demand.

### *3.2. Recent Trends in Irrigated Area*

The development of new irrigation has slowed considerably since the late 1970s, due to escalating construction costs for dams and related infrastructure, low and declining prices of staple cereals, declining quality of land available for new irrigation, and increasing concerns over the environmental and negative social impacts of large-scale irrigation projects. Lending for large-scale irrigation projects from international donors declined sharply after the 1970s: loans from four major donors, the World Bank, the Asian Development Bank, the U.S. Agency for International Development (USAID), and the Japanese Overseas Economic Cooperation Fund (OECF) peaked in the late 1970s, but by the late 1980s were just over 50 percent of the 1977-79 level (Rosegrant, 1997). These declining expenditures are reflected in the declining growth in crop area under irrigation. Globally, the growth rate in irrigated area declined from 2.16 percent per year during 1967-82 to 1.46 percent in 1982-93. The decline was slower in developing countries, from 2.04 to 1.71 percent annually during the same periods, but the lagged effect of declining investment in irrigation will be increasingly felt through future slowdowns in expansion of irrigated area.

Declining investment in irrigation has been accompanied by a decline in the quality and performance of existing irrigation systems. Although data are limited and definitions of damaged area vary between sources, estimates of annual global losses of agricultural land due to waterlogging and salinization range from 160,000-300,000 ha (Tolba, 1978; Barrow, 1991) to 1.5 million ha (Kovda, 1983). Most of the waterlogging and salinization have occurred in irrigated croplands with high production potential. Global estimates of the total area affected by salinity but still in production also vary considerably. El-Ashry (1991), Barrow (1991), Rhoades (1987), and Kayasseh and Schenck (1989) estimate that salinity seriously affects productivity in 20 to 46 million ha of irrigated land. However, with expansion of irrigation into new areas likely to be slow, the future contribution of irrigation to food production must come mainly from improvement in the productivity of the existing irrigated land base. This implies both the need to increase the efficiency of water use and the need to improve the quality of the resource base in irrigated areas, reversing the trends towards increased degradation through waterlogging and salinization of soil, as well as degradation of water quality and groundwater mining (Rosegrant and Pingali, 1994).

### *3.3. Projections of Irrigated Area to 2020*

Rosegrant, Ringler, and Gerpacio (1997) assessed future expansion in irrigated area, consistent with the underlying assumptions in the global food projections. The projections indicate a continued decline in irrigated area growth. In developed countries, irrigated area is expected to increase by only 3 million ha between 1995 and 2020, at an annual rate of growth of just 0.2 percent, compared to 0.8 percent annually during

1982-93. In developing countries, an additional 37 million ha of irrigated area is projected by 2020, at an annual rate of increase of 0.7 percent, compared to 1.7 percent per year during 1982-93. For the world as a whole, irrigated area is projected to grow at 0.6 percent per year, compared to 1.5 percent during 1982-93. The largest increase is expected in India with 17.3 million ha by 2020, as public investment in irrigation has remained relatively strong and private investment in tubewells has been very rapid. However, even in India, the projected 1995 to 2020 rate of growth in irrigated area of 1.2 percent per year is well below the rate of 2.0 percent per year during 1982-93. Area under irrigation will remain very low in Sub-Saharan Africa, despite a potential increase of 50 percent to 7.4 million ha in 2020. Simulations suggest that increased investment in irrigation can make a significant contribution to food production growth in Sub-Saharan Africa, although the amount of land under irrigation and the potential area exploitable relative to total crop area may not be large enough to generate revolutionary increases in crop production (Rosegrant and Perez, 1997).

## 4. Recent Trends in and Projections of Water Demand

### *4.1. Recent Trends in Global Water Demand*

Given the current global use of water of around 3,700 billion cubic meters (BCM), the estimated 9,000-14,000 BCM of reliable annual freshwater runoff would be adequate to meet growth in demand in all sectors for the foreseeable future, if supplies were distributed equally across the world's population. But freshwater is distributed unevenly across the globe. Per capita water availability is highest in Latin America and North America, while Africa, Asia, and Europe have far less water per capita. However, these regional figures hide the huge variability in water availability. Freshwater is poorly distributed across countries (Canada is blessed with 120,000 cubic meters (cu m) per capita per year of renewable water resources; Kenya has 600 cu m; and Jordan, 300 cu m); across regions within countries (although India has adequate average water availability of 2,500 cu m per capita, the state of Rajasthan has access to only 550 cu m per capita per year); and across seasons (Bangladesh annually suffers from monsoon flooding followed by severe dry season water shortages) (Rosegrant, 1997). Moreover, with a fixed amount of renewable water resources supplying an increasing population, per capita water availability has declined from 9,600 cu m to 5,100 cu m in Asia, and from 20,000 cu m to 9,400 cu m in Africa between 1950 and 1980 (Ayibotele, 1992).

Tightening supplies have been accompanied by rapid growth in the demand for water. Between 1950 and 1990, water use increased by more than 100 percent in North and Latin America, by more than 300 percent in Africa, and by almost 500 percent in Europe (Clarke, 1993). Global demand for water has grown rapidly, at a rate of 2.4 percent per year since 1970. In 1995, annual per capita domestic withdrawals ranged from a high of 240 cu m in the U.S. to only 11 cu m in Sub-Saharan Africa, a level that is just over one-half of the 20 cu m per capita estimated by Gleick (1996) as required to meet the most basic human needs. China, India, and other South Asian countries are all at or just above this basic human needs level. Southeast Asia, Latin America, and

WANA cluster at 56 cu m per capita to 65 cu m per capita. For developing countries as a group, per capita water demand was 33 cu m in 1995, less than one-fourth the amount in developed countries. In addition to the basic water requirements for sanitary and other domestic uses, estimates of minimum water requirements for basic food needs range from 400 cu m per capita per year (Postel, 1996) to 1,000-2,000 cu m per capita annually (FAO, 1989). However, actual minimum requirements are often higher, especially in urban areas, due to increased living standards.

Expansion of high quality freshwater supply to domestic users is essential to the development of improved health and well-being. Unsafe drinking water, combined with poor household and community sanitary conditions, is a major contributor to disease and malnutrition, particularly among children. The World Bank (1992) has estimated that access to safe water and adequate sanitation could result in 2 million fewer deaths from diarrhea among young children. However, it is estimated that 1 billion people in the developing world do not have access to potable water, and that 1.7 billion have inadequate sanitation facilities. Pollutants from disposal of untreated sewage and poor sanitation are becoming a very serious problem in domestic water supply, especially in and downstream of major cities. In addition, contaminated wastewater is often used for irrigation, creating significant risks for human health and well-being.

Environmental demands also gain higher priority with rising incomes. In a growing number of developed countries, environmental uses are even becoming the first claimant on available water resources; in developing countries, these demands are increasingly acknowledged, but honored usually only if local economic development is not hindered. However, the latent demands are expected to be served as incomes grow (Burton and Chiza, 1997; Franks, Shahwahid and Lim, 1997; Grossman and Krueger, 1997).

### *4.2. Projections of Water Demand to 2020*

Taking into account long-term growth in income, industrial expansion, and irrigation development, Rosegrant, Ringler, and Gerpacio (1997) project that global water withdrawals will increase by 35 percent by 2020, to 5,060 BCM, with growth in developing countries much faster than in developed countries. Developed countries as a group will increase water demand by 22 percent to 1,710 BCM, more than 80 percent of which will be for industrial uses. The demand pressure on water resources will be much higher in the developing world, where water withdrawals are projected to increase by 43 percent, from 2,347 BCM in 1995 to 3,350 BCM in 2020. In sharp contrast to past growth patterns in developing countries, the projected absolute increase in domestic and industrial water demand of 589 BCM from 1995 to 2020 will be greater than the increase in agricultural water demand of 415 BCM. With these differential rates of growth, the combined share of domestic and industrial water demand in total water demand in developing countries will more than double, from 13 percent to 27 percent.

## 5. Potential for Meeting Future Water Demands Through Supply Expansion

Can the rapid growth in water demand, particularly in the domestic and industrial sectors, be met without massive transfers of water out of agriculture that could derail the projected growth in crop yield and area described above? This section examines the potential for expansion of water supplies through traditional and non-traditional means.

### *5.1. New Investment in Irrigation and Water Supply*

Development of irrigation and water supplies has become increasingly expensive. In India and Indonesia, for example, the real costs of new irrigation have more than doubled since the late 1960s and early 1970s; costs have increased by more than 50 percent in the Philippines; they have tripled in Sri Lanka; and increased by 40 percent in Thailand (Rosegrant and Svendsen, 1993). In China, Pakistan and Indonesia, irrigation has absorbed over half of all agricultural investment, and about 30 percent of all public investment in India. In addition, once established, irrigation projects become some of the most heavily subsidized economic activities in the world, both directly and indirectly. In the mid-1980s, it was estimated that average subsidies to irrigation in six Asian countries covered 90 percent or more of the total operating and maintenance costs (Repetto, 1986). The cost of supplying water for household and industrial uses is also increasing rapidly. In Shenyang, China, the cost of new water supplies will nearly triple from US$0.04 to US$0.11 per cu m between 1988 and 2000 because pollution of the current groundwater source will require a shift to water conveyed by gravity from a surface source 51 kilometers (km) from the city. In Mexico City, water is currently being pumped over an elevation of 1,000 m into the Mexico Valley from the Cutzamala River through a pipeline about 180 km long, at an average incremental water cost of US$0.82 per cu m, almost 55 percent more than the previous source, the Mexico Valley aquifer (World Bank, 1993).

Because of the high costs and increasing concerns about economic, environmental, and social impacts, it will be difficult to justify construction of large-scale dams and water supply systems, despite the fact that a review of the World Bank's experience with irrigation shows that there are in fact economies of scale in irrigation projects: the rates of return to large projects have been higher than returns to small-scale projects (Jones, 1995). However, these estimates do not take into account the full range of negative externalities generated by these projects, and also do not account for the economic, environmental, and social consequences if the projects are not developed. The heightened national and international concern over the broad environmental and human effects of large irrigation projects will make it very difficult to proceed with many of these projects.

Small-scale irrigation projects can have considerable advantages over large-scale projects. However, in many cases the bureaucratic mode of implementation has effectively eliminated the potential advantages, and big and small systems often share a number of common characteristics: high capital costs per ha and per farmer; bureaucratic, costly, and inefficient management; low technical efficiency, low settler incomes, and zero or negative returns (Adams, 1990). Farmer-owned and -controlled systems, on the other hand, have a better performance record. Experience indicates that it is not so much the size of the irrigation system that determines its success, but a host of institutional, physical, and technical factors. Every river basin is different, and the appropriate choice of system size and operational characteristics in any given basin is likely to be determined by conditions unique to that basin. A pragmatic approach to project design should be taken that ensures quantification of full benefits, including not only irrigation benefits, but also health, household water use, and catchment improvement benefits (Jones, 1995) and full assessment of, and compensation for, negative environmental and resettlement costs. Selective development of new surface water must still play a role in future water resource development.

Sustainable development of groundwater resources offers significant opportunities for some countries. The massive expansion of private sector tube well irrigation in Bangladesh, India, and Pakistan is the most successful example of private sector irrigation development in the developing world. However, extensive investigation is required to determine the characteristics of aquifers (including geometry, continuity, boundaries, hydraulic characteristics, spatial and temporal variability), sustainable exploitation rates, and the potential adverse environmental and other impacts of these water sources.

### *5.2. Desalination*

The supply of freshwater through desalination is in essence infinite, but expensive. However, although desalination capacity increased 13-fold from 1970 to 1990 to more than 13 million cu m per day, desalinated water accounts for just one-tenth of one percent of freshwater use (Engelman and LeRoy, 1993; Gleick, 1993). Nearly 60 percent of the desalination capacity in the world is in the oil-rich, water-scarce Persian Gulf, and much of the rest is on island nations and in other arid countries (Postel, 1992). Although 'raw' production costs for desalination are comparable to the costs of new supplies in some of the most arid areas of the world, a wide diffusion of this technology is unlikely considering the often substantial transportation costs to pump the desalinated water inland, the high capital and energy costs, and the potential environmental damages from generated wastes. Growth of desalination capacity will likely be confined to coastal regions that are both very water scarce and relatively wealthy.

### *5.3. Recycling and Wastewater Reuse*

After being used once, freshwater can be used again in the same home or factory (usually called recycling) or collected from one or more sites, treated, and redistributed and used in another location (generally called wastewater reuse) (Postel, 1992). The greatest potential for water saving is likely to be industrial recycling, although wastewater reuse can offer significant and increasing savings as the scarcity value of water increases. Only a small fraction of industrial water used for cooling, processing, and other activities is actually consumed. Although the rest of the water may be heated or polluted, it can often be recycled within a factory or plant, thereby getting more output from each cu m delivered to that operation. In developed countries, pollution control laws have been a primary motivator for industrial water recycling. Japan, for example, produced industrial output of US$77 per cu m of water supplied to industries in 1989, compared with US$21 per cu m in 1965 (in real terms). In the U.S. between 1950 and 1990, total industrial water use fell 36 percent while industrial output increased nearly fourfold (Postel, 1992). Similar conservation efforts have also begun in water-scarce developing country cities. In Beijing, China, for example, the water recycling rate increased from 61.4 percent in 1980 to 72.3 percent in 1985; between 1977 and 1991, total industrial water use declined steadily while output increased by 44 percent in real terms (Nickum, 1994).

The rate of expansion of wastewater reuse depends on the final quality of the wastewater and on the public's willingness to use these supplies. In California, which has the highest reuse of wastewater in the U.S., this water is reused for barriers against salt water intrusion, dust control, groundwater recharge, industrial cooling, wetlands, and irrigation of parks, golf courses, and certain types of crops. Even in California, however, wastewater reuse accounts for less than 1 percent of the state's developed water supplies (Frederick, 1993). Worldwide, about 500,000 ha of cropland is irrigated by treated municipal wastewater, amounting to only two-tenths of 1 percent of the world's irrigated area. In water-scarce developing countries, wastewater reuse for agricultural irrigation can provide a strong economic impetus because it can help to conserve resources (including water and soil nutrients) and protects the environment by preventing river pollution, protecting water quality, and preventing seawater intrusion in coastal areas (Shuval, 1990). Israel undertakes the largest wastewater reuse effort in the world, treating 70 percent of the nation's sewage to irrigate 19,000 ha of cropland. Reclaimed wastewater is projected to supply more than 16 percent of Israel's total water needs by the start of the next century. Most of this would be used in agriculture to replace freshwater reallocated to nonagricultural uses (Postel, 1992). Wastewater can be used for crops that tolerate low water quality and could potentially contribute much to reforestation and revegetation activities. However, given the relatively high cost of wastewater treatment and transport to agricultural areas, it is likely that wastewater can make up an important share of agricultural water supply only in arid regions where the cost of new water supplies has become very high. In order to generate substantial increases in wastewater use, major technological improvements in wastewater treatment and reuse would be required to reduce the unit cost of wastewater reuse.

### *5.4. Water Harvesting*

Water harvesting, the capture and diversion of rainfall or flood water to fields to irrigate crops, has been used for centuries in traditional agriculture. The improvement and expanded use of such techniques can increase production and farm income in some environments. In semi-arid areas of India and Pakistan, low earthen banks are constructed to hold back the monsoon floods and submerge and saturate the fields. Crops are then planted when the floods recede. In Bihar, India, as many as 800,000 ha of land are planted under this system (Clarke, 1993). Stone bunds, terracing, and vegetative barriers can also be used for water harvesting. Vetiver grass, native to India and known there as *khus*, has been used in both Africa and Asia. When densely planted along the contours of a sloping field, the grass forms a vegetative barrier that slows runoff, allowing rainfall to spread out and seep into the soil more easily (Postel, 1992). Water harvesting can provide farmers with improved water availability, increased soil fertility, and higher crop production in some local and regional ecosytems. Water harvesting can also provide broader environmental benefits through reduced soil erosion. However, given the limited areas where such methods appear feasible, and the small amounts of water that can be captured, water harvesting techniques are unlikely to have a significant impact on global food production and water scarcity.

### *5.5. Integrated Watershed Management*

The watershed, or river basin, is the logical hydrologic unit that includes the key interrelationships and interdependencies of concern for land and water management as represented, for example, in the linkages between upstream and downstream water users. Upland watersheds are source areas for surface and groundwater recharge while downstream agriculture and urban development are directly dependent on water supplies from the upper watershed. In many regions, poor management of watersheds through deforestation, the eradication of perennials, and other human interventions in upland areas often leads to soil erosion and decreases in agricultural productivity, siltation of reservoirs and irrigation systems, adverse impacts on fisheries, wildlife, river habitat and recreational water uses, water pollution, flooding of lowland areas, and reductions in water supply for irrigated agriculture, hydropower, industrial and urban uses. The magnitude of these negative on- and off-site effects and their interdependencies have yet to be estimated in a comprehensive manner, but they appear to be large in many regions.

Integrated watershed management requires an interdisciplinary, intersectoral and watershed-wide approach to the identification of sustainable resource utilization and management practices that allow for a more effective and sustainable exploitation of water and other natural resources. Such management approaches can improve the food supply situation in the region. Measures to improve integrated watershed management include development and dissemination of appropriate technology, such as erosion control practices and fragile lands protection, active mountain, forest range and prairie management, and adaptation of farming systems to hillsides (Easter and Hufschmidt, 1985). Policies to counteract watershed degradation should be targeted towards zones of high risk and could include public investments in research, technology development, extension services, and rural infrastructure, in order to stabilize or reverse degradation. Above all, broad policy and institutional reform should address watershed degradation through, for example, the establishment of property rights to land and forests, utilization of market incentives for appropriate resource management, and reform of regulatory, tax and subsidy policies that often encourage excessive rates of exploitation of forests and adoption of environmentally damaging farming systems.

### 5.6. *Interbasin Water Transfers*

Interbasin water transfers have often been proposed as the best solution to solve acute water shortages in adjacent basins or sub-basins, particularly in arid and semiarid regions and where a large shift of water from agricultural to urban and industrial users is necessary. Plans for interbasin transfers was widespread in the 1960s and 1970s: the Soviet Union planned to divert Siberian rivers to reduce water shortages and the shrinking of the Aral Sea, at least since 1973; Chile planned to divert water from other basins for the Maipo River, to compensate for increasing water uses by the capital, Santiago, in the 1980s; the Middle Eastern countries had plans of Nile water diversions to replenish the Jordan river as early as 1902; and the U.S. planned to transfer large water quantities from Canada to the semiarid southwestern states in the 1960s. However, most of the larger-scale proposals never materialized due to huge capital costs; substantial scope for less capital-intensive alternative water savings; and increasing concerns about negative economic, environmental, and social impacts in the exporting basin, such as the potential cutting off of future development opportunities, social disruption, irreparable environmental damage, and rural-urban migration. China is an exception in that it realized several large interbasin transfers (in 1980, for example, roughly 10 BCM were diverted from the Chang into the Huai basin, and 8 BCM from the lower Huang into the Hai and Huai [Nickum, 1997]), and recently decided to carry out the proposed middle route of the South-to-North Water-Transfer Project for agricultural development on the North China Plain and for the city of Beijing. Another noteworthy transfer example is Libya, which in 1996 inaugurated the first phase of the Great Man-made River, transferring water from the arid south to the coastal region. Once completed, the network will have 5,000 km of underground pipelines with a capacity of 6.1 million cu m, providing a 50-100 year's supply, at a cost of US$25 billion (Garay and Sugheiar, 1997).

Micro-level basin transfers over short distances have proven to be viable options in some regions. Several states in the U.S. have drafted interbasin legislation in recent years (London and Miley, 1990) and Texas, for example, currently has about 80 active interbasin transfer permits, typically to serve the rapidly growing cities. However, as with large-scale transfers, the potential economic and social costs in the area of origin must be taken into account. A case where the constraints on future development in the exporting basin were not considered is the purchase of water rights by the city of Los Angeles in the Owens Valley of Eastern California. This purchase had a devastating impact on the Valley, one from which it has never recovered (U.S. Office of Technology Assessment, 1993). However, interbasin transfers do not always curtail production on irrigated lands: the Metropolitan Water District in California, for example, has a 35-year contract to pay for conservation projects in the Imperial Valley in exchange for temporary use of the conserved water. In this example, the exporting basin retains the water rights and suffers no reduction in levels of water use (Postel, 1992).

In summary, a portion of the growing demand for water will be met through new investments in irrigation and water supply systems, and some potential exists for expansion of non-traditional sources of water. However, in many regions, neither of these sources will be sufficient to meet the rapidly growing nonagricultural demands for water or to mitigate the effects of water transfers out of agriculture.

## 6. Impacts of Water Reallocation from Agriculture on Food Production

### *6.1. Global Impacts of Water Reallocation from Agriculture on Food Production*

This section explores the possible impacts on global food production of a large transfer of water away from agriculture assuming no reforms in institutions, policies, and technologies to achieve water savings and mitigate the impact of the transfer. The possible ramifications of this scenario are examined using IMPACT. This scenario is not presented as a likely outcome, but rather as an exploration of the potential effects that significant transfers of water could have on agriculture, if water savings are not simultaneously achieved through policy reform.

The transfer of water from agriculture is simulated using the following assumptions: (1) no increase in irrigated area to the year 2020, corresponding to a cutback in investments and loss of existing irrigated area due to degradation and urban encroachment to balance any current pipeline investment. Under this scenario, there would be 43 million ha less irrigated area compared with the baseline projection; (2) phased-in reductions in agricultural water use over the projections period for the 37 IMPACT countries and regions, consistent with the urban and industrial demand projections described above, assuming no improvements in water use efficiencies in agriculture and slow improvements in domestic and industrial efficiencies; (3) declines in crop area growth, in proportion to the reduction in agricultural water use; and (4) reduction in crop yield growth, in proportion to changes in relative water supply, based on the relative water supply/crop yield function approach (FAO, 1979).

The projected reductions in agricultural water withdrawals by 2020 are substantial, compared with the baseline 2020 values: for example, China, nearly 24 percent; India, 21 percent; and WANA, 20 percent; reductions in other developing countries range from 10 to 35 percent. This reallocation of water out of agriculture scenario shows dramatic impacts on demand in global food markets. In developing countries, yield growth for all cereals will slow from 1.20 percent annually in the baseline scenario to 1.07 percent per year, and area growth from 0.29 to 0.23 percent annually during 1993-2020. Rice is hit hardest, because it relies most heavily on irrigation water: rice yield growth will decline from 1.08 percent to 0.89 percent. The adverse impacts on production would be much higher except that, as water is being removed from production, cereal prices begin to increase rapidly, thereby depressing consumption and, simultaneously, inducing production increases, that partially offset the water-induced shortfalls. The average rice price is projected to increase by 68 percent between 1993 and 2020, to US$480 per mt and would be 85 percent higher than the projected baseline rice price in 2020; the price for wheat would increase by 50 percent; maize, 31 percent, and other coarse grains, 40 percent, compared to the baseline projections.

Rising food prices depress food demand and worsen food security through widening the food supply and demand gaps described above. At the local and regional level, price increases of this magnitude would cause a significant decline in the real income of poor food consumers. Malnutrition would increase substantially, given that many of the poorest people in low-income developing countries spend more than half their income on food. Higher international prices also hurt at the national level, as poor countries will have to spend increasing resources to import a large portion of their food. Sharp price increases can fuel inflation in these countries, place severe pressure on foreign exchange reserves, and can have adverse impacts on macroeconomic stability and investment.

Developing country imports will increase significantly overall, putting greater pressure on foreign exchange. In China, projected wheat imports will increase from the baseline value of 22.4 million mt in 2020 to 36.1 million mt; the country would shift from an exporting position in rice to becoming a rice importer; and total cereal imports by 2020 will increase by 76 percent, from 41.3 million mt to 72.8 million mt. In WANA, total cereal imports would increase from 65.1 million mt to 74.8 million mt. An exception is Sub-Saharan Africa, where imports by 2020 would actually decrease, because high cereal prices will severely depress demand. Although these imports of "virtual water" would help to fill the demand gap created by reduced production due to water transfers from agriculture, the general rise in food prices will slow demand growth. This shows that a strategy of virtual water imports will have limited success if there is a general cutback in water supply to agriculture worldwide without countervailing improvements in water use efficiency and productivity.

### *6.2. Micro-Level Impacts of Water Reallocation*

Many economic studies suggest that the negative local impacts of properly managed water transfers from agriculture will be minimal, but popular perceptions (such as "draining the lifeblood of farmers") are typically more pessimistic. Transferring water out of agriculture can have impacts on a wide range of stakeholders, particularly if effective institutions to manage water transfers are not in place. Reallocation can decrease agricultural productivity and irrigated area, and change cropping patterns. In addition to direct impacts on agricultural production, water transfers can negatively affect business activities, local government fiscal capacity, and the quality of public services in areas from which water is being transferred, because of the reduction in irrigated area or production and associated reductions in agriculturally linked economic activities and in the tax base. In addition, permanent transfers of water rights may limit future economic development in the area of origin and induce out-migration (Rosegrant, 1997). Whereas the buyer and seller of water presumably gain from the transfer if the seller holds secure water rights, other parties can be negatively affected (and not compensated) through reductions in water availability and quality, and instream flows. Furthermore, the water in irrigation systems is used for a wide variety of other purposes that are often not accounted for, such as hydropower generation, fishing, gardens, rural domestic water supplies, and livestock production, all activities that would be severely affected by reallocation (Howe, Lazo and Weber, 1990; Meinzen Dick, 1997).

Microeconomic and regional analyses suggest that the severity of economic impacts on the area of origin will differ according to (a) whether or not the destination of transferred water remains within the same area of economic activity; (b) whether or not transfer proceeds are reinvested in the area of origin; (c) the economic vitality of the area of origin; and (d) the strength of backward and forward linkages of the irrigated agriculture sector (Howe, Lazo and Weber, 1990). In this section, the available (but quite limited) case study evidence on potentially adverse micro-level impacts on the area of origin of water transfers is reviewed. Whereas regional or national impacts of water transfers are usually positive overall, it is the area of origin -- usually rural areas in semiarid regions -- that may face adverse income and livelihood effects, particularly if water transfers are not appropriately managed. However, the evidence shows that the impacts of water reallocation are mixed and highly complex, and with the limited evidence available, it is difficult to fully identify the underlying conditions that determine the direction and the magnitude of these impacts. Care must also be taken in sorting out the effects of water transfers from the broader effects of dynamic change in the rural and urban economies. In many cases negative effects may not be attributable to water transfers, but rather may be the result of declining competitiveness of agriculture in a given region, with water transfers occurring as a byproduct of long-term economic change.

*Urbanization and water reallocation to urban areas*

The rapid expansion of urban areas can affect irrigation and food production in a number of ways, both negative and positive. Evidence from Chile, Indonesia, Thailand, the western U.S. and elsewhere clearly indicates that cities often occupy highly productive (irrigated) farmland; draw off skilled, young farm labor; compete with irrigation for the water sources to supply residents, industry, and power; and damage water quality for agricultural production through municipal sewage and industrial effluents (Hearne and Easter, 1995; Christensen, 1994; Kurnia, Avianto, and Bruns, 1998; Howe, 1998). On the other hand, nearby cities provide farm households with markets and income that can be used to purchase more water-efficient irrigation technology and to diversify into higher-value crops. In the suburbs of Beijing, for example, both grain output and overall agricultural output value continued to increase at the same time that water had been diverted to the urban core and the overall irrigated area declined (Nickum, 1997). Hearne (1998) reports that one significant reason for the positive experience with agriculture-urban water transfers in Chile was that urban areas serve as service centers for the local agricultural areas, and that most large irrigators have houses and businesses in these communities and do not want them to be short of water.

*Impacts of water reallocation from agriculture on rural communities*

Reallocation of water out of agriculture can have negative effects on rural employment possibilities, not only directly in the irrigation sector, but even more through multiplier effects on agriculturally related activities. Idleness of forward and backward linkages of the agricultural sector can also substantially reduce the rural tax base. It is not realistic to assume that idle human and capital resources will move quickly and without cost to new uses of equal or higher productivity. Therefore, costs of water transfer out of agriculture attributable to the area of origin should be compensated and, in the case of large transfers, measures should be undertaken for human capital to adjust (Howe, 1998). On the other hand, it has also been shown that careful reallocation of water resources can favor economic growth in both urban and rural areas, and economically-induced water transfers can increase the overall living standard of the poor. Changes in rural employment possibilities and migration to urban areas are usually based on a wide array of factors, but abandonment of irrigated farming may catalyze developments.

Hamilton, Whittlesey and Halverson (1989) evaluated the minimum compensation that farmers in the Snake-Columbia river system, Idaho, would be willing to accept in a long-term option contract with a hydropower station. Such an institutional arrangement would switch the use of water resources from farmers to the utility in dry years. Results indicate that estimated hydropower benefits are 10 times greater than losses in farm income, making these contracts economically valuable. In California, indirect economic effects from water transfers using the 1991 California State Emergency Drought Water Bank were relatively small. Farmers who sold water to the Bank reduced farm operating costs by US$17.7 million, or 11 percent, and crop sales by US$77.1 million, or 20 percent. These reductions adversely affected the suppliers of farm inputs and the handlers and processors of farm outputs, but the effects were not large when compared with the agricultural economy in the selling region or with the direct benefits to farmers from the sales. Operating costs, crop sales, and agribusiness revenues dropped 2 to 3 percent in selling counties because of the Bank (Dixon, Moore, and Schechter, 1993).

Chang and Griffin (1992), in a study of water trading and reallocation in the very dynamic Lower Rio Grande river basin, Texas, find that water transfers have supported the growth in the value of agricultural production in the basin. Virtually all water transferred was from agricultural to nonagricultural uses, and 45 percent of all municipal rights had been obtained by transfer from the agricultural sector by 1990. Net benefits of average agriculture-to-urban transfers were estimated at around $12,000 per 1,000 cu m of water for the cities of Edinburg and Brownsville, indicating a sizeable aggregate benefit for the 94 BCM of water transferred from agricultural to municipal uses prior to 1991. Consultations with water sellers indicated that much of the agricultural water sold would otherwise have been unused by its owners, (sometimes due to prior conversion of agricultural land to other uses). Very rapid urban and economic growth in this area and reallocation of water over short distances likely helped prevent severe negative impacts on farm households.

A study of the impact of drought-related water reallocation from agriculture to urban uses in 1987-92 on a rural farming community in Mendota, California, found that irrigated cropland declined by 14 percent, farms by 26 percent (small farms by 70 percent). Agricultural land values decreased by 30 percent. Increasing reliance on lower-quality groundwater reduced yields, for example, by 37 percent in melons, and by 5 percent in staple crops. Labor demand decreased over-proportionately as compared to cropland, and farm and packing salary income declined by 14 percent. Three out of 7 wholesale produce firm went out of business in the area. City tax revenues declined both as a result of depressed business conditions and declining property values (Villarejo, 1997).

Palanisami (1994) finds that farmers in Tamil Nadu, India, view water transfers from rural to urban areas positively. He reports that farmers sell water to urban residents to alleviate diverse labor problems (34 percent); to achieve higher profits (44 percent); to sell surplus water (23 percent); and to sell supplies inadequate for irrigation (9 percent). Thobani (1998) reports new employment possibilities for farmers who sold their water rights in Chile and Mexico in water-intensive companies or in the larger, more profitable farms who bought the rights. Rosegrant and Gazmuri Schleyer (1994) also find evidence suggesting that area-of-origin impacts in Chile are small and that agricultural regions have benefitted substantially from water trading and sales. Farmers mostly sell small portions of their rights and maintain agricultural production with highly efficient on-farm irrigation technology for orchard or vegetable crops. However, Hearne (1998) documents that the sale of water rights by a few farmers still can have substantial negative impacts: when remaining farmers receive less canal water as seepage increases, or when canals cannot be maintained due to the decrease in members drawing water from the canal.

Sadeque (1998) illustrates that it is not always the irrigation sector that suffers from water reallocation. He shows that in rural Bangladesh, competition for the scarce water resources during the dry season has favored a transfer of water from the domestic to the irrigation sector. The increasing use of deep water table extraction technologies for irrigation by relatively wealthy farmers outcompetes the shallow hand pumps used by the landless for domestic uses, disproportionately affecting women and children, who are the water carriers. With food production being a high priority of the Bangladesh government the development of deep tube wells for irrigation has been favored to the detriment of domestic water supply.

*Impacts of reallocation on water quality and environmental degradation*

There is substantial evidence on the adverse impacts of reallocation from irrigation water to industrial uses, and the pollution of water resources with industrial effluents, poorly treated or untreated domestic and industrial sewage, agricultural chemical runoff and mining wastes has become a growing environmental concern. In the Nam Siaw Basin in Northeast Thailand, for example, discharge and seepage of wastewater from rock salt mining made water unfit for human and animal consumption, and depressed rice yields in fields irrigated from the wastewater (Wongbandit, 1994). In China, about 80 percent of the population lives in areas surrounding seven major rivers and five large lakes. Untreated municipal and industrial wastewater of 35.56 BCM is discharged in these regions; 20-30 percent of the water is polluted, and the economic loss caused by water quality degradation has been estimated at US$4 billion. In the Yellow River and tributaries, wastewater discharge is 3 BCM, and water quality has fallen below the safe drinking water standard in 60 percent of the basin (Zhang and Zhang, 1995).

However, the impacts of water reallocation from agriculture to industrial and other uses are often more complex. Kurnia, Avianto, and Bruns (1998) show some of these dynamics in the case of West Java, Indonesia. In this very productive agricultural region, water conflicts, which used to arise between farmers within or between irrigation systems, have shifted to the level of conflict between various sectors. A cluster of 31 textile firms in the Ciwalengke irrigation system in Bandung District, West Java, for example, has severely compromised the availability and value of surface and groundwater for irrigation purposes, fishing, and even domestic uses. Factories have increased their water abstraction beyond their permits through illegal installation of additional intakes or pumps in the permitted intakes. In the dry season, factories (illegally) buy or rent additional water from close upstream farmers who receive some benefits, whereas downstream farmers suffer. Yield decreases from 7 to 4 tons per ha have been reported in rice fields irrigated with polluted water, and some fields have ceased to be usable. This development speeds conversion of agricultural land to other uses. However, although many farmers lose out in agricultural production, some members of the farm household work in the factories, thereby increasing their living standards, and thus do not want factory activities to cease.

Evidence of reduced instream flows due to water reallocation with impacts on river habitat, instream and out-of-stream recreation and other effects has been reported in several states of the western U.S., and environmental demands on water resources are increasingly being acknowledged. California, for example, has implemented a new regulation that reduces exports from the Sacramento/San Joaquin Delta in order to meet federal water quality standards and to protect endangered species (Livingston, 1998). Hearne and Easter (1995), in a comprehensive study on water markets and water transfers in Chile, find no evidence of increased environmental degradation related to active water trading. In fact, by inducing conservation, institutional arrangements in Chile seem to help prevent environmental degradation in river basins. In addition, they postpone the need of dam and other infrastructure construction projects and their inherent potential adverse effects, and decrease soil salinization, (a phenomenon which often stems from over-watering upstream), and waterlogging through increased water conservation.

In summary, the evidence of the micro-level impacts on water reallocation indicates that the experience is negative for rural communities when the transfers are above the level allowing for continued farming or other opportunities in the area-of-origin; when farmers had no incentives to sell, but water was taken anyway; and when institutions and secure legislation to adequately compensate the sellers and third parties were absent. On the other hand, when sellers receive substantial benefits, sell only part of their water, have a stake in the economic development of the urban area, can rely on secure rights to their resource, are protected by adequate institutions and organizations, and have flexible tools (such as water leases or option contracts), the reallocation experience can be positive, providing economic growth in both rural and urban areas.

## 7. Water Policy Reforms to Save Water and Manage Reallocation

The evidence presented here indicates that a shift in the future allocation of water among competing uses is inevitable, and that the global trend will be to reduce the share of water for agricultural use. Rapid nonagricultural demand growth is unlikely to be only met through the expansion of supplies, or through nontraditional sources. The key question will be how to accomplish the reallocation of water from agriculture in a rational and equitable manner that minimizes costs and avoids the potentially large negative impacts of the many ad hoc transfers today on both the rural economies from which the water is drawn and on the future growth of food supply and demand. The potentially negative implications of intersectoral water transfers can be mitigated through comprehensive policy reforms that save water in existing uses and improve the quality of water and soils through improved water demand management. In order to achieve this, greater attention must be placed on the institutions for water allocation and on the rights of water users and incentives for efficient use.

The policy instruments available for demand management include: (1) enabling conditions, that facilitate changes in the institutional and legal environment in which water is supplied and used. Policies here include reform of water rights, the privatization of utilities, and laws pertaining to water user associations (WUAs); (2) market-based incentives, which directly influence the behavior of water users by providing incentives to conserve on water use, including pricing reform and reduced subsidies on urban water consumption, water markets, effluent or pollution charges and other targeted taxes or subsidies; (3) nonmarket instruments, including restrictions, quotas, licenses, and pollution controls; and (4) direct interventions, including conservation programs, leak detection and repair programs, and investment in improved infrastructure (Bhatia, Cestti and Winpenny, 1993). The precise nature of water policy reform and the policy instruments to be deployed will vary from country to country depending on the underlying conditions such as the level of economic development and institutional capability, the relative water scarcity, and the level of agricultural intensification. The mix of policy instruments will also vary from river basin to river basin, depending on the structural development of the different sectors in the region, prevailing rights to natural resources, relative water shortages, and other basin-specific characteristics. Therefore, no single recipe for water policy reform can be applied universally, and additional research is required to design specific policies within any given country, region, and basin. However, some key elements of a demand management strategy can be identified. The process of reallocating water from agriculture can be better managed through the reform of existing administrative water management organizations, through the use of incentive systems such as volumetric water prices and markets in tradable water rights, and through the development of innovative mixed systems of water allocation.

### *7.1. Reform of Administrative Management*

Institutional reform of public irrigation agencies holds considerable promise for long-term progress in improving system performance. Possible reforms include reorganization into a semi-independent or public utility mode, applying financial viability criteria to irrigation agencies, franchising rights to operate publicly constructed irrigation facilities, and strengthening accountability mechanisms such as providing for farmer oversight of operating agencies (Rosegrant and Svendsen, 1993).

Devolution of irrigation infrastructure and management to WUAs has received particular attention in recent years. In the past, turnover of the infrastructure and management of systems has often failed because of a lack of financial resources at the local level, flaws in internal structural features or external factors that affect the viability and sustainability of WUAs in managing irrigation systems. A recent review has identified some of the characteristics that appear to be associated with successful WUAs. WUAs tend to be stronger if they build upon existing social capital or patterns of cooperation. Groups are likely to be stronger if they are homogeneous in background and assets. Such associations must demonstrably improve water control and farm profitability to ensure that the benefits to farmers outweigh the costs of participation. Particularly crucial to success is a supportive policy and legal environment that includes establishment and adjudication of secure water rights, monitoring and regulation of externalities and third-party effects of irrigation, and provision of technical and organizational training and support (Meinzen-Dick, et al., 1997). The goal should not be privatization per se, but to identify the lowest level in the system at which the devolved management is efficient (subsidiary principle). Local management organizations are expected to gain greater responsibility, decision-making authority, and control over physical and financial resources. These alternative organizational forms, which replace public agency management, include Irrigation Districts, as introduced recently in Mexico, Irrigation Associations, as are being rapidly introduced in Turkey, and Irrigation and Drainage Management Companies, as established recently in Viet Nam. The critical resource needed for these organizations to be effective is local managerial capacity, including skills in interaction and negotiation with government agencies, leadership, and financial management, in addition to the standard range of technical skills required for system operation and management (Svendsen and Meinzen-Dick, 1997).

### *7.2. Water Rights, Markets, and Prices*

The primary alternative to quantity-based allocation of water is incentive-based allocation, either through volumetric water prices or through markets in transferable water rights. The empirical evidence shows that farmers are price-responsive in their use of irrigation water. The main types of responses to higher water prices are use of less water on a given crop, adoption of water-conserving irrigation technology, shifting of water applications to more water-efficient crops, and change in crop mix to higher-value crops (Rosegrant, Gazmuri Schleyer and Yadav, 1995; Gardner, 1983). In urban areas, the use of incentive-based policy instruments, such as higher water prices, secure rights to water, and devolution of services, can achieve substantial water savings and improve the delivery of services for both households and industries (Bhatia and Falkenmark, 1993; Frederick, 1993; Gomez, 1987).

Attempts to establish administered efficiency prices through increases in water charges have been met with strong opposition from established irrigators because this mechanism is perceived as an expropriation of existing water use rights, that would create income and wealth losses for established irrigated farms. This makes it difficult to institute and maintain an efficiency-oriented system of administered prices. The establishment of transferable property rights would formalize existing rights to water rather than expropriate these rights, and generate income for the water right holders rather than taxing them, and is therefore politically more feasible (Rosegrant and Binswanger, 1994).

Devolution of water rights from centralized bureaucratic agencies to farmers and other water users has a number of advantages. The first is empowerment of the water user, by requiring user consent to any reallocation of water and compensating the user for any water transferred. The second is security of water rights tenure provided to the water user. If well-defined rights are established, the water user can benefit from investment in water-saving technology. Third, a system of marketable rights to water induces water users to consider the full opportunity cost of water, including its value in alternative uses, thus providing incentives to economize on the use of water and gain additional income through the sale of saved water. Fourth, a properly managed system of tradable water rights provides incentives for water users to internalize (or take account of) the external costs imposed by their water use, reducing the pressure to degrade resources (Rosegrant, 1997). Market allocation can provide flexibility in response to water demand, permitting the selling and purchasing of water across sectors, across districts, and across time by opening opportunities for exchange where they are needed. The outcomes of the exchange process reflect the water scarcity condition in the area with water flowing to the uses where its marginal value is highest. Markets also provide the foundation for water leasing and option contracts, which can quickly mitigate acute, short-term urban water shortages while maintaining the agricultural production base (Michelsen and Young, 1993).

Establishment of markets in tradable property rights does not imply free markets in water. Rather, the system would be one of managed trade, with institutions in place to protect against third-party effects and potential negative environmental effects that are not eliminated by the change in incentives. The law forming the basis for the allocation of water through tradable rights should be simple and comprehensive; clearly define the characteristics of water rights and the conditions and regulations governing the trade of water rights; establish and implement water right registers; delineate the roles of the government, institutions, and individuals involved in water allocation and the ways of solving conflicts between them; and provide cost-effective protection against negative third-party and environmental effects which can arise from water trades (Rosegrant, 1997).

### 7.3. *Mixed Systems of Water Management*

Centralized, public administrative management on the one hand and free market allocation of water on the other hand can be seen as the polar extremes for water allocation mechanisms. However, as could be seen even in the brief summaries in the preceding sections, water allocation systems in the real world will be much more complex and diverse. Systems will be mixed both in ownership (combining aspects of public and private ownership of water supply infrastructure and water rights) and in overriding water allocation principles (combining administrative/regulatory approaches with market/incentive-based approaches). Decentralization and privatization will increasingly create systems with public ownership and management down to a certain level in the distribution system and user-based ownership below that level. For water market systems to be efficient and equitable, judicious regulation will be required. The process of water policy reform should lead to mixed water allocation systems that are responsive to local institutions and conditions.

The mixed management systems that have resulted from adjudication of groundwater rights in California offer a promising model for developing countries. These diverse and decentralized management systems developed in direct response to the depletion of groundwater resources and the degradation of the environment and have resulted in the elimination of overdrafts, the impoundment of surface and imported water for aquifer replenishment, and have stopped saltwater intrusion (Blomquist, 1995). The adjudication process has resulted in a governance structure for the water basin that establishes water rights, monitoring processes, means for sanctioning violations, financing mechanisms for the governance system, procedures for adapting to changing conditions, and includes representative associations of water users (Blomquist, 1992). Central to the governance structures is a water management program which employs a combination of instruments to influence water demand, including pumping quotas (usually based on historical use), pumping charges, and transferable rights to groundwater. Key elements for the success of these governance structures are that they are agreed upon and managed by the water users; are responsive to local conditions; operate with available information and data bases rather than requiring theoretically better but unavailable information; and are adaptive to the evolving environment. These attributes make mixed systems highly appropriate for developing country conditions.

### 7.4. *Conservation Through Appropriate Technology*

If improved demand management introduces incentives for water conservation, the availability of appropriate technology will be essential to generating water savings and higher crop production per unit of water. As the value of water increases, the use of more advanced technologies such as drip irrigation (utilizing low-cost plastic pipes), sprinklers, and computerized control systems, used widely in developed countries, could have promising results for developing countries. If the scarcity value of water is high enough, appropriate use of new technologies appears to offer both real water savings and real economic gains to farmers. Field application efficiencies in flood irrigation in developing countries are typically in the range of 40-60 percent. High-pressure sprinklers save on drainage losses but may not reduce consumptive use because of the high evaporative losses. Modern low-pressure, downward-sprinkling systems, however, can reduce evaporation considerably (Seckler, 1996). *Surge irrigation* can reduce water applications significantly. Instead of releasing water continuously down field channels, surge irrigation alternates between rows at specific intervals. The initial wetting of the channel partially seals the soil and allows water to be distributed more uniformly, reducing percolation, runoff, and evaporation. Drip irrigation also has important applications in developing countries, but it is difficult to estimate the real potential for savings from this technology. On the one hand, by directing water applications directly to the root zones, drip irrigation can significantly reduce field evaporation losses and can increase the productivity of water in areas already affected by salinity. On the other hand, drip irrigation is usually not economically viable for use on cereals, which consume by far the largest share of irrigation water in developing countries, so the scope for real water savings from introduction of drip irrigation may be limited.

Technological opportunities to reduce water withdrawals also exist at the irrigation system level. In Malaysia's Muda irrigation system, real-time management of water releases from the dam, keyed to telemetric monitoring of weather and streamflow conditions, has significantly improved water use efficiency and reduced drainage to the ocean. In North Africa, modern irrigation systems using hydraulically operated diversion and measuring devices were developed as early as the late 1940s, and were employed in irrigation schemes constructed in the 1950s. Modern schemes in this region deliver water on demand to individual farmers, allowing water users to be charged according to the volume of water delivered, encouraging conservation and efficient use of water. Some of these irrigation techniques have been transferred to the Middle East, and in pilot projects to other developing countries (World Bank, 1993). Continued increases in the value of water could make these capital-intensive irrigation distribution systems more widely feasible in other regions of the world. Adoption of high technology irrigation can have somewhat paradoxical impacts on water savings, and savings on a per ha basis may be limited. In the U.S., where detailed data is available, water withdrawals per ha of irrigated area increased by 35 percent between 1960 and 1975, declined nearly 15 percent from 1975 to 1980, increased again, and in 1990 were still higher than the 1975 level. In addition, reductions in water applications will likely be offset by increased water requirements for higher-yielding crops and increasing cropping intensities (Raskin, Hansen and Margolis, 1995). However, real water savings can be achieved with improved technologies through the increase in agricultural output per unit of water applied, or conversely, through reduction in the amount of water used per unit of output. The decrease of water (and land) per unit of production can also help to save on land resources under irrigated production, another major constraint for future global food production.

## 8. Conclusions

Water demand is projected to grow rapidly, particularly in developing countries. The increase in demand will be higher for urban and industrial uses than for agriculture. A portion of the growing demand for water will be met through new investment in irrigation and water supply systems, and some potential exists for expansion of nontraditional sources of water supply. However, supply expansion will not be sufficient to meet increasing demands. Therefore, the rapidly growing urban and industrial water demands will need to be met increasingly from water transfers out of irrigated agriculture. The management of this reallocation could determine the world's ability to feed itself. If such transfers take place without mitigating policy reforms in demand management the prices of staple cereals in global food markets could increase sharply, resulting in broadly negative impacts on low-income developing countries and the poor consumers in these countries.

The reallocation of water can also have substantial negative effects on rural economies, if supporting policy measures are not adopted. The evidence of the impact of transfers of irrigation water to urban and industrial uses on rural communities is mixed. In addition, interlinkages between urban and rural sectors and the importance of local, basin-level characteristics make it difficult to draw general conclusions about the impacts of transfers. However, some observations can be made: negative effects from water transfers can be mitigated through (1) the establishment of secure rights to water that are monitored and enforced by adequate institutions and organizations; (2) transfers of relatively small amounts from many irrigators, inducing conservation measures instead of plot abandonment; (3) reinvestment of gains-from-trade in the rural communities; and (4) adequate compensation of sellers and affected third parties. Flexible tools, in particular, markets in tradable water rights, when established in a participatory and rational manner, can facilitate and mitigate the potentially adverse impacts of water transfers, creating win-win situations for both rural and urban/industrial water users.

Comprehensive reforms are required to improve the incentives at each level of the water allocation process in order to improve the efficiency of agricultural water use and sustain crop yield and output growth to meet rising food demands while allowing transfers of water out of agriculture. Institutional and legal environment reforms must empower water users to make their own decisions regarding resource use, while at the same time providing a structure that reveals the real scarcity value of water. Key policy reforms include the establishment of secure water rights to users; the decentralization and privatization of water management functions to appropriate levels; the use of incentives including pricing reform (especially in urban contexts) and markets in tradable property rights; and the introduction of appropriate water-saving technologies. Failure to implement these reforms could significantly slow the growth in crop production in developing countries and could have devastating impacts on the rural poor.

**References**


Adams, W.M. 1990. How beautiful is small? Scale, control, and success in Kenyan irrigation. *World Development*, Vol. 18, No. 10, 1309-1323.

Allan, J.A. and J.H. Court (eds.). 1996. *Water, peace and the Middle East: Negotiating resources in the Jordan basin.* Tauris Academic Studies, London and New York.

Ayibotele, N.B. 1992. The world's water: Assessing the resource. Keynote paper at the International Conference on Water and the Environment: Development Issues for the 21st Century, January 26-31, Dublin, Ireland.

Barrow, C.J. 1991. *Land degradation: Development and breakdown of terrestrial environments.* Cambridge University Press, New York.

Bhatia, R. and M. Falkenmark. 1993. *Water resource policies and the urban poor: Innovative approaches and policy imperatives.* Water and Sanitation Currents. United Nations Development Programme - World Bank Water and Sanitation Program, World Bank, Washington, D.C.

Bhatia, R., R. Cestti and J. Winpenny. 1995. *Water conservation and reallocation: Best practice cases in improving economic efficiency and environmental quality.* A World Bank-Overseas Development Institute Joint Study. World Bank, Washington, D.C.

Blomquist, W. 1995. Institutions for managing groundwater basins in Southern California. In *Water quantity/quality management and conflict resolution: Institutions, processes, and economic analyses*, ed. A. Dinar and E.T. Loehman. Praeger, Westport, Conn., U.S.A.

Blomquist, W. 1992. *Dividing the waters: Governing groundwater in Southern California.* Institute for Contemporary Studies (ICS) Press, San Francisco, U.S.A.

Burton, M.A. and C.K. Chiza. 1997. Water, conflict and the environment: A case study from Tanzania. In *Water: Economics, Management and Demand*, eds. M. Kay, T Franks, and L. Smith. E & FN Spoon, London.

Chang, C. and R.C. Griffin. 1992. Water marketing as a reallocative institution in Texas. *Water Resources Research*, Vol. 28, No. 3, pp. 879-890.

Christensen, S.R. 1994. Water allocation conflicts in Thailand: An analysis of government failure. In Water conflicts. Natural Resources and Environment Program, Thailand Development Research Institute and Queen's University, Canada.

Clarke, R. 1993. *Water: The international crisis*. MIT Press, Cambridge, Mass., U.S.A.

Dixon, L.S., N.Y. Moore and S.W. Schechter. 1993. California's 1991 drought water bank: Economic impacts on the selling regions. Rand. Santa Monica, Calif., U.S.A..

Easter, K. William, M. M. Hufschmidt. 1985. *Integrated watershed management research for developing countries : workshop report.* Honolulu, Hawaii : East-West Environment and Policy Institute, East-West Center.

El-Ashry, M.T. 1991. Policies for water resource management in semiarid regions. *International Journal of Water Resources Development*, Vol. 7, No. 4, pp. 230-234.

Engelman, R. and P. LeRoy. 1993. *Sustaining water: Population and the future of renewable water supplies.* Population Action International, Washington, D.C.

FAO (Food and Agriculture Organization of the United Nations). 1979. *Yield response to water.* FAO Irrigation and Drainage Paper No. 33. FAO, Rome.

FAO. 1996. Food production: The critical role of water, September. Advanced edition. FAO, Rome.

FAO. 1989. *Food and Agriculture Organization Production Yearbook.* Vol. 43, FAO, Rome.

Fereres, E. and F. Ceña. 1997. Social benefits and environmental constraints of irrigation in an era of water scarcity. In *Water: Economics, Management and Demand*, eds. M. Kay, T. Franks and L. Smith. E & FN Spoon, London.

Franks, T., Shahwahid, M. and Lim, H.F. 1997. The wise use of mangrove systems: The social and environmental value of water. In *Water: Economics, Management and Demand*, eds. M. Kay, T. Franks, and L. Smith. E & FN Spoon, London.

Frederick, K.D. 1993. *Balancing water demands with supplies: The role of management in a world of increasing scarcity*. World Bank Technical Paper No. 189. World Bank, Washington, D.C.

Garay, F.J. and M.A. Sugheiar. 1997. Libya's Great Man-made River. *OPEC Bulletin*, Vol. 28, No. 6, pp. 20-27.

Gardner, B.D. 1983. Water pricing and rent seeking in California agriculture. In *Water rights, scarce resource allocation, bureaucracy, and the environment*, ed. T.L. Anderson. Pacific Studies in Public Policy, Pacific Institute for Public Policy Research. Ballinger, Cambridge, Mass., U.S.A.

Gleick, P.H. 1996. Basic water requirements for human activities: Meeting basic needs. *Water International,* Vol. 21 No. 2, pp. 83-92.

Gleick, P.H. 1993. About the data. In *Water in crisis: A guide to the world's fresh water resources*, ed. P.H. Gleick. Oxford University Press, New York.

Gomez, C. 1987. Experiences in predicting willingness-to-pay on water projects in Latin America. Paper presented at the meeting Resource Mobilization for Drinking Water and Sanitation in Developing Nations, San Juan, Puerto Rico, May 26-29.

Grossman, G.M. and A.B. Krueger. 1997. *Economic growth and the environment.* National Bureau of Economic Research Working Paper, National Bureau of Economic Research, Cambridge, MA.

Hamilton, J.R., N.K. Whittlesey and P. Halverson. 1989. Interruptible water markets in the Pacific Northwest. *American Journal of Agricultural Economics* Vol. 71, No. 1, pp. 63-75.

Hearne, R.R. 1998. Institutional and organizational arrangements for water markets in Chile. In *Markets for water: Potential and performance*, eds. K.W. Easter, M.W. Rosegrant and A. Dinar, forthcoming, Kluwer Academic Publishers.

Hearne, R.R. and K.W. Easter. 1995. *Water allocation and water markets: An analysis of gains-from-trade in Chile*. World Bank Technical Paper No. 315, World Bank, Washington, D.C.

Howe, C.W. 1998. Water markets in Colorado: Past performance and needed changes. In *Markets for water: Potential and performance*, eds. K.W. Easter, M.W. Rosegrant and A. Dinar, forthcoming, Kluwer Academic Publishers.

Howe, C.W., J.K. Lazo and K.R. Weber. 1990. The economic impact of agriculture-to-urban water transfers on the area of origin: A case study of the Arkansas river valley in Colorado. *American Journal of Agricultural Economics*, Vol 72, No. 12, pp. 1200-1209.

IIMI (International Irrigation Management Institute). 1992. Developing environmentally sound and lasting improvements in irrigation management: The role of international research, IIMI, Colombo, Sri Lanka.

Jones, W.I. 1995. *The World Bank and irrigation*. World Bank, Washington, D.C.

Kayasseh, M. and C. Schenck. 1989. Reclamation of saline soils using calcium sulphate from the titanium industry. *Ambio*, Vol. 18, No. 2, pp. 124-127.

Kurnia, G., T. Avianto and B. Bruns. 1998. Farmers, factories and the dynamics of water allocation in West Java. In *Negotiating Water Rights*, eds. R. Meinzen-Dick and B. Bruns, forthcoming, Sage Publishers, India.

Livingston, M.L. 1998. Institutional requisites for efficient water markets. In *Markets for water: Potential and performance*, eds. K.W. Easter, M.W. Rosegrant and A. Dinar, forthcoming, Kluwer Academic Publishers.

London, J.B. and H.W. Miley. 1990. The interbasin transfer of water: An issue of efficiency and equity. *Water International*, Vol. 15, No. 12, pp. 231-235.

Meinzen-Dick, R. 1997. Valuing the multiple uses of irrigation water. In *Water: Economics, Management and Demand*, eds. M. Kay, T. Franks and L. Smith. E & FN Spoon, London.

Meinzen-Dick, R., M. Mendoza, L. Sadoulet, G. Abiad-Shields and A. Subramanian. 1997. Sustainable water user associations: Lessons from a literature review. In *User organizations for sustainable water services*, eds. A. Subramanian, N.V. Jagannathan and R. Meinzen-Dick, World Bank Technical Paper No. 354, World Bank, Washington, D.C.

Michelsen, A.M. and R.A. Young. 1993. Optioning agricultural water rights for urban water supplies during drought. *American Journal of Agricultural Economics*, Vol. 75, No. 11, pp. 1010-1020.

Nickum, J.E. 1997. *Issue paper on water and irrigation*. Paper prepared for the project "Strategy and Action for Chinese and Global Food Security," Millennium Institute, USDA, World Bank, World Watch Institute, September, Washington, D.C.

Nickum, J.E. 1994. Beijing's maturing socialist water economy. In *Metropolitan water use conflicts in Asia and the Pacific*, eds. J.E. Nickum and K.W. Easter. East-West Center and United Nations Centre for Regional Development, Westview Press, Oxford.

Palanisami, K. 1994. Evolution of agricultural and urban water markets in Tamil Nadu, India. Arlington, Virginia: Irrigation Support Project for Asia and the Near East (ISPAN), United States Agency for International Development.

Postel, S. 1996. *Dividing the waters: Food security, ecosystem health, and the new politics of scarcity*. World Watch Paper No. 132, World Watch Institute, Washington, D.C.

Postel, S. 1992. Last oasis: Facing water scarcity. The Worldwatch Environmental Alert Series. New York: W.W. Norten.

Raskin, P., H. Evan and R. Margolis. 1995. *Water and sustainability: A global outlook.* Polestar Series Report No. 4. Stockholm Environment Institute, Stockholm, Sweden.

Repetto, R. 1986. *Skimming the water: rent-seeking and the performance of public irrigation systems.* Research Report No. 4, World Resources Institute, Washington, D.C.

Rhoades, J.D. 1987. The problem of salt in agriculture. In *Yearbook of science and the future.* Encyclopaedia Britannia, Chicago, Ill., U.S.A..

Rosegrant, M.W. 1997. *Water resources in the twenty-first century: Challenges and implications for action.* 2020 Vision for Food, Agriculture, and the Environment Discussion Paper 20, IFPRI, Washington, D.C.

Rosegrant, M.W. and N.D. Perez. 1997. Water resources development in Africa: A review and synthesis of issues, potentials, and strategies for the future. Environment and Production Technology Division Paper 28, IFPRI, Washington, D.C.

Rosegrant, M.W., C. Ringler and R.V. Gerpacio. 1997. Water and land resources and global food supply. Paper prepared for the 23rd International Conference of Agricultural Economists on "Food Security, Diversification, and Resource Management: Refocusing the Role of Agriculture," Sacramento, California, August 10-16.

Rosegrant, M.W., M.A. Sombilla, R.V. Gerpacio, and C. Ringler. 1997. Global food markets and US exports in the twenty-first century. Paper presented at the Illinois World Food and Sustainable Agriculture Program Conference, May, Urbana-Champaign, Illinois.

Rosegrant, M.W., M. Agcaoili-Sombilla and N.D. Perez. 1995. *Global Food Projections to 2020: Implications for Investment*, 2020 Vision for Food, Agriculture, and the Environment Discussion Paper No. 5, IFPRI, Washington, D.C.

Rosegrant, M.W., R. Gazmuri Schleyer and S. Yadav. 1995. Water policy for efficient agricultural diversification: Market-based approaches. *Food Policy*, Vol. 20, No. 3, pp. 203-223.

Rosegrant, M.W. and R. Gazmuri Schleyer. 1994. Tradable water rights: Experiences in reforming water allocation policy. Arlington, Virginia: Irrigation Support Project for Asia and the Near East (ISPAN), United States Agency for International Development.

Rosegrant, M.W. and H.P. Bingswanger. 1994. Markets in tradable water rights: Potential for efficiency gains in developing country water resource allocation. *World Development*, Vol. 22, No. 11, pp. 1613-1625.

Rosegrant, M.W. and P.L. Pingali. 1994. Policy and technology for rice productivity growth in Asia. *Journal of International Development*, Vol. 6, No. 6, pp. 665-688.

Rosegrant, M.W. and M. Svendsen. 1993. Asian food production in the 1990s: Irrigation investment and management policy. *Food Policy*, Vol. 18, No. 2, pp. 13-32.

Sadeque, S.Z. 1998. Nature's bounty or scarce commodity: Competition and consensus over groundwater use in rural Bangladesh. In *Negotiating Water Rights*, eds. R. Meinzen-Dick and B. Bruns, forthcoming, Sage Publishers, India.

Seckler, D. 1996. *The new era of water resource management: From "dry" to "wet" water savings*. Research Report No. 1. International Irrigation Management Institute, Colombo, Sri Lanka.

Shuval, H.I. 1990. *Wastewater irrigation in developing countries: Health effects and technical solutions*. Water and Sanitation Discussion Paper Series No. 2, United Nations Development Programme - World Bank Water and Sanitation Program, World Bank, Washington, D.C.

Svendsen, M. and R. Meinzen-Dick. 1997. Irrigation management institutions in transition: A look back, a look forward. *Irrigation and Drainage Systems*, 11, pp. 139-156.

Svendsen, M. and M.W. Rosegrant. 1994. Irrigation development in Southeast Asia beyond 2000: Will the future be like the past? *Water International*, Vol. 19, No. 1, pp. 25-35.

Thobani, M. 1998. How to meet water needs in developing countries: Resolving issues in the establishment of tradable water rights. In *Markets for water: Potential and performance*, eds. K.W. Easter, M.W. Rosegrant and A. Dinar, forthcoming, Kluwer Academic Publishers.

Tolba, M.K. 1978. Welcome address. In *Proceedings of water management for arid lands in developing countries workshop*. Vol. 13. Pergamon Press, Oxford.

UN (United Nations). 1996. *World Population Prospects: The 1996 Revision*, Population Division, Department for Economic and Social Information and Policy Analysis, United Nations, New York.

U.S. Office of Technology Assessment. 1993. Preparing for an uncertain climate. Government Printing Office. OTA-O-567, Washington, D.C. Accessed at <http://enso.unl.edu/ ndmc/ mitigate/ policy/ota>.

Villarejo, D. 1997. Mendota Executive Summary. Accessed at <http://www.whiteknight.com/ Alliance/mendota.htm>.

Wolter, H.W. 1997. FAO's strategies for water management with special reference to intersectoral issues. In *Strategies for Intersectoral Water Management in Developing Countries - Challenges and Consequences for Agriculture*, eds. J. Richter, P. Wolff, H. Franzen, and F. Heim. Proceedings of the International Workshop held from 6th - 10th May, 1996, in Berlin, Germany, DSE.

Wongbandit, A. 1994. Water use conflicts management in the northeast: case studies of Nam Siaw and Nam Pong, in Natural Resources and Environment Program Thailand Development Research Institute and Queen's University, Canada, *Water Conflicts*, 2nd ed. pp. 149-238.

World Bank. 1993. *Water resources management. A World Bank policy paper.* World Bank, Washington, D.C.

World Bank. 1992. *World development report 1992*, World Bank, Washington, D.C.

WRI (World Resources Institute). 1996. *World Resources 1996-97*, Oxford University Press, New York.

Zhang, Q. and X. Zhang. 1995. Water issues and sustainable social development in China. Water International, Vol. 20, No. 3, pp.122-128.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# STRATEGIC APPROACHES TO THE INTEGRATED MANAGEMENT OF FRESHWATER RESOURCES: ACTIONS NEEDED TO PROTECT HUMAN HEALTH

by

Dennis B. Warner, Robert Bos, Tetsuo Hayakawa, Jose Hueb and Mayling Simpson-Hebert
World Health Organization, Geneva, Switzerland

Paper No. 5

Prepared for the
Department of Economic and Social Affairs
United Nations

# STRATEGIC APPROACHES TO THE INTEGRATED MANAGEMENT OF FRESHWATER RESOURCES: ACTIONS NEEDED TO PROTECT HUMAN HEALTH

Dennis B. Warner, Robert Bos, Tetsuo Hayakawa, Jose Hueb and Mayling Simpson-Hebert
World Health Organization, Geneva, Switzerland

## 1 Introduction

For a large percentage of the world's population, water supplies are neither safe nor adequate. Currently, over 1000 million people do not have access to an adequate supply of safe water for household consumption. Moreover, the world's freshwater resources are limited and unevenly distributed over the global land mass.

Demand for water is nevertheless increasing in several sectors - for drinking-water (domestic needs), food production (agriculture) and product manufacturing (industry). Water use figures differ significantly in terms of continent, region, country and area and type of use, but globally, total demand for water increased by six times between 1900 and 1990, more than double the rate of population growth for the same period. Some water uses - such as irrigation for agriculture - are highly wasteful. Not surprisingly, water scarcity today is increasingly becoming a problem of regional and even sub-continental proportions. It is now particularly acute in dry zones, where competition between agricultural, industrial, domestic needs is often fierce.

Global freshwater resources are threatened not only by over exploitation, but also by poor management and ecological degradation. Untreated sewage is discharged into rivers and lakes, industrial wastes are dumped into water bodies, and run-off from agriculture fields treated with herbicides and pesticides results in contamination of surface water sources. The combination of industrial development, the exponential growth of human settlements and the ever-increasing use of synthetic organic substances is having serious adverse impacts on freshwater bodies. Many surface and groundwaters are now contaminated with nutrients, heavy metals and persistent organic pollutants (POPs).

The provision of safe water and the management of wastewater have had a central role in reducing the incidence of many waterborne or water-related communicable diseases. One of the major achievements of the past 150 years is the extent to which diseases associated with water have become of minor significance in the mortality and morbidity statistics of most developed countries and of some developing countries (especially for richer groups living in major cities). The diseases associated with contaminated water, however, remain serious public health problems for most of the world's population. Water shortages are imposing serious constraints on the expansion of food production, the growth of industry and the provision of adequate sanitation in many countries. Countries with relatively low per capita levels of available freshwater will find it difficult to meet the increasing demands for water from expanding populations as well as from agriculture and industry.

There are three crucial concerns in the relationship between water and health. The first is the constraints faced by water-poor countries and their impact on human activities. The second is the maintenance of water quality in the face of growing demand. The third is the direct link between health and water, especially the diseases associated with poor quality water and with unsanitary disposal of wastewater.

## 2 Water Development Sectors Affecting Human Health

### 2.1 Water Supply

An adequate supply of safe drinking-water is universally recognized as a basic human need. Yet more than 1000 million people do not have ready access to an adequate and safe water supply, and a variety of physical, chemical and biological agents render many water sources less than wholesome for human consumption. Health hazards resulting from waterborne epidemics are usually due to poor management of water resources, although adverse natural conditions can also be causative.

The direct effects of improved water and sanitation services on health are most clearly seen in the case of water-related diseases, which arise from the ingestion of pathogens from contaminated water or food, and from exposure to insects or other vectors associated with water. Esrey et al. (1991) calculated that access to safe drinking water and basic sanitation services for populations currently at risk would result in:

- 200 million/year fewer diarrhoeal episodes
- 2.1 million/year fewer deaths caused by diarrhoea
- 76 000 fewer dracunculiasis cases
- 150 million fewer schistosomiasis cases
- 75 million fewer trachoma cases.

Safe water supplies for all populations can only be guaranteed when access, equity and sustainability are assured. Access can be defined as the number of people who have the capability to draw sufficient quantities of safe drinking water for meeting basic personal consumption and hygiene needs. Equity refers to the fair allocation of water between countries, between rich and poor populations and between rural and urban areas. Sustainability, a newer concept, refers to the capability of maintaining a service within available resources.

**Water supply access and equity**

The number of people without access to safe water dropped from around 1600 million in 1990 to around 1100 million in 1994. Currently, more than 800 million of the unserved live in rural areas. At the same time, the number of urban unserved is actually rising sharply in developing countries due to rapid urbanization, much of which is occurring in peri-urban and slum areas. Table 1 shows water supply coverage in the developing countries at the end of 1994.

**Table 1. Water Supply Coverage: Urban and Rural Areas, 1994**

| Region | Population Served Urban | | Population Served Rural | | Population Served Total | |
|---|---|---|---|---|---|---|
| | millions | % | millions | % | millions | % |
| **Africa** | 153 | 64 | 173 | 37 | 326 | 46 |
| **Latin America and the Caribbean** | 306 | 88 | 70 | 56 | 376 | 79 |
| **Asia and the Pacific** | 805 | 84 | 1690 | 78 | 2495 | 80 |
| **Western Asia** | 51 | 98 | 20 | 69 | 71 | 88 |
| **Global** | 1315 | 82 | 1953 | 70 | 3268 | 75 |

Note: statistics are for developing countries only.
Source: WHO/UNICEF/WSSCC, 1996

Although per capita water availability is being reduced continuously due to increasing population density urban water utilities have been able to achieve at least partial coverage. The future outlook is rather bleak, however, with a water crisis predicted for many countries for the first half of the next century. Large-scale agricultural and industrial use will make it more difficult, and certainly much more costly, to supply urban areas with drinking-water in an increasingly competitive water market.

Global figures mask regional variations. Although the number of people without a safe water supply dropped by around 470 million during 1990–1994, the number unserved in Africa and in Latin America and the Caribbean has actually increased; almost all of the coverage gains have been in Asia and the Pacific.

In poorer areas, millions of people have access only to standpipes, which often receive intermittent supplies and at which they must queue for long periods, or handpumps which are poorly maintained. The health consequences resulting from the inequity of these poor services are sometimes considerable, as evidenced by the infant mortality rates which may vary between two and ten times in magnitude between those served with good water supplies and those which are not. The poor, in particular, are at high risk from epidemic diarrhoeal diseases, such as cholera.

Unaccounted for water (UFW) is a major water supply problem. In many large cities in the developing world UFW may exceed 50% of the total water produced. Most of this water is lost through leaking pipes, from overflowing service reservoirs or during distribution. Those who suffer most from this inefficiency are populations living in impoverished areas, usually the peri-urban fringes of large cities. Such people often must buy water of doubtful quality from private vendors at prices that may be 10 to 20 times higher than average piped water rates. But if measures to ensure the sustainability and organization of facilities were implemented, the extension of coverage to the fringe and poor areas of large cities would be possible. This would bring about considerable improvements in health. At the same time, the need to expand treatment and distribution facilities would be minimized, in effect releasing resources for other development activities.

**Sustainability of water supply services**

Water supply sustainability involves ensuring the continuous availability of sufficient quantities of water of sufficient quality and within adequate institutional frameworks. It also involves applying sound management practices, appropriate technologies, and full-cost accounting, and effectively maintaining facilities and equipment. In rural areas, sustainability also involves the need to strengthen the ability of communities or local governments to operate and maintain water supply systems and, where possible, build or improve facilities. In developing countries, however, the management of water supply and sanitation systems is often poor, resulting in interruptions in the provision of services and sometimes in the complete collapse of water supply systems. When the latter happens, users often resort to traditional water sources which may be contaminated.

Measures to ensure the sustainability and optimization of water supply services should deal not only with the visible effects of poor performance, such as leakage, intermittent water supplies or collapse of a handpump, but also with the causes of poor performance, including planning aspects, financial issues, operation, maintenance, information systems, human resources development, administrative issues, gender aspects and community management.

## 2.2 Sanitation

In developed countries nearly all human excreta is collected safely via sewerage systems, septic systems or other sanitation systems. However, considerable amounts of sewage are nevertheless discharged into the environment in these countries.

In developing countries the sanitation coverage picture is very different. A small proportion of the total population, very roughly 10% and mainly urban, has access to sewerage systems and a slightly larger proportion, very roughly 20%, has some type of on-site sanitation facility. But the vast majority (about 65%) of people in developing countries do not have appropriate sanitation systems.

Sanitation coverage also varies enormously by region. Table 2 shows the variability in rural and urban sanitation coverage for developing countries in the four regions of the world.

Of the unserved in developing countries (2900 million), 80% live in rural areas. Most of the faeces of the unserved are recycled for use in agriculture or deposited on land without prior destruction of pathogens, most of which eventually enter surface and groundwaters, sometimes surviving for considerable lengths of time. Not surprisingly, infectious diseases such as diarrhoeal diseases, schistosomiasis and hepatitis are endemic, and sometimes epidemic in unserved areas.

## The health threat from human excreta

On average, human beings produce 1150 g of urine and 200 g of faeces per day. Thus, globally, about 500 million kg per day of human faeces are generated in urban areas and about 600 million kg in rural

**Table 2. Sanitation Coverage: Urban and Rural Areas, 1994**

| Region | Population Served Urban | | Population Served Rural | | Population Served Total | |
|---|---|---|---|---|---|---|
| | millions | % | millions | % | millions | % |
| Africa | 131 | 55 | 112 | 24 | 243 | 34 |
| Latin America and the Caribbean | 254 | 73 | 42 | 34 | 296 | 63 |
| Asia & the Pacific | 584 | 61 | 332 | 15 | 916 | 29 |
| Western Asia | 36 | 69 | 19 | 66 | 55 | 68 |
| Global | 1005 | 63 | 505 | 18 | 1510 | 34 |

Note: statistics are for developing countries only.
Source: WHO/UNICEF/WSSCC, 1996

areas, producing a total of over one million tons per day. Most of this biodegradable organic material is disposed of with very little or no treatment, thereby polluting the environment with organisms that are highly dangerous to human health. Pathogens enter the human body via contaminated drinking-water and contaminated food, via hands contaminated with faecal matter, and, in the case of some helminthic worm infections, directly through the skin. Ingestion of faecal pathogens can cause diarrhoeal disease, cholera, intestinal worm infections and typhoid fever. Urinating into bodies of water perpetuates urinary schistosomiasis. If a dangerous pathogen, such as *Vibrio cholerae*, is introduced into a community with poor sanitation, poor water supply and poor food safety, epidemic cholera may ensue, as in South America in the early 1990s.

The most effective way to break these cycles of disease is by improving sanitation coverage, treating wastewaters discharged by sewer systems, and educating the populations at risk.

## On-site sanitation

Of the 20% of people in developing countries who have on-site sanitation, such as a septic system or latrine (such as pit, pour-flush or composting), a number are still at risk. This is because some on-site sanitation systems do not completely protect human health. For example, an on-site sanitation system may protect the health of an individual household, but its design may be such that pathogens are released into local water bodies. Pit latrines, for instance, often leach into groundwater, contaminating it with pathogens. This problem is certainly increasing in those urban areas where crucial groundwater resources lie beneath crowded communities not connected to sewerage systems. Additionally, in rural areas, the contents of pit latrines are deposited on fields to dry and decompose causing, and pathogens to wash into nearby water bodies.

**Sewerage**

Most cities in developed countries are fully sewered, collecting virtually all wastewater and removing it away from city centres. But some of this wastewater is discharged without treatment. In developing countries, cities are typically only partially sewered: the proportion of the population served may range from a small percentage to 100% in a very few cases. The treatment of wastewater also varies considerably. In most cases sewerage systems in developing countries rarely connect to effective treatment facilities. Data on these issues are not readily available. As for rural communities in developing countries, sewerage is uncommon.

**Trends in sanitation coverage**

Based upon current trends, the total unserved population is expected to increase to 3300 million by the year 2000. Various factors complicate the task of improving sanitation in developing countries. For instance, recent urbanization has been very rapid, often consisting of the mushrooming of informal, or peri-urban, settlements at the periphery of cities. Informal urban settlements are usually densely populated, suffer from poor-quality housing, and frequently lie outside the remit of the municipal waste management authority. The application of conventional waste treatment methods is obviously difficult in such conditions and innovative approaches are called for.

The state of existing sewerage systems presents further problems. Many of the sewerage networks in developing countries, especially Africa, were constructed a century or more ago. Most of these systems have not been maintained adequately and are now in dire need of rehabilitation. Additionally, increases in population density and per capita water consumption have caused the systems to become overloaded. Sanitation planning for the future must therefore take into consideration not only the financial requirements of new systems for those as yet unserved, but also the resources needed to rehabilitate systems representing past infrastructural investments. This underscores the importance of continuous operation and maintenance to avoid later costly repairs and reconstruction works.

## 2.3 Rainfed and Irrigated Agriculture

Rainfed agriculture does not involve the deliberate development and management of water resources to enhance crop production. The nature and magnitude of the environmental impact of changes following the development of water resources for agricultural production, therefore, depends on the natural situation prior to development. For example, introducing irrigation in the Sahel has a dramatic impact, while its introduction in an area with considerable seasonal rainfall, such as in parts of India, will only mean a shift in the balance between wet and dry seasons. This range in environmental impacts translates into a range of health impacts, limited by the regional distribution of diseases (often determined by other environmental factors. for instance altitude) and complicated by the "human factor". These include demographic changes related to human circulation patterns, the immune status of different affected communities and socio-cultural factors that determine behaviour, including water contact patterns.

All four traditional categories of water associated diseases (water-borne, water-washed, water-based and water-related vector-borne diseases) may be affected by irrigation development. The first two reflect the role of water as a carrier of biological contaminants, originating from human excreta. The water-based diseases are the result of the combination of a receptive environment for intermediate hosts of pathogens (aquatic snails in the case of schistosomiasis; cyclops in the case of dracunculiasis or Guinea Worm infection) and human behaviour (contamination of water bodies with excreta and water contact patterns). For the category of water-related vector-borne diseases, water provides the essential habitat for the development of mosquito vectors of disease.

Because of the above-mentioned complexities, it is generally difficult to attribute an exact number of cases of disease to irrigation development. It is easier to assess slowly developing, chronic infections such as schistosomiasis, but nearly impossible for a dynamic disease, such as malaria, which often shows a patchy pattern of outbreaks related to a host of internal and external factors.

Clearly the most important contributing factor is the type of irrigation selected for development. Surface irrigation carries a notoriously high risk for vector-borne diseases, while drip irrigation involves no additional health risks. In the latter case, human health can profit from the improved nutritional status and better access to health services that usually accompanies irrigation development. Between the most primitive forms of surface irrigation and the most sophisticated forms of drip irrigation there is a range of options, each with their own specific health risks. A number of risk factors, however, may exist but often can be managed effectively through environmental management techniques. They include:

- shallow reservoirs, including night storage dams. (In Africa, the presence of night storage dams, usually full of aquatic weeds and with easy access for children, is a guaranteed recipe for schistosomiasis; in parts of Asia, *Mansonia* mosquitoes, the vectors of brughian filariasis, breed in reservoirs covered with aquatic weeds.)

- absence of proper drainage. (This results in waterlogging and the formation of swamp and wetland areas downstream from the irrigation scheme which are usually eutrophic because of the run-off of fertilizer, thus providing a perfect habitat for the propagation of aquatic snails and mosquito vectors.)

- weed growth in the canals. (Intermediate snail hosts of schistosomiasis flourish in this environment; the infective parasite larvae (cercariae) are shed during the hottest time of the day when water contact is most desirable.)

- seepage from canals. (Canals are not usually lined, and lined canals are not well maintained or the canal bunds are deliberately broken for water poaching, which creates mosquito breeding places.)

- hydraulic structures containing standing water. (The design of new, self-draining hydraulic structures for the Mushandike Irrigation Scheme in Zimbabwe, combined with the installation of latrines in a grid-pattern in the fields, led to a considerable reduction in schistosomiasis incidence.)

Water quality can also effect the vector-borne disease risk factors of surface irrigation. Studies in California have shown that rice fields flooded with ground water produced significantly less mosquitoes than those flooded with water drawn from natural streams. Nutrient levels also are likely to play a role, similar to the case of the eutrophication of drainage swamps because of chemical run-off.

The next most important risk factor in irrigation development in relation to vector-borne diseases is the cropping pattern. Flooded rice tops the list of crops that have a major health impact, particularly in the receptive environment of Africa. In Asia, however, Japanese encephalitis is almost exclusively linked to irrigated rice production systems because the breeding of its vector, *Culex tritaeniorrhynchus*, is restricted to flooded rice fields. The introduction of new rice varieties which, together with intensified irrigation, allows farmers to grow two or even three crops of rice a year, often also mean an intensification of the vector-borne disease problems. Sugar cane is listed next after flooded rice, with particular reference to schistosomiasis as a vector-borne disease. Both the gradual spread of schistosomiasis in Ethiopia linked to the development of sugar cane plantations and subsequent migration of seasonal labourers and the late 1980s explosive outbreak of *Schistosoma mansoni* infections in the delta of the Senegal river are illustrative of this fact.

Vector-borne diseases are not the only health risks incurred by irrigation development. For lack of coordination, many irrigation schemes are developed without an adequate drinking water supply and sanitation component. Communities are then forced to rely on chemically or biologically contaminated water. While they will try to avoid the use of bitter-tasting water resulting from high concentrations of pesticide residues and fertilizers, it is more difficult to avoid the risks imposed by biologically contaminated water, which may result in high levels of diarrhoeal diseases, schistosomiasis and Guinea Worm infection. In areas where people rely on shallow wells for their drinking water, the introduction of irrigation may lead to ground water pollution from pesticide residues and fertilizers. Later on, when the water quality has deteriorated further, people will abandon this source and shift to collecting water from impoundments or canals, often risking exposure from biological hazards. Unreliable drinking water supply may force people to store water in their homes, with the inherent risk of *Aedes aegypti* breeding, and subsequent transmission of the dengue virus.

Prevention and control of the water associated health problems in irrigation development should have three targets:

- The incorporation of health considerations at the planning and design stage of any water resources development scheme, especially in irrigation development.

- The strengthening of health services necessary for an effective and efficient delivery of health care under new epidemiological conditions.

- The promotion of environmentally sound agricultural practices in order to ensure a sustainable health situation.

## 2.4 Water Reclamation and Reuse

As many communities throughout the world are reaching the limits of their available water sources, water reclamation and reuse has become an attractive option for conserving and extending available water supplies. Water reuse may also present an opportunity for pollution abatement when it replaces effluent discharge to sensitive surface waters. In agriculture, wastewater may be applied to land for the irrigation of crops. In aquaculture, wastewater or excreta may be added to aquaculture basins as fertilizers, or fish can be raised in ponds used for the treatment of wastewater by maturation (waste stabilization ponds).

Measures to protect the health of the consumers and farm workers have to be taken when using wastewater in crop and fish production. If not, the pathogens contained in domestic wastewater could be transmitted to crops or fish where they could survive until harvesting and subsequent consumption. They also could directly contaminate farm workers. The best protective measure for consumers and farmers is treatment of the wastewater. Often, sewage is only partially treated, which makes it necessary to institute appropriate techniques for water application, crop selection, worker's protection and health education.

Where crops are irrigated with raw wastewater, consumers face a significantly higher risk of infection by intestinal nematodes. For example, the irrigation of crops with wastewater was linked with a significant increase in the frequency of Ascaris infections in Jerusalem (variations in frequency of up to 30 %). In comparison, the risks of infection by bacteria and viruses are lower. However, irrigation with raw wastewater has been the cause of important cholera outbreaks. In many countries, raw wastewater is still used for crop irrigation without approval of the health authorities. This leads to the expansion and continuous recirculation of a great variety of diseases.

Aquaculture may lead to transmission of certain trematodes, and in particular schistosomiasis, if wastewater used for the fertilization of aquaculture ponds is not treated. This is still the case in East and South-East Asia. The main health hazards arise when fish become infected with human parasites from faeces and are eaten raw or inadequately cooked.

## 2.5 Industries (General)

The adverse effects of industrial activities on human health range from those of relatively high levels of exposure of small populations in certain occupational settings to those of the usually lower-level exposure of the general population in the ambient environment.

The health of the general population is sometimes damaged by polluted ambient water. Industrial activities may contaminate water through three general processes: the use of water in industrial processes, which is then released into a natural body or a sewer system; the direct discharge of a product into water; or the contamination of soil leading to leaching of the pollutants into ground water .

The major pathway by which water pollution may lead to adverse health effects is by ingestion. However, for certain chemicals, exposure may also occur through skin contact or by inhalation following evaporation.

The following are the main industrial activities affecting human health through water:

- Asbestos and man made fibres: The inhalation of asbestos fibres can cause cancer and chronic respiratory diseases. The ingestion of contaminated water supplies has also been suggested, but the evidence for gastrointestinal cancers has not been strong.

- Basic chemicals: Low dose exposure to chemical effluents, such as methylmercury, can produce long-term neurological and teratogenic effects in the general population.

- Electronics: A wide range of metals, acids, solvents and other toxins used in the electronics industry can leak from storage tanks into drinking waters and cause serious health concerns.

- Rubber and plastic products: The manufacture of rubber and plastic products involves large quantities of potentially hazardous organic and inorganic liquids and solids.

- Metal products: Health effects of the metal products industry on the general population have not been well studied; however, water pollution from cleaning operation is a major problem

- Mining of metals: The leaching of toxic minerals from mine tailings into the ground water may represent a health hazard to the surrounding population.

- Pesticides, paints and pharmaceuticals: These products are designed for use in the general environment in a multitude of applications. As a result, the potential for hazardous exposure of the population through contact with contaminated soil or water is high.

- Petroleum products: Petroleum products, including polycyclic aromatic hydrocarbons, trichloroethylenes, vinyl chloride, xylene, stylene, methylethylketone, toluene and benzene among others, constitute a wide variety of water pollutants and hazardous wastes.

- Textiles and leather: The disposal of liquid wastes from the manufacture of these products is of particular concern in developing countries because of the large volumes of toxic solutions employed and the general lack of wastewater treatment facilities.

- Wood and furniture: High concentration of chlorophenols and chlorinated phenoxyphenols (pre-dioxins) have been found in the ground water near saw mills, while chlorinated dibenzofurans have been detected in the soils at these sites.

- Thermal power generation: The combustion of fossil fuels for energy production constitutes the dominant source of sulphur emissions in the industrialized world. The resulting precipitation of acidic air pollutants causes the acidification of soils and surface waters, with the consequent corrosion of metal pipes and the increased mobilization of lead and copper in drinking water.

- Hydropower generation: The generation of hydropower does not produce wastes or other by-products harmful to human health. The creation of reservoirs, however, may enhance the spread of infections and diseases, including malaria, brugian filariasis and schistosomiasis.

### 2.6 Recreation

Untreated sewage, industrial effluents and agricultural waste are frequently discharged into inland waterways, lakes and coastal zones, endangering the use of these water bodies for recreational purposes such as swimming, canoeing and windsurfing. Recreational exposure to polluted waters can cause diarrhoea, respiratory infections, skin irritation and other diseases depending on the specific pollutants involved.

Numerous studies on the health consequences of bathing in polluted coastal waters have been undertaken but very few can be considered as constituting scientific risk assessment. Many epidemiological studies concentrate on populous Mediterranean beaches such as those in Egypt. Others have been undertaken in Hong Kong and in South Africa.

Estimating the overall public health consequences from recreational use of polluted water is difficult, but we do know that in the Mediterranean basin only about 41% of municipal sewage undergoes a secondary treatment and that 33% is not treated at all. The 150 to 200 million tourists that the Mediterranean basin attracts each year (representing about 35% of international tourism world wide) and the 130 million inhabitants of the area, may be exposed to these polluted waters. Bathing-induced epidemics are thus a possibility on many coastlines.

In Europe, 3000 bathing areas (17%) do not comply with European Community quality standards or are insufficiently monitored for compliance. For inland bathing areas, the situation is even less satisfactory, with only 30% complying with minimum requirements.

The environmental health conditions of some developing country coastlines are also cause for concern. Coastal beaches in megacities are sometimes tainted with sewage and industrial effluents, while tourist resorts along ocean shores lack sanitation facilities and sewage outfalls and are not reliably monitored for water quality and food safety. Because rigorous scientific evidence of the associated health impacts is lacking, a false sense of security has arisen.

## 3 Priority Health Issues related to Water

### 3.1 Child Health

Infant and child mortality rates clearly show the relative burden of infectious diseases between the regions of the world, as illustrated in Table 3. In 1996, the infant mortality rate, defined as the number of deaths before the first birthday per 1000 live births, ranged from a high of 88 in Africa to a low of 7 in North America and Oceania. Similarly, the child mortality rate, defined as the number of deaths before the fifth birthday per 1000 live births, ranged between 130 and 8 for the same regions.

**Table 3. Infant and Child Mortality, 1996**

| Region | Infant Mortality Rate | Child Mortality Rate |
|---|---|---|
| Africa | 88 | 130 |
| Asia | 59 | 74 |
| Latin America and the Caribbean | 42 | 51 |
| Europe | 12 | 16 |
| North America | 7 | 9 |
| Oceania | 7 | 8 |
| World | 59 | 78 |

IMR = No. of deaths by the first birthday per 1000 live births
CMR = No. of deaths by the fifth birthday per 1000 live births
Source: WHO, 1996a

The great majority of these deaths are attributable to infectious diseases, with most caused by poor environmental sanitation (see Annex 1: Table of water-related diseases and their environmental associations).

For almost two decades, Child Survival programmes have been the main vehicle for delivering selective interventions to improve the health of children. The success of this approach is shown by the fact that over the past 25 years the mortality rate of infants under one year of age has dropped 37% and the mortality rate of children under 5 years has declined 40%. Morbidity rates, however, have not in general declined. In the case of diarrhoea and other diseases related to poor environmental sanitation (water supply, excreta disposal and solid wastes disposal), they have remained persistently high, and often show increases.

The obvious response to the current situation is to give greater attention and emphasis to prevention through modifications of the physical and social environment, in other words, to find ways to incorporate environmental sanitation elements in both strategies and programmes for child health. Research and development efforts to understand the linkages of environmental sanitation with health have been carried out. In the early 1980s many studies concentrated on diarrhoea, but researchers soon expanded later into a variety of diseases related to water and sanitation. In 1991, for example, a review of 144 studies by Esrey and his colleagues of the impact of improved water and sanitation services upon six major diseases (ascariasis, diarrhoeas, dracunculiasis, hookworm, schistosomiasis and trachoma) found median reductions in mortality and morbidity ranging from 20% to 80% for most diseases, as shown in Table 4.

**Table 4. Expected Disease Reductions from Improved Water and Sanitation**

| Disease | All Studies | | Better Studies | |
|---|---|---|---|---|
| | No. | Median | No. | Median |
| Diarrhoea Morbidity | 49 | 22% | 19 | 26% |
| Diarrhoea Mortality | 3 | 65% | - | - |
| Ascariasis | 11 | 28% | 4 | 29% |
| Dracunculiasis | 7 | 76% | 2 | 78% |
| Hookworm | 9 | 4% | - | - |
| Schistosomiasis | 4 | 73% | 3 | 77% |
| Trachoma | 13 | 50% | 7 | 27% |
| Overall Impact on Child Mortality | 9 | 60% | 6 | 55% |

Source: Esrey et al, 1991

Increasingly, as can be seen in the case of WHO and UNICEF, environmental sanitation programmes are taking on a health orientation, with emphases on disease control and Child Survival. In most cases, the levels of water and sanitation services considered are relatively simple: communal water taps with household water storage, household latrines and waste disposal, and hygiene education for handwashing, food preparation and vector control. The USAID Environmental Health Project recommends a "wellness" paradigm based on household and community-level preventive actions that should be incorporated into current Child Survival programmes currently focused on case management and facility-based services.

### 3.2 Vector-borne diseases

Vector-borne diseases are transmitted by insects or other invertebrate organisms. Their distribution is therefore directly linked to the ecological requirements of specific vector species, which in many, through not all, cases usually means an aquatic habitat to support the larval stages. Because of this characteristic, one of the important entry points for preventive interventions is the control of disease vectors. Environmental management and biological control, therefore, make up the first line approach. For both environmental and economic reasons, chemical control has become an option for very specific, usually emergency, conditions.

Water resources development offers opportunities to incorporate environmental management measures as health safeguards, but it is of crucial importance that health experts participate in the early planning stages and that there is a good understanding of the epidemiology of the locally important diseases and of the ecology of local vector species. There are a large number of water-related vector-borne diseases, but globally the most important are malaria, schistosomiasis and two viral diseases, dengue and Japanese encephalitis.

### Malaria

Globally, the malaria situation is serious and worsening. Annual global malaria mortality is estimated at between 1.5 and 2.7 million and morbidity at 300 to 500 million episodes. Slightly more than 2 billion people are at risk. There are several epidemiological "types" of malaria: dry savanna and desert fringe malaria, forest malaria, urban and peri-urban malaria. Malaria associated with water resources development is mainly found in the dry savanna and desert fringes, but it may also be linked to small scale development in peri-urban areas.

Around 90% of the global malaria burden is estimated to occur in Africa south of the Sahara, where the versatile *Anopheles gambiae* species complex is mainly responsible for transmission, together with a number of other, secondary vectors. Almost all malaria in this part of the world is due to *Plasmodium falciparum*, the parasite species associated with the most severe and fatal form of malaria, and children under five and women in their first pregnancy are the most vulnerable groups.

Interactions between environmental, socio-cultural and epidemiological factors are complex in Africa, and effects of water resources development not always predictable. In some irrigated areas in the Sahel, there is actually less transmission with higher vector-densities. In other parts, irrigation development has caused a shift from seasonal transmission to perennial transmission. In Burundi, flooded rice production led to an increased and prolonged peak of malaria cases at the end of the transmission season.

In the eastern Mediterranean, the Indian sub-continent, Indonesia, parts of the Western Pacific and parts of Central and South America, examples of malaria associated with water resources development are more clear-cut and the cause and effect relationship is usually easier to determine.

### Schistosomiasis

The creation of large reservoirs in Africa has had a dramatic impact on the incidence of infections with the parasitic blood flukes of the genus *Schistosoma*, as witnessed by the well-documented cases of the Akosombo dam (Ghana), the Aswan dam (Egypt) and, most recently, the Diama dam (Senegal). Because of the sheer magnitude of their impact on the health of local communities, these large scale projects are most frequently quoted in the literature, yet it can be argued that the cumulative effect of many small and medium size dams and irrigation schemes developed in Africa over the past two or three decades has probably contributed most to the continued prevalence of schistosomiasis. An estimated total of 200 million people are infected world-wide. The drug of choice, Praziquantl, continues to be effective but out of reach of the masses because of its cost. Studies in areas where intensive case detection and drug treatment programmes were implemented, however, have shown that this approach is not sustainable if it is not accompanied by environmental sanitation and management measures that reduce the risks of transmission.

### Arboviral diseases

Dengue fever and its more lethal form, dengue haemorrhagic fever, are mainly related to urbanization and the storage of water in and around houses. Outbreaks occur in major cities in the tropics at regular intervals and usually result in hundreds of deaths and thousands of hospital beds occupied. The risks of dengue are traditionally linked to water collection in and around human dwellings and therefore are best managed through community action and health education. Recently, however, a trend has been noted, particularly in India, of dengue spreading to rural areas. It is linked to unreliable drinking water supply systems which encourage people to store water in their houses. An emphasis on operation and maintenance of drinking water supplies is crucial to avoid creating such situations.

Although Japanese encephalitis is restricted to South, South-East and East Asia, it is a serious public health problem affecting mainly children in its region of occurrence. It has a high mortality rate among those who become clinically ill. Those who recover may suffer lifelong mental sequelae. A vaccine exists but is expensive and requires a very efficient immunization delivery programme. The vectors of this disease, belonging to the *Culex gelidus* group, breed almost exclusively in rice flooded rice fields. Water resources development for the intensification or extension of this type of rice production system have had serious consequences in the form of Japanese encephalitis outbreaks. Pigs play an essential role in the epidemiology of the disease as hosts for the virus. The outbreaks apparently occur when the vector population builds up so rapidly that the mosquitoes, which in the case of the *Culex gelidus* prefer to feed on livestock, begin to feed on humans so frequently that the virus infection starts to circulate in humans. This is often the case in semi-arid areas where intensified irrigation is practised.

## 3.3 Sewage Pollution

Untreated or inadequately treated municipal sewage is a major source of surface and groundwater pollution throughout the developing world and, to a more limited extent, also in the developed world. The pathogens and other pollutants contained in sewage may contaminate rivers, lakes or shallow groundwater from which drinking water is drawn. Exposure to faecal pathogens contained in sewage may also occur while bathing in sewage polluted waters, consuming crops irrigated with raw wastewater or consuming inadequately cooked or raw fish from aquaculture operated with sewage.

Exposure to faecal pollution may lead to a multitude of diseases, of which cholera, typhoid fever, paratyphoid fever, salmonella, shigella, giardiasis, cryptosporidium and non-human *Escherichia coli* infection, hepatitis and poliomyelitis are of main concern. The incidence of waterborne diseases has been reduced substantially in developed countries, but cholera and endemic diarrhoeal disease outbreaks remain frequent elsewhere. Inadequate sewage disposal was one of the main causes for the recent cholera outbreak in Latin America where, in 1991, 380 000 cases were reported. In Peru, where the outbreak was the most severe, the abrupt halt in tourism and agricultural exports cost the Peruvian economy US$ 1000 million in just 10 weeks.

In developed countries, however, water-borne diseases from faecal pollution occur also. Major outbreaks of *cryptosporidium*, which can be traced back to drinking water contaminated by sewage and agriculture, have recently occurred in developed countries. An outbreak of this nature recently affected 400,000 people in Milwaukee in 1993.

Transmission of diseases from sewage pollution is closely linked to water use, population density and level of economic development. This was clearly seen in the mid-18th century in Europe when, at the start of industrialization, cities expanded, became densely populated with crowded inner city slums, and increased quantities of excreta were discharged untreated into urban watercourses. In developing countries, urbanization often goes together with poor sewage disposal systems, and the risk of surface and groundwater contamination is high. When the hydrogeological conditions of such cities are unfavourable (such as shallow groundwater levels), the groundwater may become totally unfit for human consumption.

### 3.4 Natural Water Quality Problems

A variety of acute and chronic health effects can result from naturally-occurring substances in drinking water. If present below a certain threshold level, these substances do not pose a health hazard. The threshold levels are set out in the Guidelines for Drinking-Water Quality, volumes 1 and 2, WHO, 1993. The following are some of the more common substances found in natural waters which have an effect on human health.

#### Fluoride

Fluoride levels of 0.5 to 1 mg/l provide substantial protection against dental caries. However, the margin between beneficial and toxic levels of fluoride is rather narrow and higher levels of fluoride in drinking water have led to adverse health effects, ranging from unsightly dental fluorosis to crippling skeletal fluorosis. Waters with significant natural fluoride content are usually found at the base of high mountains and in areas with geological deposits of marine origin. These areas are found in a belt running from Syria through Jordan, Egypt, the Libyan Arab Jamahiriya; from Algeria to Morocco; the Rift Valley running through Sudan and Kenya; and a belt running through Iraq, the Islamic Republic of Iran, Afghanistan, India and Thailand to China.

#### Arsenic

High concentrations of arsenic in drinking water are found in Argentina, Canada, Chile, China, Japan, Mexico, the Philippines and the USA. Parts of India and Bangladesh have concentrations of arsenic in their groundwaters exceeding the national drinking water standard by 70 times. Some 30 million people may be at high risk from arsenic exposure in these two countries. Ingestion of arsenic contaminated drinking water can lead to skin cancer, other skin effects, peripheral neuropathy and peripheral vascular disease.

### 3.4 Chemical Pollution

Chemical pollution results from agricultural and industrial activities which allow toxic substances to enter the environment. Some of the more common chemical contaminants are the following:

### Lead

The pipes, solder, fittings and service connections of some household plumbing systems contain lead and cause contamination of drinking water supplies. Lead accumulates in the body and effects the central nervous system, with the fetus, infants, children and pregnant women most at risk. Childhood exposure to lead can lead to a decreased intelligence quotient and other serious health effects.

### Nitrates

Drinking water contaminated with nitrates can lead to serious, even fatal, consequences, especially for infants fed with formula prepared with such water. Most nitrate comes from fertilizers spread in agricultural activities. In the human body, the nitrate combines with haemoglobin to form methaemoglobin, which prevents the transport of oxygen in the blood. In very young babies, severe cyanosis or "blue baby syndrome" occurs, which can lead to death. Although nitrates can be removed from drinking waters, the technology is expensive, and a better approach is to prevent nitrate contamination through good agricultural practices.

### Pesticides

Groundwater is especially susceptible to contamination with pesticides that are mobile in soil, such as alachlor, aldicarb, atrazine, bentazone, carbofluran, isoproturon, ethylene dibromide and simazine. Some of these pesticides are believed to be carcinogenic to humans, but all are of concern to future generations because of their persistence in soil and water.

## 4 Health-Related Strategies in Water Resources Development

The integrated planning of freshwater resources development and the integrated management by the different user groups offers many new opportunities to ensure that health safeguards are included and that health promotional measures are incorporated. For this to occur, it is crucial to carry out health impact assessment in a timely manner during the project cycle. This requires the creation at the national level of an appropriate policy and legal framework so that regulatory authorities have the means to appraise health hazards and health risks and that health safeguards are effectively included in the project design and operation.

Once such a framework is in place, other capacity building efforts should include the training of professionals who can carry out health impact assessments and the training of middle level managers to develop managerial skills for intersectoral consultation and decision making.

Integrating the development and management of drinking water supply and irrigation activities has great potential for water savings as well as overall economies of scale. In specific cases, technologies from one sector can be applied to others. This includes environmental engineering measures that help to reduce environmental health risks as well as research and development activities into the health consequences in the different sectors. Integrated management of water resources is perhaps best achieved at the river basin level, which should incorporate both the water-related health needs of communities and their capacities for meeting them. More investigation needs to be carried out on the health opportunities offered by this approach and the institutional arrangements necessary to implement it.

Good health is hard to express in economic terms. The cost of ill-health, however, in terms of health services expenditures, household expenditures and productivity lost can be a powerful argument in the debate over design and operational options in integrated water resources development. The public health sector needs strengthening in this area so that it can generate these arguments in an intersectoral dialogue.

In conclusion, the main elements of a water resources strategy to protect public health include the following:

- Freshwater should be considered a scarce, valuable and finite resource. Water resource management should be promoted to reconcile competing demands from different sectors and consumers.

- National governments should establish institutional mechanisms for intersectoral planning of freshwater resources. This can be accomplished through interministerial committees composed of representatives of the various water sectors.

- Good water management should be based on the recognition of the importance of safe and sufficient supplies for health. This includes the recognition that fresh water is a scarce and finite resource and has a cost that, wherever possible, its users should bear.

- Explicit health objectives should be incorporated into freshwater development planning. Such objectives should be a central part of all integrated water management.

- Because of the enormous effects of water-related diseases on human health, greater priority should be given to sanitation and to education about personal hygiene. Improving the quantity and quality of water and providing safe excreta disposal services are usually possible at relatively low cost, especially if optimal use is made of local knowledge and local resources and the users are fully involved in the design, implementation and management of the services provided.

- Water supply and sanitation planning should be integrated into overall urban and rural development and should be targeted upon those areas which are at greatest risk to water and sanitation-related diseases.

- Sound financial practices play an important role in achieving better water management. They include pricing structures that reflect real costs and encourage efficient use of the water.

- Fresh water should be priced in accordance with its value to health and to economic production. Innovative schemes can often reach poorer groups with major improvements at costs they can afford. Preferential tariffs or subsidies should be avoided for most consumers. They should be used only to ensure that the poorest receive a level of water service sufficient for health.

- The global priority for water pollution control is control of bacteriological and parasitic waterborne diseases. Contamination of water by heavy metals and other chemicals should also be prevented or minimized.

- More emphasis should be placed on making the best use of existing water supplies. Shortages of drinking water can often be remedied by greater attention to maintenance (since up to 60% of water supplies in a piped system may be lost in leaks) and by charging the primary users of water a realistic price.

- In regions where there is risk of floods, a central component of water resources management should be a combination of mitigation and disaster preparedness in order to ensure prompt action to limit adverse effects on health.

**References**

Esrey, S.A., J.B. Potash, L. Roberts & C. Shiff (1991). Effects of improved water supply and sanitation on ascariasis, diarrhoea, dracunculiasis, hookworm infection, schistosomiasis, and trachoma. Bulletin of the World Health Organization, 69 (5): 609-621.

Lisle, J.T., and J.B. Rose (1995). Cryptosporidium contamination of water in the USA and UK: a mini-review. J Water SRT - Aqua, 1995, 44(3): 103-117.

Mara D., and S. Cairncross (1989). Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture. WHO, Geneva.

UNCED (1992). Agenda 21. United Nations Conference on Environment and Development. Rio de Janeiro: 3-14 June 1992.

United Nations (1990a). Achievements of the International Drinking Water Supply and Sanitation Decade 1981-1990. Report of the Secretary-General. General Assembly (A/45/327), New York: 13 July 1990.

United Nations (1995). Progress made in providing safe water supply and sanitation for all during the first half of the 1990s. Report of the Secretary-General. (E/1995/86) Economic and Social Council, 8 June 1995.

WHO (1992a). Evaluation of the International Drinking Water Supply and Sanitation Decade, 1981-1990. Report by the Director-General. (A45/15) World Health Assembly, 30 March 1992.

WHO (1992b). Report of the panel on energy. Geneva: WHO.

WHO (1992c). Report of the panel on industry. Geneva: WHO.

WHO (1993). Guidelines for drinking-water quality. Vols 1 and 2. Geneva: WHO.

WHO (1994). Our planet, our health. Report of the WHO Commission on Health and Environment. Geneva: WHO.

WHO (1995b). Community water supply and sanitation: needs, challenges and health objectives. Report of the Director-General. (A48/INF.DOC./2) World Health Assembly, Geneva, 28 April 1995.

WHO (1996a). Demographic data for health situation assessment and projections - 1996. WHO/HST/HSP/96.3. Division of Health Situation and Trend Assessment, Geneva: WHO.

WHO (1997a). The world health report 1997: conquering suffering, enriching humanity. Report of the Director-General. Geneva: WHO.

WHO (1997b). Health and environment in sustainable development: five years after the Earth Summit. WHO/EHG/97.8. Geneva: WHO.

WHO/UNICEF/WSSCC (1996). Water supply and sanitation sector monitoring report 1996 (sector status as of 31 December 1994). WHO/EOS/96.15. Geneva: WHO.

World Bank (1993). World development report (1993): investing in health. New York: Oxford University Press.

## Annex 1. Estimates of Morbidity and Mortality of Diseases Related to Poor Environmental Sanitation

| Disease | Morbidity (episodes/year or cases) | Mortality (deaths/year) | Relationship of Disease to Environmental Sanitation |
|---|---|---|---|
| **Diarrhoeal diseases, including dysentery** | 4,002,000,000 episodes/yr | 2,473,000 | Strongly related to unsanitary excreta disposal, poor personal hygiene, unsafe drinking water |
| **Typhoid fever** | 16,000,000 episodes/yr | 600,000 | Strongly related to drinking water and food contaminated by human excreta, poor personal hygiene |
| **Dengue and dengue haemorrhagic fever** | 3,100,000 episodes/yr | 138,000 | Strongly related to unsanitary solid waste disposal |
| **Amoebiasis** | 48,000,000 episodes/yr | 70,000 | Related to unsanitary excreta disposal, poor personal hygiene, food contaminated by human excreta |
| **Hookworms** | 151,000,000 cases | 65,000 | Strongly related to soil contaminated by human excreta, poor personal hygiene |
| **Ascariasis** | 250,000,000 cases | 60,000 | Related to unsanitary disposal of human faeces, food contaminated by soil containing human faeces, poor personal hygiene |
| **Schistosomiasis** | 200,000,000 cases | 20,000 | Strongly related to unsanitary excreta disposal and absence of nearby sources of safe water |
| **Trichuriasis** | 45,530,000 cases | 10,000 | Related to soil contaminated by human faeces, poor personal hygiene |
| **Cholera** | 120,000 episodes/yr | 6,000 | Strongly related to drinking water contaminated by human faeces |
| **Giardiasis** | 500,000 episodes/yr | - | Strongly related to drinking water contaminated by human faecal matter, poor personal hygiene |
| **Trachoma** | 152,420,000 cases | - | Related to poor personal hygiene, lack of soap and water |
| **Dracunculiasis** | 130,000 cases | - | Strongly related to drinking water containing infected copapods |

Source: WHO, 1997a

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# CHALLENGES FACING WATER RESOURCES MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN

by
Terence R. Lee

Paper No. 6

Prepared for the
Department of Economic and Social Affairs
United Nations

# THE CHALLENGES FACING WATER RESOURCES MANAGEMENT IN LATIN AMERICA AND THE CARIBBEAN

Terence R. Lee
United Nations, Economic Commission for Latin America and the Caribbean

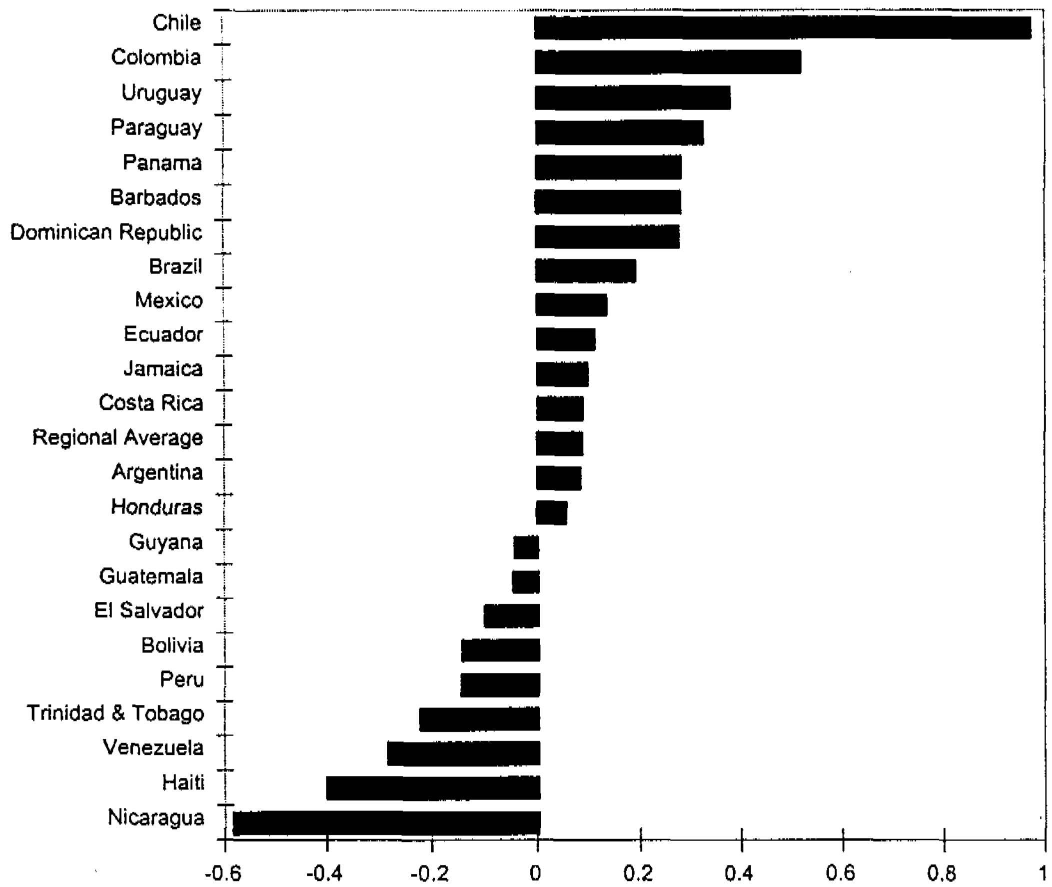
The major challenges facing water resources management at the beginning of the twenty-first century, are and will be determined for the countries of Latin America and the Caribbean by the needs of economic and social development. Oddly enough, or not, these needs are very much the same as those that were being faced as the twentieth century dawned, as well as those that have been faced for all this last century. Undeniably, the greatest challenge is to achieve what it has not been possible to achieve in this century - a high level of economic development, that is both sustainable and equitable. The achievement of sustainable and equitable economic development requires, in order of importance, that the societies of Latin America and the Caribbean, increase productivity, eliminate poverty and minimize the impact of economic activities on the environment.

The water resource has many roles to play in resolving this challenge, both as a whole, as well as, for each separate component. Fortunately, in meeting these challenges for the region, as a whole, there is unlikely to be any crisis in the physical supply of water. The average annual precipitation is estimated to be 1,500 mm, over 50% above the world average, and the annual mean runoff is 31% of the total global land surface drainage entering the oceans. The distribution of precipitation in the region is, however, very uneven and this creates some very arid regions. Moreover, the population has tended to concentrate in the less humid areas of the region, over 90% of the population lives in areas with less than 2000 mm of precipitation a year and three of the largest concentrations of population - the metropolitan areas of Lima-Callao, Peru, Mexico City, Mexico and Santiago, Chile are in areas with less than 500 mm. In these areas, and in other urban and industrial areas, there will be increasing competition among uses which will add an additional change for water resources management.

## THE ROLE OF WATER RESOURCES IN IMPROVING PRODUCTIVITY

Despite the optimism in the press and in many official reports, the economies of the countries of Latin America and the Caribbean have not grown significantly in the last 20 years. The only remarkable exception has been the sustained economic growth of Chile over the last 12 years. In many countries, there has been an overall decline in productivity, and in others recent growth has simply reflected recovery from the recession of the 1980's (Figure 1). Increasing economic productivity remains the major challenge facing the countries of the region.

Figure 1: Changes in per capita income



What is true about the economy as a whole holds equally for those goods and services closely related with the water resource. Most water-based services, not only drinking water supply, but also hydroelectricity generation and irrigation, in most countries are still managed at a loss and require considerable subsidies not only for capital expansion, but even for routine operations. These subsidies are provided at the expense of more socially profitable uses of these financial resources. If water-based services are to make a maximum contribution to economic growth in general then they must become entirely financially self-sufficient, including future capital investment.

Profitability and self-financing is quite achievable for all water-based services in all countries in the region. There are various alternative means, that are already being applied in many countries, to ensure that these services maximize their contribution to economic productivity, to increasing the productive base and through these means to economic growth.

A fundamental step in this process is the reconsideration of the role of the government and the public sector in the economy and a revival of the faith in markets. The most common policy adopted to improve productivity has been the transfer, through sale or concession, of many water-based productive activities to the private sector. An even more radical institutional change is the decision, in some countries, to let the market determine the allocation of water.

The basic components of these policies include, first, reductions on the direct provision of water services by central governments through:

I) The transfer of responsibility from a central government ministry to another public institution, such as an autonomous public corporation, to the states or provinces in the federal countries, to a regional authority or a municipality in countries with a unitary system of government;

ii) The transfer of management responsibilities to formally constituted water-user associations. This is particularly common for irrigation and rural drinking water supply;

iii) The granting of water services in concession to private companies. This is particular common for drinking water supply and sanitation, although, it is also being considered for irrigation works in some countries;

iv) Direct privatization through the sales of shares or by tender. A normal practice for hydroelectricity generation, although it is also being applied to water supply and sanitation services.

Second, in some countries, water markets have been created or are being considered through the assignment of property rights to the water rights and the permitting of the holders of the rights to freely trade them. Such markets have existed in Chile since the early 1980's.

Third, there is a trend towards self-financing. There is an increasing requirement in public policies that sellable water services (drinking water, irrigation, and hydroelectricity) finance the total costs of provision from tariff revenues, including the control of the external or environmental costs associated with their provision.

It is already clear that these policies when thoroughly applied remarkably increase the productivity of water-based services. Their continuation, deepening and widening is the basis by which the use of the water resource can become more productive and its role as an economic good be fully played at the beginning of the twenty-first century. At the same time these policies are placing new demands on human resources. Raising productivity will not only require new skills from workers in the sector, but also create many new employment opportunities. Most countries of the region have extensive training systems both within the universities and within the sector, itself, although the supply and demand are not always coincident.

## WATER AND THE SATISFACTION OF BASIC NEEDS

Much of the criticism that has been made of the poor management of water services has been justified by the ample evidence of the results of ineffective management such as the construction of unjustified or ill conceived projects and in the development of an unwieldy and overly centralized bureaucracies. The greatest failure has been in the provision of drinking water supply and sanitation services, especially in urban areas. The result has been the maintenance of human misery and recurrent crises, such as that of the recent cholera epidemic. There are far too many examples in the region of badly run water services which fail to meet the demands placed upon them to be able to claim that the administration of these services does not demand radical reform.

Over the last three decades, tremendous efforts have been made in most countries to improve public utilities. Nevertheless, the efforts have consistently failed to achieve the objectives set. One of the principle limitations has been the weak financial situation of the state-owned public utility companies due to the failure to use full-cost pricing. The lack of financial resources has been compounded, in many cases, by poor management. This two factors have had the consequence of insufficient increases and even decreases in the provision of services and have constituted an important limitation for those systems which have shown a better performance. Privatization does not necessarily have to be in the form of the sale of whole systems to the private sector, although in many cases this may be the preferred alternative. Granting a total or partial concession can have an equally effective innovative impact as can the conversion of state companies into autonomous public companies registered on the stock exchange.

Improving the financial situation of public utilities, privatized or not, demands that all customers pay for their services, a custom which has not exactly been common in the region and has implications for equity given the nature of the distribution of income in Latin

American societies. Perhaps, however, not such serious implications as the existing failure to provide services, close to 100,000,000 people have no access to services and many more have very poor services (Figure 2). Moreover, there are examples of successful solutions through direct subsidies to the consumer.

No one wishes to pay more for any good or service. But, only moving towards self-financing will allow the whole population, both urban and rural, to have access to the basic services necessary for a minimum quality of life. Moving towards the self-financing of public utilities is an end of century imperative for the countries of Latin America and the Caribbean. The financial restrictions, which have plagued public utilities, can be eliminated through the establishment of tariff systems which allow the whole cost of the provision of basic water services to be met. There should be no doubts either that this is the only way of having well managed services which maximize the contribution of the water resource to the elimination of poverty.

This is the basis for one of the strongest arguments in favour of increasing private participation in water management. Introducing private investment into public utilities requires full-cost pricing. The objective is not, however, privatization for its own sake, but the transformation of public utilities into companies where the investments and provision of services do not continue to be in deficit and where the quality of the services is low, especially for the poorest members of the population. It is here that gender differences become very significant. It is women, and children, who bear the highest proportion of the costs of lack of water and sanitation. It is women who must carry water. Not surprisingly, as everywhere, women are the most enthusiastic participants in programmes to remedy deficiencies. The only real solution to the deficiency lies in the extension of public systems, other solutions are only stop gap remedies.

## THE WATER RESOURCE AND THE ENVIRONMENT

The future growth of the economies of the countries of Latin America and the Caribbean will require that dams are built, swamps drained, rivers diverted and use water be used for the production of electricity, for irrigation, for flood protection, for drinking water supply and incidentally change the environment. Fresh water is a major component of the environment and one of the major challenges facing water management is and will be the need to minimize the environmental disruption society causes through its use of water.

On one hand, the building of dams and reservoirs, especially large dams and reservoirs, has come under mounting criticism in recent years. Part of this criticism stems from the poor performance, in many countries, of the development programmes with which the construction of the dams was related, especially, but not only, in irrigation. Much of the criticism is based, however, on a failure to consider the environmental and social impact of the reservoir on the region in which it has been inserted and the general absence of participation by the population affected in the process of design, construction and operation of the project.

On the other hand, changes in the spatial distribution and structure of human activities, related to increasing urbanization, will continue to have serious effects on the environment through changes in the patterns of streamflow and water quality. The concentration of population in large metropolitan centres has led to considerable interference in the natural order through the growth in sewerage and the subsequent discharge of untreated wastes; interference in the hydrological cycle caused by urban building; the more intensive use of agricultural land close to metropolitan regions; and the increase in the artificial regulation of stream flows.

Equally significant, from the viewpoint of the role of the water resource in the environment, have been the changes that have occurred in the economic structure. Industrial growth and changes in industrial structure have been of particular importance, and the recent adjustments in many economies will only result in greater industrial growth in the decades ahead. Over the last 20 years, for example, the manufacture of intermediate and capital goods has become as important as the production of food and other non-durable goods. The intermediate and capital goods industries and mining, all demand large volumes of water in the production process and produce larger and more complex waste discharges.

Concern for the impact of economic development on the natural environment together with the increasing awareness of the close interrelationship between poverty, especially rural poverty, and environmental degradation has placed environmental management in the forefront of political discussion.

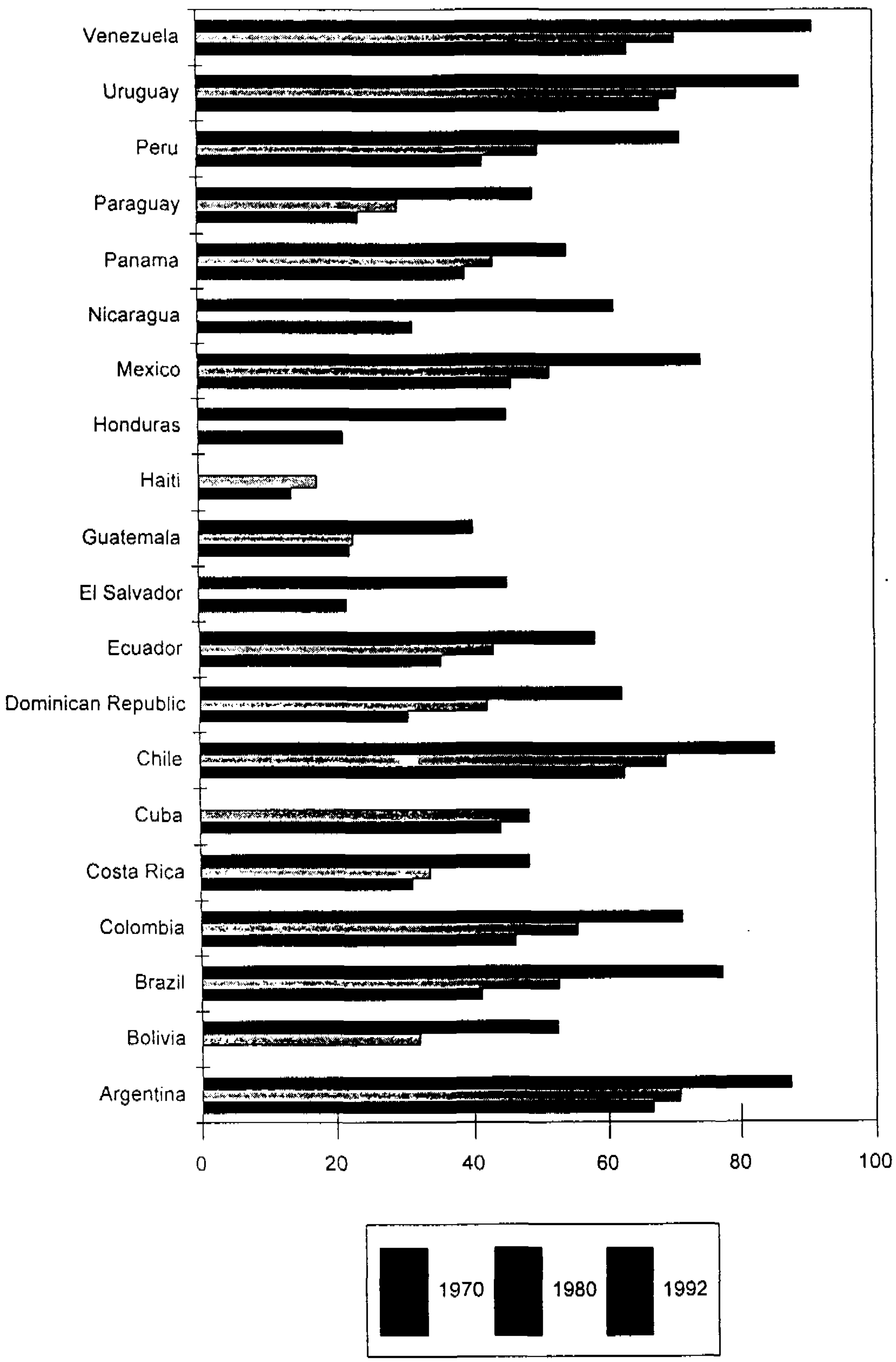
At the same time, the recent tendency towards rationalization, decentralization and privatization of former public sector responsibilities in many countries has brought about an unprecedented change in the institutional environment for water management as many new actors enter into the management and decision-making process. Management processes which were closed, are now open, and wide public discussion of water management decisions is increasingly common in many countries and has replaced the traditional centralized, closed approach to decision-making.

At the same time, the recent tendency towards rationalization, decentralization and privatization of former public sector responsibilities in many countries has brought about an unprecedented change in the institutional environment for water management as many new actors enter into the management and decision-making process. Management processes which were closed, are now open, and wide public discussion of water management decisions is increasingly common in many countries and has replaced the traditional centralized, secretive approach to decision-making.

One important aspect of the criticisms made of the traditional approach to decision making turns on the lack of consideration of the environmental consequences of water management decisions and the consequent damaging environmental effects of many decisions to construct works and assign water use. It is arguable that the over-centralization of any activity is likely to lead to sub-optimum decisions and, especially, to a failure to consider their wider implications. The more open and participatory the process of decision-making is, the more probable it is that all aspects of the decision will receive consideration.

The transfer of responsibilities from central government agencies to lower levels of government and to the private sector is producing a need for new institutional structures for water management in the countries of the region. The centralization of water management destroyed the traditions of local and user participation in management nearly everywhere. Even among the federal states of the region, only in Brazil was extreme centralization avoided and the participation of the States maintained. Now the process of decentralization demands that the idea of user participation, of partnership among the different organizations and the private sector, be recreated through the adoption of institutional structures appropriate to the traditions and idiosyncrasies of the countries of Latin America.

Figure 3: Latin America - Urban population
Percentage of total population



Centralization seem also to be the cause of the neglect of shared resources. There are 59 rivers and lakes in Latin America and the Caribbean - only one in the Caribbean, the Artibonite - whose drainage basins are shared by two or more countries. The drainage basins of these rivers account for over half the area of the countries of the region and to more than three-quarters of the total runoff. Many shared water bodies have been subject to some form of international legal arrangement, either specifically or within some broader instrument dealing with border issues. In general, however, the institutions contemplated under these agreements have not been created or, where they have been, only operate in a very limited manner, with the exception of the agreements between the United States of America and Mexico. Despite the moves within the region towards greater economic integration, it is not certain that the relative importance of shared water resources will change in any significant way. Shared basins remain marginal to the main focus of development for most of the countries of the region. One possible way in which this situation could change radically is with the growing concern for the environment.

Privatization leads, by its very nature, to an increase in the participation of non-government agents in water management. In itself, however, the transfer of responsibilities to the private sector is not a panacea and cannot create a new institutional system for water management. Such a system must be specifically created. The need for innovation in management systems is now widely recognized in the region. There has been little real progress, however, in the construction of systems of water management based on local institutions with wide social participation and where the environmental aspects of water management can be given their due weight.

It is undeniable that the creation of new institutions is complex. Simply coordinating the activities of the public sector can be a difficult task. For example, in the River Bio Bio basin, in Chile, 16 public sector institutions from 9 different central government ministries were identified as having responsibilities for aspects of water management. In addition, there are regional governments and municipalities. In many cases, these institutions have jurisdiction over the same area of water policy. In the Bio Bio example, 9 institutions were shown to share administrative responsibility for water pollution and 8 to share responsibility related to the physical modification of the river's course. There is no reason to think that such an administrative situation is any exception, either in Chile or in Latin America, as a whole.

Even given this complexity, the idea of establishing some form of river basin administrative authority for water management is very attractive and has been proposed for many years. The use of such authorities has not, however, been common in Latin America and the Caribbean. More recently, however, as part of the ongoing revolution in water management policy local management institutions have become the focus of considerable interest by governments. This is leading to the increasing discussion in the region of a need to create river basin based management institutions in order to solve conflicts between users, to better manage supply and to permit the better taking account of the impact of water use on the environment.

The regional development corporations for the Cauca Valley (CVC) and the Rio Bogota (CAR) in Colombia are examples of innovative and efficient regional institutions involved in water resource management. Both provide good examples of local environment management. The CVC began a water quality control programme in the 1960's and it now has perhaps the most successful programmes for controlling industrial pollution in Latin America. It is the type of institution which can be expected to be become more widespread in the region.

New examples of local management institutions include the creation of river basin consortia among municipalities in the state of S‹o Paulo, and other states in Brazil, a renewed interest in river basin authorities under the application of the new Mexican water law promulgated in December, 1992 and moves in Argentina and Chile among other countries, to introduce local water management institutions. It is perhaps in the transferring of administrative authority and responsibility to such local organizations that will provide the most effective means of incorporating consideration of the environmental repercussions in the water management process.

At the same time, the incorporation into public policies of the consideration of sustainable and integrated water resource management is not restricted to the creation of local management agencies. Many countries have been innovating in water quality management. For example, in Mexico, to meet the demands associated with the environmental agreements entered into under the North American Free Trade Agreement, a system of discharge charges under the 1992 National Waters Law has been introduced. In both Argentina and Chile, the institutions responsible for water quality control have recently been strengthened. In general, however, pollution control and water quality management are areas where there is least management experience in the region. It is obvious to most governments, however, that there is a need for policies and strategies for controlling pollution; for establishing information bases on pollutants and water quality; to develop useful technology for pollution control and treatment of wastes; to advance in institutional development; and to establish appropriate financing mechanisms.

## WATER MANAGEMENT IN THE TWENTY-FIRST CENTURY

Throughout this century, the demands over the water resource have gradually intensified in most countries of Latin America and the Caribbean. The intensification of demands can be expected to continue as population continues to increase and the economies renew and increase their growth. Demand will not only continue to increase, but its nature will change as the economies change. The changing and multiple role of the water resource will place tremendous pressure on the ability of managers to cope with the continually changing issues which must confronted in water management.

The necessary progress towards sustainable and integrated water resource management is still hindered by many factors. One of the most important is the tremendous deficiency, that still exists in the provision of effective and efficient water supply and sanitation services. This important and growing social need, intensified by the reappearance of cholera in the region in 1991, does not harbor well for the achievement of sustainable water management being given a high priority by either political decision-makers or the public.

If the water resource is to properly fulfill its role in increasing productivity, eliminating poverty and to minimizing the impact of economic activities on the environment then the achievement of sustainable management policies must have priority. So if the lack of adequate water supply and sanitation is an obstacle than this must be the first challenge that must be resolved.

Looking at the broader context, the years since the Mar del Plata Conference can be divided, as far as the countries of Latin America and the Caribbean are concerned, into three markedly different periods. The first, which ended in 1982, was characterized by unprecedented economic growth. It was followed, however, in the years 1982-1990, by the most serious economic recession since the 1930's. Since 1990, most countries of the region have entered a renewed period of growth and begun to recover from the effects of the recession of the 1980's.

Both the boom of the 1970's and the recession of the 1980's deflected interest in the state of the public sector which was reflected in a lack of innovation in water administration. Indirectly, however, both periods have had repercussions on the administration of the water resource which will undeniably persist into the next century.

The boom at the end of the seventies marked the climax in the expansion of public economic activities typified by the undertaking of a number of grandiose water-related projects, mainly for the generation of hydroelectricity, but also for navigation and irrigation. This expansion of the public sector was reversed during the recession and the following recuperation. In most countries of the region, the role of the state in the economy has been fundamentally revised. The objective of this revision was the reduction or redirection of state expenditures, especially capital investment, in conditions of fiscal austerity. This reduction was accompanied by attempts to increase the efficiency of the provision of services by transferring responsibilities to the private sector or, at the least, to financially autonomous public companies or to the municipalities. One of the results of this policy has been to leave the central public administrations with responsibility for licensing and supervising the activities of third parties, but not for the direct operation of productive activities related to water.

The adoption of such policies is far from even among the countries of the region. Some countries are still in the midst of macroeconomic stabilization. A few have a decade of stable policies and economic growth behind them. The reconsideration of the role of the state in water management is, however, general and marks a major change in water administration policies which had been in existence for more than fifty years. The steady expansion of the public sector in the management of water projects has been reversed.

The context in which water administration is discussed has, fortunately, changed. In the last few years, there is a noticeable general tendency in the region to apply some of the basic precepts for water resource administration which were enunciated at the United Nations Water Conference, and incorporated in the Mar del Plata Action Plan. Agenda 21, adopted at the United Nations Conference on Environment and Development, Rio de Janeiro, 1992, particularly Chapter 18 Protection of the quality and supply of freshwater resources: application of integrated approaches to the development, management and use of water resources has also begun to influence water management policy in many countries.

The emphasis in water management policies is, and will be for, at least, the beginning of the next century, on decentralization and participation. The opportunity has possibly been created for the general adoption of institutional arrangements based on the concept of integrated river basin management, by the removal of operational responsibilities away from the institutions of the central public administration to local government, to autonomous public companies or to the private sector. This institutional change may be the key to ensuring that in the twenty-first century the water resource finally fulfills the roles demanded of it by the societies of Latin America and the Caribbean.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# Integrated Water Resources Management: A Community-based Approach

by

Gourisankar Ghosh and Sadig Rasheed

Paper No. 7

Prepared for the
Department of Economic and Social Affairs
United Nations

# Integrated Water Resources Management: A Right Based Community Approach Towards Sustainable Development

by

Gourisankar Ghosh and Sadig Rasheed[1]

The global crisis of Freshwater has attracted much recent attention. It is increasingly acknowledged that the real problem behind rural poverty is the shortage of natural resources like biomass and water, rather than income poverty. The crucial strategic role of water in fighting poverty and in economic and rural development and the need for an integrated approach to water management are also well-recognized. But the multiple usage of water in survival and development makes its management more difficult, both institutionally and spatially, and much remains to be learned and understood about the implementation of such an approach. This paper will highlight some relevant issues regarding integrated management of water that require open dialogue between stakeholders at all levels.

**Crucial role of Water in The Village ecosystem:**

The "exploitation" of water has long been a source of political and economic conflict as well as of human survival. Today, it is widely understood that sustainable economic development and sustainable "exploitation," or use, of water must include the right of individuals and communities to this precious resource. Beyond the purely economic value of water resources to a nation's development, the long-term 'interest' of the nation and all its people must also be considered. Recently the Committee on Natural Resources of the Economic and Social Council of the United Nations "noted with alarm that some eighty countries, comprising 40% of the world's population, are already suffering from serious water shortages and that, in many cases, the scarcity of water resources has become the a significant limiting factor to economic and social development."

Freshwater as a crucial physical national resource is neither fully understood nor well-managed. As most developing countries are agriculturally based, there is inherent conflict between the need for water to supply irrigation and supply drinking water for the poor. Water plays a significant role in the daily survival and improvement of the primary health or nutritional status of children and women. Moreover, water, land, forest, biomass and livestock are interdependent and the benefits of water development spread across the social and economic sectors. Thus, the issue of

---

[1] Gourisankar Ghosh is Chief, Water, Environment and Sanitation, Programme Division, UNICEF New York. Sadig Rasheed is Director, Programme Division, UNICEF New York. The opinions expressed in the paper are those of the authors and not the official view of UNICEF. The authors are grateful for the comments of Alfredo Missair and especially to Dr. Anil Agarwal of CEC, New Delhi for extensive use of his materials.

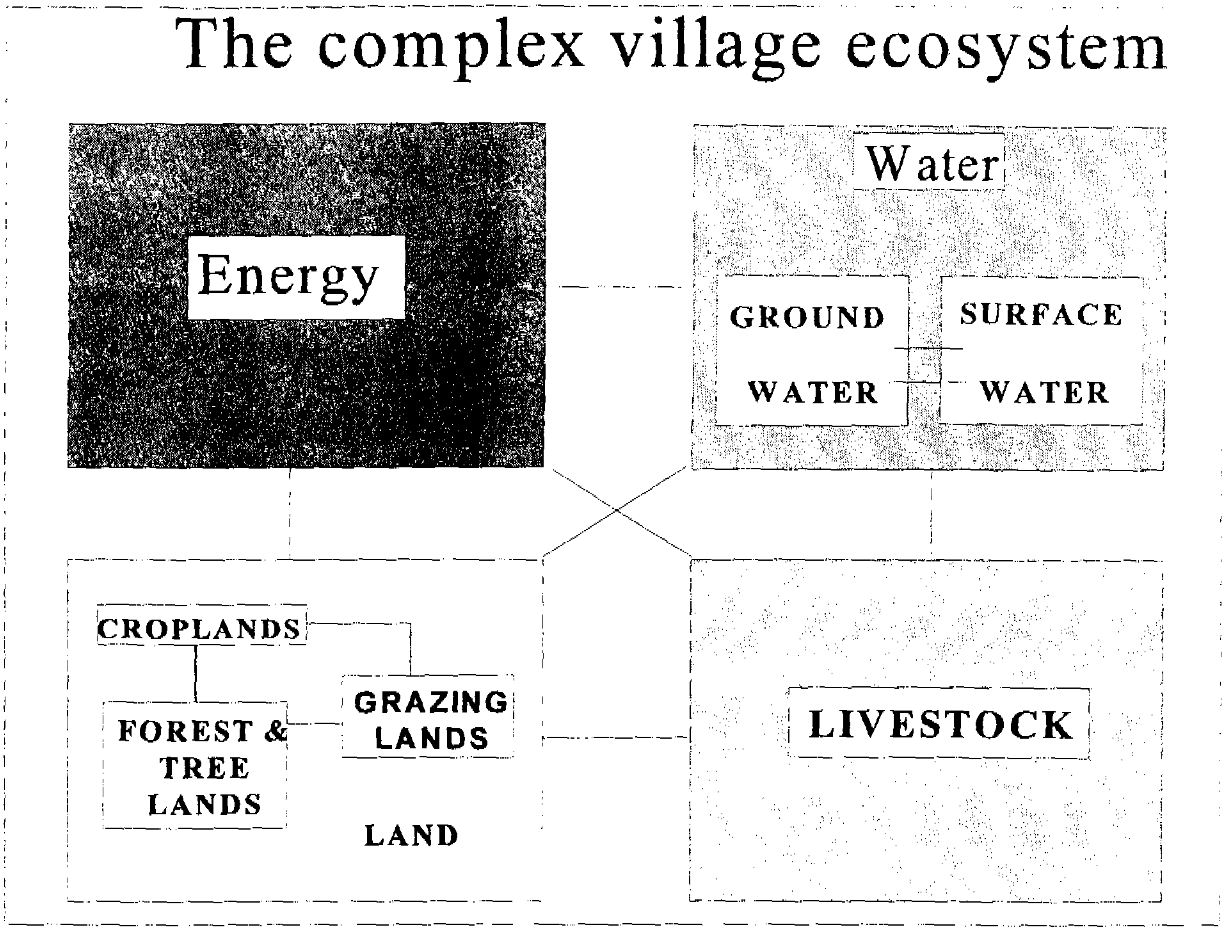



**Figure 1** Complex Village Ecosystem. (Agarwal and Narain, 1989)

- water cannot be studied in isolation or in a narrow sectoral fashion.

- a village is a complex land-livestock-vegetation ecosystem in which the land, the water, the livestock, and the energy sub-systems all interrelate. Sustainable development must be based on the holistic enrichment of the entire village ecosystem without destroying the synergy between the various subsystems Projects to promote economic growth and rural development for poverty alleviation must focus on the integrated management of the complex village ecosystem.

Agarwal and Narain elaborated that a village Ecosystem Management and Improvement Plan must be developed based on the village's natural resources, basic needs and social structure. Because the vulnerable and marginalised groups in the village may depend more on its common resources, any village ecosystem improvement plan should safeguard their access to these resources.

Society cannot progress within a framework that supports government actions while discouraging those of the people. Communities must have ownership in the development of their own water systems and other resource bases, and Government's proper role is to provide the right legal, institutional and financial support and encouragement for local initiative.

**Poverty Alleviation, Economic Growth and Freshwater:**

The Human Development Report of 1997 (UNDP) has made a clear distinction between mere income poverty and deprivation of basic human needs which are directly related to basic human rights. The World Bank in its "Rural Well Being" approach has identified the need to build "social capital." In the human poverty index used in the Human Development Report of UNDP, access to health services and to safe water were considered the most reliable basic indicators. Combining these two access variables with the prevalence of malnutrition provides a fairly broad picture of economic provisioning---private and public--- to supplement the information on survival and literacy. (Human Development Report, UNDP, 1997 page 19).

For centuries, village economies were based on a respect for nature, protection of natural resources and the development of an economic activity model that maintained harmony between social and economic issues and political and religious concerns. The current global economic system and its associated development paradigm are oblivious to traditional knowledge and to

**The Planning Process for Environmentally-sound Rural Development**

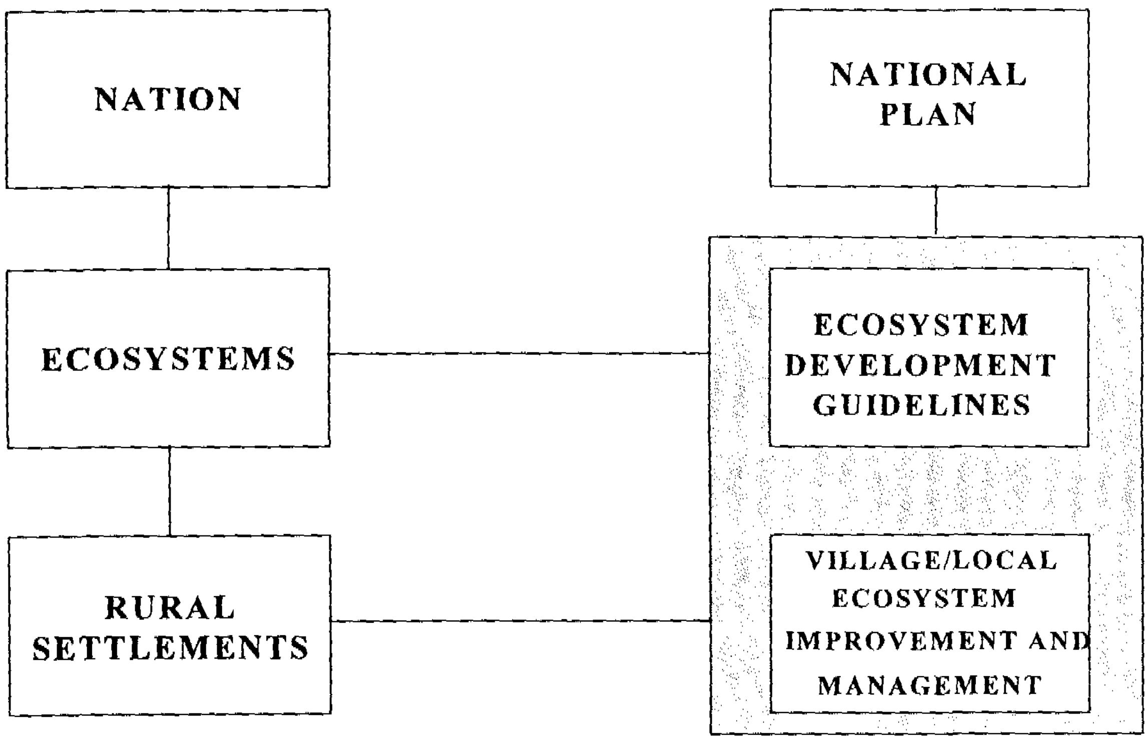



**Figure 2** Components of a village ecosystem and improvement plan (Agarwal and Narain)

the spiritual and ethical concerns that are central to many societies and cultures. ( Kamala

Chowdhury, Rural Well Being, The World Bank, 1996).

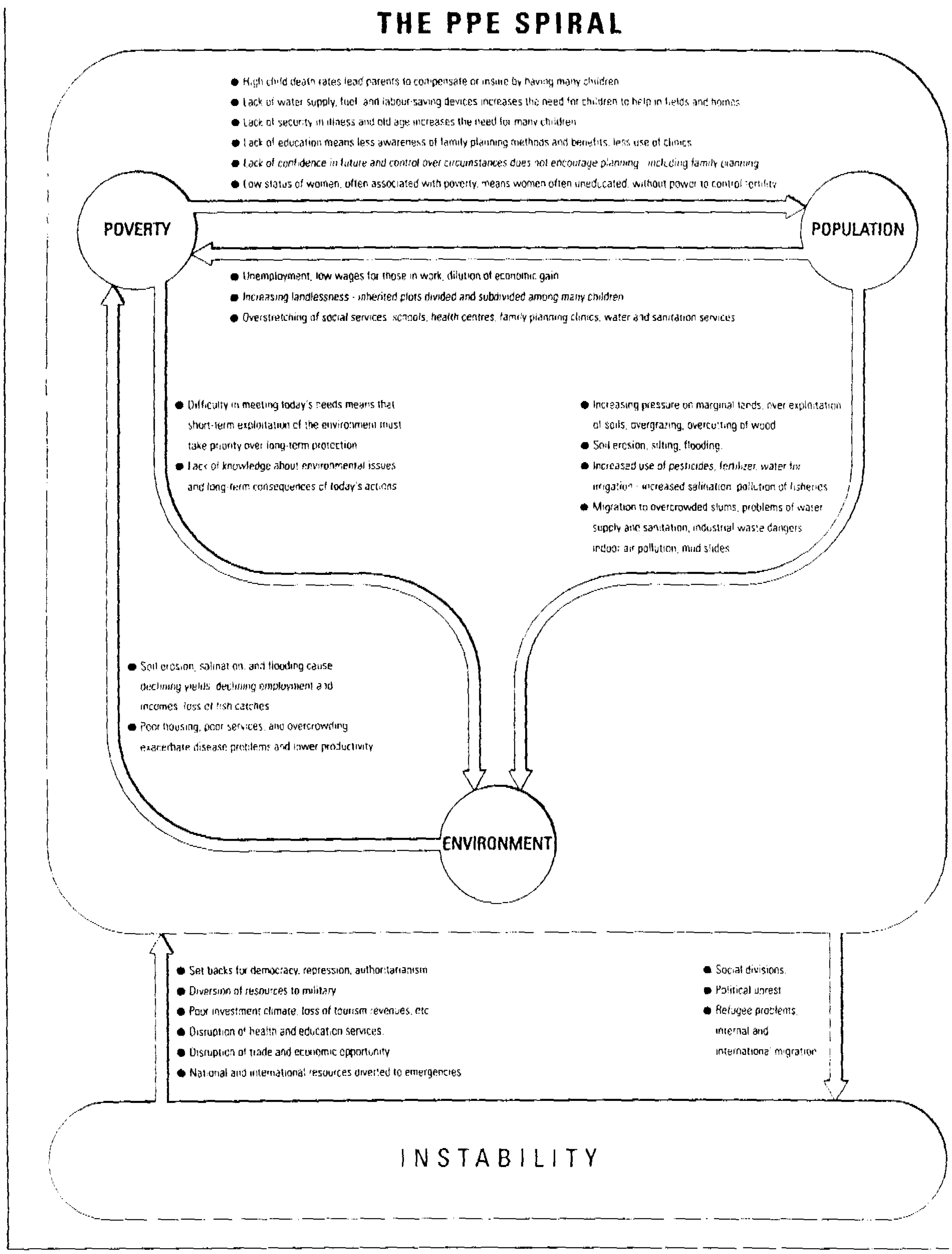
> "To understand the local economy of people not just with different lifestyles but also that of the rural poor across the developing world, economists will have to make a big effort to understand another major dimension of poverty --the dimension that emerges out of the relationship that the poor have with their environment or their natural resources base which provides them with the daily wherewithal for their survival. This dimension remains so ill-understood largely because most development workers and economists --except possibly for that fraction which studies natural resource economics or environmental economics-- do not understand environmental issues. And most environmentalists --except possibly for that fraction in the Southern countries which works with local communities to help them regenerate their environment-- do not understand poverty." (Agarwal et al, 1997).

Water has always been at the centre of village planning. Yet, the interlinkage between water, land, livestock and forest was clearly noted by Agarwal, who said that unless poverty alleviation is approached in an integrated manner, interventions will not be fruitful. It is also clear that effective integrated water management is possible only at the community level and with community ownership. a topdown approach in the development of national policies is ineffective because it ignores the important element of ownership in implementation. International agencies helping countries to develop a national water policy and institutional mechanism to handle the consequences need to take a fresh look at their approaches as standard institutional structure is not equipped to deal with poverty alleviation, equity and rights to the resources. Decentralization of the institutions and the policy development process may be an answer. UNICEF's Primary Environmental Care approach as well as numerous grassroots NGO projects have also conceptualized this idea by emphasizing community empowerment for managing local natural resources to meet people's basic needs on a sustainable basis.

**Water Crisis - Drought, Flood and Epidemic:**

a study by the Centre of Science and Environment (CSE) presented to the parliamentarians of India in 1987, observed that the total flood-prone areas in India had almost tripled during 1978-1984.The study also observed that in the same period, in almost the same areas, drought proneness increased. These two seemingly contradictory conditions are consistent, linked through their direct correlation with the region's deforestation. Removal of forest, washing of top soil, over-exploitation of grazing land, inequitable distribution of irrigated water, and neglect of the traditional tanks or water reservoirs have led to both increased flood and drought conditions. Moreover, contrary to the popular belief that these conditions are due to overuse by the indigenous population, it has instead resulted primarily from the consumption demand associated with indiscriminate commercial exploitation (some of it to supply raw materials to a foreign market) and urban growth.

The traditional balance between the forest and its native dwellers, and that of the agricultural activities and livestock grazing land was disturbed by the open market economy and higher demand for forest products in urban markets.




The above chart is limited to processes within the developing world. But the PPE spiral is compounded by the industrialized world's policies in the fields of aid, trade, finance, and debt.

**Figure 3** The PPE Spiral from The State of the World Children 1995, UNICEF.

The water management cycle cannot be complete without a balanced approach towards the management of the entire ecosystem, as displayed in Anil Agarwal's earlier diagram. The issue and problem are as local as they are global, and solutions must lie in full participation of all stakeholders at all levels, including ownership by communities and civil society. This was proven to be the case in the Jhabua case study presented in the interagency workshop, 'Integrated Rural Water Management' organized by FAO in 1993.

Gopalakrishnan in his study for the UNICEF paper "Policies, strategies and planning for integrated rural water management--a case study of Jhabua district of Madhya Pradesh state in India" presented in the same workshop, identified three specific factors that helped the district administration to make water harvesting a central issue in the drought relief agenda:

- generation of public opinion to demand water-harvesting structures;
- creation of political will to make any intervention a long-term affair;
- coordination of agriculture, irrigation, local government, health (eradication of guinea worm and diarrhoea), and school bodies (awareness campaign) activities with complete public participation.

By 1986, 1323 villages in Jhabua had gained access to nearly six thousand hand pumps, covering more than 98% of its hamlets. Most of these pumps were supported by large scale augmentation of groundwater resources that took place through recharge from surface storage of the tanks and stop dams.

The two-fold increase of the area under irrigation from 1985-1992 resulted in the harvesting of two crops per year and a significant increase in income level. Guinea worm was fully eradicated and the social communication plan for guinea worm eradication provided an intervention model for drastic reduction of other water-related diseases. Despite this success, however, the Jhabua case study reveals that direct action of the community in environmental management is far from realized. The structures or systems created for water-harvesting reservoirs are still considered government properties, and a real sense of ownership will not be developed until power is decentralized and local governments are given the responsibilities. a steady erosion of the 'rights' to common property resources has contributed to an environment that limits the collective action of the community. It is also true that areas undergoing environmental crises have a potential for radical change, social mobilization and collective action. a turnaround is possible only through an agenda of combating poverty and eco-reconstruction with full community participation and respect for the inherent right of the people.

The recent drought in Southern Africa illustrated a similar situation. Community-constructed wells became the source of both drinking water and small-scale irrigation. But the potential of the conjunctive use of surface and ground water, while fully realized by the communities, is not completely institutionalized in Sub Saharan Africa. Sub-Saharan Africa already faces serious land degradation, having lost 22% of its vegetated soils. Climatic changes associated with increasing aridity and decertification, a rapidly growing population in the midst of declining productivity, and faulty public policies have exacerbated the problem (Ysefaye Teklu, 1996). When this is coupled with rainfall reduction, the promotion of economic growth causes a diversion of water and further degradation is the result. Thus, the issues regarding household food and water security are so interrelated that one cannot be successful without the other. No policy or reform can be pushed without taking note of both.

Environmental degradation causes both floods and droughts in the same location, sometimes in immediate sequence. In this vicious cycle, epidemics of water related diseases do not lag far behind. General malnutrition, due to inadequate water quality and supply causes a series of water related diseases resulting in a chronic malnutrition cycle and a high morbidity and mortality rates of children. In urban areas as well, the environmentally fragile situations may cause serious epidemics like plague, hepatitis or serious malnutrition resulting from earthquake, flood or drought.

**Conjunctive use of Surface and Ground Water:**

Although in the hydrological cycle the linkages of surface and ground water are clearly established, groundwater is often neglected as a potential national resource base. Aquifers can store large volumes of water with almost no evaporation loss. They are generally pollution free and a source of safe drinking water unless contaminated by fluoride, arsenic or salinity due to over drawl.

In extreme dry spells the only source of water is the groundwater. The conjunctive use of ground and surface water is ideal for balancing the recharge of the aquifer. Groundwater supplies more than half of the US drinking water and nearly 96% of the water consumed in rural areas of the country. In countries of Asia, ground water is often the main source of supply for both drinking water and irrigation. In the absence of proper management, competing demands may result in the heavier agricultural requirements causing a disabling of drinking water supply devices and a lowering of the water table.

The majority of the world's urban population relies on ground water and on spot sources rather than on a piped water supply based on surface reservoirs. The percentage of as high as

**Social Equity and Groundwater**

In Western Indian state of Gujarat water is a precious commodity. Over-abstraction has caused the water table to fall, in some places by as much as 40 metres. This has deprived the poor farmers of water since they can afford only the surface or sub-surface water. Only the rich farmers can afford the $15000-20000 worth boreholes down to the depth of 400 metres. The water indirectly is controlled by such farmers who in turn at their will sell the water to poorer farmers. A groundwater law was enacted but not ratified by the government as the poorer farmers do not have representation in the power structure of the government. New schemes continued to be developed by the rich farmers utilizing water even from deeper aquifers without any control. The area has prospered but migration to urban areas started as the marginal farmers were forced to sell their lands and move in search of urban jobs.

50% or more dependance on the ground water source is increasing as the surface water supply is becoming less dependable due to a lack of adequate investment in its development and greater loss in the piped distribution system. The decentralized system of urban development demands more emphasis on urban geology and the urban aquifer development as a safe and cheaper source of water. Yet, urbanization and its heavy demand for water have resulted in falling water tables under many of the world's cities, reducing yields by the threat of saline ingress and land subsidence. Salinity ingress is a common phenomenon in Manila, Jakarta, Madras and many other cities. Some of the heavy withdraw of groundwater in Urban areas are by the rich and the poor pays high percentage of their income to pay for that water.

**Privatization, National Water Policies and the Rights Issues:**

a huge and widening investment gap exists between the actual requirement of capital and its mobilization in the water sector in both irrigation and domestic use. Moreover, the resources required for operation and maintenance are also often inadequate, resulting in inefficient systems, unmet demand and poor services. Privatization or commercialization is seen as a way to increase both efficiency and capital mobilization. But the solution is not so simple, for privatization often means 'cherry picking' of the profitable segments of the sector leaving poorer areas to fend for themselves. To attract foreign capital, governments are often eager to surrender their rights on bulk water pricing and control, agreeing to conditions and clauses which sacrifice the national interest and the right of people to safe and sufficient water use.

Water is a national social and economic resource. If the decision is made to use it for national development or attracting capital then the added value or income should also be reinvested in the social sector. Exploiting this precious resource, few developed and developing nations alike are either investing the extra income in the social sector or supporting the 20/20 principle of resource mobilization for the social sector to meet the Basic Human Needs. ( Please refer to a separate paper available for the participants specially prepared by Brikke, Visscher and Ankersmit, The Hague, 1998).

Equitable control of ground water at the local level is also often lacking. A rich farmer or enterprise can indulge in heavy drawl of groundwater through deep well pumping, lowering the water level and removing potential groundwater resources from the reach of the poor who have an equal right to national resources. In India where minor irrigation comprises nearly 50% of the total irrigation coverage, the issue of control on use of groundwater is so significant that poor marginal farmers are slowly losing their productivity due to an absence of social and legislative control of the exploitation of ground water (See box in page 7 ). In contrast, empowerment of such farmers can produce a different result as given in the box below.

**The Ralegan Siddhi Experience**

Ralegan Siddhi is a model of development in a drought-prone area of Maharashtra where average rainfall is 400 mm per year and where the villagers were not even assured one regular crop. In summer, they would regularly accept the state-sponsored drought relief measures. Today, Ralegan Siddhi has solved its scarce water conditions through an elaborate system of small dams and watershed development, drip irrigation and biogas. Not a single inhabitant of the village depends on drought relief and per capita income has increased substantially.

Anna Hazare --a retired driver from the Indian army-- began work in the village by constructing storage ponds, reservoirs and gully plugs. Due to the steady percolation of water, the groundwater table began to rise. Simultaneously, government social forestry schemes were utilised to plant 400,000 trees in and around the village. The total area under production increased from 630 to 950 hectare. The average yields of millets, sorghum and onion increased substantially. Water is distributed equitably. Cultivation of sugarcane, which requires a large quantity of water and was forbidden in the early years, was no possible..

An impressive system of decision making is taking place the village as some 14 committees operate to ensure people's participation. The elected village council is composed entirely of women. All families get water in turn and no farmer will get a second turn of irrigation until all families have been served. Since the commons belong to all, even the landless families --four to five in the village-- have a right to the water. Even where individuals hand dug wells, they have been persuaded to share water with others.

Ralegan Siddhi has now a bank of its own. The savings of Ralegan Siddhi alone is Rs. 2.3 million (about US$ 60,000). For a village that, less than two decades ago, was a drunkard's den with a badly degraded environment, this is indeed a miracle.

Source: Anil Agarwal and Sunita Narain, Creating Sustainable Livelihoods, Centre for Science and Environment, 1997.

The water crisis is more local than global but most interventions are now global. The global approach to the problem may help to articulate the issues but the solutions have to be suited to local requirements. For that reason the coordinating, moderating and facilitating role of government should not be underestimated. The role of the international community should be to help those governments with less capacity to build the capacity to protect and conserve the precious resource for development and not settle for short term gains detrimental to the long term interests of their people and environment.

The question of equitable control and distribution of water resources is a complex problem. Water is a complex issue, difficult/impossible institutionally to manage in one ministry or department. The impact is also difficult to measure as there is no linear correlation between water resource development and improvements in health, nutrition, education or income generation a proper National Water Policy should focus on national interest above profit and recognize water as a precious national resource. It should balance national and local needs and interests, industrial, agricultural and domestic use.

*Development of the National Water Policy:*

a national policy is needed to provide a statement to the people the priorities in that society for effective water management talking into consideration all aspects and demands of domestic, agriculture and industrial sectors. If there is consensus for the management of water resources through community participation then how can policies be developed in a top down approach through discussions solely at the national/global level? The recent South African experience shows the need for discussion and consensus development at all levels of the civil society. The country had to reverse the earlier policy of controlled bulk water for only the big cities and large white farmers to a equitable distribution for all the entire society and earlier homelands through a process of open consultation and debate at all levels and then enacting the law in the parliament. The commitment of the entire nation to the development of any policy can best be achieved through the fullest people's participation.

**Consensus on the issues of water Management:**

- Water is key to development
- Water is a key social and economic resources for any nation
- Right to water must be protected for equity as well as sustainable development
- Water is key to Improved Health, Improved Nutrition and Quality of life
- Private - Public partnership is essential for development of the water resources
- Community based management is essential to conserve, properly utilize and develop the water resources.
- Sustainable Water resource development is possible only through an integrated approach to soil, water, forest and livestock.

*Capacity Building at the community level:*

While the importance of the participatory role of the community is recognized, often the policy makers put forward arguments on the lack of capacity and capabilities at that level. These myths are reinforced by the fact that capacity building exercises are often confined to the national level and neglecting the needs of local institutions and communities only perpetuate this myth. The example of Ralegan Siddhi shows how the community can take the control of management of water then gain out of it and control their own development process. There needs to be much greater attention to capacity building at the local level.

*Balancing Urban-Rural Need:*

Water reservoirs and catchment areas are all contained in rural areas. Development of water resources without involvement of the communities living in those areas will create inevitable conflict and impede proper management. This includes conflicts of demand management between the agricultural, domestic and industrial sectors within and between rural and urban areas. It is critical that these demands are met in a balanced fashion. The problems of Urban water supply for domestic and economical purposes has to be met with. The problem and demand can not be looked upon in isolation. Often politically the urban-rural divide is formed which must be resolved in the approach to be developed in a national water policy.

*Private Management:*

The concept of private management and public control of water resources needs to be clearly elaborated. Private management of water resources is welcome and often desirable. Private distribution systems have been more successful, but bulk water and river basin management must be carried out through participation and safeguarding the rights of the people.

The poor are those who most often pay more and have less access to water, while and the rich pay less and consume more. The poor are still marginalised when it comes to benefits from the sector investment and relying on privatisation does not change that situation. In some cases, when profits and lack of regulations or control become the operating principles, it even worsens it. The role of the government to oversee the process and protect the right of these poorer populations through legislation and decentralised governance with people's participation.

Private resources should be brought in for capital resource mobilization and improved management of the water resources. The private sector cannot and should not be expected to subsidize and provide water for the poor. The responibility of control on bulk water, its distribution, control and ownership should remain with the government. The private sector should concentrate on effectively meeting demand

*National Planning:*

a national demand management system is critical. This includes a wide range of activities, such as: planning for efficient water irrigation systems; conjunctive use of ground and surface water; waste water recycling; recharging of the ground water; allocation of water for urban areas, industries, agriculture; use of pesticides, fertilizers etc.; monitoring control and protection of water quality; monitoring of the water flow. Building of institutions and capacity building around these activities is also critical. However, experience has shown that the cost of such an approach is beyond the means of many developing nations. Therefore, capacity building and monitoring through decentralised institutions will be helpful and desirable.A centralised and yet democratic planning process is not necessarily in contradiction with a decentralised governance mechanism.

*Land Reform and Water Policy:*

The water or hydrological cycle involves interplay with the land and soil. Water reform must go hand and hand with land reform and land policy. This is a burning issue facing many nations and typically handled in isolation from water issues. As shown earlier the entire ecosystem depends on land and water equally and the reform in one can not be without the reform in the other.

*Role Of Government as coordinator and facilitator:*

The role of government is not only as a provider but also as a facilitator and coordinator of the freshwater sector cannot be underestimated. Clear setting of policies and programmes not only attracts investors but raises confidence in the private-public partnership. The decentralization process should encourage the community to take initiatives and improve self control and monitoring. However, the responsibilities of the government will be best judged in protecting the rights of citizens to water resources.

It is clear that partnerships with civil societies and private sector is key for success. Equal partnership with NGOs will help to develop new and experimental approaches. Without decentralization and partnership no government will be true to the spirit of water for all or to sustainable development goals. How this can this most effectively be done is a question which must be resolved.

**Conclusion:**

Access to water is the fundamental right of the people. Freshwater which is the source of the drinking water supply and basic input for agriculture, the livelihood of the world's poor population is a basic human need and right. This precious resource should be protected and utilized for the development and empowerment of the population. Integrated water management is not merely the development of policies on paper but actually implementation of the same through a participatory process and decentralised institutions. Governments have to work closely with civil society and NGOs for capacity building and empowerment of the people and to protect their rights to the precious national resource.

The New Delhi slogan: " Some for All and Not All for Some" adopted in 1990 after the International decade of Drinking Water and Sanitation has been modified by the motto adopted by the South African Government which spells out the spirit of integrated water management for the future: **"Some for all forever."**

References:

The Water sellers: A Cooperative Venture by the Rural Poor by Geoffrey D. Wood and Richard Palmer-Jones , I T Publications, London, 1991

Groundwater; A Threatened Resource, United Nations Environment Programme, Nairobi, 1996

Human Development Report 1997, United Nations Development Programme, Oxford University Press, New York, 1997

The Wrath of Nature: The Impact of Environmental Destructions on Floods and Droughts, A Presentation by The Centre for Science and Environment to The Parliament Of India, 1987

Towards Green Villages: A strategy for Environmentally Sound and Participatory Rural Development by Anil Agarwal and Sunita Narain , Centre for Science and Environment, New Delhi, September, 1990

Policies, Strategies and Planning for Integrated Rural Development by R. Gopalakrishnan, Integrated Rural Water Management by Food And Agriculture Organization of the United Nations, 1994

Evaluating Health Impact, Water Supply, Sanitation and Hygiene Education By John Briscoe, Richard Feachem and M Mujibur Rahaman, UNICEF, ICDDR,Bangladesh, IDRC, Canada, 1986

Rural Well Being: From Vision to Action, Proceeding of the Fourth Annual World Bank Conference on Environmentally Sustainable Development, by Ismail Serageldin and David Steeds, The World Bank, 1997

Towards Sustainable Basic Social Services by Francois Brikke, Jean Teun Visscher and WillemAnkersmit, The Hague, The Netherlands, 1998.

World Development Report 1994: Infrastructure for Development by The World Bank, Oxford University Press, 1994

First Call For Children , UNICEF 1990

State of the World Children, UNICEF, Oxford University Press, 1995.

**ADD: Primary Environmental Care reference**

# EXPERT GROUP MEETING

# ON

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

**27 - 30 January 1998**

**Harare, Zimbabwe**

# INTEGRATED INFORMATION MANAGEMENT

**by**

**Denis A. Davis**

**Paper No. 8**

**Prepared for the**
**Department of Economic and Social Affairs**
**United Nations**

3.1.2 Countries in which the economy is sensitive to hydrological events need more elaborate information management systems that can consider "real-time" data and integrate it in a way to be responsive to ongoing circumstances and forecasts of future events. Because of the spatial nature of some information it may become necessary to consider the use of geographic information systems (GIS) for storage, display and overlaying of environmental and land use information. Consideration should also be given to the integration of satellite and radar data into integrated information systems. Use of Doppler radar data is becoming increasingly common in runoff forecasting models. Satellite technology is becoming a useful operational tool for parameters such as soil moisture, surface temperature, area flooded and the detection of oil or chemical spills. The implementation of decision support systems to better utilize the information is also recommended.

3.1.3 The primary focus when introducing improvements to integrated information systems should be on maximizing the use of existing databases, identifying users and their specific needs, and tailoring the system so that it is flexible enough to integrate information from a large number of sectors in different ways. Once a system is operative, then the focus can be on identifying and filling data gaps, implementing institutional change to make the system more user oriented and adjusting observational networks to be more responsive to operational and management needs.

3.1.4 The priority of national and international efforts for improvement of the management of integrated information should be focused on developing countries with increasing water stress. These countries are identified in the *"Comprehensive Assessment of the Freshwater Resources of the World"* as those low-income countries with medium to high water withdrawal rates compared to water availability.

### 3.2 Introducing New Approaches to Information Management

3.2.1 Integrated information management systems need to be holistic in their approach. The full range of water/land/and air parameters need to be linked to corresponding socio-economic and environmental data on critical habitats, endangered species, the health of the aquatic environment and fisheries. Integrated information management is only a tool, but an important one, to move toward sustainable development.

3.2.2 Information systems need to be dynamic rather than static. In particular the capability to move toward "real-time" data collection and use of that information for operational purposes should be incorporated. It is also necessary to have a system that in many ways can be self-learning so that new information can be used to quickly update previous evaluations. There should also be a constant feedback loop between the use of the information and the database itself, so that new types of analysis can be conducted and new forms of data collected and archived.

3.2.3 As described in Section 6.0 below, a number of nodes for information already exist at the international level. This information base was helpful in preparing the *"Comprehensive Assessment of the Freshwater Resources of the World"*. Global priorities and lending institution strategies are developed using such information, and are supported by governments responding to Ministerial Conferences or UN activities. There are still significant information gaps to be filled, however, and countries could contribute to the broader global information base through the wider implementation of information management systems at the national level. This would facilitate the timeliness of the receipt of the information at the international level and would allow quicker turnaround of information products.

### 3.3 Linking Observational Networks to Management Requirements

3.3.1 The introduction of integrated information management systems provides a strong impetuous to reshape, restructure and improve observational networks. This is particularly true for that portion of the network that directly serves management needs. The feedback from the use of the information can result in efficiencies in data observation, and may generate significant benefits to operations and management that are difficult to define in advance. There will still continue to be a need for multi-purpose observational networks which are able to define the state of the resource in qualitative terms without a specific user identified for each site. The importance of this component of the total network becomes more evident when attempts are made to generate atlas type representations or regional norms, which well may be the case when information is integrated at the basin or planning unit level.

3.3.2 Unfortunately, it is hard to convince many decision-makers that such an expense is justified. Elemental logic would argue that it is sensible to spend several percent of the budget allocated to the construction of water resource projects on information functions that will ensure that the best possible decisions are made. Few countries do so. Therefore, there is real value in studies that establish costs and benefits of observational networks and information management systems. What studies are available often demonstrate benefit/cost ratios in the 3:1 to 5:1 range, and up to 16:1 for flood forecasting. An Australian example of better management achieved by automation of irrigation control structures indicated that the value of the water saved in just one year was greater than the cost of the automation.

3.3.3 There is also a need in many countries, including developing countries and economies in transition, to consider cost recovery for observational information used for management purposes. This approach helps to develop a client relationship between data collection and data use agencies and make the data collection agency more responsive to changing needs. There are pitfalls to this approach as not all information, necessary for long-term planning and management, may have an immediate client. As an example design of a dam spillway or power plant output requires long term information on river discharge (50 years or more is preferable). Yet the benefits of reduced spillway costs or the installation of the optimum number of generating units are not realized until after the dam is built. Brazil has developed a novel approach to funding basic information needs by allocating a small percentage of the charge to hydropower entities for use of the water resource to these functions.

**Case Study - Water Quality Network**

An example of the redesign and modernization of a water quality network in response to an evaluation of management needs is Mexico. The observational programme included 564 surface water stations and 239 groundwater stations that had no overall strategic design, had major data gaps, was unrepresentative of key areas and was not being analysed for parameters such as persistent organic pollutants needed to address current issues. As a result of the optimization a primary network of some 200 stations was established to characterize important water bodies. A flexible secondary network was designed to focus on effluent discharge regulatory issues, special surveys in support of river basin planning and issue-oriented specific requirements. The new programme moves away for the traditional and expensive chemical parameter list and moves toward more innovative use of toxicity-based measures, screening techniques and new and more efficient measures of diagnosing and describing water quality. A mobile emergency capability in case of spills or natural disasters was also added. The end result is a much more responsive information

### 3.4 Integrating Land, Water and other Information

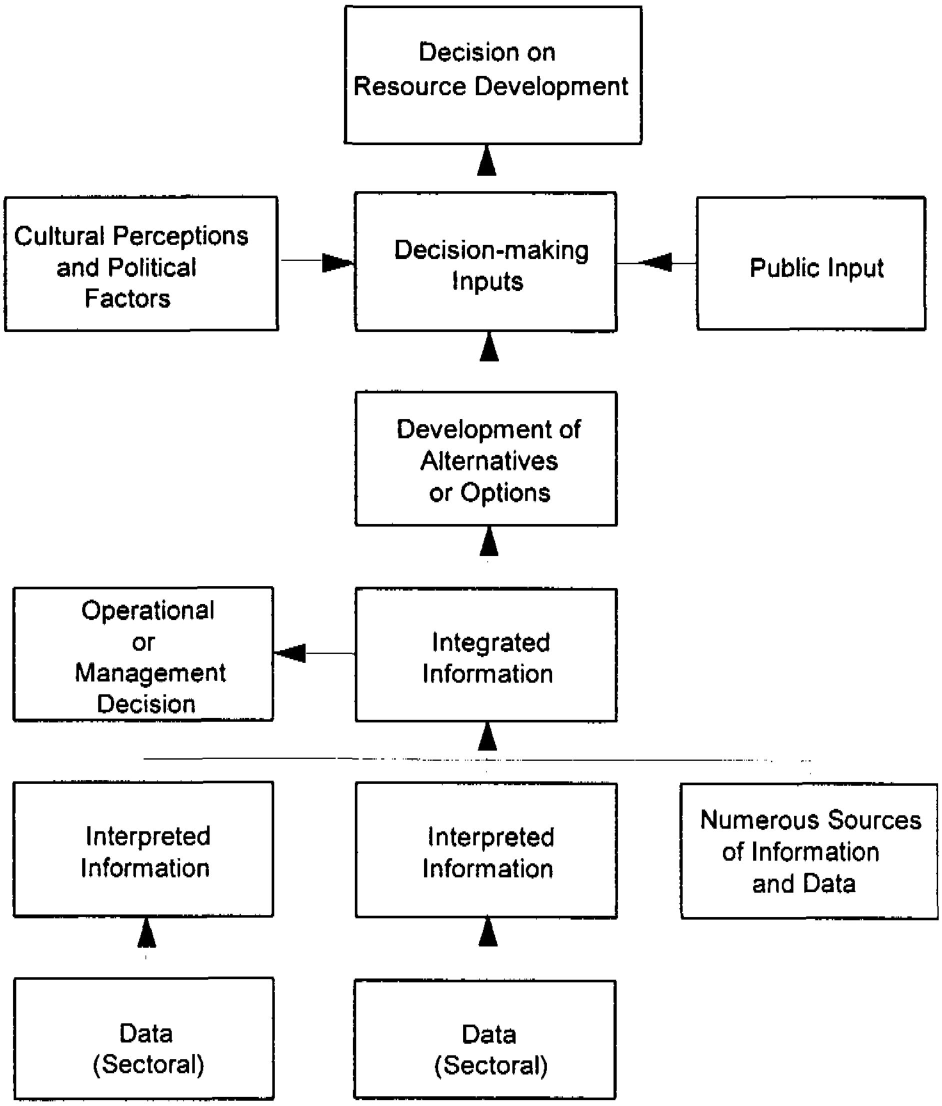
3.4.1 Integrated decision-making requires a broad information base, with the specific parameters or information sets varying dependent on the application. As an example, typical parameters used for a water resources assessment could include:

| | |
|---|---|
| Hydrometeorological: | precipitation, evaporation |
| Hydrological: | water levels, river flow, reservoir storage, sediment loading, water quality, biological data |
| Land: | soil type, land classification and use, hectares irrigated, crop types, livestock numbers, elevation, basin drainage, basin slope |
| Social: | population, population density, age distribution, growth rates, percentage of population served by water supply and sewage, political boundaries, housing stock |
| Economic: | per capita income, family income, employment rates, sectoral contributions to economy, GNP, growth rates |
| Environmental: | sensitive habitats, degraded environments, fisheries and natural resources, endangered species, trends in water quality and other indicators |
| Health: | epidemiological data |
| Other: | water availability, water supply distribution, diversions, water use by sector, water demand by sector |

The list is meant to be only illustrative, but it does indicate the breadth and types of information needed. No single agency or source can provide all of the information so there is a need for some form of integrated management system. There is also a need to integrate information at different scales (local, regional, national, multi-country to international) dependent on the nature of the decisions to be made.

3.4.2 There is a need to differentiate between "data" and "information". Data come from variables measured and recorded in a database. Parameters are derived from the measured variables. Information is an evaluation of parameters provided in a form that has meaning for decision-making or management purposes. Generally the inputs to integrated information management are not "data", but rather a group of information sets. The linkage between data and decision-making is described in Figure 3.

Figure 3 - Information Hierarchy



3.4.3 As can be seen from Figure 3 there are more inputs to decision making than the integrated information itself. Decision makers must also consider factors such as the views of the public, prevailing cultural perceptions and values, national priorities and local, regional and national political realities. To the degree possible, integrated information must be sensitive to these factors and array information and decision alternatives in a manner that can reflect them.

### 3.5 Closing Data and Information Gaps

3.5.1 Experience in the integration of resource related information for water resources assessment has resulted in identification of information or data deficiencies that are relatively common, especially in the developing countries. Reliable water use information is difficult to obtain for all sectors. Groundwater is often the forgotten resource and insufficient information is available on its quantity, quality and use. Water quality information on land based pollution is often scanty, and does not include monitoring of persistent organic pollutants which may impact on human health and the aquatic environment. Basic hydrological information is often not available to the degree that rational decisions on alternatives can be made in countries experiencing water scarcity, particularly if the country is partially reliant on external sources of water.

3.5.2 The use of integrated information management systems often identifies errors or inconsistencies between databases. For example, one of the better quality checks on hydrological data is to model a flood event using data from several sources, or several jurisdictions. Questionable or missing data are soon identified. The greater the number of uses to which databases are put, the better the understanding of the information needs for the future.

3.5.3 A number of methods exist for evaluating the adequacy of the database. The simplest approach is reference to standard guidelines or comparisons to the network densities of countries or regions in similar circumstances. If there is a rudimentary network in place then more elaborate tools exist for an evaluation. Such evaluations must be user oriented so as to determine, not only the parameters needed, but also the format and timeliness of greatest value to decision-making. For hydrological parameters, guidance on the size and type of observational networks, or network analysis procedures, is readily available from the World Meteorological Organization (WMO) and a number of national hydrological services.

### 3.6 Developing Mutually Beneficial Partnerships

3.6.1 The presence of integrated management systems within a country opens up the opportunity for external partnerships with basin commissions, regional entities and the broader international community. Particularly if a country is dependent on external sources of water as part of a transboundary basin, there are significant benefits to having communication links to parallel information sources in the other countries under the auspices of a basin commission. In this case the basin commission often acts as the information hub and central data bank, but is equally accessible to all parties. The basin commission is often tasked with providing an evaluation on an integrated information basis which may include environmental assessments and development alternatives for major projects. It can also serve as a source of technical expertise and exchange. Similar statements can be made about regional entities, which often represent countries with common problems and interests.

**Case Study - Rhine River Basin**

With a catchment of 180,000 square km and a length of 1,320 km the Rhine River is one of Europe's most important rivers. As a shipping route it is the busiest in the world. The basin embraces parts of a number of countries, most notably Switzerland, Germany, France and the Netherlands, and human influence on water quality and quantity is considerable. There is also the potential for major flood damage and pollution spills. Over the years the countries have established six international commissions or associations to deal with hydrology, protection of the Rhine and its major tributaries and Lake Constance, water treatment, and navigation. Information is shared freely and integrated into studies of benefit to all parties to the agreements. Of particular significance is the Rhine Alarm System which includes a system for forecasting the transport of dissolved or suspended material in the

## 4.0 IMPEDIMENTS

4.1.1 Even the best information management systems produce data and information containing errors and bias. Because of climate change, land use change and other factors, we can no longer depend wholly on past trends to predict the future. This must be recogonized and when in doubt the precautionary principle used in decision-making.

4.1.2 There may also be major limitations as to what hardware, software and communications can be used due to infrastructure limitations. If the basic phone system is not up to international standards, then, for example, the Internet cannot be used as the communications tool between nodes. Central databases become more attractive under such circumstances.

4.1.3 There are often scale and other factors that make integration of natural resource information with socio-economic information difficult at the local level. Hydrological information is often collected on a river basin basis, and land use information is available in a wide variety of map scales. Socio-economic data is usually collected using political boundaries. These difficulties should be regarded as challenges to overcome, rather than a reason not to integrate the information for decision-making purposes.

4.1.4 Certain adjustments to organizational and administrative frameworks may become necessary to implement integrated information management. This may result in the need for legislative and policy changes. A move to a centralized database and integration of information from many sources would most likely require major organizational changes and even the creation of new agencies or institutions. On the other hand, a non-hierarchical distributed information network will require the identification of node points within agencies and a requirement that data observation agencies supply data to those nodes. Additional protocols may be required which define data standards, quality control and archiving requirements.

4.1.5 Communication policies may need to be reviewed and revised. A nodal distributed information system works best when information can move freely in a lateral direction as well as up and down. Communication policies within agencies may take a hierarchical approach whereby information between agencies generally moves across only at the highest levels. This is an inefficient approach for sharing of information at the "working" level. As a result, policies and even long standing practices may need to change or be modified. A movement to more open information policies, particularly as they relate to public and external agencies, may be required. WMO is working, in consultation with UNESCO and the non-governmental community, to develop a draft policy on the exchange of hydrological information which may be useful to consider in this context.

## 5.0 EVALUATION OF THE CURRENT SITUATION

### 5.1 Adequacy of the Database

5.1.1 Integrated information is only as good as the database feeding it. In the case of hydrological and meteorological information the size of the observation networks for precipitation, discharge, water quality, evaporation, groundwater and water level are inventoried at the national level in the INFOHYDRO database of WMO.

5.1.2 In 1991 the United Nations Educational, Scientific and Cultural Organization (UNESCO) and WMO carried out an evaluation of water resources assessment capabilities within the various UN Regions. That evaluation concluded that countries had responded well in the late seventies to the call by the Mar del Plata Conference to develop and strengthen their water resource assessment programmes. Additions were made to hydrological data networks, instrumentation was upgraded, investments were made in data processing systems, and staff capabilities were improved. However this trend has reversed in recent years due to economic difficulties and reduced budget allocations. For example the number of operating rain gauges, recording rain gauges and hydrometric gauges in Albania have decreased to approximately 50% of the number operating in 1990.

### 5.2 Water Resources Assessment Capability

5.2.1 The lack of capability in 1991 was particularly evident in parts of Africa, Latin America and Asia. In general these are the same areas where water scarcity is the greatest and the capability to carry out water resource assessments is most critical to economic prosperity. The report also indicated that, where the capability to carry out water resource assessments was poor, the ability to integrate and manage information was also poor.

5.2.2 In view of the importance of water resource assessments for economic development, many bilateral donors and aid agencies have provided invaluable support to developing countries in an effort to maintain or rebuild their capabilities in this regard. Such aid has provided funds for equipment and training, but the weakest point has often been the inability or lack of appreciation of the need for continuous long-term funding for these activities so as to ensure their maintenance once external support has terminated.

5.2.3 One pre-request for planning and funding such activities is a clear and comprehensive definition of what facilities, staff and other resources are required. For this purpose, WMO and UNESCO have produced guidance for use by countries under the title *"Water Resources Assessment - Handbook for Review of National Capabilities"*.

### 5.3 Capacity to integrate information

5.3.1 Many developed countries possess the capacity to integrate the necessary information. A few notable examples are the use of the OECD "Pressure-State-Response" model of environmental reporting which provides an explicit framework for decision making; the integrated information management system developed at the national level in Finland; and the state of environment reporting by the Netherlands. However the experience of senior government officials would indicate that these evaluations have not necessarily been built into the decision-making process to their maximum potential. There is still a tendency, even in developed countries, not to link integrated resource, environmental and socio-economic information into long term economic and financial planning.

## 6.0 EXISTING GLOBAL INITIATIVES

### 6.1 National and Global Information Linkages

6.1.1 A number of nodes for water-related information already exist at the international level. Some are described below. Ideally a national, regional or basin node for similar sectoral information could serve as a gateway for the flow of information to international nodes. This would facilitate the timeliness of the receipt of information at the international level and would allow for quicker turnaround of information products back to the national node levels. There would be benefits both ways in terms of exchange of analytical tools, development of new integrated products and the capacity building of integrated information technology and decision support systems.

6.1.2 Discussions are currently underway between the agencies overseeing these international information nodes with a view to increasing their coordination, establishing more direct links between them, integrating to the extent possible and in general making them more accessible and responsive to potential users.

### 6.2 Global Runoff Data Centre

6.2.1 The Global Data Runoff Centre (GRDC), established in 1988, operates under the auspices of WMO and is supported by, and located in, the Federal Institute of Hydrology in Koblenz, Germany. The principal objective of the Centre is to facilitate and optimize the information exchange of streamflow data world wide. The GRDC database contains contributions from over 140 countries, and includes the data for 3200 hydrometric gauging stations located in 2900 river basins. The quality and reliability of the contributed data is verified before entry into the database. The GRDC has the capability to provide interpreted hydrological information and does so for many organizations, such as those of the UN system, and for research projects (www.wmo.ch/web/homs/grdchome.html).

### 6.3 GEMS/Water

6.3.1 The GEMS family of programmes, part of the United Nations Earthwatch Programme, is organized by the United Nations Environmental Programme (UNEP). Begun in 1977 GEMS/Water is implemented by the World Health Organization (WHO) in co-operation with WMO and UNESCO. It is an international co-operative programme now involving 56 countries that voluntarily submit data from their national surface and groundwater quality monitoring activities to the Global Data Centre. GEMS/Water also provides technical assistance, carries out training in water quality monitoring and assessment, performs inter-laboratory comparison exercises and provides training and standardized computer software. Since 1990 the Programme has moved into enhanced data assessment and capacity building, and has worked with many national and international institutions and donor agencies to foster progress in water quality monitoring and assessment <http://cs715.cciw.ca/gems/>.

### 6.4 *Flow Regimes from International Experimental and Network Data*

6.4.1 The Flow Regimes from International Experimental and Network Data (FRIEND) is a research project structured on a regional basis under the International Hydrological Programme of UNESCO. The focus of the activity is an international collaborative study of regional hydrology. As such it contains information from smaller basins and experimental watersheds which may not be found in other databases. Since its inception in northern Europe in 1985 it has expanded to include six major international groups world-wide with approximately 75 participating countries. The database is not directly available to external users, other than the contributing countries, but publications based on the FRIEND information are available:
<www.pangea.org/orgs/unesco/Friendsub.html>
<www.nwl.ac.uk/ih/prototype/research/availabl.html>

### 6.5 Aquastat

6.5.1 The Aquastat programme was launched by FAO in 1993 with a view to better assessing the situation of water use in agriculture. It focuses on irrigation and drainage, and on water balances. One of the main objectives of the programme is to better assess the state of water use for agriculture, as well as the potential for future food production. Meant to collect information at country and lower level, the programme was quickly faced with the scarcity of reliable information on water use (mostly in agriculture) and the lack of integration of water information. Emphasis is now put on integration of water resources and withdrawal through geographic information systems. From a simple data collection initiative, the programme has evolved towards more capacity building activities through training seminars and national or regional rural water information management projects:
<www.fao.org/ag/agl/aglw/aquastat/aquast1e.htm>

## 6.6 Global Precipitation Climatology Centre

6.6.1 The Global Precipitation Climatology Centre (GPCC) is a component of the Global Climatology Project of WMO and integrated into the Global Energy and Water Cycle Experiment (GEWEX). The GPCC was established in 1988 under the auspices of the National Meteorological Service of Germany and became fully operational in 1995. The Centre collects precipitation gauge data from around the world, applies quality control to the data, makes corrections, and produces monthly precipitation means on a grid of 2.5 degrees by 2.5 degrees latitude and longitude. The information is based on data from approximately 6,000 stations located in more than 130 countries. The database has recently been expanded to 40,000 stations to achieve a real means at a grid density of 0.5 degrees. The GPCC is not authorized to disseminate data received from individual countries. However, the derived gridded data products are freely available (www. dwd.de/research/gpcc).

## 6.7 World Hydrological Cycle Observing System

6.7.1 The World Hydrological Cycle Observing System (WHYCOS), launched in 1993 by WMO with support of the World Bank, is designed to provide reliable, consistent and easily accessible hydrological information on key river systems around the world. WHYCOS is being developed in the form of regional components (HYCOS's) within a framework of common guidelines and standards, but designed to meet regional priorities defined by the countries within the region. The data from each site is transmitted in real-time through the Global Telecommunications System of WMO to both national and regional databases. The programme is also designed to strengthen the technical and institutional capacities of national hydrological services to meet the needs of end users, including integrated information related to status of water resources, trends and risks. WHYCOS is in the early implementation stages but should provide a source of high quality data on the hydrologic cycle for use at the national, regional and international level in the future (www.wmo.ch/web/homs/whycos.html).

## 7.0 ACTIONS FOR CONSIDERATION

1. Water scarce developing countries must act now to develop integrated water resource management decision-making capabilities so that the negative socio-economic and financial impacts of sector by sector decision making can be reduced. In support of integrated decision-making and a move to sustainable development there need to be integrated information management systems and adequate observational networks in place.

2. All countries are urged to evaluate periodically their data collection and information management systems to ensure they meet management and decision-making requirements, are cost effective and user oriented. In some cases this may require changes to institutional, legislative and policy structures.

3. Developed countries, international organizations, and aid agencies may be asked to assist in the transfer of information management technology, decision support systems and network evaluation tools, and in general assist in associated capacity building in developing

countries and economies in transition.

4. UN Agencies, through the vehicle of the ACC Steering Committee on Water Resources, may be charged with developing the framework for an international level integrated information system that can build on existing initiatives such as GRDC, GEMS/Water and Aquastat. In particular, the initiative should include the addition of water use, socio-economic, environmental and health data. Governments are urged to support such initiatives directly and host nodal components for which their agencies have particular expertize. As an example, consideration could be given to a common node for water availability and water use.

5. Governments are also urged to facilitate the international exchange of water-related data as a basis for improved management of shared water resources and to permit international studies of resource availability and scientific research into climate variability and change.

6. Strong support from national governments and funding institutions is needed for international initiatives such as WHYCOS which are designed to improve the availability of basin information that is needed for integrated decision-making.

7. UN Agencies, assisted by various partners, should periodically conduct comprehensive assessments of freshwater, agricultural lands and other natural resources. These assessments would give visibility to critical problems and assist in setting priorities for the global community.

## References

1. UN ECOSOC, Economic Commission for Europe, Committee on Environmental Policy, Working Party on Water Problems. Draft Guidelines on Water-Quality Monitoring and Assessment of Transboundary Rivers. CEP/WP.1/R.13, 19 December 1995.

2. Hoekstra, Arjen Y., Indicators of Sustainable Development - A Case Study for Water, SCOPE Scientific Workshop on Indicators of Sustainable Development, Wuppertal, November 15-17, 1995.

3. UNESCO, International Hydrological Programme, Water resources in the OSS countries - evaluation, use and management, May 1995.

4. Ongley, Edwin D., Water Quality Monitoring and Management - Modernization Issues for Developing Countries, UNEP & WHO Collaborating Centres for GEMS/Water, National Water Research Institute, Canada Centre for Inland Waters, Burlington, Ontario, 1997.

5. Government of Zimbabwe, Notes on the organization of The Harare Expert Group Meeting on Strategic Approaches to Freshwater Management, 28-31 January, 1998, Zimbabwe Department for Economic and Social Affairs.

6. Arriens, Wouter L., Bird, Jeremy.,Berkoff, Jeremy., Mosley, Paul, Toward Effective Water Policy in the Asian and Pacific Region, Theme Paper and Comments, Asian Development Bank, Manila, Philippines, 10-14 May 1996.

7. Arriens, Wouter L., Bird,Jeremy.,Berkoff, Jeremy., Mosley, Paul, Toward Effective Water Policy in the Asian and Pacific Region, Country Papers, Asian Development Bank, Manila, Philippines, 10-14 May 1996.

8. Arriens, Wouter L., Bird,Jeremy.,Berkoff, Jeremy., Mosley, Paul, Toward Effective Water Policy in the Asian and Pacific Region, Overview of Issues and Recommendations, Asian Development Bank, Manila, Philippines, 10-14 May 1996.

9. UN FAO, Water Resources Management in Africa - Compilation and Analysis of Activities of the United Nations Organizations. ACC Subcommittee on Water Resources, Prepared by Food and Agriculture Organization of the United Nations, Rome, Italy, July 1996.

10. Najlis, Pierre., Kuylenstierna, Johan L., Twenty Years After Mar del Plata - Where Do We Stand and Where Do We Go? Mar Del Plata Anniversary Seminar, Stockholm, 16 August 1997.

11. Klohn, Wulf., Appelgren, Bo, Water and Food Security. Mar del Plata 20 year Anniversary Seminar, Stockholm, 16 August 1997.

12. Perks, A., Winkler, T., Stewart, B., The Adequacy of Hydrological Networks: A Global Assessment. World Meteorological Organization, Technical Reports in Hydrology and Water Resources, WMO/TD - No. 740, 1996.

13. UN, Department of Economic and Social Affairs, Activities of the Economic and Social Commission for Western Asia in the Area of Water Resources, Prepared for the Third Session of the Committee on Natural Resources, 6-17 May, 1996.

14. UN ECOSOC, Activities of the Economic Commission for Europe in the Area of Water Resources, Prepared for the Third Session of the Committee on Natural Resources, 6-17 May 1996.

15. UN ECOSOC, Freshwater Resources in Asia and the Pacific, Prepared for the Third Session of the Committee of Natural Resources, 6-17 May 1996.

16. UN ECOSOC, Freshwater Resources, Prepared for the Second Session of the Commission on Sustainable Development, 16-27 May 1994.

17. WMO/UNESCO, Report on Water Resources Assessment, Progress in the Implementation of the Mar del Plata Action Plan and a Strategy for the 1990s, 1991.

18. UN/Stockholm Environment Institute, Comprehensive Assessment of the Freshwater Resources of the World, Published by the World Meteorological Organization, 1997.

19. WMO/UNESCO, Water Resources Assessment - Handbook for Review of National Capabilities, June 1997.

20. Kundzewicz, Z. W., Kraemer, D., Striving Towards Assessment of Mountain Water Resources, World Meteorological Organization - Hydrology and Water Resources Programme Internal Document,1997.

21. UN Department of Economic and Social Affairs, Indicators of Sustainable Development - Framework and Methodologies, 1996.

22. UICN, Population Reference Bureau, L'eau - et la dynamique demographique, Rapport sur l'initiative collaborative et l'atelier organise a l'occasion du Congres mondial de l'UICN a Montreal (Canada) en octobre 1996.

23. European Commission, The Euro-Mediterranean Partnership and Sustainable Development. Brussels, 1997.

24. Postel, Sandra, Dividing the Waters: Food Security, Ecosystem Health, and the New Politics of Scarcity, World Watch Paper, September 1996.

25. WMO, Guide to Hydrological Practices - Data Acquisition and Processing, Analysis, Forecasting and other Applications, 5th Edition, WMO-No. 168, 1994.

26. Natural Resources Forum, A United Nations Journal, Volume 21, Number 3, ISSN 0165-0203, August 1997.

27. ICOLD. Position Paper on Dams and Environment, ICOLD, May 1997.

28. Serageldin, Dr. Ismail, Will there be enough water for all mankind in the twenty-first century?

Speech delivered at Water Futures conference sponsored by Green Cross International and The State of Geneva, 1997.

29. WHO, WSSCC, UNICEF, Water Supply and Sanitation Sector Monitoring Report - Sector status as of 31 December 1994, Prepared by World Health Organization, Water Supply and Sanitation Collaborative Council and United Nations Children's Fund, WHO/EOS/96.15, 1996.

30. Hall, Alan J., Large-Scale Hydrological Studies, Contained in World Meteorological Organization, Commission for Hydrology, Working Group on Applications, First Session, Geneva, 17-21 November 1997, Document HCAP-1/WP, 7, 11 November 1997.

31. WMO, Seventh Planning Meeting on World Climate Programme - Water. Final Report, WCASP - 45, WMO/TD-No. 854, Geneva, October 1997.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# WATER AND FOOD SECURITY

by

Prof. M. S. Swaminathan

Paper No. 9

Prepared for the
Department of Economic and Social Affairs
United Nations

# Water and Food Security

by
Prof. M S Swaminathan
Director, Centre for Research on Sustainable Agricultural
and Rural Development
Madras, India

## I. EVOLUTION OF THE CONCEPT OF FOOD SECURITY

The concept of food security has been undergoing refinement during the last 50 years. Immediately after World War II, food security meant building emergency grain reserves and ensuring the physical availability of food in the market. After the onset of the green revolution in the late sixties, it became obvious that economic access to food is equally important for ensuring food security at the household level. During the eighties, it became evident that the gender dimension of food security should receive attention, in view of the growing feminisation of poverty and agriculture. This was highlighted at the World Conference on Women held at Beijing in 1995. The principle of social access, with reference to women and marginalised communities was hence added to the concept of food security. Finally, after the UN Conference on Environment and Development held at Rio-de-Janeiro in 1992, there has been an increasing understanding of the role of environmental factors in food security. The ecological foundations essential for sustained agricultural progress are increasingly under stress due to human activities. Agenda 21 of UNCED addresses these concerns. Without safe drinking water and environmental hygiene, the biological absorption and retention of food will be poor. Thus, environmental access to food becomes important.

Based on the above considerations, the Science Academies Summit held in July 1996 at the M S Swaminathan Research Foundation, Madras, India, in preparation for the World Food Summit convened by FAO in Rome in November 1996, proposed the following comprehensive definition of food security.

Policies and technologies for Sustainable Food Security should ensure:

* that every individual has the physical, economic, social and environmental access to a balanced diet that includes the necessary macro- and micro-nutrients, safe drinking water, sanitation, environmental hygiene, primary health care and education so as to lead a healthy and productive life;

* that food originates from efficient and environmentally benign production technologies that conserve and enhance the natural resource base of crops, animal husbandry, forestry, inland and marine fisheries.

## II. WATER AND FOOD SECURITY

### A. Physical Access

Humanity now uses over one-half of the total accessible freshwater runoff. Projected growth rates in irrigated area are significantly lower than in the recent past. For the world as a whole, irrigated area is projected to grow at 0.6 percent per year, as compared to 1.5% during

1982-93. Current global water use is around 4500 cubic kilometres. However, freshwater is distributed unevenly across the globe. Countries with freshwater resources in the range of 1000-1500 cubic metres per capita per year face water stress, particularly in drought years. Agriculture is by far the biggest user of water, accounting for more than 70 per cent of water withdrawals worldwide and more than 90 per cent water withdrawals in several low income developing countries. Population rich and land hungry countries like India and China, have no option except to produce more food and other farm commodities from less per capita arable land and irrigation water availability in the coming millennium. The largest increases in irrigated area during the coming decades are expected in India and China. However, even in India, the projected 1995 to 2020 rate of growth in irrigated area of 1.2 per cent per year is well below the rate of 2.0 per cent per year achieved during 1982 to 1993. Much of the additional irrigation water comes from groundwater and this source is being increasingly exploited in an unsustainable manner. Major irrigation projects are running into serious environmental and social problems.

The adequate availability and equitable and efficient use of irrigation water are essential for converting the green revolution into an evergreen revolution. A study in eight Asian countries revealed that of the additional 117 million tons of rice produced between 1965 and 1988, 34 million tons can be directly attributed to irrigation. Even the remaining attributed to new varieties and fertilizer would not have been possible without water. Irrigation water has helped to increase not only crop productivity but cropping intensity, thereby leading to an increase in yield per day. In the tropics and sub-tropics, where there is abundant sunshine during most of the year, multiple cropping techniques have spread fast, both because of irrigation projects and the availability of photo-intensitive crop varieties. This has facilitated crop-livestock integration, through the introduction of fodder crops in the rotation.

Some of the urgent steps needed in the area of irrigation water conservation and sustainable use are:

* Harvest and conserve rain water;

* Promote conjunctive water use of river, rain, ground, sea and sewage water, in appropriate combinations;

* Prevent unsustainable exploitation of the aquifer;

* Ensure efficiency, economy and equity in water use through cooperative management of watersheds and command areas;

* Regulate the expansion of water markets and water lords;

* Introduce proactive measures to avoid water conflicts.

B. Economic Access

Government pricing policy, particularly with reference to electricity for pumping ground water, often results in inefficient and unsustainable exploitation of precious water resources. On the other hand, private ownership of ground water resources leads to the emergence of water lords and water markets. A national policy relating to access to water for all should be designed in such a manner that first, irrigation does not result in long term harm to soil health and secondly, gender and social equity in sharing the available water is ensured. Participatory management of irrigation water resources, including systems of rotational distribution of water, will help to foster the equitable and efficient use of water. Pricing policies should signal the inter-generational equity aspects of water use.

Irrigation has been an important factor in poverty alleviation in several developing countries. When water is available, there is not only crop security but also opportunities for multiple cropping, mixed cropping and agro-forestry systems of land use. Irrigation has a multiplier effect on employment both at the production and post-harvest phases of agriculture. It makes Integrated Intensive Farming Systems (IIFS) possible. Irrigation water thus enhances purchasing power.

### C. Environmental Access

This again is a multi-faceted issue. Sewage and industrial water recycling, including their incorporation in conjunctive water use systems will confer both public health and economic benefits. Ecological problems associated with unscientific water use such as water logging, salinisation and soil erosion are well known. Serious nutritional problems such as arsenic poisoning, due to the tapping of the deeper layers of the aquifer, have been reported in Bangladesh and the State of West Bengal in India.

Environmental and social problems are also serious in several major multi-purpose irrigation projects. For example, China's Three Gorges Dam over the Yangtze river will help to halt floods in the South of China and bring irrigation water to the northern part of the country. However, environmentalists have several concerns. Similarly, the Narmada project in India, designed to provide drinking water to 40 million people and irrigate 1.8 million ha. will lead to the displacement of nearly 250,000 people and to inundation of 117,000 hectares of land. It is obvious that every nation will have to weigh carefully the pros and cons of large multipurpose water projects and choose the ones which confer maximum social benefit with the least ecological harm. There is need for large numbers of professionals trained in Green Audit procedures with reference to irrigation projects. Opposing unsustainable development alone is not enough; there must be equal emphasis on proposing sustainable options. This is going to be a major challenge in the next century with reference to irrigation projects.

### D. Social Access

This again has several dimensions. Gender inequity is most serious in the case of drinking water, since women are invariably entrusted with the responsibility of fetching water for domestic use. Destruction of forests leading to the disruption of hydrologic cycles has affected adversely the nutrition and livelihood security of women.

Social cohesion and cooperation in the harvesting, storage and use of water will help enormously to strengthen irrigation water security. In a recent study, published under the title "Dying Wisdom", Anil Agarwal and Sunita Narain (1997)* , illustrate the power of social action, characteristic of the past but fast vanishing now, with the following examples.

i. Jaisalmer

A district in the Thar desert of Rajasthan, India. Annual rainfall is 100 mm. During the drought year of 1987, the Government's piped water supply ran dry. But there was enough water for the people who stuck to their rainwater harvesting structures called kunds (small water conservation structures).

ii. Cherrapunji, Meghalaya

A village in the northeast with annual rainfall of 15,000 mm. Yet this village suffers from water storage during summer months.

Thus, peoples' participation in water harvesting, conservation and efficient use will foster both sustainable food and drinking water security. However, there will be no cooperation in water saving unless there is equity in water sharing. Irrigation Water delivery systems and on-farm management of water can be made more efficient, if community-centred systems of water management are promoted. Globally, more than 50% of the cultivated area will continue to depend on rainfall and hence, rainwater management is vital for sustainable food security. In the past, famines were invariably associated with the failure of rainfall. Irrigation systems have helped to reduce variability in production from year to year and have provided insulation against total crop failure in years of drought.

## III. COMPETING DEMANDS FOR WATER

Currently, water use goes to four major sectors - domestic needs including drinking water, agriculture, industry and ecosystem conservation. In most calculations, the need for water to maintain ecosystems, particularly those rich in biodiversity, is not taken into consideration. For example, many mangrove forest ecosystems, which occur in the estuaries of major rivers, are adversely affected when the flow of fresh water goes down. Salinity then goes up and not all Mangrove species can withstand a high degree of salinity. Indiscriminate deforestation disrupts hydrologic cycles and increases the frequency of floods and drought. Hence, water allocation policies should include adequate provision for safeguarding the integrity of critical ecosystems. Disruption of hydrologic cycles hastens the process of desertification, as is evident from the ravines of the sub-Himalayan zone. There is need to standardise methods for calculating the water requirements for the conservation and sustainable management of forests and natural ecosystems, so that this need can get integrated in sectoral assessments.

The need for policy making and implementation structures to deal with water allocation and use issues in a holistic manner is becoming urgent in many countries. This will be clear from the recent decision of the International Irrigation Management Institute (IIMI) in Sri Lanka to change its name to "International Water Management Institute (IMI)" in order to enable it to look at water problems in its totality. River basins are highly integrated hydrological systems with the same water flowing and recycling through the agricultural, domestic, industrial and environmental sectors.

The following aspects will need integrated attention while developing a holistic approach to water management:

* Demand: While global demand projections are useful, what matters to individuals is the local availability of water. The need for water for household use and for agriculture, industry and ecosystem conservation will have to be assessed both locally and nationally. The qualitative aspects of water should receive equal attention.

* Supplies: Different methods of enhancing water availability will have to be promoted at the local and regional level. An appropriate mix of major, medium and mini-irrigation projects will have to be fostered. Conjunctive use of different sources of water such as rain, river, ground, sea and waste water will have to be promoted, as is being done effectively in countries like Israel. Computerised systems of water management and delivery need popularisation. Water Information Shops can be started in areas characterised by severe water scarcity.

* Management: Efficient systems of water management, including equity in distribution and the control of pollution will have to receive attention. Seasonal fluctuations in demand will have to be addressed through suitable management protocols.

* Conflict resolution: Conflicts are likely to grow at the national and regional levels on sharing water. At the local level, conflicting inter-sectoral demands, of the kind described later, will have to be resolved. Suitable institutional structures will have to be developed for a proactive resolution of emerging conflicts. The Water Court operating in the city of Valencia in Spain since many centuries is a good example of a local initiative in resolving conflicts amicably. In the new millennium, conflicts are likely to arise between the need of water for human use and that needed for irrigation. There are also possibilities of conflicts between countries, if changes in precipitation and temperature occur as a result of climate change induced by green house gas emissions. The Framework Convention on Climate provides a mechanism for cooperation among countries in preventing adverse changes in rainfall, temperature and sea level.

* Technology development and dissemination: This has to receive high priority, since technologies are now available to harvest every drop of water and use it economically and efficiently. Local level water users' associations can help to save and share water based on the principles of equity and efficiency.

* Public awareness, social mobilisation and information empowerment: This is an area of great importance, particularly in countries where a majority of farmers operate small holdings. In India and China, for example, the average size of holding is less than one hectare. Group cooperation will be essential under conditions of small and fragmented holdings for both water harvesting and efficient use. Without equity in water sharing, cooperation in water saving will not be forthcoming.

* Resources: The requisite managerial, institutional and financial resources will have to be mobilised for achieving the above objectives. Institutional structures will be needed for demand forecasting and management and for advice on efficient water use.

* New Partnerships: Coalitions of all concerned - scientists and engineers, political leaders, mass media, civil society, farm families, private sector industry, women's organizations and bilateral and multilateral donors - will have to be formed to tackle water problems on an end to end basis.

* Population: With every increase in population, there is a decline in per capita availability of water, a situation which can be altered only by new technologies such as solar desalination of sea water. For example, water availability per capita in India was over 5000 cubic metres (m3) per annum in 1950. It now stands at hardly more than 2000 cubic metres per capita. By year 2025, per capita availability is projected at only 1500 cubic metres (Fig.1). Such quantitative data alone are not adequate to get a real picture of the water availability status. Pollution affects water quality both in rivers and ground water. Also, there are gross inequalities between basins and geographic regions. Water markets, if they are organised in a non-exploitative manner, can help to meet the minimum household and agricultural needs.

## IV. MANAGING COMPETING DEMANDS

Sandra Postel (World Watch Paper 132, September 1996) has described the problems faced in dividing waters for different uses. In a more recent paper (December 1997), Mark W Rosegrant of the International Food Policy Research Institute and Claudia Ringler of the International Irrigation Management Institute, have dealt with the global impacts of water reallocation from agriculture on food production. Their calculations indicate that the projected reductions in agricultural water availability will be substantial by 2020. The reduction can be as much as 24 percent in China and 21 percent in India. Their model also suggests that reallocation of water out of agriculture can have a dramatic impact on global food markets. In developing countries, yield growth for all cereals will slow from 1.20 percent annually to 1.07 percent per year during the period 1993 to 2020. The area decline during the same period will be from 0.29 to 0.23 percent. Rice will suffer most, since it needs larger quantities of irrigation water. Consequently, the average price of rice is projected to increase by 68 percent between 1993 and 2020.

In addition to direct impacts on agricultural production, water transfers can negatively affect business activities, fishing and hydropower generation. Under conditions of scarcity, water markets grow. They can be of benefit to those who do not own a well or other source of water, if they function in a regulated environment, where making profit out of water scarcity becomes unethical. Rosegrant and Ringler recommend policy reforms such as the establishment of secure water rights to users, the decentralization and privatization of water management functions to appropriate levels, pricing reform, markets in tradable property rights, and the introduction of appropriate water saving technologies. While developing public policies for specific agro-ecological and socio-economic conditions, the trade-offs among various policy options will have to be carefully considered.

Often, local solutions will have to be found to manage water scarcity. Contingency plans and alternate cropping strategies will have to be developed for different water availability situations. Crop life saving irrigation methods will help to optimise yield under conditions of water scarcity. Most of these methods will require the active cooperation of all the families residing in a watershed. Management procedures relating to inter-sectoral availability of water should keep in view the needs of women. It is women who are mostly in charge of fetching and managing water at the household level. Hence, the gender dimension should be internalised in all technological and policy issues relating to water.

## V. MEETING THE CHALLENGE

Trends in water consumption indicate that demand for water for household and industrial uses in developing countries could double as a proportion of total water demand in the next 25 years. Scope for water supply expansion will at the same time be limited because development of irrigation and urban water supplies is becoming increasingly expensive, and often involve high costs in terms of environmental degradation and human resettlement. Without fundamental reform of water management, the rapid growth in urban water demand will require large transfers of water from irrigated agriculture, thereby threatening food security. Hence, water supply and demand should be managed in an integrated fashion, considering simultaneously all uses and sources.

How can we accomplish this objective? At the global level several initiatives like organisation of a Global Water Partnership and a World Water Council have been taken in recent years. At a meeting held at Valencia in Spain in December 97, the participants recommended the establishment of an International Water Centre for undertaking research, analysis, appraisal, information dissemination, training and consultancy activities. Such a Centre could also specialise in water laws and help in resolving water disputes through analysis and information. It was felt that we urgently need a new age instrument for promoting sustainable water security in the world.

Charity begins at home - while global mechanisms and institutions are important, it is essential that every country sets up institutional structures to deal with national and local level problems. International Conflicts over water are often precipitated by a failure to meet local, provincial, national and regional water demands for household, agriculture and industrial uses as well as for environmental / ecosystem services. The various sources of water and sectoral needs are indicated in Fig. 2.

An institutional structure for dealing with the multiple dimensions of water management at the country level is proposed in Fig 3. I have suggested the title "National Water Trust" instead of the commonly used term National Water Authority, to emphasise that water management should be carried out in the trusteeship mode. We must consider ourselves as trustees of water sources and not as owners. This will help to instill the feeling that management of water should not only be in the interests of the present generation but also of the generations yet to be born. Thus, the guiding principle for the work of the National Water Trust will be intra- and inter-generated equity.

Provincial and local level units of the National Water Trust can be organised, according to needs. The National Water Trust will serve as the hub of a grid of institutions including policy making bodies. It will thus serve as the flagship of a national system for sustainable water security.

## VI. WATER SECURITY : BRIDGE TO A MILLENNIUM OF HOPE

1998 marks the bi-centenary of Thomas Malthus's essay on population. In 1798, Malthus warned "the period when the number of men surpass the means of subsistence has long since arrived". When Malthus wrote his essay, the global population was less than the current population of India alone, namely 970 million. There is adequate food in the world today at current levels of purchasing power. Hunger is presently more related to economic access than physical access. Irrigation water availability and management have played a pivotal role in keeping Malthusian predictions at bay. Our ability to maintain a satisfactory balance between population and food production will depend both upon population policies and food production strategies. Every nation will have to develop an appropriate mix of water supply augmentation and demand management through socially and ecologically constructed policies and technologies. Comprehensive policy reform that promotes efficient use of existing water supplies will be needed in most countries. The National Water Trust proposed in this paper would be of help in integrated planning and decision making.

Above all, cooperation between countries sharing the same river or water source will become increasingly important. This is also true for States within a country having a federal constitution. Differing perceptions on the value of artificial rainmaking is a case in point. National and international mechanisms for proactive action on potential water conflicts will have to be put in place. International cooperation is also essential for avoiding adverse changes in climate, particularly precipitation and sea levels, arising from the accumulation of greenhouse gases in the atmosphere. A major step in this direction has been taken at the Conference of Parties to the Framework Convention on Climate Change held at Kyoto in December, 97. Meanwhile, it will be prudent for all countries to be prepared for different weather probabilities based on computer simulation models. Both avoidance and mitigation strategies should be developed. It will be appropriate in this context to recall the words of Mahatma Gandhi. "Nature provides for everybody's need but not for everybody's greed".

Figure 1 : Population Growth and Water Avilability Index in India (in cubic meters)

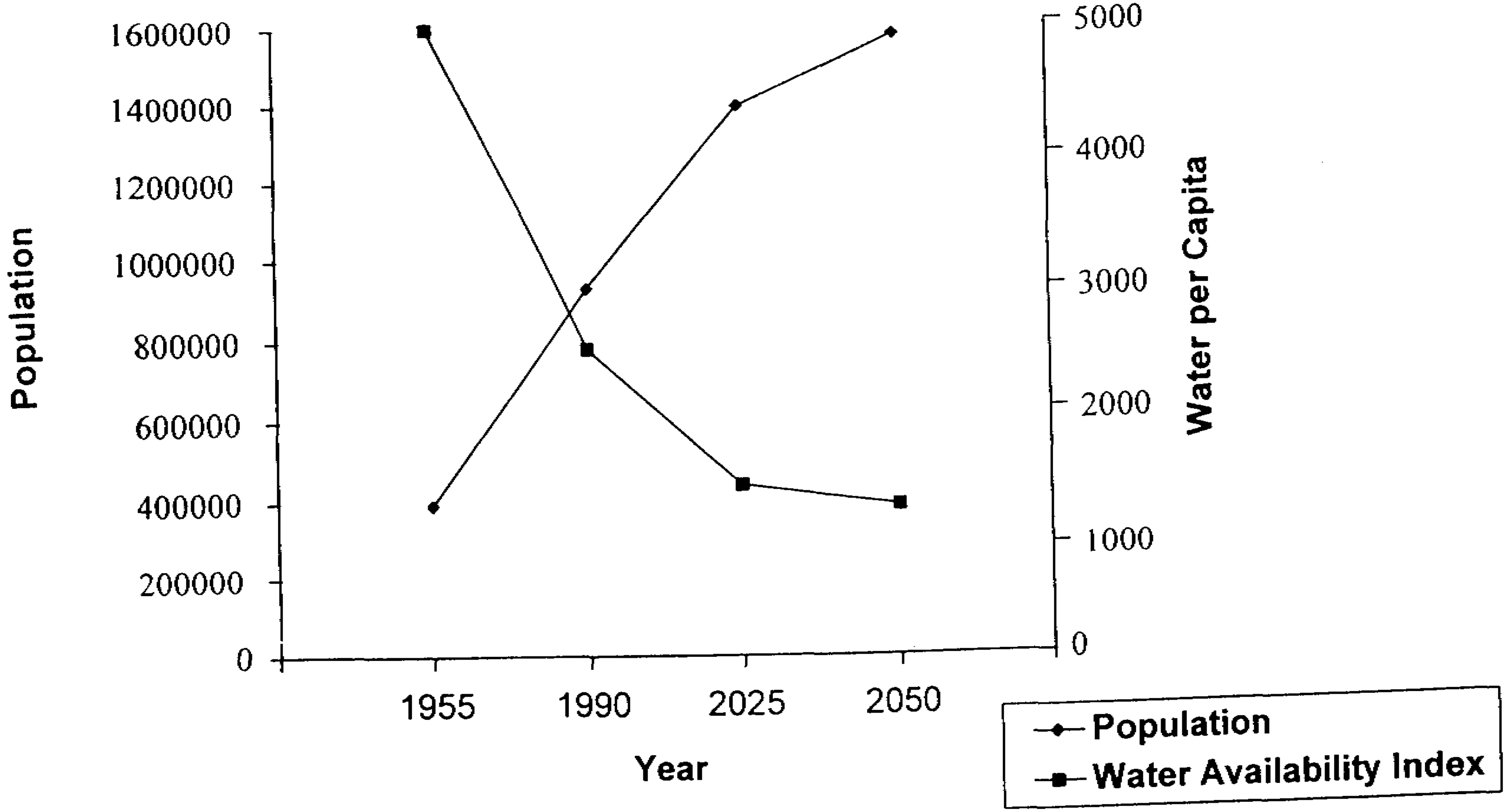


Figure 3

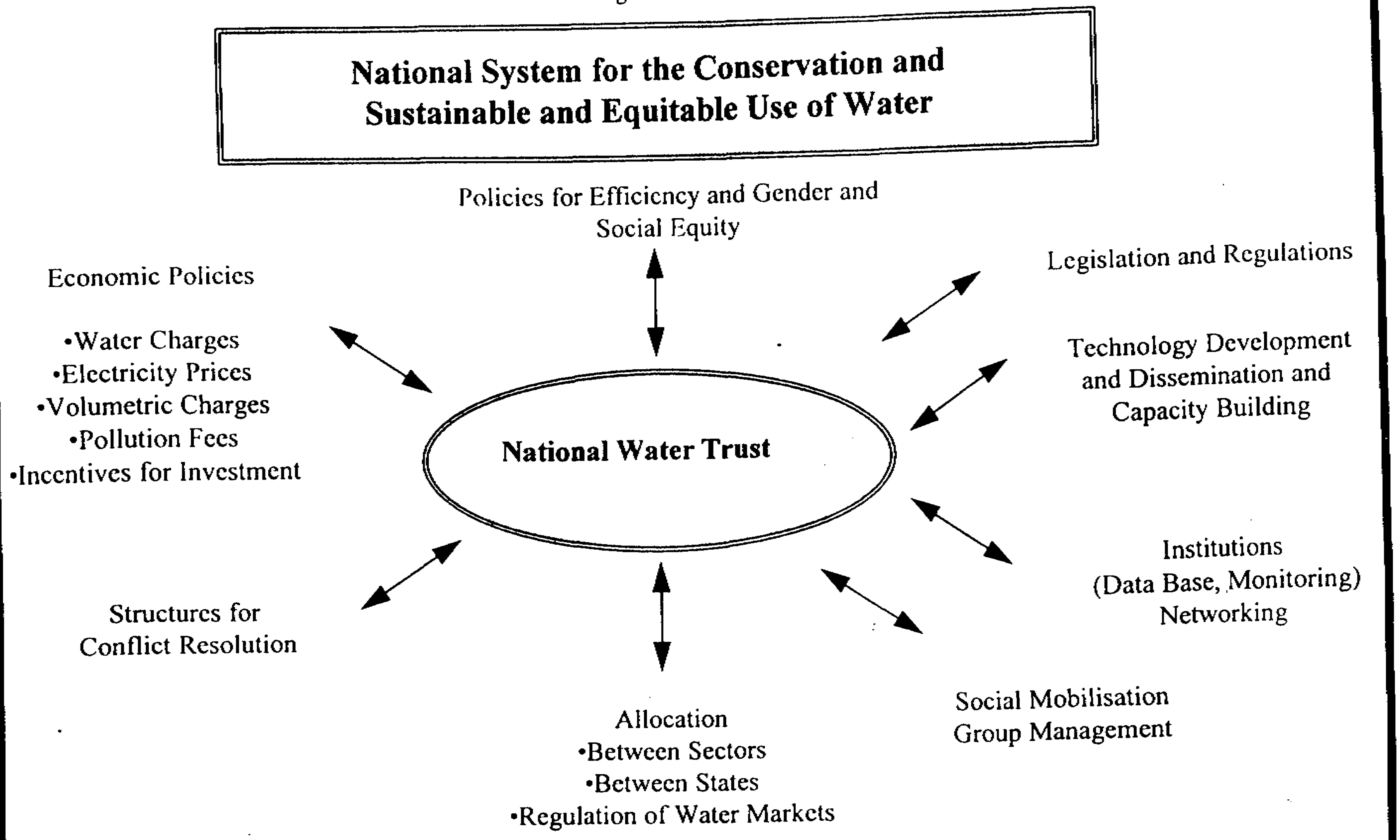
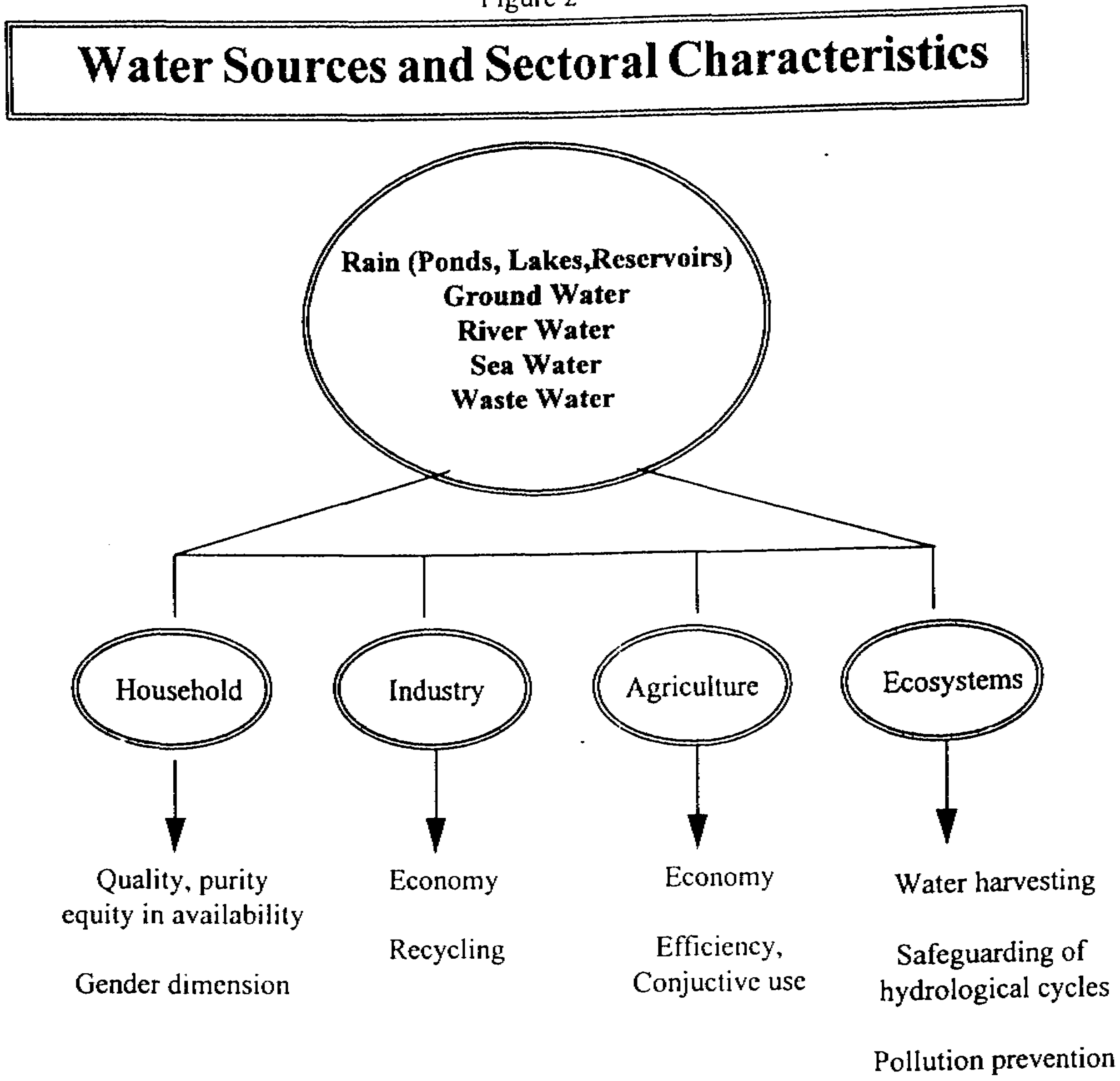

National System for the Conservation and
Sustainable and Equitable Use of Water
Policies for Efficiency and Gender and
Social Equity
Economic Policies
•Water Charges
•Electricity Prices
•Volumetric Charges
•Pollution Fees
•Incentives for Investment
Legislation and Regulations
Technology Development
and Dissemination and
Capacity Building
National Water Trust
Institutions
(Data Base, Monitoring)
Networking
Structures for
Conflict Resolution
Social Mobilisation
Group Management
Allocation
•Between Sectors
•Between States
•Regulation of Water Markets

Figure 2


Water Sources and Sectoral Characteristics
Sources
Rain (Ponds, Lakes,Reservoirs)
Ground Water
River Water
Sea Water
Waste Water
Sector
Household
Industry
Agriculture
Ecosystems
Needs
Quality, purity
equity in availability
Gender dimension
Economy
Recycling
Economy
Efficiency,
Conjuctive use
Water harvesting
Safeguarding of
hydrological cycles
Pollution prevention

# EXPERT GROUP MEETING

# ON

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

**27 - 30 January 1998**

**Harare, Zimbabwe**

# PROBLEMS FACED AND POLICY RESPONSES TO MANAGE WATER IN EUROPE

**by**

**Rainer E. Enderlein**

**Paper No. 10**

**Prepared for the**
**Department of Economic and Social Affairs**
**United Nations**

# PROBLEMS FACED AND POLICY RESPONSES TO MANAGE WATERS IN EUROPE

*by Rainer E. Enderlein*

## I. Introduction

Four decades of dialogue, negotiations and concerted action have shaped the regional cooperation on water management pursued under the auspices of the United Nations Economic Commission for Europe (UN/ECE) which has now 55 member countries (all European countries, Canada, Central Asian republics, Israel and the United States).

Work has evolved in line with the changing needs and priorities in the region. From the earlier focus on water-quantity issues, such as water use in industry and flood management, the emphasis shifted to a holistic approach to the environmentally sound management of inland water resources and riparian vegetation, wetlands, riverine floodplains and associated wildlife and habitats

The response of the Commission and its member Governments to the challenge of the degradation and overuse of water resources has been productive in terms of declarations, strategies, and policy recommendations to promote and implement rational and ecologically sound water management, the conservation and restoration of water resources and related ecosystems, and pollution control. These activities culminated in the *Convention on the Protection and Use of Transboundary Watercourses and International Lakes*, which was adopted on 17 March 1992 and entered into force on 6 October 1996.

## II. PROBLEMS

In Europe, the amount of water available for sustained consumption is very unevenly distributed. Overall, there is however no severe water shortage problem [1]. Many countries are heavely dependent on external contribution of water through transboundary rivers to meet their demands, some of them receive more than 50 per cent of their waters from neighbouring countries. Industrial water use varies widely between countries. In Finland, Germany and Belgium, industry accounts for some 80 per cent of all water abstractions, whereas more agrarian countries (Greece, Portugal, Spain) abstract less than 30 per cent for industry. About 25 per cent of the water abstracted in Europe is used for agriculture as a whole Agriculture accounts for more than 50 per cent of all water abstraction in Albania, Bulgaria, Greece, Italy, Romania and Spain [1].

Untreated or insufficiently treated industrial and municipal waste water, inappropriate agricultural practices causing water pollution by nutrients and pesticides, seepage from old and new landfills, leaching of hazardous substances from decommissioned industrial sites and former military areas continue to threaten the quality of waters and related aquatic ecosystems in large parts of Europe. Sediment contamination, particularly by hazardous substances, is another troublesome issue. When dredged, these sediments require additional treatment and appropriate disposal in order to minimize their adverse effects on terrestrial ecosystems and waters.

Many countries in Europe have documented widespread increases in nitrate concentrations in groundwaters. Many aquifers in Europe have also been polluted by heavy metals, pesticides and oil. Disposal of wastes, both hazardous and domestic, and the impact of acid deposition have repeatedly been found to be responsible for the deterioration of groundwater quality. In addition, there are numerous cases where the abstraction of large amounts of groundwater for irrigation has caused the introduction of saline water into aquifers.

**Transboundary Waters in Europe**

In Europe, the extent of the economic and environmental relevance of transboundary watercourses and international lakes is clearly demonstrated by the magnitude of these resources. In fact, more than 50 per cent of the 31 major rivers in Europe with a drainage area of over 50,000 $km^2$ have transboundary catchments. The catchment area of the Danube, one of the largest rivers in Europe, is shared by seventeen countries. A great number of small and medium-sized waters criss-cross the boundaries between two or more States.

It appears from national reports that organic pollution is still a serious problem for the rivers Daugava, Dniepr, Elbe, Meuse and Scheldt. The bacteriological quality of some transboundary rivers in Europe, including the Danube, although improving, is low. Algal growth in transboundary surface waters, particularly international lakes, remains a major problem as a result of pollution from agricultural sources.

Although the water quality of many larger rivers gradually improves, there are a number of small brooks and streams which do not yet get sufficient attention in water pollution control. Trends in pollution by heavy metals and other toxic substances are not very encouraging either. [2]

The long history of water-construction works has led to a situation where many important surface waters in Europe are heavily regulated and hence far from being in pristine condition. River regulation has been undertaken to the greatest extent in Western and Southern Europe. The portion of river reaches that are still in a natural state is low, typically below 20 per cent [1]. Water resources development projects have often created conflicts between various uses at the catchment area level, including transboundary waters, as it was the case with the Gabcikovo project on the Danube between Slovakia and Hungary.

More than 120 million people in the ECE region, not considering Canada and the United States, still do not have access to save drinking-water. Faecal contamination is widespread. Health-related problems also arise from the discharge of persistent organic pollutants, oil products, chromium, organic matter, as well as from saline intrusion into groundwaters. The lack of adequate treatment of source waters, particularly in terms of disinfection, the poor quality of the distribution system, and insufficient maintenance or renewal of the supply networks, are all linked to outbreaks of water-borne disease.

**Poor quality of the supply system in cities**

In the UN/ECE region as a whole, the direct cost in terms of clean water that is unaccounted for has been estimated at some $10 billion a year. In some large cities in Albania, Romania and Norway, almost half the drinking water that leaves the water purification plants is thought to be wasted in this way. In most countries the national average has been estimated at some 30 per cent. Some cities have reported leakages of 70 to 80 per cent. Moreover, some 50 per cent of this wasted water re-enters the sewage system and is promptly treated again. This puts an unnecessary burden on waste-water treatment plants and pushes up their costs. [3].

In some countries in transition, the population also suffers from supply cuts, giving rise to a further drop in water quality in the supply system. Although the consequences of poor water management are mostly felt at the local or provincial levels, water pollution and water shortage have had a transboundary impact too.

## III. CHALLENGES

In addition to the conventional tasks of water management to protect life and property against floods and droughts, ensure drinking-water supplies, satisfy the water demand of industry and agriculture, and improve water quality, new issues are emerging in Europe:

þ One of the major new goals of water management policy in Europe is the conservation and, where possible, restoration of aquatic ecosystems to a target state of high ecological quality.

þ Achieving the goals of sustainable development also requires significant changes in production and consumption patterns, particularly in the highly industrialized countries in Europe, to optimize the use of water resources and minimize waste-water production.

þ Responsible managers became aware that in the long-term, respect for the prime characteristics and functions of water constitutes the only rational basis for intervening in water systems, whether by regulation, drainage, abstraction or waste disposal.

These new requirements have given rise to the development of policies which include the application of the precautionary principle, pollution prevention at source, the use of the polluter-pays principle and cooperation among States to prevent disputes on water issues. They add a new dimension to water resources development by harmonizing the use of water, the orientation of investments and technologies, and institutional aspects. These policies are at the root of many measures intended to use and develop water resources in an efficient, environmentally sound, equitable and reasonable manner in order to satisfy society's demand for water, water-related goods and services. They also safeguard the ecological functions of waters, ecosystem integrity and biological diversity.

**Financial programme under the new 1992 French Water Law**

In France, for example, the introduction of the new 1992 water law was backed by a financial programme for water covering the 1992-1996 period. Of a total of US$ 13.5 billion, some US$ 9 billion was earmarked for reducing pollution from point sources in the municipal and industrial sectors. Some 80 per cent of this latter amount was earmarked for the construction or upgrading of municipal sewer networks and treatment plants, whereas the remaining 20 per cent was foreseen for the reduction of pollution from industry. These sums are roughly double the amounts spent for the same purposes in the 1986-1991 period. [2]

Many countries have invested large sums in improved treatment of industrial and municipal waste water, thus cutting down emissions from point sources. On the other hand, the share of pollution from diffues sources is growing. Governments in cooperation with the industry, agriculture and the public at large must seriously address the remaining non-sustainable activities.

Moreover, a number of obstacles to the abatement of water pollution cannot be resolved unless relevant national policies and strategies are rendered compatible at the international level. Measures taken unilaterally or among riparian countries alone may in some cases distort competition and trade patterns. Region-wide cooperation can ensure that the national water policies in the various catchment areas are coordinated effectively and that the various transboundary water agreements and the activities of relevant bilateral and multilateral institutions are vigorously implemented.

**Cooperation on the river Rhine**

Between 1965 and 1986, the authorities in the five Rhine States invested about USD 50 million in the construction and improvement of indusrial and municipal waste-water treatment plants in the catchment area. In 1987, the riparian countries agreed that every State should reduce the remaining pollution of 47 most harmful substances by 50 per cent in the period between 1985 and 1995 which required investment in the order of USD 20 million. [4]

A number of ECE countries have recently defined new national strategies for the protection and use of water resources or are in the course of drawing up new strategies. In most cases, however, the strategies are presented in very general terms without quantifiable goals and objectives. An exception to this are the strategies of some riparian countries in the catchment areas of the rivers Rhine and Elbe, which have given rise to concrete action plans drawn up under the auspices of joint bodies.

**Achievements for the river Elbe**

For the river Elbe and its catchment area, the first action programme to reduce emissions of harmful substances was drawn up in 1992 to resolve the most severe problems of water pollution from point sources. The programme included specific provisions for the construction of municipal waste-water treatment plants in the Czech Republic and Germany. 15 priority substances received particular attention as the goal was to reduce their input by 30 per cent by 1995. From 1991 to 1995, 126 waste-water treatment plants with a capacity over 20,000 population equivalents were constructed, 30 in the Czech Republic and 96 in Germany. From 1989 to 1994, the pollution of the Elbe was reduced (station Schnakenburg, 474.5 km downstream the border with the Czech Republic) by organic pollutants (40 %), phosphorus and nitrogen (30 %), mercury (80 %), cadmium (20 %) and AOX (50 %). [4]

The same still applies to sustainable water management. It is most often described in general terms as a goal, rather in terms of concrete criteria and action. This makes it difficult to compare national strategies and draw on existing experience. In fact, clearly defined measurable goals to be attained in both the short term and the long term should be included. This calls for an examination of the methodological basis of existing strategies and the development, if appropriate, of a certain set of minimum requirements to be considered when improving existing strategies on transboundary waters.

## IV. POLICY RESPONSES

***Promoting waste-water minimization at source and rational use of water***

While the promotion of low- and non-waste technology will continue to be the cornerstone of ECE policies and strategies to prevent water pollution from point sources, the shortfall between realization of that objective and the current situation must nevertheless be faced. Therefore, add-on measures for waste-water treatment will have to be developed further and applied together with environmentally sound in-process technology:

þ Policies of integrated water management should give priority to promoting pollution abatement and waste-water minimization at source. The core of these policies is the application of the best available technology (BAT) and the precautionary principle for containment and treatment of hazardous substances. The control of pollutants within industrial processes, the selective treatment of industrial waste water allowing recycling of water, and recovery of valuable substances, where appropriate, is included.

þ The appropriate measures also include total or partial prohibition of the production or use of hazardous substances. Substitution of potentially hazardous substances in industry, trade and service is another aspect.

**Water management and investments in Austria**

In Austria, the institutional framework is given by the Water Act which has been amended in 1959 and 1990. A Water Management Fund provided in the 1959-1992 period long-term loans at low interest rate (1-3%) for water supply, sewerage and waste-water treatment investments. The loans, with maturities between 20 and 50 years, covered from 40% to 80% of investment costs. Since 1993, there was a shift to subsidies for interest payments on loans which still cover 20% to 60% of investment costs. The necessary capital is provided from general taxes (55%), bonds and credits (20%) and interests and capital refunding (25%). Overall, the investment costs for pollution control amounted to 25 billion USD (1996 prices) in the 1959-1996 period or 50.000 AS/capita. Investment and operational costs for sewerage and sewage treatment amount to 1.5% of Austrian GDP. At present, 75% of the population is connected to the sewerage system. The key success factors are seen to be: the introduction of solidarity financial instruments and a long time to implement policies. However, these factors were made possible by a number of favourable circumstances including: needs of a flourishing tourism, strong ecological movement, technological development, effective state bureaucracy, positive public opinion in the reconstruction period after the World War, and participatory democracy. [5]

Considerable progress has been achieved in Western Europe and some countries in transition in the development and application of waste-water treatment and sanitation technology, the establishment of appropriate design standards, and the imposition of restrictive discharge authorization procedures. Total volumetric discharges of effluents have been cut by introducing in-plant measures and modifying production processes. From the regulatory point of view, discharge-oriented control based on technological requirements is applied in a wide variety of industries. For new industrial plants, the application of best available technology is frequently required to achieve maximum pollution prevention together with an optimum degree of safety.

**Water pollution control in countries in transition**

An enormous task lies ahead if countries in transition are to prevent, control and reduce water pollution from point sources. Most central and eastern European countries suffer the consequences of past developments. Industrial waste waters are frequently discharged into the sewer network or directly into the recipient waters without any proper pre-treatment. Moreover, many municipal treatment plants in central and eastern Europe are only mechanical-biological plants. Treatment plants are often overloaded and improperly operated, and they use inappropriate treatment technologies. The degree to which the load of pollutants is reduced is therefore often smaller than expected.

These countries have reported that improvements can only be achieved over a period of time, that priority decisions have to be taken and stepwise solutions sought. However, a clear-cut approach to solving these problems has still to be found. For example, emission limits have to be set for the discharge of hazardous substances. There is, however, little experience to assess whether these limits are in fact realistic given their time frames and the associated costs and other constraints in countries in transition.

In addition, many countries lack funds for the construction of municipal waste-water treatment plants. A prudent approach could well be not to build new plants until facilities are upgraded and the pre-treatment of waste waters discharged by industries into municipal sewers can be assured. Such a policy is already practised in some countries. [2]

The concept of rational water use, as developed in the earlier 1980s under the auspices of ECE, remains an important element of policies promoting pollution prevention at source. It covers not only water-quantity aspects. The protection of the resource against pollution became an immediate component of the concept, as it called for the control of pollutants within industrial processes, recycling of water and recovery of valuable substances. The rational use of water also decreases the fundamental need for additional energy and raw materials needed for abstraction, distribution, storage and treatment of raw water as well as the treatment of waste water and, therefore, lowers the pressure on other resources.

### *Applying the polluter-pays principle*

Degradation of aquatic ecosystems and the inefficient use of water resources require intervention to properly price environmental resources and internalize environmental costs.

Therefore, the perception of water as a freely available public good can no longer be maintained.

In order to promote economic incentives to reduce pollution and improve resources use, water prices and charges should be high enough to induce changes in behaviour, and foster preventive measures and low- and non-waste technologies. However, such measures should be phased in gradually, to take due account of the social and economic implications.

The polluter-pays principle, by virtue of which costs of pollution prevention, control and reduction measures should be borne by the polluter, in many instances guides the elaboration and use of economic instruments. With the Water Convention, this principle also became a central element of the protection and use of transboundary water resources. The idea of applying the polluter-pays principle to solve the problem of compensation for damage has not yet taken on. It is closely linked with responsibility and liability issues related both to the prevention of water pollution and containment and restoration of damage.

**Economic and financial instruments**

Economic and financial instruments are used to complement other policy instruments. Their basic objective is to ensure the appropriate pricing of water resources and water-related services in order to promote an efficient use and allocation of these resources. Charges, levies and fees for abstractions and discharges are intended to promote both the rational use of water and the control of pollution in accordance with the polluter-pays principle.

As one would expect, the method of determining charges and the use of charge revenues varies from country to country. To be an effective incentive against pollution, charges and fines must be set at high enough levels to make it costly to continue the ways of the past. However, due to the present situation and state of industry in some countries in transition, the charges have been set at a fairly low level. In Croatia, for example, charges amount to some DM 0.16 for each cubic metre of waste water. The ability to enforce tax levies is also of paramount importance. In Hungary, the law states that non-compliance by dischargers can lead to the cessation of the activity, however, this has happened in very few cases. Another important element in economic policy is how the funds collected from polluters are used, for example, to control pollution, improve the environment, or cover the general expenses of the Government. [2]

Integrating the true environmental costs and risks into economic activities will help make decision makers aware of the implications of their policy decisions, although obviously the price of many environmental assets is difficult to determine. This is a further challenge for research and development.

Issues associated with the physical and financial assessment of damage resulting from transboundary impact need to be further resolved through regional cooperation under the Water Convention. In particular, there is a need for methods which would enable European countries to evaluate the adverse effects on water uses and related ecosystems caused by the chronic pollution of transboundary waters.

***Promoting best environmental practices***

*Water pollution from agriculture*

The prevention, control and reduction of water pollution from diffuse sources also demonstrate the need for international coordination and the convergence of policies among countries:

þ In many instances, information on technical measures to prevent and control diffuse water pollution is adequate. This applies particularly to the control of diffuse sources in agriculture through best environmental practices for the reduction of inputs of nutrients and pesticides into waters.

þ Lack of implementation is, however, more often the key problem, for economic or policy reasons. This is why achievements in the prevention, control and reduction of water pollution originating from agriculture vary among European countries. Enforcement of provisions to restrict certain activities in sensitive areas, both for surface waters and groundwaters, meets with enormous difficulties in some countries. Moreover, a total or partial prohibition of the production or use of substances hazardous to waters and related ecosystems is not yet common practice.

þ Codes of good agricultural practice are a new form of assistance to farmers to reduce water pollution by fertilizers and pesticides. As country-wide action guidelines, they become the basis for evaluation, support and control in a number of countries.

þ The understanding that good agricultural practice should be adhered to without financial compensation is gaining ground. In order to meet specific environmental objectives, however, compensation is paid. This includes, for example, compensation for making more environmentally sound changes in agricultural production, going beyond good agricultural practice, such as extensification and the restoration of flood plains and former wetlands.

There are a number of areas where further action is required. In particular, a better coordination or even integration of agricultural policies with environmental protection policies and land-use planning is needed. Moreover, there is a need for economic measures, at both the national and international levels, to bring agrarian policy tools, which - in a number of countries - currently aim at keeping down production, in line with protection measures for water and the environment in general. Furthermore, mechanisms for financial regulations and distribution of environmental protection costs are not yet sufficiently developed.

**Cleaning up of contaminated sites**

In the discussion concerning the degree to which contaminated sites are to be cleaned up, the proposed goals range from mere hazard prevention required by regulations to the ecologically desirable restoration of the status quo ante or of an area's multi-functionality. The ultimate goal in cleaning up contaminated sites is to prevent hazards to human life and health. Another clean-up goal is to prevent hazards to the natural environment, especially to the groundwater itself, taking into account the existing or planned uses of the relevant site.

Basically, the clean-up of contaminated sites cannot meet the aims of the precautionary principle. This also applies to groundwater protection. Strict application of the precautionary principle would disregard the difference between general, precaution-oriented protection of water bodies and clean-up restricted to hazards prevention. Such a strict application would accord groundwater greater priority than that accorded to human health as far as protection is concerned.

In general, groundwater damage should be cleaned up with the aim of restoring the "original" condition where possible; i.e. with the aim of restoring the natural exchange mechanisms within the groundwater. On the other hand, groundwater pollution, as a rule, cannot be completely cleaned up, due to hydrogeological factors and the limited effectiveness of technical procedures. Nevertheless, the minimum aims of the clean-up of groundwater damage must be to prevent health hazards wherever possible; prevent strong ecotoxic effects and other massive environmental pollution; restore the potential for use; and restore the extent and function of valuable resources.

Particular attention should be given to soil pollution from substances that can move easily through groundwater. Such pollution should be cleaned up immediately, to prevent further propagation within the subsoil and within the aquifer. This will reduce the costs of groundwater clean-up measures in the long term. [6]

The assessment of the impact of proposed measures in the agricultural sector on all environmental media is another area of concern, since many measures still address the impact on water in isolation from the impact on soil, air or the living environment. The objectives of education, training and consulting will also have to be broadened, since these measures are often still designed to achieve higher agricultural production regardless of the adverse impact of agricultural practices on the environment.

*Other pollution sources*

There is also a need for strengthening international cooperation and the convergence of policies among countries to control water pollution from other sources, both diffuse and line sources. While activities under the 1979 *Convention on Long-range Transboundary Air Pollution* and its related protocols contribute to the protection of waters against possible impacts from air-borne pollution, there are four particular areas of common concern which would require cooperative activities in Europe:

One area is water pollution from waste disposal sites and other land disposal technologies and practices, such as surface impoundments and land treatment, deep-well disposal and deep-surface disposal. Although nowadays waste disposal sites are progressively controlled under licensing systems, waste has in the past often been disposed of in a random way at poorly engineered or even uncontrolled sites. Even some recently designed waste disposal sites do not have a leachate management system.

The release of hazardous substances from industrial areas into waters during handling and storage is another problem of common concern. Although industry normally receives detailed guidance for the handling and storage of hazardous substances, leakage or uncontrolled disposal have

**Soil and groundwater pollution**

Soil and groundwater pollution problems from the carefree use of chemicals and waste disposal have become very pronounced in countries in transition when the occupier or owner of land has changed and previously inaccessible areas have suddenly become public or private property.

Large centralized industries have not paid much attention to the environment. Many have exploited nature without hesitation, leading to extensive and far-reaching pollution of the soil and the environment and the deterioration of human health.

Reverting military bases and training grounds to civilian use has created huge problems. The moral obligations and liabilities are easy to define, but the armed forces have usually operated under their own rules. Requests for corrective action or compensation often lead nowhere, especially in the case of multinational military forces. However, in most countries national military forces are developing an increasingly positive attitude to the environment. [7]

repeatedly been the source of severe surface-water and groundwater pollution, including transboundary water pollution.

Decommissioned industrial sites and land contaminated by past industrial activities are another significant source of pollution in a number of countries. Abandoned sites for manufacturing chemicals and chemical products, coke and refined petroleum products, and basic iron and steel are a particular problem. Diffuse pollution from abandoned military sites is another threat, particularly in countries with economies in transition. Uncontrolled storage, use and disposal of hazardous substances were repeatedly reported to deteriorate groundwaters. It is often difficult to pinpoint the precise cause and extent of the damage as there are no adequate records to serve as guidance.

The broad use of herbicides on non-agricultural land, such as roads, railway tracks, airfields and other hard surfaces, grass verges and amenity areas is a further area of concern. Some of these substances are persistent and highly mobile in soil water. They have already been found in groundwaters with concentrations exceeding the maximum permitted levels for drinking-water use. For these reasons, some countries have recently restricted and even prohibited the use of some herbicides, such as atrazine and simazine. At the domestic level, guidelines for the control of weeds on non-agricultural land have also been drawn up in some countries.

Cooperation in the application or research into and development of effective techniques for the prevention, control and reduction of transboundary impact, as stipulated in the Water Convention, could focus on the evaluation of the environmental hazards posed by contaminated sites, lay the common ground for setting priorities for the rehabilitation of such sites, and provide for cost-effective rehabilitation measures. Specific regulations, guidelines, methods and techniques have to be drawn up and rendered compatible between countries to control water pollution from these sources.

***Promoting contingency planning***

Policies promoting the prevention of, preparedness for, and response to industrial accidents need to be been drawn up or further developed, both at the national and transboundary levels:

þ Water acts or accidents ordinances have introduced a system of preventive action, directly related to facilities, to avoid hazardous incidents and accidents. Owners of industrial facilities dealing with large quantities of hazardous substances are often required by law to meet certain safety standards. In particular, they must carry out risk analysis, implement monitoring and control systems and plan detailed emergency measures.

þ Individualcontingency plans have often to be approved by the provincial or local water inspectorate. Water-management authorities have to regularly check the status of such measures and the compliance with legal regulations. Contingency systems and guidelines for a safe drinking-water supply in the municipalities are also being developed.

**Industrial accidents**

While most industrial accidents with the potential of adversely affecting water quality can be contained within the boundaries of the industrial plant, there are those cases where impacts extend beyond these boundaries and have adverse effects, both short-term and long-term, on life, life-support systems including water, or property. Accidental groundwater pollution has also had severe consequences for drinking-water supplies, and increasing attention is being given to the operation and monitoring of chemical storage facilities and waste-disposal sites. Some countries reported on water acts or accident ordinances that had introduced a system of preventive action, directly related to facilities, to avoid hazardous incidents and accidents. Contingency systems and guidelines for a safe drinking-water supply in the municipalities are also being developed. In many other countries, however, proper contingency planning is still lacking. Recent reports have even shown a degree of unpreparedness at the subregional level. [2]

At the transboundary level, the 1990 *Code of Conduct on Accidental Pollution of Transboundary Inland Waters* provides guidance to the competent authorities in individual member countries in their task of protecting transboundary inland waters against pollution resulting from hazardous activities in the event of accidents or natural disasters. It also formed a basis for the ECE *Convention on the Transboundary Effects of Industrial Accidents*, which covers issues regarding the prevention of, preparedness for, and responses to industrial accidents, including those with a transboundary impact on waters and related ecosystems.

***Developing and applying water-quality objectives***

Water-quality objectives are increasingly used in Europe as an important policy instrument to prevent, control and reduce pollution in surface waters, including transboundary waters. They aim at ensuring the multi-purpose use of fresh water, while supporting and maintaining aquatic life and/or the functioning of aquatic ecosystems. Water-quality objectives are being developed by water authorities to set threshold values for water quality to be maintained or achieved within a certain time period:

þ Water-quality objectives, set at a level that provides for the protection of the most sensitive use of a water body, are considered as the ultimate goal, that is, as a target value which indicates a negligible risk of adverse effects on water uses and the ecological functions of waters.

þ In some countries, the setting of water-quality objectives is accompanied by the development of a time schedule for compliance with the objectives. Such objectives, which represent the result of a balance between what is desirable from an environmental point of view and what is feasible from a technical and economic point of view, are regarded as a policy goal to be attained within a certain period of time.

For some river basins, action plans covering both point and diffuse pollution sources have already been designed, which permit a phased approach to the prevention, control and reduction of water pollution. The setting of emission limits on the basis of best available technology, the use of best environmental practices and water-quality objectives became integral parts of these action plans to provide for measures which are both technically and financially feasible, and legally implementable.

***Ecosystem approach to water management***

The ecosystem approach is a new instrument for integrated water management. It is a departure from the earlier focus on localized pollution and the management of separate components of the ecosystem in isolation, and from planning which often ignores the profound impact of land use on water quality. As a concept for managing water resources, the ecosystem approach has been discussed in scientific circles for well over a decade, but had never fully achieved the status of a working principle until recently.

Through its *Guidelines on the Ecosystem Approach in Water Management,* ECE aims to promote a holistic approach to the environmentally sound management of inland water resources and riparian vegetation, wetlands, riverine floodplains and associated wildlife and habitats. In this approach humans are central to the well-being of the system. The approach recognizes the social, economic, technical and political factors that affect the ways in which human beings use nature, because of their ultimate effect on the integrity of the ecosystem.

As the approach also takes a long-term view, it is part of policies to achieve sustainable water management. Some lessons can already be learned from the practical application of the ecosystem approach in water management, both at the domestic level and in transboundary waters:

þ Practical experience suggests, for example, that the maintenance and improvement of conditions in aquatic ecosystems should be laid down as basic requirements in water laws and other related legislation. Moreover, legal provisions should, as far as possible, provide concrete guidance for planners and decision makers in cases where trade-offs have to be made between ecosystem-maintaining functions of water, on the one hand, and perceived short-term economic benefits, on the other.

þ The ecosystem approach requires planning to be based on ecosystem boundaries rather than on political or jurisdictional borders. It also calls for increased intergovernmental cooperation at all levels, since many aquatic ecosystems cross national boundaries. Riparian countries should incorporate ecosystem considerations both into the water management plans for their respective parts of catchment areas of transboundary waters and into bilateral or multilateral action plans for the entire catchment areas of these waters.

þ Ecosystem-based water management requires strengthened coordination of water-management activities carried out in key water-related sectors within the catchment area, including water-supply, pollution control, hydropower production, transport, industry, agriculture, fisheries and aquaculture, forestry, tourism and recreation. Governmental institutions should involve private sector organizations, land-owners and public-interest groups, both in the preparation and the implementation of action plans, in order to reach broad consensus. They should also encourage concerted action by policy makers, industrialists, farmers, planners, water managers, scientists and the general public.

> **Ecosystem approach in the catchment area of the river Danube**
>
> In the catchment area of the river Danube, the joint goals and principles of strategic action plans in general are well established, the key issue remains to set the real priorities. So far, 180 hot spots have been identified, the majority affecting the Danube tributaries, but only a small number of them have been addressed through investment projects. Priorities among the hot spots still need to be set. The *Strategic Action Plan (SAP)* for the Danube drainage basin needs to establish guidelines for setting real priorities for creating real bankable projects linking environmental and economic effects. To that end, more political support and commitment is needed from various governments to address environmental problems. The *Danube River Protection Convention* serves as umbrella for programme activities, and the *Programme Coordination Unit (PCU)* integrates EU activities (PHARE, TACIS) with the input from GEF (Global Environmental Facility). There is a need to involve even more the relevant business sectors (industry, transport, agriculture) in the process of implementation. [5]

þ The ecosystem approach to water management gains momentum by channelling substantial management responsibility to local authorities, as they generally take land-use decisions. Land use and activities in the catchment area have an important influence on aquatic ecosystems. Coordinating land-use planning and water-management planning helps to further the ecosystem approach.

*Environmental impact assessment*

Environmental impact assessment (EIA) has already proven to be a major instrument to implement and strengthen sustainable water management as it not only combines the precautionary principle with the principle of preventing environmental damage at source but also arranges for public participation:

þ EIA has become an important tool for an integrated approach to the protection of the environment as it requires a comprehensive assessment of the impacts of an activity on the environment contrary to the traditional sectoral based approach.

þ EIA looks into alternatives of a proposed activity and brings facts and information on environmental impacts to the attention of the decision-makers and the public. In this respect, EIA is already used as an effective instrument for improving the quality of the environment at the national level.

> **ECE Convention on Environmental Impact Assessment in a Transboundary Context**
>
> This Convention specifies the procedural rights and duties of Parties with regard to transboundary impacts of proposed activities and provides procedures, in a transboundary context, for the consideration of environmental impacts in decision-making. The EIA Convention also requires Parties to endeavour to apply the principles of EIA to policies, plans and programmes. In accordance with its relevant provisions, a risk assessment has to be undertaken as part of the EIA procedure in relation to the appropriate proposed activity in order to assess the potential risk on, inter alia, water resources and aquatic ecosystems.

In many European countries, EIA is already required for such water-related investments as hydropower projects, dock construction and large dredging activities. Other examples include the establishment, removal or substantial modification of a water body or its banks and the construction of dykes and dams; the expansion, construction or removal of a national waterway; and the construction and operation or the substantial modification of waste-water facilities with a certain minimum capacity. Non-water-management activities which may have an adverse impact on water resources are also subject to an EIA in some countries. These include, for example, the construction of oil and gas pipelines, opencast mining and sludge-storage areas. The use of EIA in water management tends to be limited, however, to internal waters.

## PROTECTION AND USE OF TRANSBOUNDARY WATERS

Some 150 conventions, treaties and other arrangements have been concluded between European countries to strengthen cooperation on transboundary waters at bilateral, multilateral and pan-European levels. These agreements bear witness to the concern and interest of European countries in striving together to prevent the deterioration of water quality in transboundary waters and to ensure reasonable and equitable use and joint conservation of transboundary waters. An important element of cooperation under several transboundary water agreements is the development - by joint bodies (e.g. river commissions) - of concerted action programmes to reduce pollution loads. Examples include the action programmes of the International Commission for the Protection of the Rhine against Pollution (1987), the International Commissions for the Protection of the Moselle and Saar (1990), and the International Commission for the Protection of the Elbe (1991).

The cooperation under the Water Convention encourages riparian States to make appropriate cooperative arrangements for the protection and sustainable management of transboundary waters. In doing so, Parties are aware that the problems that they are facing are not unique to transboundary waters. They are seen in the context of integrated water management. Thus, cooperation on transboundary waters will also help to improve the management of internal waters and ensure consistency in the protection and use of both internal and transboundary waters. The Parties will therefore apply, as appropriate, the principles of the Water Convention when drawing up, revising, implementing and enforcing their national laws and regulations on water.

Cooperation covers five programme areas: joint bodies, assistance to countries with economies in transition, integrated management of water and related ecosystems, land-based pollution control, water supply and human health. Since 1990, some 20 bilateral and multilateral agreements have already been revised, supplemented and updated to meet the exigencies of integrated water management, including the prevention, control and reduction of transboundary water pollution. Progress under these agreements as well as achievements under the Water Convention itself will be evaluated in the year 2000 on the occasion of the second meeting of the Parties.

One activity should be specifically mentioned: The Meeting of the Parties to the Water Convention and the World Health Organization's Regional Office for Europe launched an initiative to prepare an international instrument on the prevention, control and reduction of water-related disease for submission to, and adoption at, the Third Ministerial Conference on Environment and Health (London, 1999). This initiative is supported by the United Nations Environment Programme. Water-related disease refers to any significant and widespread adverse effects on human health, such as death, disability, illness and disorders, caused directly or indirectly by the condition, or changes in the quantity or quality, of any waters. The aim is to cover surface fresh water, groundwater, estuaries and coastal waters which are used for recreation or the production or harvesting of shellfish, as well as any water in the course of abstraction, treatment or supply and any waste water in the course of treatment, discharge or re-use. Elements of this international instrument have now been finalized for submission to intergovernmental negotiation meetings.

**References**


[1] Europe's Environment - The Dobis Assessment. Edited by D. Stanners and Ph. Bourdeau. European Environment Agency. 1995.

[2] Policies and Strategies for the Protection and Use of Transboundary Waters. CEP/WP.1/R.1. UN/ECE, Geneva, 1994.

[3] Press release: "Burst water main floods central Manhattan" - How Safe Are Our Water Supply Systems ? UN/ECE, Geneva, 12 January 1998.

[4] Proceedings of the International Conference "Management of Transboundary Waters in Europe", Mrzezyno, Poland, 22-25 September 1997. *[in preparation]*

[5] National communications on the implementation of the Strategic Action Plan in countries in the catchment area of the river Danube. December 1997. Unpublished.

[6] H.P. LÜHR: Assessment and Planning Techniques - Introductory report for the 1995 UN/ECE Seminar on the prevention and control of groundwater pollution from the storage of chemicals and from waste disposal, CEP/SEM.1/R.3. UN/ECE, Geneva, 1995.

[7] Mr. J. PUOLANNE: Liability and Compensation for Damage - Introductory report for the 1995 UN/ECE Seminar on the prevention and control of groundwater pollution from the storage of chemicals and from waste disposal, CEP/SEM.1/R.2. UN/ECE, Geneva, 1995.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# STRATEGIC ISSUES OF FRESHWATER MANAGEMENT IN AFRICA

by

YILMA E., DONKOR,S.M.K., & KOL, S.

Paper No. 11

Prepared for the
Department of Economic and Social Affairs
United Nations

# STRATEGIC ISSUES OF FRESHWATER MANAGEMENT IN AFRICA

YILMA E., DONKOR,S.M.K., & KOL, S.
FOOD SECURITY AND SUSTAINABLE DEVELOPMENT DIVISION
U. N. ECONOMIC COMMISSION FOR AFRICA

## INTRODUCTION

1. This paper is intended to serve as background or working document for the Harare Expert Group Meeting on "Strategic Approaches to Freshwater Management" and deals with the issues and suggested strategies for tackling them so far as the African region is concerned. It represents a synthesis of existing documents, discussions and proceedings of meetings in which UNECA has participated in or initiated on the topic. It attempts to cover the most important issues but does not pretend to be either exhaustive or complete but it is our wish that it serves as a starting point and stimulant for discussions by the Expert Group on the state of Africa's Freshwater Resources and their future management to ensure sustained development on the continent.

## BACKGROUND

2. Water resources and their sustained use is essential for human life. Historically, access to a reliable water source both in quantity and quality has been a prime prerequisite for the development of all forms of human civilization and socio-economic activity. Recognising this, the 19th Special Session of the General Assembly, held in June 1997, expressed as a matter of urgent concern the fact that more than one fifth of the world's population still do not have access to safe drinking water and more than one half of humanity lacks adequate sanitation. This lack of acknowledged basic human necessities occurs primarily in the developing countries and is especially true for most parts of Africa. Further demand for freshwater arise in the areas of agricultural irrigation, industrial development, hydroelectric generation as well as the preservation of ecosystems. These demands are increasing in parallel with the growing human population which in Africa exceeds 3% per annum.

3. Globally, although 70% per cent of the earth's surface is covered with water only 3% of it is the form of fresh water. Seventy-nine per cent of this fresh water resources are unavailable since they form the ice-caps covering the two poles of the earth. Of the remaining 21 %, about 20% is inaccessible groundwater and only 1% occurs as fresh water in rivers, lakes and wells.

4. The current best estimates of the regional water resources potential is given in Table 1 which is an extract from the FAO survey under the AQUASTAT programme in 1995.

5. In Africa only a minimal amount of the gross potential water resources can currently be used as a viable fresh water source and many African countries are expected to experience water scarcity by the year 2025(Fig. 1). The projected increase in scarcity requires a conscious change from regarding water as a common , abundant, low-cost communal good provided (virtually ) free by Government, to an economic good with real and opportunity costs which need to be (partially or wholly) recovered to provide continuing investment in the provision of greater accessibility to larger segments of society especially in the Rural Areas.

Table 1 Regional Distribution of Water Resources Source: FAO, 1995.

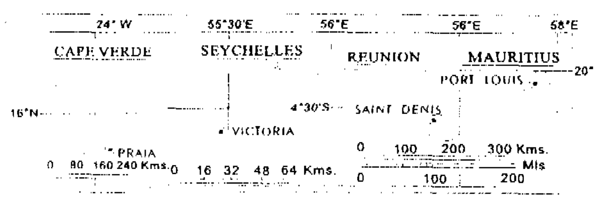
| Region | Area | Precip | Internal renewable resources | | | |
|---|---|---|---|---|---|---|
| | (1000km$^2$) | (Km$^3$/yr) | (Km$^3$/yr) | (mm/yr) | % of total | % of precipitate |
| Northern | 5753 | 411 | 50 | 8.7 | 1.2 | 12.2 |
| Sudano-Sahelian | 8591 | 2878 | 170 | 19.8 | 4.3 | 5.9 |
| Gulf of Guinea | 2106 | 2965 | 952 | 452.0 | 23.8 | 32.1 |
| Central | 5329 | 7621 | 1946 | 365.2 | 48.8 | 25.5 |
| Eastern | 2916 | 2364 | 259 | 88.8 | 6.5 | 11.0 |
| Islands (IS) | 591 | 1005 | 340 | 575.3 | 8.5 | 33.8 |
| Southern | 4739 | 2967 | 274 | 57.8 | 6.9 | 9.2 |
| Total | 30025 | 20211 | 3991 | 132.9 | 100.0 | 19.7 |

* Internal Renewable Resources:( cubic kilometres/year) Average Annual flow of rivers and groundwater generated from endogenous precipitation.

** The Regions are:
**Northern:** Algeria, Egypt, Libya, Morrocco, Tunisia.
**Sudano-Sahelian:** Burkina Faso, Cape Verde, Chad, Djibouti, Eritrea, Mali, Mauritania, Niger, Senegal, Somalia, Sudan.
**Gulf of Guinea:** Benin, Cote d'Ivoire, Ghana, Guinea, Guinea Bissau, Liberia, Nigeria, Sierra Leone, Togo.
**Central:** Angola, Cameroon, C.A.R., Congo, Equi. Guinea, Gabon, Sao Tome, Dem. Rep. of Congo.
**Eastern:** Burundi, Ethiopia, Kenya, Rwanda, Tanzania, Uganda.
**Ind. Ocean Islands:** Comoros, Madagascar, Mauritius, Seychelles.
**Southern:** Botswana, Lesotho, Malawi, Namibia, S. Africa, Swaziland, Zambia, Zimbabwe.

## Figure 1. COUNTRIES PROJECTED TO EXPERIENCE WATER STRESS OR WATER SCARCITY BY 2025


*Source: Population Action International, 1993*




*The boundaries and names shown on this map do not imply official endorsement or acceptance by the United Nations.*

*Les frontières et les noms indiqués sur cette carte n'impliquent pas reconnaissance ou acceptation officielle par l'Organisations des Nations Unies.*

6. There is a wide disparity in the distribution of water resources of the continent. About 30 per cent of the total surface water resources of the continent are in one single river basin, namely the Congo basin, and 75 per cent of the total water resources are concentrated in eight major river basins: the Congo, the Niger, the Ogoagué (Gabon), the Zambezi, the Nile, the Sanga, the Chari-Logone and the Volta. (ECA, 1976)

7. Present knowledge of availability of groundwater is not adequate to permit a quantitative appraisal of the resource. However, it is known in general terms that groundwater exists in almost all parts of the region, in some places more than in others. Most groundwater occurs in non-sedimentary precambrian crystalline rock formations whose water holding capacity is not good except where there are fissures, joints, faults and weathering. Along the coasts in west , central and eastern Africa, groundwater exists in sedimentary formations. These formations have better yields but are affected in some cases by intrusion of saline water. The exploitation of this resource is marked in North Africa where more data and information are available and hydrogeological maps have been prepared and in the Sahel zone where surface water is scarce. (E.C.A., 1989)

8. In Africa, fresh water is primarily withdrawn for agricultural use mainly for irrigation purposes which represents 85 per cent of the total withdrawal. Domestic and municipal demands represent 9 percent followed by industry which accounts for 6 percent of water withdrawals in the region. The Regional distribution of water withdrawals is presented in Table 2.

9. In terms of population, Africa represents 12.2 per cent of the world population with the highest growth rate of 3.01 per cent. Whereas its total fresh water resources stands at 10.2 per cent, its per capita withdrawal is the lowest.(proceedings of the International Conference of Water and Environment, Dublin, Ireland, January 1992). This is reflected by the situation where nearly two thirds of the rural population have no access to clean and reliable water sources and less than 20 per cent have sanitary disposal facility (WHO, 1996). Consequently, 80 per cent of all sickness is attributed to water borne diseases.

10. As regards food production, the record in Africa shows that the region remains a net importer of cereals which is one of the major food items. This situation exists despite the fact that less than 25 percent of the estimated Cultivable area is currently being actually cultivated ( FAO, 1995). With regard to land use, it is estimated by ECA (1993) that at the end of 1991, 6 % of the land area was utilised to cropland, 29 % to permanent meadows and pastures, 24 % to forest and woodland and 40 % to other uses whilst noting that the Kalahari and Sahara deserts cover about 25% of the African land mass.

11. In 1987, of the global installed hydroelectric power of 537,647MW, Africa generated only 16,799MW or 3 percent of the global total (UNEP,1991). Taking into account that one third of the world's hydroelectric power generating potential is in Africa, this represents a dismal level of development and provides more scope for a clean energy source for overall development which has barely been tapped( Ayibotele, 1994).

Table 2 Regional Distribution of Water Withdrawals Source: FAO, 1995

| Region | Withdrawals by Sector | | | | | |
|---|---|---|---|---|---|---|
| | Agriculture $x10^6m^3/yr$ | Community $x10^6m^3/yr$ | Industries $x10^6m^3/yr$ | Total $x10^6m^3/yr$ | As % of total | As % of internal resources |
| Northern | 65000 (85%) | 5500 (7%) | 5800 (8%) | 76300 (100%) | 50.9 | 152.6 |
| Sudano-Sahelian | 22600 (94%) | 1200 (5%) | 300 (1%) | 24,100 (100%) | 16.1 | 14.2 |
| Gulf of Guinea | 3800 (62%) | 1600 (26%) | 700 (12%) | 6100 (100%) | 4.1 | 0.6 |
| Central | 600 (43%) | 600 (43%) | 200 (14%) | 1400 (100%) | 0.9 | 0.1 |
| Eastern | 5400 (83%) | 900 (14%) | 200 (3%) | 6500 (100%) | 4.3 | 2.5 |
| Islands (I.D) | 16400 (99%) | 200 (1%) | 20 (-) | 16620 (100%) | 11.1 | 4.9 |
| Southern | 14100 (75%) | 3000 (16%) | 1800 (9%) | 18900 (100%) | 12.6 | 6.9 |
| Total | 127900 (85%) | 13000 (9%) | 9020 (6%) | 149920 (100%) | 100.0 | 3.8 |

A key statistic worth noting is that the percentage of the internal renewable water resources generated from endogenous precipitation which is withdrawn for the three major uses on a continental scale is only 3.8 percent.

## KEY ISSUES AND STRATEGIES.

INSTITUTIONAL

12. Some key issues requiring a focused attention are:

(a) **Co-ordination**

13. Water activities are often split among a number of ministries/departments. The fragmentation of responsibilities among sectoral ministries and administrative agencies have hindered co-ordination and impeded the attempts to integrate water management activities within the sector itself and with other sector development programmes at the national level.

14. The future strategy should focus on making institutional reforms and establishing legal instruments in countries where these have not yet been done. Similarly, steps should be taken by governments to designate the functions of co-ordination and administration of water activities to some national focal point or centre. To assist in the implementation of multi-sectoral programmes, countries sharing common river/lake basins should adopt the river basin unit as a basic planning unit. The improved co-ordination should at the minimum lead an adequate capability for prioritising and formulating long term plans with clear written guidelines, adequate project, financial management and overall manpower capacity and clear rules of cooperation with Donor agencies in cooperation agreements support national and regional policies and strategies.

(b) **Legislation**

15. With institutional and administrative changes that have been or should be introduced to adequately coordinate water management, most African countries are discovering the need to update their legislations to match more dynamic and more demanding circumstances. Inadequate legislation has often been a serious impediment to water development or its optimal use. Of equal importance to the formulation of enabling legislation is the need to establish mechanisms to enforce its provisions. In some countries, progress is underway especially where lending institutions like WB and ADB see legislation as a precondition for loan approval. Specific pieces of legislation needed normally concern water allocation and control, regulations for waste discharges and pollution control, and land allocation and degradation control.

(c) **Human Resources**

16. The dearth of adequate human resources with training,skills and experience in the scientific, technical, managerial and administrative functions required for the development, conservation, and management of water resources is a crucial constraint in the development of Africa's water resources. This is due to the fact that human resources and institutional development policies were often unclear or non-existent resulting in frequent movement of indigenous personnel. (E.C.A.)

17. The traditional response to the human resources problem has been to train more staff either locally or organize training programmes abroad, often in and with the assistance of

developed countries. Meanwhile, the human resources needs in Africa were filled by foreign experts under the Technical Assistance programmes. The net result of this traditional approach is that, after nearly thirty years, Africa still suffers from insufficient human resources capacity for sustainable development.

18. A brief look into the training institutions in Africa shows that despite the fact that these institutions have their own financial and managerial problems, they are producing engineers, administrators and managers. The problem is not the number of people trained and qualified, but it is in the ability and willingness of African countries to retain and deploy the experts appropriately. It has been observed in the past that many experts have for one reason or another left the sectors for which they were trained in search of better employment opportunities, either in another enterprise in the country or another African country or ultimately in developed countries. These reasons include misallocation, under-utilization as well as non-utilization of human resources. A report prepared by the United Nations in 1988 indicated that there were about 70,000 African professionals working outside the continent, while at the same time about 80,000 expatriates worked in Africa. The cost of this anomaly to Africa is estimated at US$4 billion per year( E.C.A.). This is an issue of concern requiring serious attention to rectify the problem by all concerned.

19. A possible strategy would be give equally qualified African Professionals equal conditions of service as the expatriate counterparts on a competitive, market-driven basis with donor support under the Bilateral programs.

(d) **Policy and Planning**

20. In the African region, although there is a growing awareness of the need for clear policy directives and good planning as prerequisites for national and subregional water development activities. There have been several constraints like man-made and natural disasters as well as economic hardships and political problems which served and "killer constraints" to the speedy formulation of comprehensive national water policies and for improving water resources planning.

21. A persistent difficulty is faced in creating proper links between the water sector and critical sectors like agriculture and rural development. The interfaces between water and irrigation, and water and livestock development are good examples of this, but health, urban development, hydropower and transportation could be cited as areas where conflicting priorities exert pressure on over-burdened public sector institutions.

22. The problem of water resources development has its root in the lack of clear policy directives acknowledging the high priority that must be accorded to it with due recognition to the need of strengthening the national institutions in which water development is vested. The policies should be cohesive embracing the management, conservation and rational use of water. The usual mention of water with single sectors like agriculture, health or rural development should be discontinued. The case for integrated and multi-purpose development of water should as a priority be convincingly put across to policy-makers. Emphasis should be laid on strengthening national capabilities and the implementation of national programmes as a first

priority. On the other hand, the importance of sub-regional, regional and global programmes of action provide essential inputs. At the subregional level, increasing food production and the fight against drought and desertification can best be effective if groups of countries coordinated their policy and planning efforts for common goals and objectives. The activities of international river/lake basin organizations and those of inter governmental bodies like IGADD and CILSS are very crucial. Activities of these organizations can be viewed as part of the planning continuum.

23. The weakest point is that of sector analysis, that is; the examination and assessment of the resources, needs, problems and opportunities in the sector. Insufficient cross sectoral harmonization and reconciliation with national development targets at the macro-economic level should be corrected. The usual mention of water often with single sectors which does not permit embracing an integrative approach has been a persistent problem in many countries of Africa. The essence of planning should be perceived in the integration of sectoral plans and programmes with overall water resources management within the framework of national socio-economic objectives. The water sector programme like other sectors should from time to time be reviewed in terms of objectives, targets, plans and resources in order to delineate the portions which can be funded from national and external sources.

24. Another important aspect is that there should be consistency between donor aid policies and programmes and the recipient's development objectives and goals. The international community can contribute greatly to the planning and development of water resources in a holistic manner by assisting governments to improve their planning capabilities and mechanisms and by strengthening national programmes for medium-term and long-term water resources development.

25. The priority target for the future must be building-up national capabilities for the proper planning, execution and management of development programmes. If this implies a slowing down in the rate of implementation of projects until proper frameworks for development have been established, it would still be preferable to piecemeal and uncoordinated programmes without solid formations which have been features of water related activities in many African countries in the past.

26. In view of the fact that adequate policies at the national and subregional levels are essential to guide the proper development, conservation, administration and use of water resources, member States are urged to formulate and effectively establish overall policies:

- on institutional responsibilities and co-ordination of water activities
- on issuance of permits for water abstraction and use
- on industrial water use, treatment of effluent and their safe discharge
- on agriculture water use, return water, limitations on pesticide and insecticide uses
- on determining lower quality water use for various purposes
- on rules and regulations regarding abstraction and use of groundwater
- on tariff policies for drinking water supply, agriculture, industrial and other uses
- on international water courses and on regional co-operation.
- on land and water conservation
- on population and family planning

- on the role of women and on popular participation
- on water and health questions
- on integration of water development within the national socio-economic development planning

## WATER RESOURCES ASSESSMENT, WATER QUALITY AND CLIMATE.

27. Water resources assessment including the identification of potential sources of primary importance. The determination of water sources, their extent, dependability and quality as well as the impact of man's activity on the available water is crucial.

28. Since 1991, there has been little evidence to indicate that major positive changes have taken place or that progress has been achieved in water resources assessment. The water situation in Africa continues to worsen. The UNDP financed World Bank project aimed at evaluating the status of existing hydrological data collection system of the SADCC counties concluded that "the overriding constraints are financial and managerial. Few countries now have services which can be compared favourable with those existing 10 to 20 years ago. No country has a service which is adequate as a basis for sustaining the many water developments which can be expected in the region in the coming decades". (Secretary-General, 1993).

29. In Africa the meteorological and hydrological services which are responsible for basic network infrastructures for assessment activities have suffered serious deterioration in the past decade or so. The coverage, operation and maintenance of these networks are inadequate and they have been allowed to run down since governments could not maintain them. The situation with regard to groundwater assessment is worse. Sediment transport and water quality monitoring are done on ad-hoc basis. In general there is lack of equipment, laboratories and other components of infrastructure needed for water resources data assessment.

30. One of the latest considerations of this issue was at the UNECA/WMO International Conference on Water Resources: Policy and Assessment, organised in Addis Ababa in 1995. This conference proposed a new flexible and adaptable strategy which is based on the following. (E.C.A., 1995):

1. There should be unequivocal evidence of a national initiative for a demand driven activity.
2. The Assessment should be planned and implemented within the capacity of the national economy.
3. Political Will to cooperate on the river, lake and groundwater basins at the subregional, regional and international levels should be enhanced and backed by concrete action.
4. Direct linkages should be established with other water resources management strategies, such as the one being prepared at the time for Sub-Saharan Africa by the World Bank.
5. There should be willingness of the agencies in charge of the water resources information systems to improve their efficiency, productivity and to take initiatives and participate in the water resources development process.

6. Donors and UN agencies involved in water sector should co-ordinate their activities in the Region and align their support as much as possible, along the lines of this strategy.
7. A world-wide campaign should be launched to promote this proposed strategy, improving the awareness of the problems and highlighting water resources assessment programmes adopted by African countries.

This was then translated into an Action Plan whose main components are: (UNECA/WMO, 1995)

1. Management Capacity Building.
2. Awareness and Promotion.
3. Sustainable Financial Base.
4. Integrated Approach to WRA.
5. Refined Subregional initiatives and responses.
6. Role of the External Support Agencies (ESA)
7. Conference follow-up.

31. The degradation of water quality is primarily one of the fundamental problems having its roots in poor planning and management of development projects. In the past few years the problems of pollution from domestic, industrial and agricultural sources have been growing. Several countries in Africa are faced with problems of bacteriological and contaminating organic water loads, suspended solids and nitrate pollutants. There is a threat of increased problem from agricultural and associated increase in fertilizer and pesticide uses. Many shallow groundwater resources appear to be contaminated by pathogenic agents largely from faecal sources and there is absence of systematic water quality monitoring. As a result, an adverse health impact prevails among the large majority of population in Africa.

32. Experience has shown that uncontrolled groundwater development in the Sahel has been one of the causes of environmental degradation. Past experiences resulted in the lowering of water tables, drying of wells, salt water intrusion in coastal areas and a decrease of pressure in aquifers. The impact of over-exploitation of groundwater had negative economic and environmental repercussions some of which cause permanent damages.

33. Climate change is increasingly becoming recognized to have a serious impact on water resources. High temperatures and decreased precipitation lead to decreased water supplies and increased water demand. They might also cause deterioration to the quality of fresh water bodies putting strain on the already fragile supply in many countries.

**Strategy**

34. The future strategy should focus on immediate launching of a systematic programme of refurbishing existing networks for assessment of surface and groundwater quantity and quality. Water quality monitoring and sediment measurement should be carried out systematically. The data already procured as well as those generated particularly from the numerous boreholes drilled through assistance programmes from bilateral and multilateral sources that were provided to African countries since 1981 in the framework of promoting the international Drinking Water

Supply and Sanitation Decade objectives should be analyzed to update the knowledge on these resources. Action is also needed to study the effect of climate change on fresh water resources. There is also a strong need for all countries to have in place water pollution control programme.

**Drinking Water Supply and Sanitation**

35. Over the period 1981-1990 an additional 110 million people in Africa of the WHO region (Brazaville) were provided with safe drinking water and 80 million people with adequate sanitation facilities. However, regional population during that period increased by 140 million. In July 1993, the information was that 54 per cent of the African regional population did not have safe water and 64 per cent were without proper sanitation. The continuing and growing needs of Africa for expansion of water supply and sanitation services is an issue of growing concern in the region. By 1994, 326 million Africans out of a total of 707 million were served with safe drinking water and 243 million had access adequate sanitation ( Warner, 1996).

36. Both the WHO and JMP information sources confirm that the achievement in the water supply and sanitation sector in africa has been painfully disappointing. The general conclusion that can be drawn is that there has been a widening gap of the unserved population, leaving the majority to a high risk of incidence of debilitating and incapacitating diseases. It is realized that up to 80 per cent of all endemic disability is caused by water borne diseases.

37. Among the major constraints to development of the sector is the high population increase. African population has more than tripled in 44 years between 1950(220.3 million) and 1994 (707 million) and it is expected to reach 1115.6 million by the year 2010. Against this situation of high population increases, sub-Saharan Africa is expected to fall short of the anticipated progress in other regions. Other constraints to development of the sector include economic hardships, political problems , civil strife, natural disaster, rural-urban exodus of people, the dispersed nature of population distribution in the rural setting, the problem of maintenance and operation of systems and facilities and policy questions. Constrained by these difficulties, the provision and expansion of domestic and municipal water supplies have been hampered; systems have been inefficient with high leakage and much unaccounted for water making them unsustainable and unreliable. Development was therefore outstripped by population increases. Under such circumstances, it is clear that the planning for providing potable water and sanitation for all will have to be targeted beyond the year 2010.

**Strategy**

38. The future strategy should be based on prioritization of population groupings to be served and should be based on setting realistic targets by governments, promoting population and family - planning policies, adopting low-cost technologies, introducing cost-sharing mechanisms and tariff policies on a phased approach, increasing community participation particularly of women in rural areas where the need is greatest. It is necessary to ensure that drinking water and sanitation programmes take place in the context of national planning and are fully integrated within the framework for environment and sustainable development. Privatization of the maintenance and operation of water supply systems and orientation to the rural sector in the

package for rural development and human settlement programmes is perceived as a sound strategy of ensuring sustainability.

**Water for Agriculture**

39. A persistent difficulty is encountered in creating proper links between the water sector and critical sectors like agriculture and rural development. The weak inter-faces between water and irrigation, and water and livestock development are good examples of this. The overall sector of agriculture production being the largest contributor to the economy in the majority of African countries, an improvement of its performance will correspondingly generate resources for development in other sectors.

40. Past experience reveals that in high-rainfall, high-productivity zones, increasing pressure on land and fragmentation of holdings have resulted in fertility decline. In low-rainfall and drought-prone areas, over grazing and shifting cultivation (in wetter-than-average years) encroaching on marginal lands continue to undermine and upset the equilibrium of the already fragile ecological balance.

41. During the last three decades, Africa's semi-arid lands have come under pressure by people and livestock at a rate considerably faster than the more fertile areas. Consequently, conditions of hunger, and even famine have become increasingly common in these areas as is the occurrence of drought. This sets in train endemic poverty i.e. poverty of land and resources to continue. The continuing depletion of forest cover as a result of search for cultivable land and/or fuel wood by the poor make the agro-pastoralist and herdsmen appear as both perpetrators and victims of this phenomenon. A root cause of deterioration in most countries of Africa is the struggle for survival since poverty, environmental degradation and population growth interact in the dynamics of the chain process.

42. In the context of African large-scale irrigation, inter-basin water transfer and high-technology desert-irrigation donot seem to provide viable alternatives solving the problem of famine and food-aid dependence because of the relatively high-cost involved which is beyond the means of most governments. The record of large-scale modern irrigation has not been good in sub-Saharan Africa, not only because of capital cost which is double those in other continents but because of numerous factors such as weaknesses in planning and management, and maintenance constraints that have not allowed irrigation schemes to fulfil their desired objectives.

43. Often, it is argued that small-scale irrigation development aimed at the bulk of food producers, including pastoralist will have the greatest impact that would lead to long-term benefits. This needs to be demonstrated in practice in order to evaluate the real impact of the approach on food production and to bring about a change in the orientation of domestic and external funding policies. Currently several countries in Africa, such as Ethiopia, Mali,and Burkina Faso, are implementing small-scale irrigation through water-harvesting technologies and construction of micro-dams. Other such as Zimbabwe have as a matter of policy used small-scale irrigation as a basis of rural resettlement and growth.

44. One of the fundamental problems of African development is its weakness in producing enough requirements for food and in meeting the objective of establishing food-security. Inefficient internal markets and unpredictability of rainfall partly account for the problem. About one-third of the continent is known to be too dry for any rained crop production. With 93.5% of the cultivated area under rain-fed conditions, the annual fluctuation in the size of African food and agriculture production can largely be attributed to the variability in the rainfall regime. This is amply demonstrated in the year following the drought in the mid-80s. In 1985 for example, there was a marked regional recovery of 10% in food production. This was followed by a further increase in 1986. In 1987 agriculture output increase was only 0.5%. The agricultural production was then declining again. Past records reveal that production has been declining steadily for the past two and half decades and dependence on food imports has consequently been growing. Going back to 1975/87 we can see that Africa produced 83% of her cereal requirements and imported 8 million tons. It is, however, estimated that by the year 2000 the net import will have risen to 49 million tons and Africa will only be producing 56% of the cereal she needs. At the same time food imports as well as food-aid keep on growing resulting in unhealthy dependence so far as the basic items of food are concerned. The contribution of irrigation to food production therefore is significant since 53 per cent of the land area under irrigation in Africa is devoted to cereal production viz. rice, wheat, maize, barely, millet and sorghum. Currently, the regional distribution of land under irrigated farming in Africa remains low and is estimated at about 14.2 million hectares, with most of this area in Egypt, Sudan and Morocco. A large proportion of the irrigated area is classified as modern and a small part constitutes traditional small-scale projects.

**Strategy**

45. It is obvious that food shortage is a major crisis. It is also recognized that to save the situation a wide range of policy measures will have to be adopted in the areas of production inputs, price incentives, credit facilities, assured markets, transportation and extension services including the control of water to make it available for irrigation in the dry season. A major policy recommendation is required to institute better utilization and improvement in management of water resources and the establishment of low-cost irrigation schemes. The development of national capacity and capabilities with a view to enhance the quality of management will be very crucial.

46. For developing countries of Africa, a major portion of the needed increase in food production is expected to come from existing irrigated and rainfed lands through increasing yield per unit area and yield per unit of water consumed. FAO's International Action Programme on Water and Sustainable Agricultural Development puts emphasis on increasing water use efficiency through modernization and improvement of existing irrigation schemes, and rehabilitation of waterlogged and salinised irrigated lands. It recommends the promotion of small-scale water programmes for purposes of expanding supplementary irrigation, water harvesting and soil moisture conservation are recommended to increase the available water for rainfed arable lands. It is also suggested to continue expansion of irrigation at a rate that can be justified in terms of meeting the goals of food security, increased farm income, improved rural development and conservation of the natural resource bases. FAO suggests that the scale of new irrigation development should be appropriate to it being sustainable with focus on

medium - and small-scale developments while large-scale developments must be considered as components of multi-purpose projects. All developments are to be subject to the stipulation of an environmental impacts assessment at the planning stage before being pursued. Community involvement, particularly of women is considered a necessary condition during all phases of development.

**Regional Co-operation**

47. Regional cooperation is a sine-qua-non for harmonization of individual national water development programmes through cooperative arrangements between countries sharing common basins. There are 54 transboundary river/lake basins in the region, with most countries being riparian to at least one basin. Of these only a handful have some form of intergovernmental organizations charged with the exclusive task for integrated development of natural resources, energy and other infrastructures. The river and lake basins that have organizations are: Senegal, Gambia, Niger, Chad Orange and Kagera. It is known that 14 countries practically have their entire territory falling within international river systems. Under such conditions, cooperative arrangements for joint and multi-purpose development would be essential to realize environmentally and economically sustainable development. In Africa, past experiences of most river/lake basin development were not successful.

48. One of the reasons for past failures of river/lake basin organizations in Africa relates to the problem of not applying the concept of multi-purpose planning. There has been over-emphasis on hydro-power development for urban, commercial and industrial uses at the expense of resilient ecology, human population and agricultural potential including livestock, forestry and fisheries. The historical records of the river basin organizations in africa reveal that most of them started with ambitious programmes that demanded huge capital outlay. It is also observed that river basin planning has invariably been the prerogative of most energy and irrigation agencies and this needs to have a new perception to encompass all other aspects of economic and social elements.

49. The experiences and lessons learnt about river/lake basin development in Africa have been useful because almost all of the existing organizations are effecting significant transformation often resulting in structural changes with major shift focusing on basin planning and on identification of programmes which meet the needs of members States.

50. Integrated water resources development and management should base itself by making water an integral part of the ecosystem, having social and economic dimensions, the quantity and quality of which determines its utilization. This outlook suggests that water is a commodity which is finite and needs to be used with great care in order that development may be sustainable.

51. River/lake basins should be adopted as geographical units for development planning at the national and subregional levels ( U.N., 1988). Most of the existing river/lake organizations in Africa have been faced with severe financial and institutional problems and the largest majority of the river and lake basins do not even have an organizational framework or even agreements to cooperate in the use of shared water resources.

<u>Strategy</u>

52. The starting point would be the perception of the river basin as a geographical and hydrological unit most suited to serve as a vehicle for socio-economic development. Based on this principle and given that the total commitment of member States sharing common basins are secured, the next move would be geared to taking steps towards strengthening existing basin organizations and creating new ones. As a preliminary step, river basin planning should focus on long-term and sustainable development programmes in a holistic and integrated manner. For this purpose, strengthening of the organizations in terms of capacity building in the technical and managerial fields and in institutional arrangements as well as assisting in the development of policies and legal frameworks to make the institutions operational is a sine-quo-non. Among the main objectives is the need to strengthen the planning units of these institutions.

53. The efforts for creation of new basin organizations which has started in the Nile, Zaire and Zambezi should continue. Similar steps should be taken to start consultation and dialogue among riparian states having common interest on other shared basins. These should be based on assuring each state of the economic benefits that could accrue from cooperative ventures.

54. The strategy of making river/lake basins as geographical units for multi-purpose planning is fitting since they are natural entities which can be conceived as vehicles for socio-economic development for riparian countries. It is necessary to note that the river basin units form eco-system continuum in which careful planning could embody efficiency and equity. The river basin unit can accommodate sustainable development by encompassing a range of activities that seek to maintain equilibrium of eco-systems and bio-diversity and thereby enable the optimization of resources utilization through proper and rational planning. It is therefore recommended that countries sharing transboundary basins cooperate and agree to use the river/lake basin entity as development nuclei and adopt the method of multi-purpose planning for development of resources in these basins.

**<u>Drought and Drought Control.</u>**

55. African countries over the ages have been subject to the ravages of extreme hydrometeorological events, such as droughts and floods. In this paper we made drought an issue because it's impact in Africa has normally been more severe and longer lasting than it's alter ego, floods. Major droughts occurred in the 19th Century and the early decades of this century. The most traumatic one was that of the mid-1980's which affected 20 countries and some 30 million people in subsaharan Africa. (E/ECA/CM.13/15, 1987) The occurrence of drought in varying parts of Africa is so frequent and the responses to ameliorate it's impacts so adhoc that a systematic integration of all aspects of the phenomenon in education and overall economic planning is called for. The areas with high risk are those faced with failure of seasonal rainfall (ie Sahelian region) and those that are vulnerable to human and animal pressures ( ie semi-arid region of southern Africa). A common observation is that all sectors of society is anxious about a drought when it occurs and are prepared to pay whatever price necessary to avoid it recurrence, however this resolve always seems to dissolve with the jubilation over the first drought breaking rains.

**Strategy**

56. A good overall strategic principle which the Governments and peoples of Africa could adopt for combating drought can be expressed in a simple statement:

> " When in the midst of a Drought prepare for the next Floods and as the floods wreak their havoc donot forget to prepare for the coming Drought."

Some of the concrete measures that should be taken are Soil and Water Conservation, afforestation, reforestation and strengthening of national emergency relief bodies to combat and mitigate the effects of Drought.

57. At the regional or subregional levels, groups of countries need to strengthen the capabilities of their regional and subregional institutions to manage Drought and be able to optimally acquire and share resources when the impact of drought is regional. An excellent example of such regional strategies was the way the Southern African Development Community (SADC) effectively and efficiently handled and controlled the worst effects of the e regional Drought of 1992/93.

## CONCLUSIONS AND RECOMMENDATIONS.

**Population Pressure**

High population growth rate is putting pressure on the land and water resources in Africa. This is increasing the demand for basic needs at a rate faster than countries are able to meet. It is also depleting and degrading resources.

> It is therefore recommended that African government assisted by the appropriate international organizations formulate population polices that take into account the consumptive water requirement for drinking purposes and for food production at different standards of living, various production technologies, and water shortage that may arise out of climate change.

**Water Resources Assessment**

The assessment of water resources which is a prerequisite for water resources planning, design, operation and maintenance, has not been given the attention it deserves. Progress made in the decades of the 60s and 70s have been lost.

> It is recommended that African governments improve the assessment of their water resources by improving and expanding data collection on all aspects of the hydrological cycle (including groundwater, sediment transport and water quality). It is highly recommended to develop data banks, use of GIS, adopt methodologies for analyzing data that are appropriate to the various climatic regions and also incorporate the impact of climate change. They should take advantage of the World Bank/UNDP Sub-Saharan

Hydrological Assessment Project that is currently going on to rehabilitate, improve and strengthen their hydrological services.

**Institutional Aspects**

Institutions for planning and managing water resources have had their responsibilities fragmented among various sectoral ministries and administrative agencies. These have hindered co-ordination and impeded attempts to integrate water management activities within the sector itself and with other sector development programmes at the national level.

To overcome these problems it is proposed that national focal points like water resources Commissions, Boards or Ministries for Water Resources be established to be responsible for the formulation of overall water policies and ensuring their implementation. They should also co-ordinate water resources planning and management at the national level, and provide effective linkages with the social and economic sectors dealing with agriculture, health, industry including mining, energy, transportation and also with finance and economic planning.

**Water Legislation**

Water legislations in many countries are fragmented in various enactments, some of which are even not known. In many cases the necessary regulations have not been passed to enable the provisions of the main laws to be implemented.

It is therefore recommended that countries which have not already done so reform their water laws so that they deal comprehensively with: (a) water allocation and abstraction from surface and groundwater sources; (b) waste discharges into water bodies surface and groundwater) from point and non-point sources (agriculture, human settlements, industry and mining), and (c) land use and land degradation.

**Water Pricing and Cost Recovery**

There has been lack of appreciation that water in addition to its social importance, has an economic value which must be treated as such in all its competing uses. This has affected the sustainability of projects. As funds for operation and maintenance, expansion and rehabilitation of water projects in particular for drinking and irrigation purposes have not been fully recovered. Governments have attempted to take on the responsibility to provide these funds but have been unable to do so.

To overcome these problems it is recommended that African governments should formulate clear cost recovery and tariff policies which will take into account costs of investment, operation and maintenance, system expansion, replacement and return on investment. In order to avoid adverse effects on the poor and disadvantaged sections of the populations full cost recovery must be a goal to be attained gradually and over time.

**Operation and Maintenance**

In many countries water supply projects particularly for drinking and irrigation purposes are not operating as deigned and constructed. This is due to poor operation and maintenance. Consequently many systems lose considerable amount of water through leakages and seepage.

> To overcome the above and conserve water it is recommended that countries improve their operation and maintenance practices taking into consideration the preparation of O&M manuals, the provision of spare parts, proper training of their O&M staff to follow approved procedures and improve their supervision.

**Human Resources Development**

The shortage of adequate human resources with skills and experience in the scientific, technical, economic, financial and managerial functions required for proper conservation, development and management of water resources at all levels has been a crucial constraint to effective performance of most water agencies. In spite of the fact that many people have been trained in various fields, there are deficiencies in areas like economic and financial analysis of water projects. Also most trained people have not been retained in their jobs because of poor employment conditions and lack of job satisfaction.

> It is recommended that governments improve human resources development policies taking into account: (a) manpower surveys and needs assessment at all levels; (b) implementation of appropriate education and training programmes particularly for middle level technicians; (c) effective utilization of trained manpower; and (d) improvement in employment conditions.

**Transboundary Co-operation**

With over 57 transboundary river/lake/groundwater basins in the region it would have been expected that co-operation in the development of transboundary water resources for the socio-economic development of riparian countries on an integrated and equitable basis would have been seriously addressed and proper mechanisms for co-operation established. The mechanisms for existing basin institutions have been constrained by (a) absence of clearly designated and mandated agencies to act on behalf of their countries; (b) technical and managerial weaknesses at the level of the Secretariats of the basin authorities; (c) inadequate funding by member states of the basin authorities; (d) inability to mobilize external funds for pre-investment studies and investment; and (e) politicization of the selected of key personnel.

> In view of the above it is recommended that countries sharing the same basin should co-operate to develop their water resources in an integrated, holistic and basin wide manner on a fair and equitable basis to meet their just socio-economic development goals. In this regard they should set up institutions with clear mandates to promote co-operation and development, they would also provide adequate financial and political support to the institutions and where such institutions do not exist they should be set up. Further UN

agencies dealing with water resources should encourage and support African countries to implement the relevant portion of Chapter 18 of Agenda 21.

**Integrated Land and Water Management**

The lack of proper linkages between the water agencies and economic sectors in which water plays a role have adversely affected effective management. Similarly the lack of appreciation of the impact of water management on the land and vice versa have further compounded the issue. Consequently, the environmental impacts of water and land development on each other have not been taken as integral parts of such development.

It is therefore recommended that African countries recognize the linkage between land water resources and develop policies that will integrate land and water resources development and management in a holistic manner using the river basin as a unit. This should take account of social, economic, land cover, and land use data in addition to climate, hydrological and water resources data. It should also take into account environmental impacts and their dynamics and measures to eliminate or minimize adverse effects. The policies should recognize the multi-objective nature of the above approach to management which will also require multi-disciplinary teams trained in the techniques of systems analysis incorporating risk and uncertainty.

## References


1. U.N. 1977. Report of the United Nations Water Conference E/CONF.70/29. Mar del Plata.
2. U.N. 1980. Lagos Plan of Action for the Economic Development of Africa (1980-2000). Lagos.
3. E.C.A. 1991. Progress in the implementation of the Mar del Plata Action Plan (MPAP) in Africa and Strategies for 1990s. E/ECA/CM.17/15, 29 January 1991.
4. E.C.A. 1976. African Regional Report. Addis Ababa.
5. E.C.A. 1989. Conservation and Rational Use of Water Resources in North African Countries, UNECA, Addis Ababa.
6. E.C.A. 1994. Developing Africa's Physical Infrastructural Capacities. Addis Ababa.
7. E.C.A. 1990. Paper by S. K. Imandson, ECA/MRAG/92/54.
8. E.C.A. . Towards Sustainable Development in Africa, Agenda for Action. Addis Ababa.
9. UN.SG. 1993. Report of the Secretary General, E/C.7/1994, 21 December 1993.
10. W.M.O. 1993. Report of the Sixth Session of the Working Group on Hydrology of the WMO Regional Association for Africa (Abidjan, Côte d'voire, 24 November - 3 December 1993).
11. W.H.O. . WHO Newsletter on Environmental Health No. 19.
12. F.A.O. 1990. In International Action Programme on Water and Sustainable Agricultural Development.
13. U.N. 1988. Proceedings of the United Nations Interregional Meeting on River and Lake Basin Development with Emphasis on the African Region, Addis Ababa, Ethiopia, 10-15 October 1988., ST/TCD/13.
14. E.C.A. 1987. Water Resources: Progress in the Implementation of the Mar del Plata Action Plan Review of the situation with regard to the development of water resources in the drought-stricken countries of the African Region, E/ECA/CM.13/15, 24 February 1987.
15. E.C.A. 1995. Water Resources: Policy and Assessment, Report of UNECA/WMO International Conference, Addis Ababa.
16. Warner, D.B. AFRICA 2000: An African Approach to Water Supply and Sanitation Development. W.H.O., Geneva, 1996.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# DEVELOPMENT OF STRATEGIC APPROACHES TO FRESHWATER: EXPERIENCES IN ASIA AND THE PACIFIC AND RELATED ESCAP ACTIVITIES

by


Cengiz Ertuna
and
Le Huu Ti


Paper No. 12

Prepared for the
Department of Economic and Social Affairs
United Nations

# DEVELOPMENT OF STRATEGIC APPROACHES TO FRESHWATER: EXPERIENCES IN ASIA AND THE PACIFIC AND RELATED ESCAP ACTIVITIES[1]

by
Cengiz Ertuna
Chief
and
Le Huu Ti
Economic Affairs Officer
Water Resources Section
Environment and Natural Resources Management Division
ESCAP

**ABSTRACT**

Since the adoption of Agenda 21, the development of strategic approaches to freshwater continues to be a major challenge to the developing countries in Asia and the Pacific, particularly with respect to the rapidly increasing population and an increasing complexity of economic liberalization. Within such complex context of strategic approach development, emerging policy issues identified by the recent ESCAP meetings of experts are reviewed and some experiences of selected countries in the region, including developed, newly developed and developing members of ESCAP, are analyzed to illustrate the achievements, the overall framework of freshwater resources management and the continuing efforts being made in the region. The emerging strategic issues include urgent strategic issues for the regional economic and social development and strategic issues that need to be tackled for sustainable management of the water resources. In that context, a brief summary of ESCAP activities in the recent years is presented together with possible future directions of regional activities that need to be carried out at the national and regional levels in support of the development of strategic approaches to the implementation of the freshwater recommendations of Agenda 21.

---

[1] The views expressed herein are those of the authors and do not necessarily reflect the views of the United Nations.

# I. INTRODUCTION

The Asian and Pacific region extends over a total area of about 36 million $km^2$ or 27 per cent of the world's land area (1997). With nearly 60 per cent of the world's population and over 60 per cent of the world's irrigated land, the region is more densely populated and more intensively cultivated than any other region. The region also displays various types of physical features, from arid deserts to the most humid areas of the world.

There is an extremely uneven distribution of precipitation over different parts of the region. For example, precipitation is exceptionally abundant on the southern slopes of the Himalayas, on the western slopes of the mountains of India and Indo-China, and on the islands of Indonesia, which receive annually from 1,500 mm to excess of 3,000 mm of rain and in some locations considerably more. On the other hand, almost all the north-western part of the region is extremely dry, with an annual precipitation of less than 200 mm. Moreover, not only is there a sharp difference in the amount of total annual precipitation, but precipitation also varies considerably from one season to another during the year. The rainfall in a large part of the region is characterized by a monsoon climate pattern with very distinctive dry and rainy seasons. During the long dry season, temporary water shortage is experienced in many river basins, while during the rainy season severe floods may cause tremendous damage in the same river basins.

The Asian and Pacific region has several of the world's most important river systems. Seven of Asia's largest river systems, namely the Chang Jiang, Huang He, Mekong, Ayeyarwaddy, Brahmaputra, Ganges and Indus, have a total drainage area of more than 6 million $km^2$, much of which is heavily populated, particularly along their lower reaches. Therefore, the economic development and the welfare of people in this region are very dependent on the progress made in the development and management of its water resources.

Although the current per capita per year use of 400 $m^3$ appears to be only 12 per cent of the per capita renewable resources of 3,360 $m^3$ of the region, only a small portion of the renewable water resources can be tapped. This amount is less than the relevant estimates for the other regions with the exception of West Asia. Naturally, the per capita availability has been decreasing with the high growth of population. By the year 2000, annual per capita water availability would be considerably less compared with that in 1950, about one fourth in South Asia, one third in North China and Mongolia, and forty per cent in south-east China. The most critical ten-fold reduction from 7,500 $m^3$ per capita in 1950 is expected to occur in Central Asia, which is now experiencing a severe water crisis in the Aral Sea Basin.

The Economic and Social Survey of Asia and the Pacific-1997[2] pointed out that the ESCAP region has made major strides in economic and social progress during the past half-century and per capita income growth has been much faster than elsewhere in the world. It also pointed out

---

[2] Asia and the Pacific into the Twenty-first Century: Development Challenges and Opportunities, Economic and Social Survey of Asia and the Pacific-1997, ST/ESCAP/1727, New York, 1997.

that nevertheless, some 70 per cent of the world's poor people live in the ESCAP region. Although most countries in the region have been able to reduce the incidence of poverty in terms of the head-count ratio, the rate of reduction appears to have slowed down since the mid-1980s in many countries. However, the overall impressive economic achievements together with the rapid growth in the population put more and more pressure on the limited availability of freshwater resources in the region. Furthermore, the developing countries in the region have generally made voluntary moves towards policy liberalization with the expectation that such liberalization would have a favourable long-term impact on their economies. Such a policy liberalization and the rapidly mounting pressure on the freshwater resources have resulted in an increasing complexity in the management and development of freshwater resources in the region. This thus requires the development of strategic approaches suitable to freshwater management in the region. Important strategic issues that need to be considered for such a development are discussed below.

## II. STRATEGIC ISSUES IN THE REGIONAL CONTEXT

At the regional level, strategic issues in freshwater resources management are conceived in the context of regional economic and social development and can be described in two groups: (i) urgent strategic issues, and (ii) other strategic issues required for sustainable development.

### A. Urgent strategic issues in freshwater resources management

Urgent strategic issues are those most faced by the developing countries of the region and closely related to poverty alleviation and equitable economic development. A major problem in most countries of Asia and the Pacific, as in developing countries in other regions, is inefficiency in the use of water resources. In major irrigation countries, the widespread use of flood irrigation leads to low efficiency, poor crop yields and degradation of the soil. Water utilities in the large Asian cities have been notoriously inefficient in the past, with enormous quantities of water unaccounted for. Hundreds of millions of people live at the margins of cities, and uncontrolled solid and liquid waste disposal into water courses and open areas has put an enormous burden on the ability of urban water utilities to keep up with the demand for good quality water. Industries mainly use "once-through" processes, with little thought of recycling or in-house water treatment. Toxic effluents are often discharged directly into the water courses, causing existing water supplies to become contaminated.

Many of the countries in the region have experienced problems in major project structures and related systems covering dams, canals, pipelines and equipment which are approaching the end of their useful life, requiring huge public investments for their renovation. Most of the countries and areas in the region expect such problems in the future. Preventive maintenance is insufficient, resulting in general degradation of the hydraulic structures and equipment and frequent failures. Interruptions in water supplies not only inconvenience the public but may result in economic losses as well.

## 1. Municipal and domestic water use

Although domestic water use accounts for only about 7 per cent of total withdrawals in the region, the rapid growth of urban centres in many developing countries has put a severe strain on the availability of safe water in large cities. The lack of or inadequate availability of water has in turn become one of the limiting factors in socio-economic development as an important indicator of the quality of life in urban areas. Inadequate operation and maintenance procedures have traditionally been a major stumbling-block to the improvement of water supply and sanitation services not only in the urban but also in rural areas of Asia and the Pacific. A number of water supply systems in the region which are lying in disrepair and require heavy expenditure for rehabilitation reflects this situation.

The first priority is to improve efficiency in municipal water utilities, which often have volumes of unaccounted-for water amounting to up to 50 per cent of total water supplied in some of the largest cities of Asia. Some deferment or reduction in the urban water supply investment requirements could be achieved if the countries were able to improve the operating efficiency of the existing infrastructure, particularly in large cities. Considerable water savings may be achieved by reducing leakages and wasteful consumption practices. Leak detection programmes in Bangkok and Manila, for example, have led to a greatly decreased quantity of unaccounted-for water usage, allowing for the postponement of construction of new facilities. Water pricing, including effluent charges, is also an important instrument for stimulating efficient use of water in the household and at commercial establishments.

## 2. Agricultural water use

Irrigation in Asia has been one of the most important activities involved in the increase of agricultural production since the early 1960s. Following the rapid growth of the 1960s and 1970s, the pace of expansion in irrigation slowed considerably, owing to a lack of suitable sites for reservoirs and opposition to new construction by environmentalists and local farmers who could be displaced. Further increases in yields and production in the region will therefore have to come from increased efficiency and more rational use of water on existing irrigated land, and on rainfed agricultural land, rather than from expansion of irrigated areas.

In the region, traditional agricultural water policies have concentrated on supplying water for irrigation to meet national development goals. In many countries the methods of irrigation employed lead to low efficiency, poor crop yields and loss of fertility of the soil. There has not been much effort to promote the efficient use or reduction of wastage of irrigation water. The irrigation efficiency level for most schemes in Asia is between 30 and 40 per cent. As a result, the ratio of actual irrigated area to planned irrigable areas is also low, especially on large-scale projects. If the water wasted were made available for use, many water supply expansion projects could be postponed and much larger areas of agricultural land could be irrigated. Common problems are: inadequate planning and design; deficiencies in on-farm irrigation and drainage facilities; and poor operation and maintenance.

Urgent action is required to improve on-farm management in countries with a poor record of efficient usage. This would include: education and training of extension staff; a clearly defined division of responsibilities between farmers and irrigation authorities; strengthening of water and soil management research under irrigation and rainfed conditions; monitoring and evaluation of irrigation performance; and establishment of realistic water pricing policies to reduce wastage of water in agriculture. Implementation of such measures will vastly increase the yields, reduce the water use, keep the systems functioning well, reduce problems, such as salinity and water logging, increase incomes and reduce investment requirements.

### 3. Industrial water use

In developed countries with an established industrial base and water pollution laws strictly enforced, industrial water demands are relatively stable or even decreasing, owing to the introduction of water-saving technologies. In the developing countries of Asia, however, water demands in industry are rising rapidly, with increased concentrations of effluents being released. Direct investment from industrialized countries sometimes involves the establishment of polluting industries in developing Asian countries which have less strict controls on pollution than the home country. Many industrial products require the use of large quantities of water for each unit of output, and the rate of water withdrawals per unit output is very high in the region, indicating considerable inefficiency in the production processes. Furthermore, there are great variations in water withdrawals among industries producing the same product. Therefore, there is scope for increasing the efficiency of water use by attaching regulations related to the amounts of water to be used per unit of production and disposal of effluents, and also by offering incentives.

## B. Other strategic freshwater issues on sustainable development

### 1. Water resources assessment and quality monitoring

In order to improve the management of water resources, there is a need for greater knowledge about their quantity and quality. In many countries/areas of the Asia and Pacific region, there are considerable inadequacies in the availability of data on their water resources, specially on groundwater and water quality. There is a need for regular and systematic collection of hydrological, hydrometeorological and hydrogeological data to be accompanied by an adequate system for processing quantitative and qualitative data on various types of water bodies. In order to be able to collect, analyze and disseminate reliable information on water resources, it is necessary to strengthen the existing mechanisms. In some countries, different agencies collect water resources data with no coordination between them at all. There is a serious need for strengthening and coordinating arrangements in collection and processing of data and for improvement of data gathering networks as well as for improvements of monitoring systems. An inventory of the country's water resources, including quality of water at each source, needs to be prepared as soon as adequate data become available.

## 2. Other water management issues

In many countries of the region national water policies have been developed some of which have been translated into national master water plans. In several countries, including China and India master plans have been prepared at both the national and provincial levels. However, there is a serious need to improve management of the water resources in order to satisfy the freshwater requirements for sustainable development of the countries of the region. Traditionally, water resources management has been supply oriented, without paying sufficient attention to options for influencing water demand and increasing water use efficiency. The emerging trend is to take concerted or integrated action towards conservation of water resources. The holistic management of water as a finite and vulnerable resource and the integration of sectoral water plans and programmes within the framework of national economic and social objectives are therefore of utmost importance to the countries of the region. Consequently, there is a need for the national governments of the region to adopt policies and methodologies for integrated management of their water resources based on comprehensive ecosystem assessment, taking into consideration that the main task is the allocation of available resources among competing uses in an environmentally-sound, economically efficient and equitable manner in order to satisfy the present and future demands of society for water and water-related goods and services.

Watershed management is an area which needs immediate attention. Denuded watersheds have given rise to higher flood peaks and lower discharges during the dry season. Perennial flow patterns of rivers have changed over time. Erosion processes have increased, and higher sediment flows threaten the survival of costly big reservoirs, particularly in China and India. Vegetative cover in the catchments needs to be restored by reforestation and conservation. It is feared that unless the threats of deforestation, waterlogging and salinization are checked, large schemes may end up with only marginal benefits.

There is a need for strengthening of the international cooperation in the region in the field of water resources management. The experience accumulated by some countries in the efficient management of water resources has to be made available to other countries. Cooperative arrangements are particularly important for the joint management of transboundary water resources by all riparian states concerned.

### 3. Institutional and legal frameworks

One of the major obstacles to efficient water resources management in the region is the sheer number of public, semi-public and private agencies involved in the exploitation of the resource. Government agencies dealing with water supply include ministries of agriculture, health, rural development and industry, while semi-autonomous water utilities in some cities provide municipal water supply. Groundwater resources may be exploited by mineral resources agencies or semi-public agricultural cooperatives. In some countries, each river basin authority manages the water resources of one hydrological basin. Various agencies dealing with different water uses often carry out their activities in isolation. In addition, in many countries of the region, private businesses, industries and farmers are pumping both surface water and groundwater with very little overall regulation. This uncontrolled use of water has led to imbalances in the hydrological cycle, shortages for some essential uses, a lowering of the water table in many areas, salt-water intrusion and increasing costs for exploitation. The lack of a clear division of responsibilities between organizations for urban and rural water supply, between central and provincial or local activities and between public and private sector agencies results in duplication of efforts without achieving national development goals.

Legislation, regulating ownership, use and protection of water resources support the national water policy statements in many countries of the region. Such legislation cover at least the ownership of and the right to use surface water, as well as the protection of surface-water quality. Several countries, including Bangladesh, India, Malaysia, the Republic of Korea, the Republic of Palau and Sri Lanka, have indicated that their water legislation had not yet been formulated to regulate ownership or the right to use groundwater. This may contribute to uncontrolled exploitation of groundwater in many areas, causing a decline in the water table and land subsidence. In many countries, such as China, India and the Philippines, water is defined as public property. In these countries and others, national water policies emphasize the multi-purpose use of water and provide for the coordination of the development of water resources.

### 4. Demand management and other economic issues

As mentioned earlier, demand management has not been practiced widely in the region. There is a strong need for realistic alternative measures to increase the efficiency of water utilization through demand management rather than providing more water. Unless water prices are raised significantly and effluent fees are introduced, there are no economic incentives for industries to save water. Through enforcing effluent standards and providing subsidies to reduce waste loads, pollution levels could also be significantly reduced. The industrial sector could also be motivated to use appropriately treated municipal waste water in processes which do not require good quality water. In India, for instance, industrial enterprises in the water-short city of Madras have been willing to buy treated waste water from the city authorities for reuse in their factories.

In most of the irrigated lands of the region, there has not been much effort to reduce wastage of irrigation water through pricing mechanisms. The countries have only recently attempted to collect water fees for irrigation, mainly under conditions of water shortage. If properly implemented, however, pricing policies could reduce the wastage of resources by ensuring the development of optimum-sized water systems. The difficulty of implementing irrigation pricing policies in Asia is that, except for tubewell or pumping projects, it is very difficult to assess the quantity of water actually consumed in most irrigation areas. Moreover, the majority of farmers may be unwilling to pay for an unreliable and inadequate supply for water in some of the large irrigation projects because of the low level of revenue collected, operation and maintenance have been inadequate and systems have deteriorated, resulting in unreliable water supply. This is a vicious cycle found in many developing countries of the Asian and Pacific region.

## III. EXPERIENCES IN STRATEGIC APPROACH DEVELOPMENT

### A. An overall view of experiences in the region

Towards integrated water resources management, as articulated in Agenda 21, integration of sectoral water plans and programmes within the framework of national economic and social policy, as a dynamic, interactive, iterative and multisectoral approach to water resources management is gaining recognition within the region. For example, the goal of sustainable development is implicit in the current Eighth Five Year Plan of India (1992-1997), which underlines the significance of ensuring a coordinated and integrated governmental action for conserving nature and ensuring sustainable use of natural resources through a participatory process. In China's Agenda 21, it is recognized that the realization of objectives of other fields of governmental planning becomes increasingly dependent on successful water resources management.

In line with parts of Agenda 21 related to freshwater resources, most of the countries of the region have adopted or revised their national water policies, reflecting the priority attached to water resources development within the national socio-economic development plans. For example, Indonesia undertook a major policy review of its water resources policy during the period of 1991-1994 to meet the needs of development and to accommodate the changing environmental and resource requirements and society's aspirations. The policy review took into consideration the Agenda 21 approach to deal holistically with water resources management issues and the four main principles of the Dublin Statement. In Pakistan, a comprehensive national water policy is expected to be formulated to provide an appropriate framework for water resources management by 1998.

In a number of the countries of the region, national water resources policies have been translated into action programmes or master water plans. The scope of these activities ranges from more sector-oriented plans, such as improvement of water quality, to more comprehensive development plans. Following are some examples from countries in the Asian-Pacific region:

- In Bhutan, a Power System Master Plan (1994) has been formulated to identify a number of possible sites for hydropower plants. These sites have been selected employing technical, economic and environmental criteria.

- In Bangladesh, a National Water Plan II for the period 1990-2010 has been prepared as an updated continuation of the National Water Plan which covered the period between 1985 and 2005.

- In the Islamic Republic of Iran, the Second Five-Year Socio-Economic and Cultural Development Plan (1995-1999) includes a number of objectives related to the environment and water resources. Also specific targets have been set for various water resources development projects.

- Maldives has developed an action plan in the field of environmental management which gives priority to the development of national policy guidelines concerning wise use of groundwater resources.

In several other countries of the region, the preparatory work for the formulation or revision of national action plans has been initiated, often with the assistance from international organizations. In Mongolia, there is the intention to revise the Master Water Plan elaborated in the first half of the 1970s, in order to reflect adequately the new social and economic realities of the country's transition period to a market economy. In Sri Lanka, it is envisaged to formulate an action plan for comprehensive water resources management that will synthesize the results of the subsectoral plans at the national planning level. The action plan is expected to have a positive effect on the quality of investments in irrigation, water supply, power generation and environment protection subsectors, and to strengthen their linkage with national development goals.

The concept of management of water resources within a river basin or sub-basin context, facilitating integration of land- and water-related aspects, has been widely applied in the region. In Australia, China and Japan, water management has been already been exercised at the river basin level to a certain extent for a number of rivers of national significance. In India, the national water policy asserts that water resources planning be undertaken for a hydrological unit, such as a drainage basin or sub-basin. In Indonesia, basin institutions for water resources management, including for both planning and operation, have been introduced recently in some river basins, but have yet to become fully functional.

Basin-wide approach might be quite beneficial to the management of a large number of transboundary water systems in the region if the riparians could agree to cooperate for formulation and implementation of development plans. For example, Indicative Plan for the development of land, water and related resources of the Lower Mekong basin was prepared in 1970 by the then Committee for Coordination of Investigations of the Lower Mekong Basin, comprising Cambodia, Lao PDR, Thailand and Viet Nam. The Plan was revised in 1987, and at present a number of specific projects identified in the Plan are being implemented under the auspices of the Mekong River Commission, which was set up in April 1995 as a replacement to the above mentioned Committee.

In Central Asia, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan reached in 1992 an agreement on joint management of transboundary waters in the Aral Sea Basin, and established the river basin authorities for the Amu-Darya and the Syr-Darya. Rivers, which are the main tributaries of the Aral Sea. These authorities have been entrusted with the main function of allocation of the scarce water resources available to the riparian countries, also taking into account the need to release a specified amount of water into the Aral Sea. Bangladesh and India have recently reached an agreement on the sharing the Ganga/Ganges waters at Farakka. There are several other transboundary rivers in the region, where the respective riparian countries undertake jointly development and management activities in the field of water and water-related resources.

The old problem of fragmentation of institutional responsibilities for water resources development, management and conservation among sectoral agencies, central and provincial authorities, which had been a major obstacle to the introduction of integrated water resources management, has been alleviated to a certain extent in several countries of the region by creating some institutional mechanisms for coordination. In China, India, Thailand and some other countries, there are interagency coordination committees and groups composed of high ranking representatives of various agencies and ministries dealing with water resources issues. However, the coordination of activities on water resources development, conservation and protection needs further improvement, particularly at lower administrative levels. This is particularly important in the light of the on-going exercise on decentralization of responsibilities in the water sector, which is taking place in several countries of the region.

Although most countries of the region have adopted water legislation regulating to a certain extent the ownership, use and protection of water resources, there is a need in some countries, especially in the countries with economies in transition, to review the existing water legislation in order to incorporate relevant provisions associated with the economic value of water, rational use of finite water resources, protection of the aquatic environment, etc. For example, in Lao PDR, a Water Law has been drafted recently and submitted for approval to the National Assembly. The proposed law aims to streamline policies on water resources assessment, planning, use, quality and protection, and designates a central administrator for water resources management. In Mongolia, the new Water Law that became effective from 5 June 1995, incorporates water management concepts such as water resources development in the context of sustainability, recognition of EIA procedures and some others. In Central Asian states, water legislation is also being revised substantially.

### B. An analysis of the experiences in the development of strategic approaches

The experiences in the development of strategic approaches to freshwater resources development and management in the region are rich. Such richness in experiences reflects the diversity of the economic, social, cultural, political and environmental conditions in the countries. The experiences also reflect the priority issues identified and urgent needs in water resources management conceived by the respective Governments. In general, these experiences can be viewed from two distinct viewpoints: (i) the principal driving force for such a strategic approach, and (ii) the process leading to a firm development of strategic approaches.

## 1. Towards an effective principal driving force

In most countries, it is recognized that the Government plays the principal driving force in a strategic approach to freshwater resources development and management. Several experiences in the region are available in this respect. Within the scope of this paper, two examples are provided for reference.

The first example relates to the functions of the Governments as extracted from the Australian experience: "Governments will work to ensure that development decisions which impact on water resources are based on acceptable water quality and quantity criteria, and that management requirements to meet those criteria on a sustainable basis are recognized. Efforts will be focused on using water more efficiently; allocating water for stream-flow and other environmental uses; and minimizing pollution. Careful resource management policies, pricing policies aligned to the real value of the resource, and a national approach to environment protection measures for water quality." (extracted from Australia's National Strategy for Environment and Sustainable Development - Water, 31 July 1996).

The second example reflects efforts in enhancing the effectiveness and efficiency of the principal driving force as reflected in the following three important elements in the functioning of the Malaysian Department of Irrigation and Drainage (DID): (a) Integrated water resources planning needs to be based on the "Total Planning Doctrine" to achieve a sustainable community as the fundamental objective of the Malaysian Vision 2020[3], (b) the DID work is guided by the vision: "*Towards excellence in the planning, development and management of water resources for sustainable agricultural and socio-economic growth in line with the national vision*", and (c) the DID aims to achieve its mission:" *To provide quality, efficient and effective services in the fields of irrigation, drainage, river engineering, coastal engineering and hydrology through sustainable development and integrated management of the nation's water resources.*"

---

3 To achieve Vision 2020, which is based upon the underlying premise of attaining balanced communities, a comprehensive and universal planning doctrine has been formulated. This "Total Planning Doctrine" is a guiding principle for development planning processes. The doctrine postulates that man is the focal point for development. As part of the planning processes, accurate and timely indicators for key policy variables, particularly performance indicators which measure conditions and changes in human settlements, are required. Identification of indicators for measuring sustainability of development plan is carried out at two levels. The first involves the identification of ***land-use planning criteria for sustainable development.*** In this respect, the goals of sustainable development are used, i.e. resource conservation, built-environment in harmony with natural environment, environmental quality and social equity. The second involves the identification of ***land-use planning criteria for sustainable community.*** To ensure wide acceptance and full support from the public, Malaysia has been exercising a consultative process at all levels in order to get opinion from the public, based on the moderation approach, on all aspects before any decision is made. The success of realizing sustainable community is largely dependent on the extent of commitment from the public and the local government. Thus, people empowerment and decentralization of power to the local government are the major agendas being addressed in Malaysia. (Extracted from "Planning Practices in Malaysia" prepared by Puan Hajjah Norasiah Bte Hj. Yahya, representative of the Federal Department of Town and Country Planning, Peninsular Malaysia for discussion at the Workshop on Guidelines and Manual on Land-use Planning and Practices in Watershed Management and Disaster Reduction, Bangkok, Thailand, 18-21 March 1997.)

## 2. Process towards strategic approaches

The development of strategic approaches to freshwater resources management needs to be specific to each country. The stages of development and success in such a process can be illustrated by the following seven strategies recommended by the participants of the Regional Consultation Workshop towards a Policy for Water Resources Development and Management in the Asian and Pacific Region, organized by the Asian Development Bank (ADB) in May 1996 (Towards Effective Water Policy in the Asian and Pacific Region, Volume I: Overview of Issues and Recommendations, Ed. Wouter Lincklaen Arriens, et. al., ADB, 1996)

(1) Prepare and adopt a national water policy and action program. Conduct a national water sector assessment, and formulate and implement a coherent national action program for water sector development, including a national water policy, a water sector apex body, water law, and strengthening of institutions, information, monitoring and learning. *And mobilize government resources to direct the implementation of the national action program in a committed and sustained manner to the achievement of its objectives.*

(2) *Invest to manage the country's priority river basins.* Formulate and implement action programs for the country's priority river basins with investments in physical infrastructure, institutions, and capacity building for water resources development, management, and conservation. *And mobilize public sector financing and sustain commitment to carry out these priority river basin programs.*

(3) *Increase the autonomy, and accountability of service providers.* Formulate and implement phased action programs in the water supply and irrigation subsectors to increase the autonomy and accountability of water service providers including, as appropriate, commercialization, corporatization, private participation, and strengthening of community organizations. *And vigorously promote local and viable revolving cycles of investment, customer service, and user charges to satisfy water demands in each use.*

(4) *Develop incentive, regulation, and awareness for sustainable water use.* Formulate and implement incentives, regulatory controls, and public information and education programs to promote sustainable water use, economic efficiency, conservation environment protection, and water quality standards; and estimate the economic costs associated with government policies, strategies, programs, and projects that deviate from the economic optimum.

(5) *Manage the use of shared water resources and develop cooperation.* Develop programs to manage shared waters in the country, cooperate with other riparian countries in the planning, development and management of shared international water resources; and promote transboundary understanding, joint projects, and free exchange of information and experience.

(6) Enhance water information, consultation, and partnerships. Formulate and implement water sector policy, strategies, programs, and projects using systematically developed approaches to information, consultation, participation, public-private-NGO partnerships, and learning, to promote commitment to, and understanding of, actions agreed to be in the public interest.

(7) Invest in capacity building, monitoring, and learning. Develop, implement, and sustain programs that will ensure the success of water sector development activities through capacity building, monitoring, evaluation, research, and learning at all levels, particularly in public sector institutions.

### C. Remarks

From our review, it was revealed that significant achievements in the development towards an effective principal driving force reflected the advanced stages of economic development of the respective countries. This is the case for the countries which have sufficient financial and technical resources. On the other hand, achievements in most of the developing countries in the process of development of effective strategic approaches are quite diverse. The diversity of these experiences can be described by not only the important progress in such a complex process (amid the complexity of economic liberalization and democratization of natural resources management) but also the difficulties in maintaining continuity and consistency in policy and decision making due to the lack of necessary financial resources and technical capacity. These constraints make it difficult to achieve the goal proposed in Agenda 21 for all the Governments to establish national strategies for integrated water resources management by year 2000. In such a context, the challenge for the region is to develop an overall strategic approach to help the developing countries in the region to firmly move towards national strategic approaches to freshwater resources development and management. The rate of progress for such a process will depend on available resources in the respective countries and assistance from the international community.

## IV. ESCAP AND THE DEVELOPMENT OF STRATEGIC APPROACHES

### A. Recent ESCAP activities

In the implementation of Agenda 21 in the Asian and Pacific region, ESCAP has been focussing its efforts on assisting the countries of the region in the formulation and implementation of plans and programmes in the following major areas of integrated water resources development and management in their national economic and social development activities: preparation of guidelines on integrated and sustainable development of water resources; water resources assessment; establishment of pricing policies and structures for water supply; promotion of private sector's participation and investment in water resources projects; and promotion of women's role and participation in water supply and sanitation. ESCAP formulates regional projects, conducts studies, organizes expert group meetings, workshop and seminars, disseminates information and provides technical advisory services.

## 1. Integrated water resources development and management

On the implications of Agenda 21 for integrated water resources management in Asia and the Pacific ESCAP organized several expert group meetings and regional workshops on the annual basis on various aspects of integrated water resources development and management since 1992 to review the progress, to exchange experiences among the countries and to recommend possible strategies to overcome any problems and obstacles. In addition, in order to order to support the member countries in their efforts on integrated development and management of their water resources, ESCAP secretariat organized, among others, the following activities since the UNCED:

- Seminar and publication "Towards an Environmentally Sound and Sustainable development of Water Resources in Asia and the Pacific", December 1992

- Seminars on flood loss prevention and management in Myanmar, Pakistan, Iran, Solomon Islands (1993), and in Fiji, Samoa and India (1994)

- Seminar and publication on Integrated Water Development and Management in Asia and the Pacific (1995)

- Advisory missions to member states on various aspects of integrated water development and management, especially on integrated river basin development planning (1992-1997).

With respect to the most recent activities on sustainable development of water resources, an ad-hoc expert group meeting was held (Bangkok, 1996) followed by a seminar which finalized the guidelines on water and sustainable development in the region (Bangkok, 1996) which was published in 1997. Another expert group meeting was held (Bangkok, 1996) to review and analyze water pricing policies and structures in the ESCAP region, followed by two separate workshops, on the establishment of pricing policies and structures for urban and rural water supply (Manila, 1996) and the other for irrigation water supply (Jakarta, 1996) which produced two relevant publications in 1997.

## 2. Water resources assessment

For assessment of water resources in the region, computer applications were introduced through the organization of a regional workshop (1993) and subsequent advisory missions. Subsequently, another regional workshop was held in 1995 to discuss and finalize a "Guidebook to Water Resources, Use and Management in Asia and the Pacific". As a result of these efforts, the following publications were produced:

- A publication on Computer Applications for Groundwater Assessment and Management, June 1993
- Publications on the water resources in Japan (1994) and Myanmar (1995)
- Guidebook to Water Resources and Water Use in Asia and the Pacific (1995), presenting information on urban use and water demand in 45 countries/areas in the region.
- A country study on China is under production.

### 3. Water supply and sanitation

ESCAP activities in this area focus on mobilization of community participation and resources to contribute towards universal access to water supply and sanitation. These activities were carried out mostly in collaboration with other United Nations agencies, particularly UNICEF, DDSMS, WHO, UNDP-World Bank Programme on Water Supply and Sanitation. Among the major activities were the establishment of a guidebook on the promotion of investments for water supply and sanitation projects and promotion of the role and participation of women in water supply and sanitation. For the establishment of the guidebook on promotion of investments, an expert group meeting was, at first, held to formulate the contents of the guidebook (Bangkok, 1996) and subsequently, a seminar reviewed and finalized the guidebook (Pattaya, 1996). A subregional workshop on promotion of private sector participation in the water sector was held (Macau, 1997), utilizing the guidebook as the basic material. With respect to the promotion of women's role and participation in water supply and sanitation, ESCAP organized, in close collaboration with other international agencies, four national workshops on the use of the training modules of *the United Nations Training Package on Women, Water Supply and Sanitation (WWSS)* in the Philippines, the Lao PDR, Viet Nam, (1996) and Thailand (1997). The experiences learnt from the national workshops were compiled and published in 1997 for wide dissemination.

Other ESCAP activities on drinking water supply and sanitation were:

- Workshop on testing of training modules on women, water supply and sanitation, September 1992
- Regional seminar on water management in urban areas, March 1993
- Seminar and publication on Urban Water Resources Management (1993)
- National seminars on urban water resources management, Viet Nam (1993), Myanmar, Kazakhstan (1994)
- National seminars in Azerbaijan, Kyrgyzstan, Turkmenistan and Uzbekistan on drinking water supply and sanitation, 1994
- Regional seminar on efficient water use in urban areas, Singapore (1997)
- Advisory missions on improvement of drinking water supply and sanitation and urban water management (1994-1997).

### 4. Protection of water resources, water quality and aquatic resources

ESCAP has undertaken the following activities recently, with regard to the protection of water resources, water quality and aquatic ecosystems:

- Expert Group Meeting on Protection of Water Resources, Water Quality and Aquatic Ecosystems, October 1994
- Workshop on Water-related Problems in Low-lying Coastal Areas, November 1995
- Publication on Protection of Water Resources, Water Quality and Aquatic Ecosystems in Asia and the Pacific, 1995

- Regional seminar to review the status of water quality problems in Asia and the Pacific, Bangkok, 1997.
- Advisory missions on protection of water resources, water quality and aquatic ecosystems.

### 5. Other supporting activities

ESCAP has also continued its work on natural disaster reduction, particularly on flood control and management in the region. A detailed study on the natural hazards of the region was undertaken and a publication on "Natural Hazards and Natural Disaster Reduction in Asia and the Pacific" was prepared (1995). Appropriate land-use planning and practices was an area where efforts were recently directed to reduce damage due to water-related disasters and to enhance productivity of land through watershed management. A workshop was organized and the Guidelines and Manual on Land-use Planning and Practices in Watershed Management and Disaster Reduction was published in 1997. ESCAP continues to provide substantive support to the work of the Typhoon Committee and the Panel on Tropical Cyclones. ESCAP continues the promotion of technical cooperation among developing countries (TCDC) in the region and to provide its traditional substantive support to the work of the Mekong River Commission.

ESCAP also organizes the IDNDR Day every October with the participation of the U.N. agencies and concerned government departments in Bangkok. ESCAP has also recently provided advisory services on various aspects of water resources development and management and also on water-related natural disaster reduction to Brunei Darussalam, Cambodia, Islamic Republic of Iran, Kyrgyzstan, Lao PDR, Mongolia, the Philippines, the Republic of Korea and Uzbekistan In addition, ESCAP continued to disseminate advanced technology and know-how on water resources development and management through its various publications. These included the quarterly issues of the Water Resources Journal and the semi-annual issues of Confluence.

## B. Coordination of activities in the region

The Interagency Sub-committee on Water for Asia and the Pacific was established in 1978 as the Interagency Task Force on Water for Asia and the Pacific in pursuance of the recommendation of the United Nations Water Conference (Mar del Plata, March 1977). At that time, the Task Force was entrusted with the main function to assist cooperation and, as appropriate, joint action among participating agencies in their programmes to assist countries in the investigation, development, use and management of water resources for all purposes, with particular reference in the first instance to follow up to the Mar del Plata Action Plan, approved by the United Nations Water Conference.

In 1994, the terms of reference of the Task Force were revised in order to strengthen its role in the coordination of regional activities and to achieve a fully coordinated approach to fulfilling the needs of countries of the Asian and Pacific region to implement Agenda 21, approved by the United Nations Conference on Environment and Development (Rio de Janeiro, June 1992), in the key area of water resources. Now, the Sub-committee is assigned with responsibility for the formulation of common strategies for concerted action by its member agencies at the regional level for both the implementation of the recommendations of the Mar del Plata Action Plan and the achievement of the goals set in chapter 18, dealing with freshwater resources, of Agenda 21.

Since the inception of the Sub-committee, ESCAP has been serving as its secretariat and maintaining liaison on behalf of the Sub-committee with the Administrative Committee on Coordination (ACC) Sub-committee on Water Resources at United Nations Headquarters. The Sub-committee is currently composed of representatives of the 16 participating international organizations, with the Director of the Environment and Natural Resources Management Division of the ESCAP Secretariat as Chairperson, the Director of the UNEP Regional Office for Asia and the Pacific as Co-Chairperson, and the Chief of the Water Resources Section of the above Division as Secretary. Recently, the ESCAP/WMO Panel on Tropical Cyclones and the Asian Institute of Technology joined the Subcommittee as observers.

## V. FUTURE DIRECTIONS IN STRATEGIC APPROACH DEVELOPMENT

### A. A Plan towards strategic approaches

Despite the experiences of having assisted the developing countries in the region in water resources development and management for nearly 50 years, ESCAP needs to sharpen the focus of its programme in water resources and prioritize its activities, due to the limited resources available and the rapidly increasing requirements for technical assistance and the increasing complexity of natural resources management.

An effective plan for ESCAP activities aiming at assisting the developing countries in the development of strategic approaches is expected to be built on the past achievements and experiences. Such a plan needs to address the different levels of need of the countries and to take into account their respective experiences and status of economic and human resources development. One of the most important challenges for such a plan is to effectively assist the countries in mobilizing maximum participation of all the corresponding stakeholders in the respective countries. Such assistance must ensure continuity and consistency of the related activities so as to firmly establish a firm process of development of strategic approaches. From our experiences, such a programme of assistance needs to aim at assisting the countries' experts to help themselves and to mobilize participation of stakeholders by themselves. In that context, development and transfer of appropriate tools and methodologies is indispensable. On the other hand, ESCAP plan needs also to address the urgent needs of water resources development and management of the countries.

On the above basis, the programme of work of ESCAP in the water resources sector has been structured along the following three main directions:

(1) Promotion of tools and methodologies in strategic planning in water resources sector and compilation of related experiences in the region;

(2) Provision of technical assistance to the developing countries to address urgent needs in water resources development and management in the region; and

(3) Promotion of more active cooperation among the member countries and close collaboration among the international organizations and United Nations agencies dealing with the water sector. In this connection, it is expected that the programmes of cooperation between ESCAP and the other international organizations will lead to a long-term partnership to effectively meet the increasing needs of the region.

Throughout the past many meetings of experts in Asia and the Pacific, the importance of integrated water resources management has always been emphasized. Depending on the stages of development of the countries, strategic approaches may differ from one to another in respect of priority areas, activities, scope, direction and expected goals for the short and long terms. Within such strategic approaches, priority areas could play a deciding factor in the practicability and feasibility of the respective implementation programmes. Promotion of such approaches together with cooperation in tackling issues in the priority areas need stronger regional cooperation in priority regional issues. From the most recent expert group meeting of experts (Integrated Water Resources Management in Asia and the Pacific, Water Resources Series No. 75, ST/ESCAP/SER.F/75, 1996), typical priority areas were identified for the national and regional levels as reproduced below.

## B. Possible directions at the national level

### 1. Policy and strategy formulation

(1) Countries that have not yet formulated national policies and strategies for integrated management of their water resources should do so and adopt as quickly as possible such policies and strategies. They should take into consideration that the main task is the allocation of available resources with priorities among competing water uses in an environmentally sound, economically efficient and equitable manner, also taking into account the social considerations, in order to satisfy the present and future demands of the society for water-related goods and services.

(2) The policies should be translated into action by means of the implementation of basin-wide, regional and national plans and programmes for optimal water resources development and protection. A river basin/sub-basin could be an appropriate unit for master water planning and coordinated management, especially in countries with federal structures, in which provincial or state governments have primary jurisdiction over the development and management of water resources.

(3) Review and revision of policies and action programmes in the water sector should be carried out on a regular basis in order to reflect adequately the recent socio-economic changes and trends in the respective countries and to adjust accordingly the existing master plans in order to fulfill their objectives.

(4) In the national water policies the highest priorities should be given in accordance with the priorities established in the relevant parts of the water development and management activities of Agenda 21. Special attention should be given by donors, national Governments, local and regional bodies to the drinking water supply and sanitation needs of mountain regions, small island nations, arid and drought prone areas, and urban poor areas to achieve the goal of universal access to safe water and sanitation.

(5) Urgent action towards conservation of water resources should be taken in order to achieve sustainable water resources development. Within the framework of integrated water resources management, strong emphasis should be given to measures to increase the efficiency of water use, which is low in various sectors of the economy in many countries of the region, particularly in irrigated agriculture.

(6) The efficient utilization of water resources should be mainly achieved through water demand management in the agricultural, domestic, municipal and industrial and hydro-electric power sectors. Water demand management measures should be vigorously promoted by using economic incentives and legal instruments wherever needed.

## 2. Institutional issues

(7) Diagnostic assessment of the organizational framework in the water sector should be undertaken to identify overlapping institutional responsibilities among sectoral agencies and organizations dealing with water resources and to improve administrative and managerial structures for the integrated management of water resources. Institutional barriers to integrated land and water resources management should also be identified and removed.

(8) Institutional fragmentation of responsibilities for water resources management, impeding the promotion of integrated water management, should be alleviated through effective coordination mechanisms. To this end, countries that have not set up mechanisms for coordinating all water-related activities at the national, provincial or river basin/sub-basin levels, should take action in establishing one to ensure an integrative multisectoral approach to water resources management.

(9) Responsibilities for water management should be delegated, to the extent possible, to the lowest appropriate levels, to ensure the involvement of water users including women in the planning, implementation and management of water projects. This would require adequate public awareness and education for the efficient utilization of water resources. Where appropriate, more functions for the provision of water services should be transferred to the private sector, financially autonomous entities, and community organizations under the overall regulation of the Government. At the same time, the safety of the structures and socio-economic responsibilities should also be ensured. The legal and administrative system should be further strengthened, in particular with respect to the enforcement of regulatory measures.

(10) As lack of information for planning and decision-making is still a significant problem, countries should enhance their capacities for water resources assessment. This may include a

further strengthening of coordinating arrangements in the collection and processing of data as well as the improvement of monitoring systems.

### 3. Economic aspects of water management

(11) More attention should be given to the economic efficiency of water development projects, greater reliance on water pricing and mobilization of resources of the private sector and communities. The economic efficiency of projects could be improved by rehabilitating deficient systems (for example, those with waterlogging and salinity problems), reducing wastage and unaccounted-for water, recycling and reusing waste water and improving operation and maintenance. Efforts should be strengthened to recover a larger proportion of investment and recurrent costs for water resources projects and services.

### 4. Human resources development

(12) High priority should be given to the development of human resources, since the decentralization of water resources management necessitates training of water management staff at all levels. Training capacities should be adequately strengthened and updated from time to time taking into account the advances made in the sector through research and development efforts.

(13) To further promote water use efficiency and water conservation, activities to raise public awareness and education for increased user participation should be continued and where possible accelerated.

## C. Priority issues at the regional level

### 1. International cooperation

(14) International cooperation in the field of water resources management should be strengthened in Asia and the Pacific. Further regional cooperation should be aimed at the exchange of information and experiences in such areas as the formulation of master water plans and investment programmes; water resources assessment and demand estimation; integration of water and land management; promotion of water conservation through improved water-use efficiency; water demand management; institutional reforms including decentralization of management to local authorities, private enterprises, communities, non-governmental organizations, etc.

(15) Regional cooperation should also be promoted to support the efforts of the countries concerned in education, training and research in the water sector with a view to strengthening their ability for integrated management of water resources in a sustainable way. Countries which have training potential should be encouraged to accept trainees from other member States through regional cooperation.

(16) ESCAP, UNEP and other international organizations and agencies should widely disseminate knowledge and information among national Governments and institutions on integrated water resources policy development and management techniques and policies by

organizing activities such as seminars, workshops, regional expert group meetings and study tours, and preparing pertinent guidelines reflecting prevailing socio-economic and environmental conditions of the countries in the region.

(17) There should be a quantum increase in external assistance from donor countries and agencies for the water resources development of developing countries of the region in line with the priorities indicated in chapter 18 of Agenda 21. Economic viability should not be the sole criterion for such funding, but social benefits in the long run should also govern the activity so that implementation of the provisions in chapter 18 and other relevant chapters of Agenda 21 could be speeded up.

### 2. Transboundary water resources

(18) In the case of transboundary water resources, riparian countries should be encouraged to harmonize, where appropriate and in conformity with existing arrangements, their water resources strategies and action programmes.

(19) Cooperation between countries for the integrated management of transboundary water resources could include the exchange of relevant hydrological and meteorological data and information on the environment, joint studies on the assessment of transboundary water resources, notification and consultation on planned development activities in the water sector, collaborative planning of transboundary water resources development wherever feasible, and implementation of mutually agreed water resources development projects.

(20) The experiences gained in the joint development and management of water resources in the Lower Mekong Basin and in the Aral Sea Basin by respective riparian States should be disseminated widely.

## D. Preparation for the future

Within the context of the development of strategic approaches in the region, ESCAP is making efforts to collect existing strategic planning methodologies in water resources and related experiences in the region for review and subsequent dissemination. It is hoped that ESCAP will be able to benefit also from the experiences of the other international organizations and United Nations agencies. In this connection, efforts will be made to strengthen the existing close cooperation with the other United Nations agencies, international organizations and other regional organizations, such as the Asian Development Bank, the Mekong River Commission, the Typhoon Committee, the Panel on Tropical Cyclones, and the Asian Institute of Technology (AIT) towards long-term partnership in water resources management. It may be noted that a programme of close collaboration with the Asian Institute of Technology (AIT) has recently been initiated during a meeting between the ESCAP Executive Secretary and AIT President. Within such a programme, it is expected that a detailed plan will be worked out at a later stage in order to help build up long-term partnership in human resources development in support for the development and implementation of strategic approaches to freshwater in the region.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# WATER QUALITY - A GLOBAL CONCERN

by
RICHARD HELMER, EDWIN D. ONGLEY, NORMAN E. PETERS

Paper No. 13

Prepared for the
Department of Economic and Social Affairs
United Nations

WATER QUALITY - A GLOBAL CONCERN

RICHARD HELMER, EDWIN D. ONGLEY, NORMAN E. PETERS
WHO - GENEVA

## INTRODUCTION

1. The present paper deals with actions needed to protect the health and productivity of the environment, and impacts on human health from degradation of water resources. The paper commences by presenting an overview of water quality issues (Section A). Priorities and challenges are then examined (Sections B and C respectively). Finally, a global water quality initiative, including an action plan, is proposed (Section D).

## A. OVERVIEW OF WATER QUALITY ISSUES

2. Human health and economic development are threatened or restricted by multiple water quality issues that limit human welfare and water uses, including microbiological pollution, organic pollution, salinization, acidification, metal pollution, pollution by toxic organic compounds, nitrate pollution, radionuclide pollution, thermal pollution, and increases in total suspended solids. In addition to these issues, which are all related to human activities such as agriculture and related land uses, urbanization, industrialization, mining, land-use change, and climate change, there also are some natural water quality issues which may occur at specific sites and may cause severe limits to human development in the form of water-related diseases, such as cholera, malaria, and parasites, and excesses of harmful substances, such as fluoride, arsenic, metals, and salts.

3. The health of the aquatic environment also is greatly affected by all human activities listed above and by the world-wide modification of surface-water networks by damming, water diversion and withdrawals that modify the physical component of the aquatic ecosystems and its water discharge regime. The amount of pristine waters is very rapidly decreasing and when considering long-range atmospheric pollutants which now reach the polar regions and the Amazon basin, it can be said that, strictly speaking, pristine waters no longer exist. Near-pristine waters are restricted to where human activities are still very limited, i.e., in Arctic and sub-Arctic regions, in a few tropical forests, and in some arid areas. The temperate zone is the most severely affected area, particularly in the Northern Hemisphere between latitudes 35°N and 50°N where near-pristine waters only occur in small basins, in biosphere reserves and national parks.

4. At the very early stages of economic development, human development was greatly limited by water-related diseases that are mostly controlled by hydrology, i.e., the management of still and running waters, and by climate. The worst conditions probably are found in the humid tropics and associated wetlands, although a very severe disease, river blindness or onchocerciasis, is typical of fast-running streams where the insect-host of the parasite lives. In the early 1900's, malaria was still a major factor controlling human settlement in extended regions in Europe. DDT use, now banned in Europe and replaced by more environmental-friendly pesticides, has nearly eradicated this disease in Europe. However, malaria is still among the number-one health issues on the planet, together with other water-related diseases such as bacterial diarrhoea, onchocerciasis and schistosomiasis (Bilharzia), a parasitism linked to an aquatic snail that typically develops in shallow still waters, as around lakes and reservoirs.

Bilharzia is a typical example of a human-enhanced natural health issue which has developed with reservoir construction e.g., Lake Nasser in Egypt.

5. Water quality problems arising from natural conditions occur in many continents and are linked to local characteristics of a humid climate. In most arid regions, surface and groundwater are more mineralized than in humid areas and may exceed the drinking water health standards. In certain geological settings, where evaporites (halite, gypsum) and other easily soluble minerals such as fluoro-apatite or arsenic-bearing minerals occur, concentrations of fluoride, arsenic and other substances may well exceed the WHO drinking water limits. In these regions, such waters may be the primary or sole water resource that causes massive degradation of population health.

6. Primary causes of water quality degradation by human activities can be grouped into six different categories according to the major factors controlling these issues: population density, changes in water balance, land-use indicators, long-range transboundary atmospheric transport of pollutants and concentrated pollutant sources and global climate change. The first cause, in human history, and still the most important one, is the development of populations and particularly of cities; where there is a concentration of direct pollution sources of pathogens, oxygen consuming organic matter, nutrients, metals and organic micropollutants to surface and/or groundwater. Moreover, cities also are responsible for many of the long-range atmospheric pollutants such as sulphur dioxide and nitrogen oxides causing acid rain and acidification, and some micropollutants. In most cases, industrial activities also are linked to urbanization.

7. Land-use change through construction, deforestation and agriculture and associated use of fertilizers, defoliants and agrochemicals has been operating for more than two thousand years and still is very rapidly expanding in the humid tropics (deforestation) and arid tropics (desertification). Diffuse sources of material (pesticides, nitrate, phosphorus, and suspended solids) also have affected the quality of continental waters. Irrigation, which is the fastest growing water use, will cause severe degradation of water quality through salinization of surface water (irrigation returns) or groundwater. In most semi-arid and arid regions, the use of water for agriculture is one of the most important issues. Management failures with respect to salt, nutrients and pesticides have been major causes of water quality degradation, and in turn, the land and water management reflects the lack of adequate scientific understanding.

8. The quantitative management of water resources also is one of the major causes of water quality degradation. Documented impact studies of large schemes such as the Colorado River basin, Lake Nasser (created by the Aswan dam) and the Aral Sea, have attracted more attention to this issue. Reservoir building, water diversion for irrigation or for urban supply, changes in water discharge regime or reservoir stratification lead to drastic changes in water quality, sometimes connected to other major causes of degradation as agriculture. Salinization, development of water-related parasites, contamination of aquatic food webs by mercury, increased erosion downstream of reservoirs, eutrophication and anoxia due to reservoir stratification are now common.

9. These water quantity changes are adding to water quality changes. In some cases major rivers and lakes have already disappeared or are severely affected. The Aral Sea is the most

publicized example of such change. The Colorado and Nile rivers, once two of the major world rivers, are no longer discharging to the ocean; and the volume of Lake Sevan, Armenia's key water resources, has been drastically reduced, causing severe water quality degradation. Large reservoirs, e.g., Lake Nasser, have recently been implicated in increasing local seismic activity, even to the point of jeopardizing the dam's integrity.

10. Some single pollution sources may affect wide areas due to the amount, density or nature of their pollutant loads. These are referred to herein as concentrated pollution sources or "pollution hot-spots" and concern i) megacities, ii) major mining areas and iii) nuclear facilities. For iii), chronic pollution usually is regulated and has a local influence; but the Chernobyl accident has reminded the world about the possible global contamination of water from such facilities through long range atmospheric transport of radionuclides. Megacities are increasing in both size and number. Only a few of these megacities are actually properly connected to waste-treatment plants; but many of them are located in rapidly-developing countries, e.g., China, India, Nigeria, Egypt, Mexico, Indonesia and Brazil, where the sewer network and treatment facilities are not growing as fast as the population. The degradation of local water resources, both surface and groundwater, forces some of these megacities to import water and/or expose much of the population, which are not yet connected to tap water, to unsafe local water.

11. Major mining and smelting areas occur anywhere, e.g., in densely populated regions or in remote places, such as the sub-Arctic regions of Siberia and Canada, in Central Africa, and the island of New Guinea. When these sites are located in such places, environmental regulations do not exist or, if regulations do exist, they are not enforced adequately. The result is that high concentrations and enormous loads of metals and salts can be discharged, some being equivalent to loads coming from areas 1,000 or 100,000 times larger. Some industries also can be considered as hot-spot polluters: a single fertilizer plant may discharge as much phosphorus as 100,000 $km^2$ of a forested basin.

12. Global climate change probably is not the most critical issue for water quality. It is much slower than most other global changes, such as untreated pollution, the rates of water diversion and reservoir building, and the increase in nutrient concentrations in rivers. However global climate change will affect sensitive areas where some changes in the water balance may greatly affect the water availability. Salinization problems will increase in both arid regions and coastal zones where seawater intrusion will affect the developed coastal aquifers.

**Limits of water use due to poor water quality**

13. As discussed previously, the principal water quality issues usually are related to multiple causes. As an example reservoir eutrophication can originate from nutrient increase from various sources (urban, industrial, agricultural, and from specific reservoir management). Sources of major pollutants impacting continental waters include atmospheric, point (e.g. sewage, industrial effluent), diffuse (e.g. agriculture, dredging) and mixed (e.g. urban run-off, waste disposal) sources.

14. In turn, water quality degradation, or sometimes natural water quality, will greatly limit specific uses. Each user has specific requirements, such as optimum quality, health and other

use thresholds, and criteria for the frequency of threshold exceedance. Transport, power generation and cooling are among the least demanding activities, whereas drinking water, aquatic biota and fisheries are the most demanding.

**Development of water quality issues**

15. The development of water quality issues depends on the stage of economic development and on the countries water resources capacity and willingness to recognize and face the issues. However, for long range atmospheric pollutants and for climate change, as well as for nuclear accidents, the issues may develop in countries that have achieved the best environmental practices. A typical example is acid rain in Scandinavia originating from other countries and associated surface-water acidification.

16. In industrialized countries, there generally is a chronological succession of issues that have been encountered over the last 100 years, such as faecal pollution, oxygen-consuming pollution, metal pollution, eutrophication, and radioactive wastes. Most of these issues have been, or can be, addressed. In the 1950's, nitrate pollution started due to fertilizer use then not yet properly addressed. In the 1970's, acidic atmospheric deposition led to extended regional problems in northeastern USA, eastern Canada, Scandinavia, and central Europe. In some cases, atmospheric pollution control is starting to produce positive results, in that atmospheric acidifying components have been decreasing and surface-water quality is improving.

17. In the least developed countries, many of the above-mentioned issues do not exist because of the lack of economic development. However the related lack of sanitation leads to problems of pathogens and organic pollution, and sometimes local groundwater contamination by nitrate still is poorly understood.

18. Rapidly-developing nations such as India, China, Brazil, and Indonesia, are experiencing the development of all pollutant sources, which are listed above for the industrialized countries, in a much shorter period than in Western Europe or North America. The pollutant production rates are increasing, sometimes an order of magnitude faster, consistent with the population growth of some megacities. The combination of multiple pollution issues, rapid changes in economic development and rapid population growth will produce critical water quality issues in many more areas of the globe than have heretofore been observed. However, because of the lack of appropriate water quality surveys and health statistics, not only is the severity of environmental degradation not always documented, but processes causing the degradation are not well understood.

19. Eastern European countries are somewhat apart in that their industrialization and intensive agriculture were achieved well before 1989, but the enforcement of environmental regulation generally was not realized, leading to case studies of extreme pollution. When combining these pollution issues with water quantity management, very poor quality of surface and groundwaters is the result in many cases.

## B. PRIORITY CONCERNS

### Healthy ecosystems maintenance

20. Aquatic ecosystem health, while simple to understand in the abstract, is difficult to assess or predict in meaningful terms and is closely linked to water quality. The science behind ecosystem health is difficult and not fully developed, and the political acceptance of a meaningful implementation of the concept is difficult. Indeed, whereas aquatic biodiversity is politically acceptable as a public good in developed countries, such a concept is not generally implementable in most developing countries where basic public health needs and economic development are the priorities and where environmental needs are low on the list of priorities. Nevertheless, it is recognized by some developing countries that degraded (aquatic) ecosystem health, however that may be defined, is causing systemic failure in economic planning and development. How to deal with restoration of aquatic systems remains, however, a scientific and policy dilemma for such countries.

### Safeguarding drinking water supplies

21. Water is vital for life. It is important in social welfare, especially that of the poor. The poor pay the most for water and suffer the greatest in terms of impaired health and lost economic opportunities. Over one billion people lack access to adequate supply of safe water and 1.7 billion people do not have adequate sanitation. Contaminated water causes millions of preventable deaths every year, especially among children. Given the importance of this social interface, it must be asked how effective water resources management can help to alleviate poverty and ensure that the poor are the beneficiaries rather than the victims of bad water management decisions and policies (Serageldin, 1995).

### Food security

22. Even now the role of agriculture on water quality is substantial. Although few countries are able to quantify the role of agriculture in national water pollution, the United States is an example of a developed country where agriculture is the major polluting source for surface and ground water for a broad range of substances (US EPA, 1994). This is typical of countries where point sources have been broadly regulated. There has been widespread concern in Europe for several decades over increases in nitrogen, phosphorus and pesticide residues in surface and ground water.

23. While there is no doubt that point sources of pollution are having a major impact on water quality in developing countries the role of agriculture and other types of non-point sources is not known and may be substantial. The absence of reliable data makes the assessment of agriculture relative to point sources difficult or impossible in such countries. Moreover, the presence of large shallow lakes with large internal loadings of phosphorus, especially in Asian countries, is a major complicating and often overlooked factor when remediation projects are planned.

24. The debate over the freshwater scarcity issue is greatly complicated by the global debate over the future of food security. Water used in agriculture amounts to some 70 % of total water withdrawals; agriculture is responsible for 93 % of total water consumed by all economic sectors (United Nations, 1997). Nevertheless, the FAO (Alexandratos, 1995) has provided a somewhat reassuring picture of the world's ability to produce enough food to meet the demands of a growing global population. Others such as Brown (1996) take a much more pessimistic view that reflects observations such that with the world population increasing at some 90 million annually, large pressures will be exerted on water quantity and quality by agriculture.

25. The food security issue has the following water quality implications (Ongley and Kandiah, 1998):

- Intensification of production both of rainfed and irrigation agriculture and of aquaculture will lead to increasing levels of fertilizer and pesticide runoff;
- Further expansion of rainfed agriculture into marginal lands that are highly susceptible to erosion will increase sediment runoff and freshwater turbidity and siltation;
- The need to rehabilitate salinized irrigation lands and to more effectively utilize salinized land will add to salinity loadings to aquatic systems;
- Intensification of livestock raising, especially in Asia, to meet increasing demand for protein will result in increasing loadings of faecal matter, organic and inorganic wastes;
- Expansion of the agro-food processing industry will increase loadings of organic matter pollution.

**Integrated water management**

26. An integrated approach to management which needs to take into account both water quality and quantity needs to be addressed. This should consider that all types of water, freshwater, coastal and marine, are considered in a management continuum and that land-based activities are an integral part of this sustainable management approach. In order to deal with pressures on water resources, a new approach to management is necessary (Serageldin, 1995). This is discussed in more detail in Section D of this paper.

## C. CHALLENGES

**Policy and institutions**

27. Although there are many factors that contribute to the water quality challenges world wide, including factors such as lack of funds, lack of access to appropriate technologies, inadequate expertise at the national and local levels etc., the fundamental root cause is institutional and policy failure at national levels. Only when this is recognized and accepted by national governments will there be the opportunity to make significant change through the processes of financial and technical aid and capacity building.

**Data needs**

28. The challenge of the next decade is to rethink how water quality data are collected and used, and to take advantage of new capabilities that can revolutionize the information effectiveness and cost-efficiencies of data and assessment programmes at the national level. Water quality and quantity networks are failing to provide the kind of information governments need to develop, implement and monitor water policies and programmes. For water quality, these are highly inefficient and ineffective, often are duplicated in two or more government agencies, are expensive to operate, and fail to provide the kind of information necessary to develop control options, or for investment into remediation programmes. This applies to data collection, to data management and deployment for decision purposes both for point and non-point source management.

29. Many developing countries are unable for institutional, financial and technical reasons to mount stable, reliable monitoring and assessment programmes. Water quality monitoring is often fragmented amongst several government agencies: ministries of health, industry, transportation, energy, agriculture, etc. In too many countries there has been a virtual collapse of systematic data programmes for water quantity and quality. In most developing countries and some developed countries there are no national data standards to ensure data quality and it is assumed (usually incorrectly) that legislated laboratory quality control as part of the analytical process will suffice. Data unreliability, including intentionally fraudulent data are all too common. There is a profound lack of data, especially on man-made organic and inorganic compounds of industrial and agricultural origin in most countries outside the developed world. In many countries data holdings remain on paper records only and are unavailable in electronic database format.

30. In the case where information is available, the challenge becomes one of how to make the information useable. Accessing knowledge and its use in decision-making remains extremely difficult for developing countries. Specific attention needs to be paid to new information technologies that permit user-friendly use of knowledge bases (as well as data) for decision-making for planning, development and issue-specific management.

31. For regional and global assessment purposes, the data challenge is serious leading to an information gap dilemma. It has been impossible to carry out comprehensive assessment of, for example, nutrient or contaminant status in large parts of the world. The linkage with global issues such as biodiversity or source-identification of toxic chemicals that are transported long distances by atmospheric processes, cannot be established. Consequently, effective solutions are difficult to derive. Loadings of pollutants to oceans and coastal and inland seas from the world's rivers are poorly known. For domestic purposes the data challenge is verging on catastrophic for many countries. National governments and river basin agencies do not have the data required to develop effective policies for water resource planning, for pollution abatement and remediation, for cost-effective source control, or for determination and application of water quality standards for maintenance of ecosystems and biodiversity. Sadly, many donors and international financial institutions fail to recognise the inadequacies of national and regional monitoring programmes.

**Capacity building**

32. Most countries have need for the building of personnel and institutional capacity in the methods of developing and applying water quality programme elements to real water management issues. The need is not for new science nor new methodologies; the need is for transfer of existing knowledge and modern methodologies.

33. A central area of capacity building in the water quality sector is the fact that water quality management is a complex issue that involves a wide range of needs, institutional, scientific and technical, and programme requirements that must be considered. Most developing countries are not well equipped to handle such complexity within an holistic context. Often, basin remediation requires a set of trade-offs amongst the various aquatic components and amongst users.

34. Capacity building needs to focus on core competencies that do not exist at the national level and that are essential for efficient and effective planning and decision-making. There are many fundamental problems with capacity building programmes in the water quality sector. Too often these are a collection of short courses which donors are able to provide, and which fail to take into account the question of sustainability once the donor leaves. Problems may occur when capacity building is associated with 'tied aid'. Frequently, this leads to inappropriate technology transfer and infrastructure development. Another aspect is the failure of many internationally funded programmes to build appropriate capacity at local levels that can in turn, be used in similar projects in the same country.

**Raising awareness**

35. In order that water quality issues are brought to the fore, it is important to raise political awareness. Although increasingly water quality is recognized as a central issue in social and economic development, many governments still believe water quantity to be the issue of importance, not water quality. This is due to i) the political and donor attention to water quantity in past years, ii) data on water quantity being more accessible than water quality and iii) water scarcity being more easily conceptualized at a national level than water quality. The consequence is that national governments tend to be unaware of the aggregate impacts and associated economic implications of water quality deterioration at a national level. Furthermore, without the knowledge of economic losses associated with degraded water quality in the various economic sectors (e.g., agriculture, industry, public health), national or regional governments have no basis to develop a cost effective national or basin-wide remediation and investment strategy for water quality (Ongley, 1997c).

## D. A WATER QUALITY INITIATIVE

**Basic considerations**

36. In recent years water quality problems have attracted increasing attention by authorities and communities throughout the world (see Sections A and B), especially in the developing countries but also in countries in transition from central planning economies to market economies

where previous neglect concerning environmental protection are becoming a major obstacle for further and sustainable economic and social development. The international community has acknowledged the severity of the problems incurred by deteriorating water quality and agreed formally to take action to protect the quality of freshwater resources. The most recent demonstration of this was provided by the United Nations Conference on Environment and Development in Rio de Janeiro, 1992, the result of which was Agenda 21.

37. The principles of Agenda 21 cover water resource management in general. Water resources management entails two closely related elements: maintenance and development of adequate *quantities* of water of adequate *quality*. It is very important to notice this integrated relationship between water resources management and water pollution control since past failures to successfully implement water management schemes may be attributed to negligence of this fact.

38. The present framework does not comprise water resources management in general but concentrates on the aspects that relate to water quality, with special emphasis on the conditions typically prevailing in developing countries and countries in economic transition. The aim is to demonstrate an approach to water quality management, focusing on a process which will support an effective management of water pollution. The suggested approach may be applied at various levels, from the catchment or river basin level to the level of international cooperation. The elements and processes involved in a framework for water quality management are presented in Figure 1.

39. The framework is based on discussions that took place at the 17th and 18th sessions of the ACC Subcommittee on Water Resources in 1996 and 1997 (an inter-agency co-ordinating group comprising the organisations of the United System dealing with water resources) and on ideas supported by the Water Supply and Sanitation Collaborative Council (WSSCC). A detailed account of the framework can be found in Helmer and Hespanhol (1997) which is the result of the WSSCC Working Group on Water Pollution Control.

40. Since it is widely agreed that a properly developed policy framework is a key element in sound management of water resources and since water resource management comes under the direction of environmental legislation, water resource planning and public health, any policy statement must be clearly defined in proper policy documents. Some general principles should be considered within the policy making process. These are summarized by Larsen et al. (1997) for water pollution. A water quality management policy should ideally be seen as a part of a coherent policy framework ranging from overall statements (government statutes, constitutions, etc.) to specific policy statements defined for environment and water resources management as well as for particular sector developments. The policy making process should therefore incorporate consultations and seek consensus with all line ministries relevant for water resources management including organisations responsible for overall economic development policies, and when formulating new development policies for other sectors, water resources policy statements should be taken into account when relevant. Finally, policy statements must be realistic and long-lived; they must be applicable in practice and must pass a laborious political adaptation process.

41. Current policies are unsustainable, economically, socially or environmentally and this stems from four principal failures (Serageldin, 1995): i) the refusal to treat water as an economic and social good; ii) excessive reliance on government for water and wastewater services; iii) fragmented management of water between sectors and institutions with little regard for conflicts or complementarities between social, economic and environmental objectives; iv) inadequate recognition of the health and environmental concerns associated with current practices.

42. A new approach for water management within a sustainable development framework is necessary which:
- Addresses quantity and quality concerns through an integrated approach;
- Integrally links land use management with sustainable water management;
- Recognizes freshwater, coastal, and marine environments as a management continuum;
- Recognizes water as an economic and social good and promotes cost-effective interventions;
- Supports innovative and participatory approaches;
- Focuses on actions that improve the lives of people and the quality of their environment.

43. A key element to this is the concept of a "management continuum". All types of water, freshwater (surface and groundwater), coastal and marine, must be included in a unified management approach as they are inextricably linked; also there must be a broader recognition of "downstream effects" from human activities. A key link with this is land-based activities and their impact on water resources, and ultimately on the coastal and marine environment (Serageldin, 1995).

**Understanding water quality problems**

44. Land-water processes are intimately linked. A land management decision is a water resource decision. The basic fact that water runs downhill provides the most essential building block for evaluating natural and human influences on hydrologic processes. Processes affecting water quality and quantity must be understood along water pathways in the landscape. Upstream impacts affect downstream users. The most natural framework for this evaluation is the drainage basin. Evaluation of water quality evolution along pathways throughout a basin provide information on processes not only related to natural occurrence, transport and transformation, but also human influences caused by land and water use through alteration of the landscape, water abstraction, and waste disposal. Given the continued and accelerated human intervention in natural ecosystem functions, it is necessary to identify critically important relations among factors effecting ecosystem degradation, and most notably water quality degradation. The effects of human interventions in the environment, primarily land and water management, on changes in water quality are not well understood particularly as human interventions also may have positive benefits in slowing and possibly reversing degradation.

45. Process understanding and associated monitoring and modelling are the basis for policy and management decisions (Figure 2). Contrasting water quality responses in similar climatic and hydrogeologic settings, but with differing resource management actions will provide tools for increasing management efficiency and improving the scientific basis for resource management. Understanding important aspects of ecosystem function and developing associated management strategies at a range of temporal and spatial scales and for a range in biophysical

conditions is the goal of this project. Higher levels of understanding throughout the range of conditions and scales (Figure 3) result in disproportionately increased costs as the number of sites and individual studies needed to address uncertainties and linkages increase. The basic framework is to work across both temporal and spatial scales within drainage basins representative of the types of conditions for major biophysical units. Intensive investigations will provide transfer value on processes for management and monitoring of other drainage basins in related units.

46. Despite the growing development of water quality surveys, since the 1970's in many countries, and through the development of the GEMS/Water programme in 1978, many questions remain unanswered. Many of these questions are addressed at the local scale, i.e., from streams to small rivers. The first set refers to the pollutant pathways and interactions with the atmosphere, the biosphere, the soils and aquifers. In each of these, transfer and reaction and other key controlling factors should be identified, model parameters or constants should be measured or estimated at a variety of temporal and spatial scales and for a range of biophysical zones existing at the earth's surface. However, most of the development of water quality science is still conducted in a few characteristic environmental or biophysical zones, such as the humid temperate zone. Process-level studies need to be evaluated for all environmental conditions, particularly where water quality is already affected or at risk.

47. After process models are validated, they must be developed to operate reliably on a larger basin scale, which means simplification of structure, a change in parameterization and linkage to economic information. Such models may still contain major process components, but other components will temporarily be empirical algorithms linking a constituent concentration or load with key environmental factors such as water runoff, soil moisture content and economic indicators. Such models may be used to fully simulate the water quality over a large basin, some of them are just statistically distributed (e.g. by hydrological stream order), or are fully geographically distributed at various resolutions. In all cases, for rivers, lakes, and for groundwater, the water flow models are a prerequisite to any water quality model, although some empirical models may not need highly developed hydrodynamic models.

48. Another limit of water quality knowledge at the subregional scale is the spatial resolution of available economic statistics; i) these statistics are known over administrative and political limits that do not correspond with basin boundaries, and ii) the resolution is generally very coarse and variable. The population distribution may be known at the municipal level, but in most global reports it is given at the country level. Pesticides and fertilizer use data generally are also given at the country level, which is too coarse for many process models. Some information, such as the major treatment plants, major point sources of pollutants, and dams, should be known precisely.

49. Remote sensing is a very important tool that may be used to fully describe the landscape, e.g., relief, drainage network, soil type, and vegetation, at various resolutions. However, except for a few variables such as total suspended solids, chlorophyll, and temperature, and in only some surface waters, remote sensing cannot give much information on water quality. Concurrently, continuous measurements of water quality are still very rare and costly, and also

limited to a few variables. Water quality information is, by nature, discontinuous in both time and space.

50. At the global scale, there is a need for a full description of the water quality issues. Existing global assessments are still mostly qualitative and present many gaps in undocumented regions, as for most of Africa. Mapping water quality issues at a global scale implies a systematic regionalization based on biophysical provinces, and using some of the available indicators, such as population density, gross national product or energy consumption, and waste-water treatment rate.

51. Because hydrologic and hydrochemical processes are linked in biophysical regions, global water quality needs to be presented and evaluated for biophysical/geophysical regions rather than political or geographic regions. The current geo-political clustering of data often masks important information related to cause and effect for biophysical regions contained within the cluster. All major "pollution hot-spots" should be inventoried and geo-referenced. Typologies linking biogeographic features, economic production, and qualitative indicators, such as enforced environmental policies and regulations, should be established and mapped at the global scale. Geographic Information Systems (GIS) are important tools at the regional to global levels. GIS will enable the reconstruction of the past global evolution of water quality provided that key indicators are also available, and the prediction of future trends. Combination of multiple water quality issues also should be considered, faced with the future trends of water quantity demand at the global scale.

52. The World Health Organization has published documents concerning the rapid assessment of sources of air, water and land pollution for quantification of pollution sources. The main aspects of these publications are that they focus on the source inventory aspects of the management process, provide control options and they introduce easy-to-use water and air quality models. The Rapid Assessment procedure has been found particularly useful in developing countries in the design of environmental control strategies and policies using relatively modest resources. The rapid assessment procedure is most useful in making an initial appraisal of the sources and levels of emissions from an area that has little or no previous pollution load data. It is also useful in selecting priority areas to conduct more extensive monitoring surveys; for conducting case studies as part of public health programmes directed at pollution control; and for formulating pollution control policies and regulations for national environmental health activities (Economopolous, 1998).

53. In addition to action required to improve scientific understanding of the processes in water bodies exposed to severe pollution loads, it is important to consider actions for increased understanding of wastewater minimization, re-use and recovery. In particular, it is important to consider wastewater as a resource.

54. In many arid and semi-arid regions, water has become a limiting factor, particularly for agricultural and industrial development. Source substitution appears to be the most suitable alternative to satisfy less restrictive uses, allowing for the use of better quality water for domestic supply. Whenever water resources are not fully available to satisfy demand, reclamation and use of wastewater should be promoted for urban, industrial,

landscape/recreational purposes, and particularly for irrigation of crops since it involves large volumes of water. Governments should be prepared to establish and control the process within a broader framework of a national effluent use policy, forming an integral part of the national plan for water resources management. Lines of responsibility and cost allocation principles should be worked out among the various sectors involved. Health, legal and regulatory issues should be conveniently addressed; socio-cultural as well as religious aspects should be fully considered during the planning, implementation and operational phases of reuse systems in order that the practice is accepted by users and the public in general.

**Management tools and instruments**

55. Management tools are a necessary means to address identified problems. These are numerous and include regulations, management procedures and by-laws, water quality standards, economic instruments, monitoring systems, water quality modelling tools and environmental impact assessments and cross-sectoral coordination. Whatever management tools are chosen, there must be a balance between the input of resources against the severity of the problem and available resources and they must ensure sustainability (Larsen and Ipsen, 1997).

56. In terms of monitoring, the process of monitoring and assessment should be seen as a sequence of related activities (Figure 4) that starts with the definition of information needs and ends with the use of the information product (UN/ECE, 1996). It is very important to have cost-effective water quality monitoring networks which provide the necessary data for decision making. Problems associated with data are discussed in Section C.

57. There has been a revolution in monitoring practices and technologies, especially in the use of cheap screening tools. Agencies need to learn how to design, modernize and implement data programmes so that client needs are served. Modernization also includes the use of modern laboratory methods and of alternative biological measures that are appropriate for that country, multiple techniques within monitoring programmes, data quality objectives, optimization of the national network, information systems, quality control, quality assurance, accreditation, good laboratory practice and reporting.

## E. ACTION PLAN FOR WATER QUALITY MANAGEMENT

58. The preceding sections have described various elements and aspects of what could be considered as an action plan for water quality management. Some elements are identical to elements from traditional master plans, but contrary to prescriptive and rather rigid master plans the action plan concept provides a flexible and dynamic framework for development and management of water resources. It is very important to recognize the dynamic nature of the action plan concept because a significant value of the concept lies in its flexibility. The action plan should be continuously monitored and adjusted in order to take account of recent development trends. Only a flexible and non-prescriptive approach will allow for such changes.

59. One of the main results of the action plan is a list of actions proposed for implementation in order to achieve the goal of effective and sustainable water quality management. The actions can typically be organized according to the following categories (Figure 1):

- Actions supporting development of an enabling environment, which is a framework of national legislation, regulations and local by-laws for encouraging sound management of water pollution and constraining potentially harmful practices;
- Actions supporting development of an institutional framework, which allows for close interaction between national, intermediate and local levels;
- Actions enhancing planning and prioritization capabilities that will enable decision makers to make choices between alternative actions based on agreed policies, available resources, environmental impacts and the social and economic consequences.

60. Across all categories training and capacity development may be an integrated element of the proposed actions. As well as skill-based training related to developing assessment capabilities, in order to carry out the functions described in the short term strategy, there may be a need for various training, education and information activities at various levels, such as orientation programmes, curriculum development and extension training.

61. In accordance with underlying principles of the government as an enabler in a demand-driven approach and management at the lowest appropriate levels, a structure is called for that facilitates decentralization of management. National agencies should be concerned with essential functions not to be dealt with at other levels, and should act as enablers that review and revise the overall structure so that it responds to current needs and priorities.

62. The recommended framework should be one which attempts to strike a balance between national and local levels in carrying out the identified management functions previously outlined. The envisaged organizational framework should as far as possible build on existing structures.

*Action plan implementation*

63. Several UN programmes, commenced in the 1970's, are providing water quality assessments, which clearly demonstrate that the quantity and quality of water available for domestic, industrial and agricultural use is now a strategically important global issue. A summary of major programmes is given in Annex I. A recent UNEP report, entitled the Global Environment Outlook, identified water quality as an issue of highest priority for the management of the global environment (UNEP, 1997). The UN agencies have been actively involved in data collection and analysis for two decades, and all of their most recent assessments support these rising concerns and the urgent need for action to address the global water quality issue. The UN Programmes across its agencies that would be essential collaborative links to this comprehensive global water quality initiative are the Global Environment Monitoring System for water (GEMS/Water), the Hydrology and Water Resources Programme (HWRP) of WMO, the International Hydrology Programme (IHP) and the International Action Programme on Water and Sustainable Agriculture Development (IAP-WASAD). The water quality initiative proposed herein would build on activities of other programmes, e.g., IHP and GEMS/Water, and would continue to interface with them. However, this programme would expand the research from data collection, compilation and statistical analysis of current status and trends to scenario analysis and a compilation of robust management strategies for the future within diagnostic basins. The diagnostic basins, in turn, characterize specific climate/hydrological conditions and associated human pressures and impacts.

64. The proposed water quality programme should focus on understanding the biophysical processes controlling quantity and quality of water supply in these basins. This process knowledge, incorporated into simple, robust, mathematical models, will allow basin behaviour to be simulated and scenario analysis conducted to build understanding of impacts of possible management strategies on the supply and quality of water. Figure 3 may help place in context what has been achieved in current UN global monitoring and assessment programmes and how this initiative will be built upon to provide the predictive tools, analysis capability and understanding, essential to ensuring an adequate supply of quality water for the global needs as sought by the Agenda 21 strategy.

65. The GEMS/Water programme, which to date is the only international programme strictly devoted to water quality, has significantly contributed toward a global appreciation of the current water quality status and trends by working with long-term fixed-station monitoring and by providing some synthesis at the regional scale (levels B and C of Figure 3). Statistical analysis has provided a generalized status for geo-political regions and given a broad overview of trends. The IHP has contributed, along with national efforts, to understanding the hydrological and ecological processes that effect water quality as represented by levels C and D in Figure 3. The efforts for process level understanding under the IHP are limited, and full understanding or a sequential approach through data collection and analysis was never within its scope. Workshops and symposia, supported by the International Association of Hydrological Sciences, among others, have contributed to communication among scientists working on specific water quality topics. What the proposal herein highlights is a more comprehensive generation and application of quantitative process knowledge to the prediction of water quality trends and scenarios than heretofore has been proposed. Furthermore, the proposed programme will use an examination of the global basins in terms of the basins representing particular climatic, hydrogeologic and biophysical behaviour in response to a range of anthropogenic stresses. The vulnerability of water resources to water quality degradation as a consequence of a set of demands and stresses are determined by the biophysical processes that operate in the particular region. Each hydrogeologic region can be expected to respond differently to anthropogenic stress and to require specific management strategies to slow or reverse water quality degradation.

66. The basins will not be analyzed in terms of national and geo-political boundaries alone but will be treated as hydrogeological entities subjected to a set of human demands. This approach, where the work moves between level D and C of Figure 3, will provide predictive capacity and robust management strategies, and therefore, increased "capacity to deal with complex water management questions" as sought by the strategy arising from Agenda 21. The proposed programme will be designed to ensure that data are appropriate for predictive process models to be used to examine the impact of policy, the currently available management options, and alternative scenarios. Expensive data collection can be carefully targeted, costs reduced and emphasis given to high quality, data collection, analysis and processing procedures.

*Developmental considerations*

67. Interventions must move from curative to preventive. The costs of inaction, mitigation and restoration are high. By changing management approaches to preventive rather than curative,

prevents expensive problems from occurring and promotes the sustainable use of diverse and fragile resources.

68. Co-operation to avoid conflict by competing sectoral demands is vital. Transboundary pollution and the diverse demands on water availability are important causes of conflict. Efforts must therefore be refocused on international cooperation for both water quality and quantity issues.

69. Incentive structures must be built into the management approach. These incentives must encourage efficiency and reduce environmental damage. Pollution prevention must be promoted by adoption of efficient process technology, waste minimization, recycling and resource recovery and high operation and maintenance standards. The 'Polluter Pays Principle' and the 'User Pays Principle' should be actively promoted to encourage polluters to adopt cost-effective measures.

70. Environmental assessment should be conducted for all proposed actions to provide a basis for integration of environmental concerns into the project design process. They should evaluate all alternative actions. They provide an effective means for establishing frameworks for environmental mitigation and monitoring plans. They must integrate resettlement plans and measures to conserve cultural heritage.

71. Investment in human resources and training programmes is critical for improving water management. The quality of long-term benefits from any programme or project is fundamentally related to the institutional capacity and human resources available for its implementation. Experience must be drawn from scientists and engineers but also from administrators, economists, financial managers and the social sciences.

72. It is important that innovations must move from piloting to mainstream. There must be a change in principles, practices and technologies of water quality management programmes which will promote and test pilot innovations and disseminate experiences to allow benefits to be realized at an operational level.

73. For successful planning and implementation of projects, participatory approaches are recommended. Planning must occur at the lowest appropriate level, be demand-based and representatives from all sectors of society which will be affected must be involved.

Acknowledgments

This paper has been assembled by WHO on behalf of the UN agencies collaborating on water quality issues, particularly those organizations co-sponsoring the global water quality monitoring programme GEMS/Water. The paper is largely based on document ACC/SWR/1997/3, entitled "A Comprehensive Global Water-Quality Initiative", which was submitted by UNESCO to the Eighteenth Session of the ACC Sub-committee on Water Resources in Vienna, 1-3 October, 1997. The document ACC/SWR/1997/3 was prepared by a Water-Quality Task Group at UNESCO, 7-11 July, 1997 with the following membership: Drs N. E. Peters (Chairman), S. S. D. Foster, T. C. Hazen, M. Meybeck, V. Tsirkunov, J. Williams, M. Bonell (UNESCO) and W. Rast and G. Schneider (UNEP).

The strategic and specific inputs on water quality monitoring and related subjects was provided by Dr E. D. Ongley, Director of the WHO/UNEP GEMS/Water Collaborating Centre, Burlington, Canada. Text was taken from background papers he had prepared for the ACC Sub-committee meeting in Vienna, 1-3 October 1997. Water quality management aspects of the paper are based on material prepared by Drs H. Larsen and N. H. Ipsen, VKI Water Quality Institute, Copenhagen, for the Water Supply and Sanitation Collaborative Council Working Group on Water Pollution Control and the resulting publication 'Water Pollution Control - A guide to the use of water quality management principles' (Helmer and Hespanhol, 1997). Technical and language editing of the paper was by Dr E. Baroudy of the Monitoring and Assessment Research Centre at King's College London.

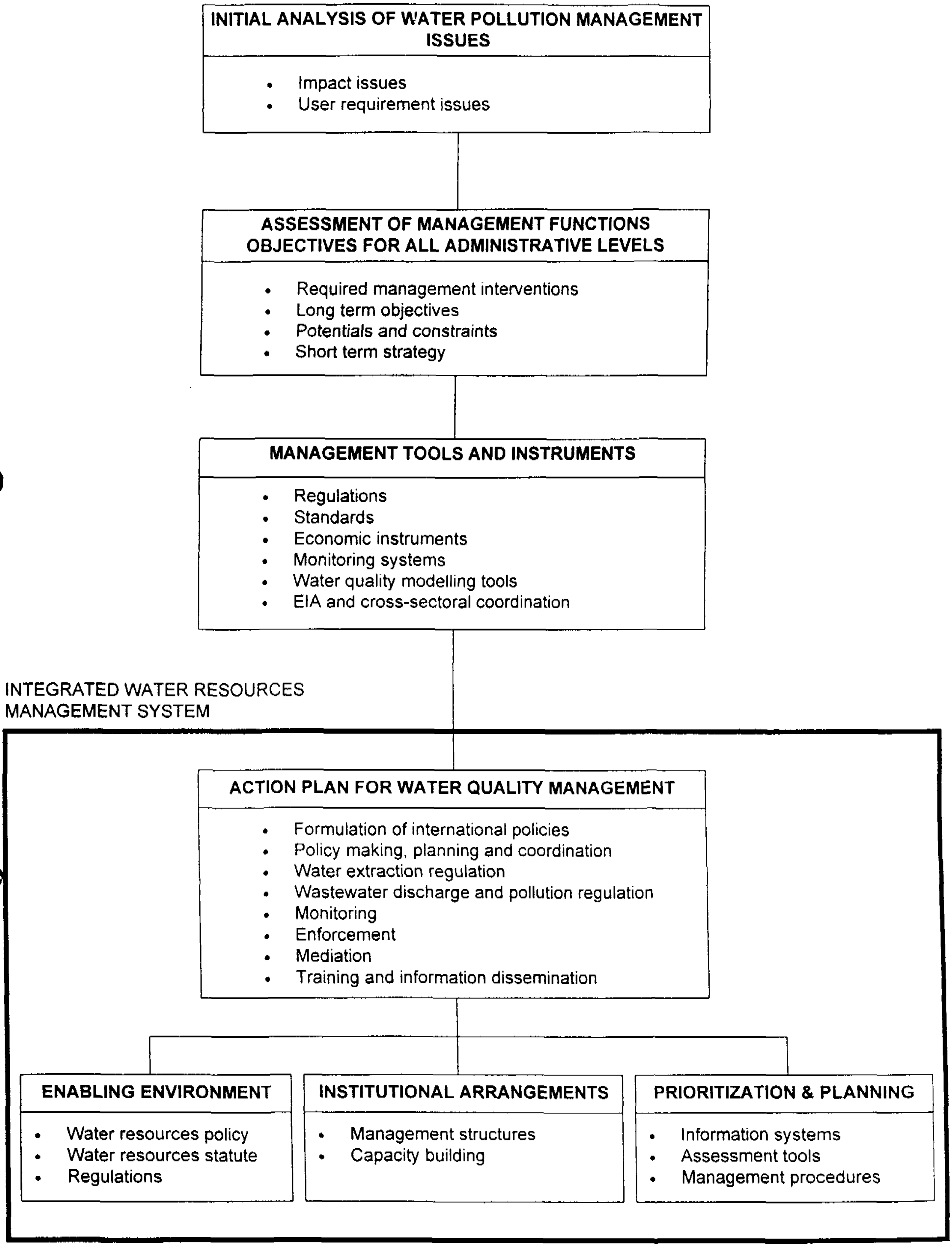



Figure 1 Elements and processes of an action plan for water quality management.

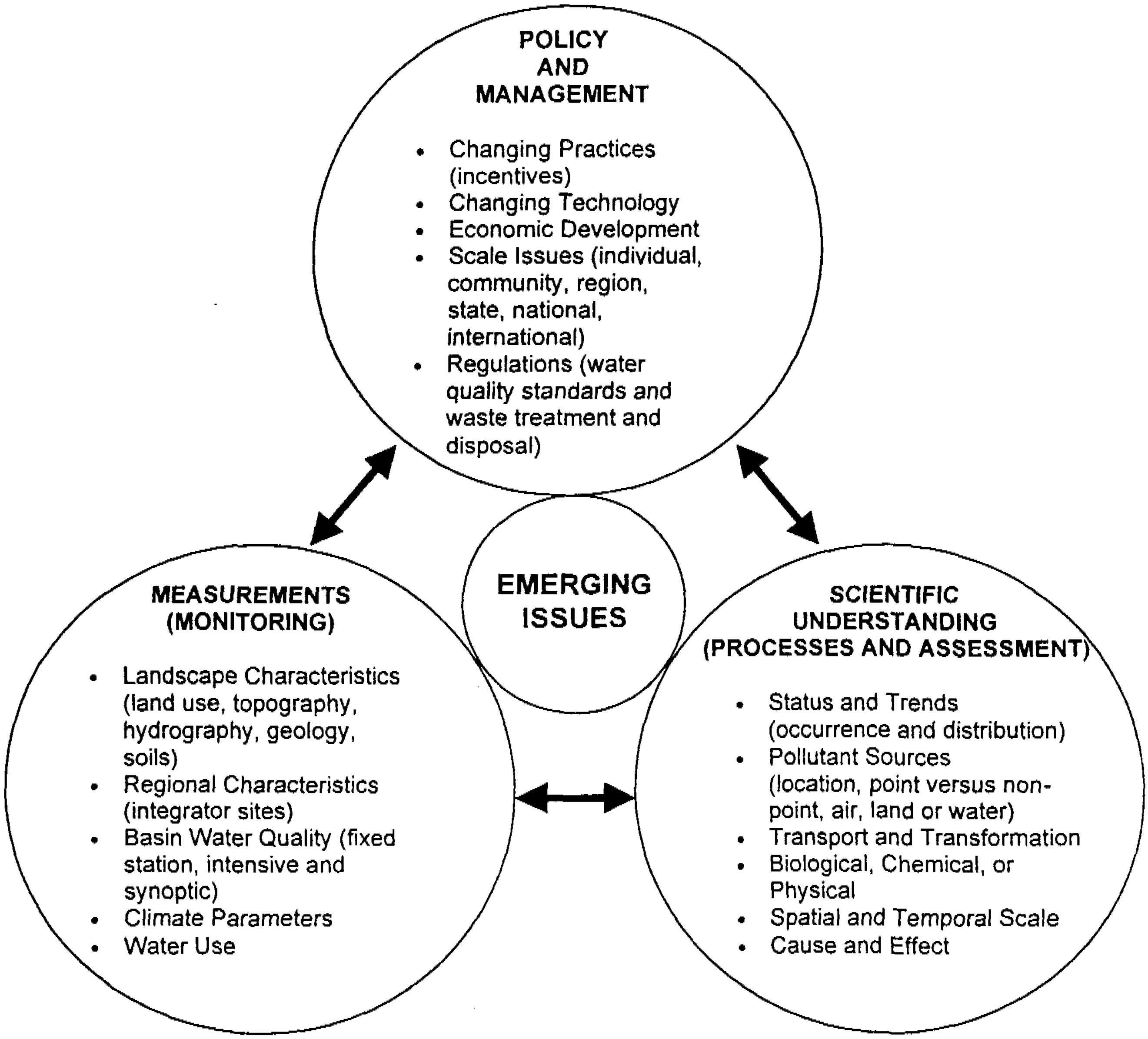



Figure 2 Scheme for management, scientific investigation and monitoring at a drainage-basin-scale for ecosystem function.

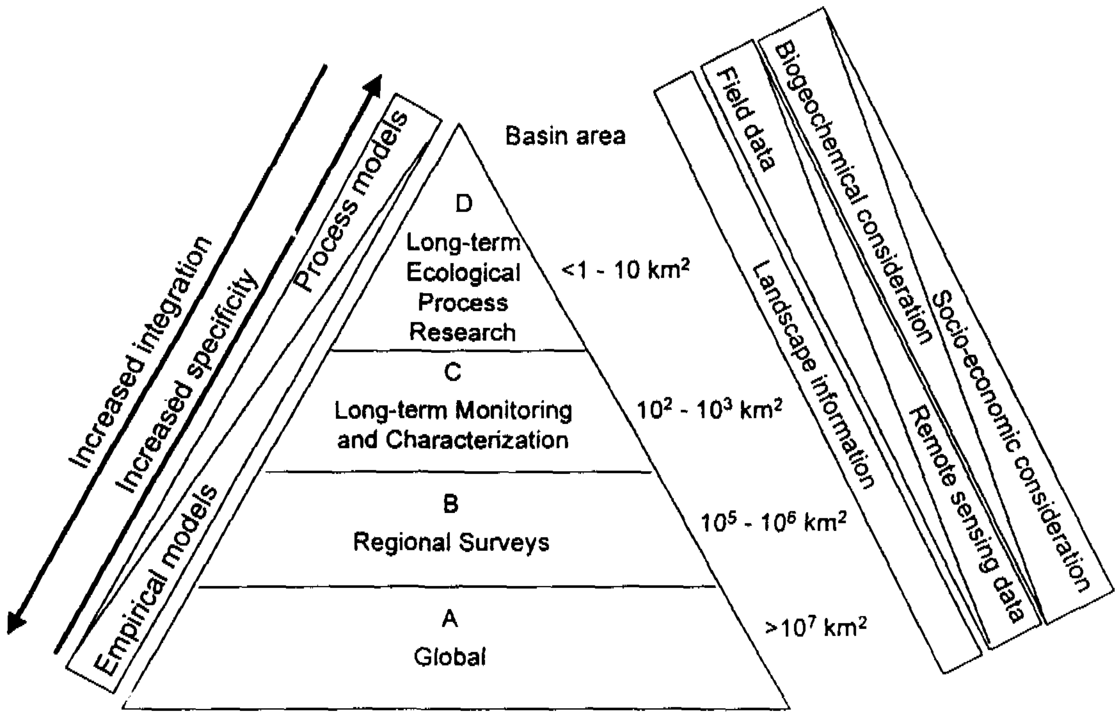



Figure 3 A framework for investigating water quality.

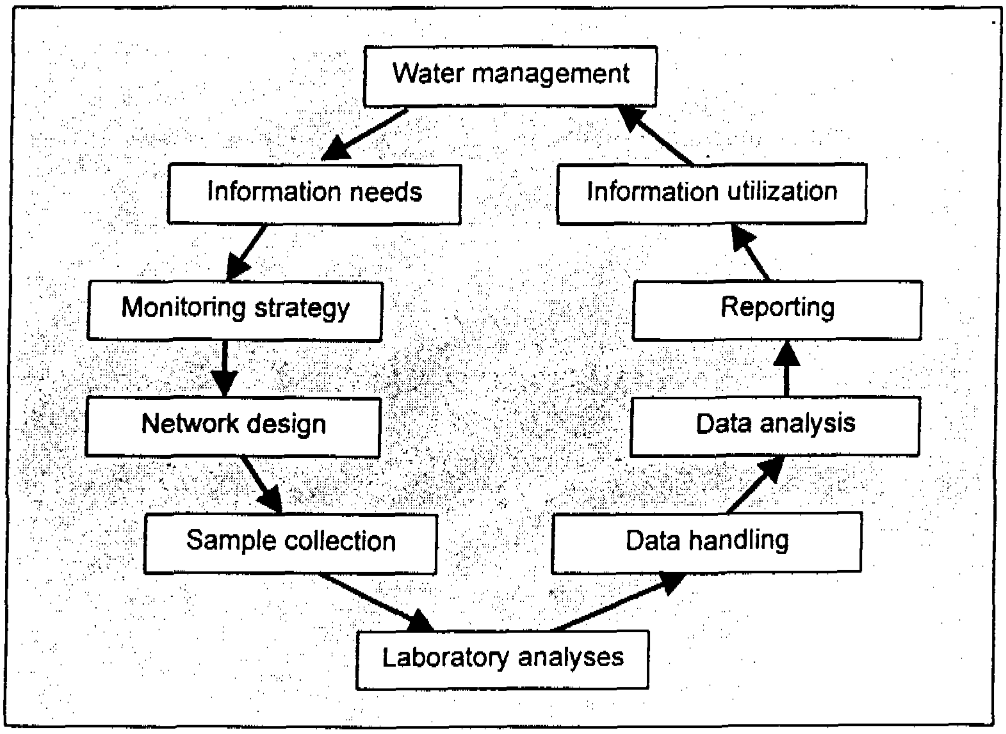



Figure 4 The monitoring cycle.

References

Alexandratos, N. (ed.) 1995. *World Agriculture Towards 2010: An FAO Study.* FAO, Rome.

Brown, L. R. 1996. *Tough Choices: Facing the Challenge of Food Scarcity.* The Worldwatch Environmental Alert Series, Norton & Company, New York.

Economopoulos, A. P. 1998. *A Rapid Approach to Effective Environmental Management.* Published on behalf of WHO, E. & F. N. Spon. (In press).

Helmer, R. and Hespanhol, I. (eds) 1997. *Water Pollution Control. A Guide to the Use of Water Quality Management Principles.* E. & F. N. Spon, London.

Larsen, H and Ipsen, N. H. 1997. Framework for Water Pollution Control. In: Helmer, R. and Hespanhol, I. (eds). *Water Pollution Control. A Guide to the Use of Water Quality Management Principles.* E. & F. N. Spon, London.

Larsen, H., Ipsen, N. H. and Ulmgren, L. 1997. Policy and Principles. In: Helmer, R. and Hespanhol, I. (eds). *Water Pollution Control. A Guide to the Use of Water Quality Management Principles.* E. & F. N. Spon, London.

Ongley, E. D. 1994. Global water pollution: challenges and opportunities. Proceedings 17. Integrated Measures to Overcome Barriers to Minimizing Harmful Fluxes from Land to Water. Publication No. 3, Stockholm Water Symposium, August 10-14, 1993.

Ongley, E. D. 1997a. Water quality: an emerging global crisis. Paper submitted to the United Nations ACC Sub-committee on Water Resources on behalf of the GEMS/Water Collaborating Centre, Burlington, Canada.

Ongley, E. D. 1997b. Water quality programme development. Paper submitted to the United Nations ACC Sub-committee on Water Resources on behalf of the GEMS/Water Collaborating Centre, Burlington, Canada.

Ongley, E. D. 1997c. The economics of water quality. Paper submitted to the United Nations ACC Sub-committee on Water Resources on behalf of the GEMS/Water Collaborating Centre, Burlington, Canada.

Ongley, E. D. and Kandiah, A. 1998. Managing water pollution from agriculture in a water scarce future. Proceedings of the 1997 Stockholm Water Symposium, August 11-14, 1997. (In press).

Serageldin, I. 1995. Strategic water resource management: Themes for a new millennium. Proceedings of the Fifth Stockholm Water Symposium, August 13-18, 1995.

United Nations, 1997. Comprehensive Assessment of the Freshwater Resources of the World. Report of the Secretary General. Commission on Sustainable Development, 5th Session, 7-25 April, 1997. Document E/CN. 17/1997/9.

UN/ECE, 1996. Task Force on Monitoring and Assessment. Guidelines on Water Quality Monitoring and Assessment of Transboundary Rivers.

UNEP, 1997. The Global Environmental Outlook. Oxford University Press, New York.

US EPA, 1994. National Water Quality Inventory. 1992 Report to Congress. EPA-841-R94-001, Office of Water, Washington DC.

United Nations Agency Programmes Dealing With Water Quality Issues: Collaborative Links Essential To A Global Water Quality Initiative

## GEMS/Water

A joint UNEP/WHO programme on global water quality was initiated in 1978, which promotes sustainable freshwater quality management. Its work revolves around:
- International cooperative data programme and monitoring;
- Data and information sharing;
- Global and regional assessments;
- Capacity building and technical cooperation;
- Advice to governments and international agencies;
- Information products;
- Partnerships.

The most recent statements (WHO/UNEP, 1991; UNEP, 1995) from the GEMS/Water programme indicate that the emerging water pollution issues are:
- Accidental pollution, wherein major industrial accidents result in large-scale contamination of a vital water body, will occur with increasing frequency;
- Land disposal of wastes and disposal of mine tailings. At present annual quantities of contaminants as heavy metals as a result of production and consumption are eight times greater than total new fluxes to oceans;
- Increased salinity and land degradation. Problems of salinity from dry land including irrigated agriculture and disposal of mine waste will continue to increase worldwide resulting in significantly increased land degradation and salt loads to freshwater resources;
- Water disinfection by-products. Contamination from halogenated organic compounds from chlorination in water supplies is an emerging issue.

GEMS/Water (Meybeck et al., 1989) provided the first global assessment of water quality. The GEMS/Water assessments indicated that gaps in the global monitoring programmes consisted of gaps in geographic coverage and measurements of key parameters. The programme also recommended that heavy metal and organic micropollution be included and that the lack of monitoring African, Latin American and South-East Asian regions be addressed. The assessment also recommended that work move beyond data gathering, monitoring and statistical analysis toward a better understanding of the basic biogeochemical process and interactions that fundamentally determine water quality. The need for quantitative modelling of catchment, stream and groundwater processes was seen as an important step forward.

In the GEMS/Water report (WHO/UNEP, 1991) Water Quality, which was published for the Dublin conference on Water, a Global Strategy for Water Quality Management, was outlined. Central to this strategy was a focus on water monitoring and problem assessment coupled to a research and development programme. The programme gave priority to:
- Elimination of health risks from wastewater re-use in crop production;

- Use of water of marginal quality for irrigation or groundwater replenishment;
- Simplified procedures for water quality monitoring and assessment;
- Study of distribution pathways of inorganic and organic micro-pollutants, particularly agrochemicals in aquatic systems;
- Ecotoxicological studies of the long-term effects of harmful chemicals on aquatic biota;
- Development and applications of simplified mathematical models of water quality for management purposes.

Critical to these research and development objectives was the development of institutional capability and the development of twinning and networking of research centres to improve communication, coordination of monitoring, data analysis, model evaluation and application to water quality management.

During its nearly twenty years of operation the major achievements of GEMS/Water are:
- Establishment of a global network of dozens of national institutions dealing with water quality surveys in 40 countries from all continents including the former USSR, China, India, Indonesia, and Brazil - connected through regional meetings, training courses, the former Water Quality Bulletin, and the GEMS/Water Newsletter, both published at the National Water Institute in Burlington, Ontario;
- Establishment of the only existing global data base on water quality for rivers, lakes and groundwater, including millions of data points from about 250 designed stations. This data base is handled by Environment Canada at Burlington, Ontario, and is accessible through the Internet;
- Training of one hundred water quality engineers and managers from all continents in English, French, Arabic, Spanish and Russian. GEMS/Water Training packages to water quality survey and management are now available from several British Institutions;
- Conducting analytical quality control (AQC) on certified samples sent to dozens of water quality laboratories in all continents. This global AQC programme has been managed by US EPA in Cincinnati;
- Editing of several books, manuals, and reports in the field of water quality assessment, and monitoring, at the regional scale (e.g., South East Asia and the former USSR) and at a global scale. The GEMS/Water monitoring manual is available in several languages, including English, Spanish, French and Russian.

Many countries, such as India, Malaysia, and Tanzania, developed their national water quality networks in the early 1980's on the basis of the GEMS/Water recommendations. However the overall activities of GEMS/Water, such as training and publication of the Water Quality Bulletin, have been dramatically reduced recently due to the lack of funds. Some of the major deficiencies of the programme are:
- Geographic gaps in data due to the inability to properly organize a satisfactory water quality monitoring programme in the least-developed countries, particularly in Africa, and to raise the monitoring level to the highest standards, particularly for micropollutants. Both of these require enormous specific funds that are lacking in the programme, and are better provided through bilateral funding and/or twinning. However, a specific programme on micropollutant analyses in deposited sediments, which primarily involves US and Canadian institutions, currently is being considered;

- Little effort was focused on the monitoring and assessment of groundwater and lakes/reservoirs and consequently, data for them are deficient in the GEMS data base;
- Many aspects of water quality, such as process studies, calibration and verification of water quality models for science and management, regulation and management, were not addressed in GEMS/Water.

**The UNESCO International Hydrological Programme (IHP)**

The UNESCO International Hydrological Programme (IHP) set down the detailed plan for 1996-2001 to include 8 themes which are relevant to the issue of water quantity and water quality, namely:
- Global hydrological and geochemical processes;
- Eco-hydrological processes in the surface environment;
- Groundwater resources at risk;
- Strategies for water resources management in emergency and conflicting situations;
- Integrated water resources management in arid and semi-arid zones;
- Humid tropics hydrology and water management;
- Integrated urban water management;
- Transfer of knowledge, information and technology.

**United Nations Conference on Environment and Development, Rio de Janeiro, 1992**

An important step was taken at the UN Conference on Environment and Development at Rio de Janeiro in June 1992 when freshwater quality became part of Agenda 21. Wherein it states that "the holistic management of freshwater as a finite and vulnerable resource, and the integration of sectoral water plans and programmes within the framework of national economic and social policy, is of paramount importance for action in the 1990's and beyond. To this end, water resources have to be protected, taking into account the functioning of aquatic ecosystems and the perenniality of the resource, in order to satisfy and reconcile needs for water in human activities.

**United Nations Economic and Social Council, Commission on Sustainable Development**

In 1997, the WMO published on behalf of numerous UN and other International agencies, a 'Comprehensive Assessment of the Freshwater Resources of the World'. The actions and recommendations in this document were presented to the General Secretary of the UN Economic & Social Council, Commission on Sustainable Development. This document recommended:
- Managing water quantity and quality together in an integrated and comprehensive manner;
- Building up need expertise on water issues, among water uses and decision-makers at all levels, thus increasing capacity to deal with complex water management issues;
- Enhancing national water resources assessment capabilities and measurement networks and establish water resource information systems that empower people to understand the options available for sustainable urban, industrial, domestic and agricultural development in combination with environmental conservation;
- Establishing within existing institutions, especially the UN system, a global water information network to compile information with particular emphasis on water quality, water quantity and

water use. The institutions also should conduct regular global and regional water assessments. Water information programmes should be implemented at national and international level and should establish models to ensure compatibility between data of individual nations. The Commission on Sustainable Development should carry out periodic global freshwater assessments using existing networks of experts;

- Building international collaborative arrangements, such as:
    - Global Water Partnership
    - Water Supply & Sanitation Collaborative Council
    - World Water Council;
- Strengthening collaboration with non-governmental organizations;
- Developing north-south academic partnerships to build research capacity on a broad range of water-related issues, including those of quantity and quality.

WMO's responsibilities within the UN system concentrate on the collection and application of hydrological data, which concerns both surface water and groundwater, and covers both the quality and quantity of freshwater. These responsibilities are fulfilled by;

- providing guidance to countries through their National Hydrological Services on policies and techniques for monitoring water quality;
- assessing the current state of monitoring networks by country and globally;
- organizing technical meetings and publishing reports.

In this WMO collaborates with other international programmes, most notably GEMS/Water. It also works with other agencies to provide direct technical support to countries, such as the series of regional components which are being developed under the World Hydrological Cycle Observing System (WHYCOS). Each component includes the installation of state-of-the-art stations for monitoring climatic, water quantity and water quality parameters for compilation in real-time into regional and national databases for use in operation and planning. Funding for these projects has been provided by the World Bank, the European Union and certain donor countries.

References

Meybeck, M., Chapman, D. and Helmer, R. (eds) 1989. *Global Freshwater Quality - A First Assessment*. Basil Blackwell.

UNEP, 1995. *Water Quality of World River Basins*. Nairobi, UNEP Environment Library, No. 14.

WHO/UNEP, 1991. Earthwatch - Global Environment Monitoring System 'Water Quality'. Progress in the Implementation of the Mar del Plata Action Plan and Strategy for the 1990's.

**EXPERT GROUP MEETING**

**ON**

**STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT**

**27 - 30 January 1998**

**Harare, Zimbabwe**

# MAJOR WATER PROBLEMS AND ISSUES IN THE ESCWA REGION

**by**

**Omar I. Touqan**
**UN-ESCWA**

**Paper No. 14**

**Prepared for the**
**Department of Economic and Social Affairs**
**United Nations**

# I. INTRODUCTION

The lack of adequate water supply in the ESCWA members countries has considerably affected their growth and development. Scarcity of water resources in the region is attributed in general to the fact that most of the ESCWA members countries are situated in arid and semi-arid zones characterized by large variations in rainfall, limited surface water, and non-renewable ground water sources. Their variations contribute towards the inadequacy of water resources in each individual country.

Variety of remarkable of adjustments to water supply fluctuations and deficits has been made in the ESCWA member countries over the years. More recently, however, rapid population growth, socio-economic development, increased urbanization, and industrial and agricultural activities have placed great strains on the water resources, particularly in the GCC countries and Yemen. Many of the ESCWA member countries are now faced with the challenge of meeting increasing water demands in all sectors. While some countries have adequate water supply to fulfill short-term requirements, others have limited sources with few possibilities for developing additional supplies without relying heavily on groundwater mining and the use of non-conventional sources, which requires substantial financial and technological investment. The water situation is further complicated by the fact that substantial volumes of available surface and groundwater are being withdrawn from rivers and aquifers, some of which are shared between countries within and outside the ESCWA region.

In addition, the countries of the ESCWA region, with serious overdraft conditions as regards their water resources and unsolved problems of shared water basins among riparians, are living through the sequence of water quantity and quality issues with neck-breaking succession. Furthermore, they are doing so over a short period, as compared with over a century and half that the developed industrialized countries have taken to face the sort of problems currently afflicting the ESCWA region. Thus, situations, have arisen in many ESCWA member countries in which more advanced pollution issues appeared before control over traditional pollution sources had been successfully achieved. The people of the region know that they must give the highest priority to ensuring the satisfactory supply of "good" quality water that is so essential to their sustainable development. Therefore, with their water-poor region, they must exercise the greatest care in sustaining their water resources both quantitatively and qualitatively. The question of water quality and water quality control to provide "good" water, is a pivotal one that requires quick action in setting up the most affective water action plan, involving not only the much needed modern legislation but also viable management and organization.

Intensive use of both surface and groundwater resources to meet rising demand, has led to further exploitation of water resources in excess of natural renewability, as well as to the deterioration of water quality. This has compelled some of the ESCWA member countries to invest in the construction of hydraulic structures to store and regulate water flow, and water conveyance in the domestic sector. Excessive over utilization of available water sources in some of the ESCWA member countries has created water shortages. Rising demand is not only placing great strains on water resources, especially the most easily accessible sources, but also brings about an entirely new progression of environmental and technological concerns, and their associated development costs.

The water situation in most of the countries in the ESCWA Region has remained uncertai n and precarious for a quite considerable time. Also, present prevailing rates, at which water resources are developed and managed, to meet the ever increasing demand for water and to achieve sustainable economic development, are perhaps insufficient to impede the prevailing gap between water availability and demands. If such trend rates persist, the water situation will ultimately deteriorate in both space and time. Therefore, urgent issues, with new scope and approach for water evaluation, planning, development and management, should be addressed if the degrading water situation is to be avoided. Table 1 gives some basic parameters in order to perceive the magnitude of anticipated water resources challenges.

Solution to water shortages must be based on a number of factors including accurate information about water resources in the region; reliable assessment of water requirements in all sectors; strengthening of both institutional arrangements and capacity building; and the implementation of integrated water development and management approaches. Regional cooperation is particularly important in the case of shared water resources, both within and outside ESCWA member countries. Solutions need to be implemented at both the country and regional levels, taking into account the socio-economic circumstances and development needs of each country involved.

Currently there is a focus on many regional plans and policies prepared on the water resources of the region. The issues of water shortages resulting from inefficient use, degradation of water quality and ineffective public- and private-sector water resource management are considered to be the three priority issues identified for action in the region. The inadequacy of water quality monitoring in the region, together with the institutional incapabilities and the lack of legal and regulatory prowess, were duly identified. These observations were frequently recorded in many regional and national gatherings on water resources in the ESCWA region. The problem of degradation and depletion of water resources are identified as being of the highest priority among the environmental constraints in the region. A strategic objective of the regional plan is water quality improvement and efficient water use, which comes under one of the main goals of sustainable development.

Hence, the following strategic objective components are defined towards the solution of water problem in the ESCWA region:

Increase effective use of water;
Enhance water quality;
Improve water management.

*TABLE 1: PHYSICAL, RAINFALL AND LAND-USE PARAMETERS IN THE ESCWA REGION*

| Country | Area[1] | Population[2] (Million) | | | Annual population growth rate (%) | Average[3] Rain-fall (mm /year) | Agricultural Land-use[4] (1000 hectar) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1000km²) | 1990 | 2000 | 2025 | | | Total arable land | Rain-Fed | | Irrigated | | Forests | Pastures |
| | | | | | | | | 1990 | 2000 | 1990 | 2000 | | |
| Bahrain | 0.68 | 0.52 | 0.68 | 1.00 | 3.1 | 75 | 7 | | | 3.8 | 7.0 | - | 4 |
| Egypt | 1001.45 | 52.47 | 64.21 | 90.35 | 2.2 | 20-200 | 4452 | | | 2690 | 3945 | 2 | |
| Iraq | 438.32 | 18.92 | 26.34 | 50.00 | 3.4 | 50-650 | 11500 | 2493 | 1416 | 3257 | 4334 | 500 | 4000 |
| Jordan | 97.74 | 3.45 | 5.25 | 9.97 | 4.2 | 50-650 | 1450 | 1305 | 1205 | 60 | 75 | 125 | 100 |
| Kuwait | 17.82 | 2.04 | 2.64 | 3.77 | 2.8 | 30-140 | 163 | | | 1 | 1.2 | - | 1340 |
| Lebanon | 10.40 | 2.70 | 3.33 | 4.70 | 2.2 | 200-1500 | 350 | 275 | 275 | 70 | 70 | 95 | 10 |
| Oman | 212.46 | 1.50 | 2.18 | 4.75 | 3.4 | 80-400 | 56 | | | 46.2 | 56 | | 1000 |
| Qatar | 11.00 | 0.37 | 0.50 | 0.86 | 3.4 | 75 | 6 | | | 2.6 | 6 | - | 5 |
| Saudi Arabia | 2149.69 | 14.13 | 20.70 | 44.75 | 3.8 | 35-400 | 4500 | 385 | 400 | 201 | 426 | 1600 | 85000 |
| Syria | 185.18 | 12.53 | 17.87 | 34.08 | 3.6 | 150-1000 | 5864 | 3336 | | 531 | 1051 | 452 | 8531 |
| U.A.E. | 83.60 | 1.59 | 1.95 | 2.65 | 2.2 | 80-160 | 15 | | | 8.9 | 10.9 | - | 300 |
| Yemen | 527.97 | 9.20 | 13.22 | 28.17 | 3.7 | 10-1000 | 3708 | 3342 | 3400 | 408 | 608 | 125 | 16000 |

1 Source; UNESCO Statistical Yearbook, 1990.
2 Source; Egyptian Statistical Yearbook, 1992.
3 Source; ESCWA, 1992.
4 Source; Arab League, Economic Report, 1990.

This paper will focus on the recent development in the ESCWA region regarding prevailing water conditions such as water availability, water demand, water quality, etc. Then, special attention will be given to the difficulties faced by water manager regarding water planning, policies and strategies. Conclusions reached indicate that the region countries are in the process of developing various water strategies, plans and policies.

## II. WATER SITUATION IN THE ESCWA REGION

### A. Water Resources Availability

Availability of water resources varies from country to country within the ESCWA region, depending on the physiographical and hydrogeological setting. Among the ESCWA member countries, Egypt, Iraq, the Syrian Arab Republic, and Lebanon, have relatively dependable surface water sources in the form of major rivers and springs. Rivers flows in these countries originates both from within and outside the national boundaries. In addition to available surface water, water supply is supplemented through extraction from groundwater reserves in Egypt, Jordan, Lebanon, the Syrian Arab Republic, and the West Bank and Gaza. Jordan is faced with water deficits, and the West Bank, and Gaza have limited surface water and renewable groundwater sources to meet their needs. Relatively abundant surface water, and groundwater reserves are frequently renewed through rainfall, perennial river flow, and floods. The Nile in Egypt, the Euphrates and Tigris in Iraq and the Syrian Arab Republic, the Orentis and Litani in Lebanon and the Syrian Arab Republic, and the lower Jordan river in Jordan represent major water sources for domestic, industrial and agricultural requirements within these countries. In contrast, the GCC countries and Yemen, are characterized by a harsh desert environment and are devoid of rivers and lakes. The water resources consist of limited quantities of runoff resulting from flush floods, groundwater in the alluvial aquifers, and extensive groundwater reserves in the deep sedimentary formations. Some of these countries are rely on non-conventional water sources such as desalination of sea and brackish water, and limited use of renovated waste water (table 2).

Water allocation from the Nile river in Egypt is estimated at 56.5 billion cubic meters (bcm) per year, while the estimates for the Euphrates and Tigris in the Syrian Arab Republic and Iraq are 26.8bcm and 76.9bcm, respectively. 1/ 2/ 3/ The average surface water flow in Lebanon is estimated at 2.5bcm, 4/ while for Jordan it is 0.875bcm. 5/ The major problem associated with management of surface water is the transboundary nature of rivers shared between member and non-member countries. Typical examples are the Nile and Euphrates rivers, where the headwaters are located outside the ESCWA region. Lack of formal agreements for sharing flow from the Euphrates and Tigris rivers has created serious shortcomings in efficient water utilization. A number of large dams have been constructed on these rivers to regulate the water flow. Water stored behind the dams is the main domestic source for the domestic irrigation and industrial purposes in Egypt, Iraq and the Syrian Arab Republic and Iraq, and to a limited extent in Jordan and Lebanon.

Surface water in the extremely arid countries of the GCC countries and Yemen consist of runoff generated from flash floods. The average annual volume of water generated from flooding events is estimated at 5.3bcm.6/ 7/ The intermittent nature of flow renders it an unreliable source. The total average annual water generated in Saudi Arabia and Yemen are estimated at 2.2bcm and 2.1bcm, respectively. The amount of surface water available in Oman and the United

---

1/ Saad, Background document on the Implications of Agenda 21 for Integrated Water Management in the ESCWA region. 1995.

2/ Egypt Country Paper presented at the Expert Group Meeting on the Implications of Agenda 21 for Integrated Water Management in the ESCWA Region, 1995.

3/ Water Resources Data Base in the ESCWA Region, 1992.

4/ Lebanon Country Paper presented at the Expert Group Meeting on the Implications of Agenda 21 for Integrated Water Management in the ESCWA Region, 1995.

5/ Jordan Country Paper presented at the Expert Group Meeting on the Implications of Agenda 21 for Integrated Water Management in the ESCWA Region, 1995.

6/ Khoury, J., Water Resources in the Arab World and their Future Projection. Symposium on Water Resources and Utilization in the Arab World, Kuwait, 1986.

7/ Abdulrazzak, M.J., Water Supplies Versus Demand in Countries of the Arabian Peninsula. Journal of Water Resources Planning and Management, May/June 1995.

Arab Emirates was estimated at 0.92bcm and 0.12bcm, respectively. The remaining GCC countries have only negligible amounts of surface runoff.

In general, utilization of surface runoff is directed towards traditional flood irrigation, especially in the southwestern region of Saudi Arabia and most of Yemen. Also, the regulated and unregulated flood flow is the main source of groundwater recharge to the shallow alluvial aquifers. More than 300 small dams have been constructed during the past two decades mainly in Saudi Arabia for the purposes of flood protection and groundwater recharge with a combined storage capacity exceeding 0.5bcm. Fifty two dams have been, or are being, constructed in Oman, the United Arab Emirates and Yemen for the same purpose.

Groundwater resources in the ESCWA region consist of water stored in both shallow and deep aquifers. Carbonate aquifers are predominant in Jordan, Lebanon and the Syrian Arab Republic while sandstone is prominent in northern Egypt and southern Iraq. Shallow quaternary wadi deposits located in the coastal plains and inland basins, as well as the alluviums of river flood plains, contain groundwater of good quality that is frequently recharged by perennial river flow. The shallow aquifers in Egypt's Nile delta, Iraq, Jordan, Lebanon, the Syrian Arab Republic and the West Bank hold groundwater reserves adequate to partially meet their respective water requirements. This region also contains aquifers of large aerial extent in which significant reserves of groundwater, with varying degrees of salinity, are stored. Water quality in relation to salinity, and their location at considerable depths, however, determine how the water can be utilized.

Groundwater reserves of the shallow alluvial aquifers also represent one of the main sources for many of the countries of the Arabian Peninsula. Alluvial deposits along the main wadi channels and flood plains of drainage basins make up the shallow groundwater system in Kuwait, Oman, Saudi Arabia, the United Arab Emirates and Yemen. Groundwater in the shallow aquifers is the only renewable water source in these countries.

Another main source of water in Bahrain, Kuwait, Qatar and Saudi Arabia is the non-renewable fossil groundwater stored in the sedimentary deep aquifers. These aquifers store significant amount of groundwater that are thousands of years old. The major aquifers are the Saq, Tabuk, Wajid, Minjur-druma, Wadia-Biyadh, Damman, Um Er-Radhuma, and Neogene. These aquifers cover two-thirds of Saudi Arabia and some of them extend into Bahrain, Kuwait, Oman, Qatar, the United Arab Emirates, and Yemen, as well as into Iraq, Jordan, and the Syrian Arab Republic.

Vast amounts of groundwater stored in the deep aquifers serve as a dependable source of water for irrigation and limited domestic requirements, in the central and northern regions of Saudi Arabia, and to a lesser extent, in the other countries of the peninsula. Although water in the deep aquifers is ample in quantity, the quality varies greatly, and is suitable for domestic consumption in only a few areas. Total dissolved solids range from 400 to 20,000 parts per million (ppm). Good quality water is stored in only the Saq, Tabuk, Wajid, and Damman aquifers. Although the estimated storage capacity of the deep aquifers is very large compared to annual extraction, currently there are constraints in some locations, associated with the allowable amount of decrease in artisan pressure, as well as limits on drilling and pumpage.

Non-conventional water sources are being utilized to supplement natural sources in order to satisfy water requirements in many of the ESCWA member countries. Brackish and sea water desalination has also become a viable alternative to meet rising demand. The GCC countries rely largely on desalination to help satisfy domestic water demand, and during the last 20 years these countries have become increasingly dependent on desalination to meet their water supply requirements. They have become, by necessity, world leaders in desalination of sea water and brackish groundwater for domestic consumption. The high salinity of groundwater in most of the GCC countries has compelled them to rely on desalinated sea water. Current desalinated water output, produced from numerous desalination plants located in Bahrain, Kuwait, Oman, Saudi Arabia, the United Arab Emirates, and Yemen, has reached 1.7bcm in 1995, compared with a world-wide capacity of 5.7bcm. Limited amount of desalinated water is being produced in Egypt, Iraq and the Syrian Arab Republic, mainly through the private sector, in comparison to the GCC countries where desalination is relatively more common. These capacities cover all desalination plants and include numerous units in private sector ownership for industrial or other purposes. Kuwait, Saudi Arabia and the United Arab Emirates, rely on large-scale plants capable of producing large volumes of water. Small plants with an estimated production of 33mcm exist in Egypt, Iraq, Jordan and the Syrian Arab Republic.

Existing waste water treatment facilities in many of the ESCWA member countries face difficulties in handling the ever increasing volumes of waste water generated by increased water consumption and urbanization. Waste water discharge from major urban centers is polluting shallow alluvial aquifers and the coastline, as well as causing urban water tables to rise. The main emphasis has been simply to dispose of waste water rather than to treat and reuse it, due to the extensive capital investment required for water treatment systems. Planning for full utilization of treated effluent remains in the early stages, and the regional treatment capacity is sufficient to handle only 40 per cent of the domestic waste water generated. However, reuse of renovated waste water is being practiced in varying degrees for urban landscaping and irrigation. The regional total reused volume of renovated waste water and drainage water is estimated at about 5.5bcm, which is far less than the treated and untreated volume usually available from domestic water consumption. Reuse of treated effluent is currently estimated at 60mcm in Egypt, 52mcm in Jordan, 50mcm in the Syrian Arab Republic. Approximately 4.8 bcm of drainage water is being used for irrigation in Egypt. The use of waste water ranges between 217mcm in Saudi Arabia to 9.1mcm in Yemen (table 2). The ratio of reuse to domestic and industrial water requirements range from 27.7 per cent to 30 per cent. In the region as a whole, renovated waste water meets a small fraction of water demand. Water resources estimates based on various hydrological and hydrogeological investigations carried out in the ESCWA region, are given in table 2.

The quality of drinking water and sanitation services in most of the ESCWA member countries has improved over the last 10 years, with the exception of Iraq, Lebanon, and Yemen. Progress has been made in achieving targets established for most urban areas, however, rural communities in the ESCWA region are still inadequately serviced in terms of safe drinking water, sanitation facilities and easy accessibility. The United Nations Economic Sanctions on Iraq have had a major adverse impact on water supply and sanitation facilities. Availability of safe drinking water and sanitation is also a major problem in Gaza. The armed conflict in Yemen had a detrimental impact on water supplies and sanitation facilities. Complicating the situation is the expectation of increased urbanization to nearly 75 per cent by the year 2025, which is expected to exert even more pressure on water supply and sanitation facilities.

## B. Water Demand

Imbalances between increasing water demand and existing limited water resources are being experienced by most of the ESCWA members countries. During the last decade, water demand in all sectors has increased dramatically as a result of high population growth, improvement in the standard of living, and efforts to establish self-sufficiency in food and industrial development. Currently, agriculture is the primary water consumer. Industrial water demand varies among the nations in the region, but is roughly equivalent to domestic water requirements.

Water requirements for all sectors in Egypt and Iraq are supplied mainly from river flow, while in Jordan, Lebanon, the Syrian Arab Republic and the West Bank and Gaza, both groundwater and surface water are used to satisfy requirements. Drainage and renovated waste water partially meet irrigation requirements in Egypt, Jordan and the Syrian Arab Republic.

Domestic and industrial water requirements for most of the GCC countries are satisfied through desalinization and a limited amount of groundwater from both shallow and deep aquifers. Yemen relies solely on groundwater resources for all sectors. In all GCC countries, and Yemen, agricultural requirements are met through abstraction of water from shallow alluvial aquifers located in the coastal strips and inland basins, and from deep aquifers covering most of the Arabian peninsula. In Saudi Arabia, rapid expansion of agricultural activities during the past two decades has resulted in substantial increases in water demand, leading to extensive mining of the deep aquifers. Likewise, agricultural water demand has sharply increased Bahrain, Oman, Qatar, and the United Arab Emirates, where groundwater reserves are being mined. This agricultural development is a direct result of government policies encouraging self-sufficiency in food production. Government incentives and subsidies have made it possible for large areas to be cultivated, placing great strain on the existing groundwater resources.

Total water demand for agricultural, industrial and domestic purposes in the ESCWA region reached 139bcm in 1990 (table 3), with the major consumers being Egypt, Iraq and the Syrian Arab Republic, requirements are expected to reach 179,4bcm by the end of the century, and 244.2bcm by the year 2025, as shown in (table 3). Agriculture accounts for the majority of water use, followed by the industrial sector.

Water requirements for the agricultural sector accounts for the majority of water use in the ESCWA region as a whole, with demand estimated at 117.8bcm in 1990, with a combined demand of 98.2bcm for the group of countries that include Egypt, Iraq, Jordan, Lebanon, the Syrian Arab Republic and the West Bank and Gaza, and 19.6bcm for the group of countries include Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, the United Arab Emirates and Yemen. In 1990, the percentage of agricultural demand ranged from 62 to 90 per cent of the total water demand in the northern ESCWA region, while in the south it ranged from 21 to 93 per cent, as shown in (table 4). Agricultural water demand in the ESCWA region is projected to reach 150.4bcm and 187.5bcm in the years 2000 and 2025, as shown in (table 2).

Industrial activities in most of the ESCWA member countries have also contributed to increases in total water requirements, although not as dramatically as the agricultural sector. Industrial water demand reached 10.5bcm as of 1990 in Egypt, Iraq, Jordan, the Syrian Arab Republic, West Bank and Gaza and only 0.3bcm in the GCC countries and Yemen. The percentage of industrial water demand ranged between 0.4 and 11.3 per cent, with the smaller percentages being reported for the GCC countries. Countries with relatively well established industrial infrastructures include Egypt, Iraq and the Syrian Arab Republic. Industrial establishment is still fairly limited in the southern region. Industrial demand is projected to reach 14.6bcm and 25.6bcm in the years 2000 and 2025, respectively, with the highest demand being by Egypt, Iraq and the Syrian Arab Republic.

Industrial production structure in most of the ESCWA member countries is geared towards consumer goods and petroleum refinement. Many industries in the region, especially in Egypt, Iraq, Jordan, Saudi Arabia and the Syrian Arab Republic, rely on raw materials derived from agricultural product. Most industrial activities are confined close to major urban centers, requiring competition with the domestic sector to satisfy water requirements. In urban areas with concentrated industrial activities, industrial water requirements represent the major water consumer in relation to domestic requirements. In most of the GCC countries, field development and petrochemical industries are considered to be water-use intensive. Industries in Egypt and Iraq utilize surface water from major rivers, while the remaining ESCWA member countries rely on groundwater supplemented with surface water, desalinization, and a limit amount of recycled water.

Domestic water requirements represent only a small fraction of total water requirements in the ESCWA member countries. In 1990, domestic requirements were estimated at 10.5bcm, which is expected to reach 14.4 and 30.9bcm in the years 2000 and 2025, respectively, as a result of increased population growth and improved standard of living. Domestic demand has been estimated at 7.7bcm for countries with large populations such as Egypt, Iraq, the Syrian Arab Republic and Saudi Arabia, which represents 4.7 to 34 per cent of the total water demand. In comparison, domestic demand for the remaining countries was estimated at 2.7bcm, accounting for a range of 5.8 to 77 per cent of total demand, as shown in (tables 3 & 4).c

Based on current trends and projections, water demand for each individual country is shown in (table 2). Water shortages are expected to increase as a result of increased demand and limited renewable supplies in most ESCWA member countries. Current water resources such as perennial surface water, renewable groundwater, desalinization, and reclaimed waste water are sufficient to meet expected water demand. Thus, in order to offset the imbalance between supply and expected demand, mining of groundwater, especially from the deep aquifers, may be required to meet agricultural and other demands. Expected domestic and industrial demand increases in the next 30 years may also necessitate the construction of additional desalinization and treatment plants to produce water and treat waste water, for most of the countries in the region, especially the GCC countries, unless strict integrated management approaches including water conservation measures and effective management schemes are implemented, and good quality groundwater is used solely for domestic and industrial use.

If present domestic consumption patterns continue unaltered, most countries of the ESCWA region will be required to allocate financial resource towards the construction of hydraulic structures, distribution systems, and the construction of new desalinization plants and support facilities with capacities capable of handling increasing demand. A large number of waste treatment plants will also be required to handle the resulting wastes. This huge investment may result in considerable economic strain, especially in those countries with limited financial resources. However, proper planning and integrated development and management of water resources, along with just allocation of shared water sources through equitable agreements, will contribute significantly towards alleviating water deficits. Many countries of the region have already taken steps towards the implementation of management programs, including proper planning and conservation measures, to promote reduced water consumption and optimal allocation of water resources.

TABLE 2. *WATER RESOURCES IN THE ESCWA REGION, 1995*

*(Million cubic metres)*

| Country | Population | Conventional water resources | | | Non-conventional water resources | | | Total |
|---|---|---|---|---|---|---|---|---|
| | 1994 MN* | Surface water** | Groundwater*** | Subtotal | Desalination | Waste water reuse | Subtotal | |
| Bahrain | 0.55 | 0.2 | 90 | 90.2 | 75 | 9.5 | 84.5 | 174.70 |
| Egypt | 62.101 | 55500 | 650 | 56150 | 19 | 4900 | 4919 | 61069.00 |
| Iraq | 19.092 | 76880 | 1500 | 78380 | 7.4 | N.A. | 7.4 | 78387.40 |
| Jordan | 4.057 | 660 | 275 | 935 | 2.5 | 52 | 54.5 | 989.50 |
| Kuwait | 1.62 | 0.1 | 182 | 182.1 | 240 | 83 | 323 | 505.10 |
| Lebanon | 3.481 | 2500 | 12000 | 14500 | 1.7 | n.a. | 1.7 | 14501.70 |
| Oman | 2.049 | 918 | 10500 | 11418 | 32 | 25 | 57 | 11475.00 |
| Qatar | 0.532 | 1.35 | 2500 | 2501.35 | 92 | 25 | 117 | 2618.35 |
| Saudi Arabia | 18.18 | 2230 | 84000 | 86230 | 795 | 217 | 1012 | 87242.00 |
| Syrian Arab Republic | 13.733 | 22688 | 3000 | 25688 | 2 | 50 | 52 | 25740.00 |
| United Arab Emirates | 2.15 | 125 | 20000 | 20125 | 385 | 110 | 495 | 20620.00 |
| West Bank & Gaza | 2.238 | 30 | 150 | 180 | N.A | N.A | N.A | 180.00 |
| Yemen | 13.468 | 2000 | 13500 | 15500 | 9 | 9.1 | 18.1 | 15518.10 |
| **Total** | **143.251** | **163532.65** | **148347** | **311879.7** | **1660.6** | **5480.6** | **7141.2** | **319020.85** |

*Source*: Compiled by ESCWA Secretariat from country papers and international sources, 1994 and 1995.

* Demographic and related Socio-economic data sheets for the countries of ESCWA, No. 8, 1995.

** The flow of Tigris and Euphrates rivers will be reduces by upstream abstraction in Turkey.

*** Shallow Aquifer groundwater reserve will varying water quality.

n.a. Information is not available.

TABLE 3. *PAST AND PROJECTED WATER DEMAND FOR ESCWA REGION 1990, 2000 AND 2025*
*(Million cubic metres)*

| Country | 1990 | | | 2000 | | | 2025 | | | Total demand | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Domestic | Agriculture | Industrial | Domestic | Agriculture | Industrial | Domestic | Agriculture | Industrial | 1990 | 2000 | 2025 |
| Bahrain | 86 | 120 | 17 | 169 | 124 | 26 | 230 | 271 | 73 | 223 | 319 | 574 |
| Egypt | 2700 | 49700 | 4600 | 3100 | 59900 | 6100 | 4700 | 69100 | 10900 | 57000 | 69100 | 84700 |
| Iraq | 3800 | 40000 | 5600 | 4600 | 52000 | 7000 | 10500 | 66000 | 10500 | 49400 | 63600 | 87000 |
| Jordan | 190 | 650 | 43 | 340 | 1090 | 78 | 750 | 1090 | 175 | 883 | 1508 | 2015 |
| Kuwait | 295 | 80 | 8 | 375 | 110 | 105 | 670 | 140 | 160 | 383 | 590 | 970 |
| Lebanon | 310 | 750 | 60 | 550 | 1200 | 150 | 1100 | 1600 | 450 | 1120 | 1900 | 3150 |
| Oman | 81 | 1150 | 5 | 170 | 1270 | 85 | 630 | 1500 | 350 | 1236 | 1525 | 2480 |
| Qatar | 76 | 109 | 9 | 90 | 185 | 15 | 230 | 205 | 50 | 194 | 290 | 485 |
| Saudi Arabia | 1508 | 14600 | 192 | 2350 | 15000 | 415 | 6450 | 16300 | 1450 | 16300 | 17765 | 24200 |
| Syrian Arab Republic | 650 | 6930 | 146 | 1277 | 14820 | 480 | 3145 | 25000 | 1297 | 7726 | 16577 | 29442 |
| United Arab Emirates | 513 | 950 | 27 | 750 | 1400 | 30 | 1100 | 2050 | 50 | 1490 | 2180 | 3200 |
| West Bank & Gaza | 78 | 140 | 7 | 263 | 217 | 18 | 787 | 415 | 61 | 225 | 498 | 1263 |
| Yemen | 168 | 2700 | 31 | 360 | 3100 | 60 | 840 | 3800 | 137 | 2899 | 3520 | 4777 |
| **Total** | **10455** | **117879** | **10745** | **14394** | **150416** | **14562** | **31132** | **187471** | **25653** | **139079** | **179372** | **244256** |

*Source*: Compiled by ESCWA Secretariat [illegible]m country papers and international sources, 1994 and 1995.

TABLE 4. PROPORTION OF WATER DEMAND BY SECTOR TO TOTAL DEMAND IN ESCWA REGION 1990, 2000, AND 2025
(Percentage)

| Country | 1990 | | | 2000 | | | 2025 | | |
|---|---|---|---|---|---|---|---|---|---|
| | Domestic | Agriculture | Indusrial | Domestic | Agriculture | Industrial | Domestic | Agriculture | Industrial |
| Bahrain | 38.6 | 53.8 | 7.6 | 53.0 | 38.9 | 8.2 | 40.1 | 47.2 | 12.7 |
| Egypt | 4.7 | 87.2 | 8.1 | 4.5 | 86.7 | 8.8 | 5.5 | 81.6 | 12.9 |
| Iraq | 7.7 | 81.0 | 11.3 | 7.2 | 81.8 | 11.0 | 12.1 | 75.9 | 12.1 |
| Jordan | 21.5 | 73.6 | 4.9 | 22.5 | 72.3 | 5.2 | 37.2 | 54.1 | 8.7 |
| Kuwait | 77.0 | 20.9 | 2.1 | 63.6 | 18.6 | 17.8 | 69.1 | 14.4 | 16.5 |
| Lebanon | 27.7 | 67.0 | 5.4 | 28.9 | 63.2 | 7.9 | 34.9 | 50.8 | 14.3 |
| Oman | 6.6 | 93.0 | 0.4 | 11.1 | 83.3 | 5.6 | 25.4 | 60.5 | 14.1 |
| Qatar | 39.2 | 56.2 | 4.6 | 31.0 | 63.8 | 5.2 | 47.4 | 42.3 | 10.3 |
| Saudi Arabia | 9.3 | 89.6 | 1.2 | 13.2 | 84.4 | 2.3 | 26.7 | 67.4 | 6.0 |
| Syrian Arab Republic | 8,4 | 89.7 | 1.9 | 7.7 | 89.4 | 2.9 | 10.7 | 84.9 | 4.4 |
| United Arab Emirates | 34.4 | 63.8 | 1.8 | 34.4 | 64.2 | 1.4 | 34.4 | 64.1 | 1.6 |
| West Bank & Gaza | 34.7 | 62.2 | 3.1 | 52.8 | 43.6 | 3.6 | 62.3 | 32.9 | 4.8 |
| Yemen | 5.8 | 93.1 | 1.1 | 10.2 | 88.1 | 1.7 | 17.6 | 79.5 | 2.9 |
| **Average** | **24.3** | **71.6** | **4.1** | **26.2** | **67.6** | **6.3** | **32.6** | **58.1** | **9.3** |

*Source*: Compiled by ESCWA Secretariat from country papers and international sources, 1994 and 1995.

## C. Challenges Confronting Achievement of Water Balance

A critical analysis of the aforementioned information, regarding water resources availabilities and requirements for all purposes, indicate clearly an expected water imbalance for the years 2000 and 2030. Table (5) shows that only 65.5% of the overall available water resources in the ESCWA Region is developed and utilized. Also, if we consider the current water losses and low efficiency of the various water-systems due to the prevailing inadequate practices in utilizing the water for irrigation, domestic and industrial purposes, the above-mentioned percentage will be much lower. Therefore, in order to satisfy all water demands by the year 2000, the percentage of developed water resources to those available should be raised to 73%, on the assumption that all water losses can be technically avoided and the water-use efficiency can be practically promoted. The situation by the year 2030 will be much more challenging since it will require to develop all available water resources in addition to arranging for the provision of new water sources of about 25525 million $m^3$, or at a rate of about 850 million $m^3$ /year in the ESCWA Region.

Table (5) shows the water balance in each particular country in the region, indicating a high degree of variability of the percentage of readily developed water resources to those available. However, the high percentages recorded in some countries do not necessarily conceive appropriate development, but may be rather due to over-exploitation which results in water deterioration in both quantity and quality. On the other hand, apparent of surplus water resources in some countries, are impeded from being appropriately developed and conveniently used unless firm water agreements between these countries and the river riparians are endorsed, maintained and respected. This issue by itself, constitutes a major challenge. Also, the assumption of the possibility of developing all water resources estimated to be available remains doubtful besides challenging.

With the ever-increasing demands to water supplies, in respect to time and space, the term sustainable development tends to be thus relative in these two respects. However, in order to achieve a relative balance between water availability and demand in any particular country, the major challenges should be progressively tackled. Accordingly, the broad means of implementation that may enable overcoming the water-supply constraints comprise; among others, the following main activities:

1. Full respect and maintenance of whatever water-agreements between river-riparian countries.

2. Conservation and protection of various water sources, surface and ground water through establishing appropriate engineering structures.

3. Integration of water development and management.

4. Optimization of food production per unit volume of water through adapting bio-technicological means and crop-substitutions.

5. Rationalization of water usages, particularly in agriculture through introducing new irrigation techniques.

6. Development of non-conventional water-sources, e.g., re-use of agricultural drainage water, treatment of waste-water and desalinization salt and brackish-water, on in other words, promotion of water multipliers and recycling issues.

7. Adoption of realistic policies pertaining to water-usage allocations, within the frame work of the particular national water strategies and priorities.

### D. Water Quality Degradation

Deterioration of water quality within the ESCWA region has become a problem in recent years. This is due, in part, to increased water consumption which, in turn, results in increased waste production resulting in the degradation of water quality in both surface and groundwater resources. The decline of water quality results from a number of factors, the most important of which are: (a) increased discharge of untreated or minimally treated domestic and industrial waste water; (b) discharge from agro-processing plants; high levels of agricultural chemicals and salts in irrigation drainage water; (c) discharge of hazardous and toxic industrial wastes; and (d) overdraft of groundwater resources resulting in depletion, saline water intrusion and eventual water quality deterioration.8/ Together, these factors result in diminished water supplies in regions where water is already scarce. Over consumption of water, in the absence of sewerage networks in many of the major urban centers in the ESCWA region, results in water table rises which create major health and environmental concerns as well. Extensive farming activities in the delta and flood plains along large rivers such as the Nile and Euphrates, have resulted in water contamination by brackish and saline drainage water.

In view of this, it is evident that water development and use programs for the ESCWA region need to focus on the implementation of strategies and legislation governing water quality management. In the past, shortages in water supplies to meet rising demands have diverted attention from the problem of deteriorating water quality. Each ESCWA member country has different perspectives and priorities regarding water quality in relation to water utilization. In some countries, emphasis is placed on reducing pollution from domestic and agricultural sources, while in others the priority is simply providing adequate water supplies to meet rising demand, or preventing contamination of shallow and groundwater sources.

---

8/ ESCWA, 1995-14, Assessment of Water Quality in the ESCWA Region.

The status of water quality in the ESCWA region is currently affected by development activities and water use practices within each of the member countries. A recent survey of water resources in the area indicated increases in the level of pollution in all sources. In Egypt, for example, waste from the domestic and agricultural sectors is contributing to water quality degradation, depending on the location. In the Nile delta, drainage contaminated with agrochemicals and pesticides is affecting water quality in both surface and shallow groundwater aquifers. Lack of adequate authority to enforce laws governing the discharge of industrial and domestic effluent has contributed to increased pollution loads in surface water. Nearly four-fold increases in chemicals such as nitrogen, phosphate and potash fertilizers were detected between 1960 and 1988, are also contributing to contamination of shallow groundwater aquifers. Varying qualities of drainage water empty into the Nile, but nevertheless, the overall quality of water in the Nile is good for all purposes. There are some locations where pollution has temporarily exceeded the ability of the Nile to assimilate or dilute impurities. However, for the most part the quality of water in the Nile from the Sudanese border to the city of Cairo can be described as good.

Water quality in the Tigris and Euphrates rivers in Iraq depends on a number of factors including the quality of water originally received at the border crossing, the level of water use, and land resource characteristics. Water from the Euphrates is used mainly for irrigation purposes all along the river course and as a result water quality deteriorates in a downstream direction. Return drainage is one of the main causes of water pollution in Iraq. The lower part of the Euphrates is naturally prone to salinization as a result of this area being cultivated for centuries, coupled with poor drainage and natural soil salinity. In addition, other development activities in the lower reaches of the river have contributed to further reduction in water quality. Planned development activities in Turkey, the Syrian Arab Republic and Iraq, aimed at utilizing water from the Euphrates for irrigation of cultivated lands and expanded industrial development, are expected to contribute even further to water quality degradation, unless water quality management strategies are formulated and implemented.

In the Tigris river, development activities in the upper and middle reaches have drastically reduced the amount of flow, resulting in declining water quality. Irrigation return and flow from chemical and industrial centers, as well as untreated sewage, have contributed towards the general deterioration in water quality. Water quality in the upstream reaches of the river is good, but declines drastically in the lower reaches in Iraq, where the total dissolved solids may reach as high as 30,000 ppm near Basra.

Water in the Orentis river in Lebanon and the Syrian Arab Republic is used mainly for irrigation and industrial purposes. Major causes of pollution are untreated sewage along the river course, especially near the major urban centers of Homs and Hama in the Syrian Arab Republic. Health risks from water borne diseases are common along the lower reaches of the river.

The Litani river in Lebanon contains water of excellent quality which is being used to meet domestic water requirements for the city of Beirut, as well as other nearby villages and towns.

Sources of pollution include untreated sewage and industrial wastes from sugar factories, poultry farms, wineries and clusters of tanneries, as well as irrigation return flow in the Bekaa valley.

*TABLE 5. WATER BALANCE IN THE ESCWA REGION*
*(Million $m^3$/year)*

| Country | Total* Available W.R. | Total* Utilized (Developed) W.R. | Percent Utilized to Available W.R. | Water Demands for all Purposes | |
|---|---|---|---|---|---|
| | | | | Year 2000 | Year 2030 |
| Bahrain | 290** | 290** | 100** | 306 | 616 |
| Egypt | 68519 | 64500 | 94 | 69100 | 97767 |
| Iraq | [82007] | 46200 | 56 | 47337 | 74398 |
| Jordan | 884 | 712 | 80 | 1187 | 1606 |
| Kuwait | 758 | 654 | 86 | 1582 | 3526 |
| Lebanon | 2802 | 1200 | 43 | 1746 | 3172 |
| Oman | 2103 | 424 | 21 | 1056 | 2115 |
| Qatar | 195 | 199** | 102** | 249 | 513 |
| Saudi Arabia | 8760 | 4570 | 53 | 5979 | 13365 |
| Syria | [25279] | 6400 | 25 | 9330 | 14915 |
| U.A.E. | 797 | 577 | 72 | 1769 | 3150 |
| Yemen | 4902 | 2650 | 54 | 3358 | 7678 |
| TOTAL | 197296 | 128376 | 66 | 142999 | 222821 |

* Figure assumed representative to year 1990.
[] Pending prevalence of water agreements with river-riparian countries.
** Figures indicate over exploitation.

The countries of the Gulf Cooperation Council (GCC) and Yemen are faced with water quality deterioration of groundwater resources. The absence of dependable surface water has contributed towards the exploitation of shallow and deep groundwater aquifers. The promotion of agricultural activities with increasing areas of irrigated land, the use of pesticides and herbicides, are all contributing towards increased pollution levels in the shallow groundwater resources, especially in Oman, Saudi Arabia, the United Arab Emirates and Yemen. Discharge of treated and untreated effluent into wadi channels in excess of the magnitude designated for reuse also contaminates groundwater reserves. As groundwater quality deteriorates, its scope of use diminishes, thereby reducing supplies and intensifying water shortage. In addition, improper groundwater well design, where multi-aquifer systems are involved, contributes to the blending of water with different qualities, sometimes leading to deterioration of water that would ordinarily be of good quality. The impoundment of flood water behind dams, for the purposes of flood control and groundwater recharge, also contributes to quality deterioration of groundwater if the water is stored behind dams for long periods of time. This may be particularly true in Oman, Saudi Arabia, the United Arab Emirates and Yemen where impounded water may undergo changes in salinity due to high evaporation rates, eutrophication from weeds and biomass decay, as well as agricultural and domestic pollution. However, regulated release of water over short periods of time reduces the magnitude of water quality deterioration, and thus minimizes its impact on the groundwater reserves.

## E. Water Legislation

Lack of comprehensive water legislation in the ESCWA members countries has contributed significantly to inefficiency and mismanagement of water resources in the region. In view of regional development activities within the last 20 years, existing laws and regulations which were effective half a century ago, have become obsolete as competition for water utilization increases and water supplies diminish. Authorities responsible for water resource development and management continue to operate along traditional lines, with marginal changes brought about on an ad hoc basis.

Integrated development and management of water resources in the ESCWA region is contingent upon the instigation of an effective legal framework and sound institutional directives to ensure that formulated policies are put into effect. Broad based water legislation is needed to provide a framework for an integrated approach to the regulation, development and management of water and other related water activities. Comprehensive water legislation needs to include guidelines for national utilization of water resources including desalination, water use priorities, water ownership, jurisdiction of authorities responsible for controlling utilization, protection, pricing, and beneficial uses, as well as the issuance of use permits, and provisions for conflict resolution. In addition, appropriate water legislation would provide mechanisms for ensuring the most equitable economic and sustainable uses of available water resources, taking into consideration socio-economic conditions and the need for national development.

Some of the ESCWA member countries have taken steps towards unifying and centralizing their water authorities in order to improve institutional management. Efforts are also being made to revise and formulate new water legislation with respect to all areas of water development, but particularly the protection of water resources from pollution.

Review of the evolution of water legislation in the ESCWA region reveals that countries that depend largely on surface water have enacted laws designed to provide for quality standards and pollution control. On the other hand, countries that rely mostly on groundwater have issued directives aimed at regulating water extraction, well drilling, and the quality of both drinking and renovated waste water. The oldest water legislation was established in 1925 in the Syrian Arab Republic governing public ownership of water and licensing, while the more recently enacted legislation includes a directive issued in Egypt in 1994 concerning the protection of the environment including water resources, as well as a decree in Yemen, issued in 1995, dealing with the establishment of a national water resource authority. The majority of water legislation was enacted during the period 1967 to 1985. During the last five years Egypt, Lebanon, Oman, Qatar, the United Arab Emirates, and Yemen have made some efforts towards revising, modernizing, or introducing new water laws. Egypt enacted environmental law No. 40 in 1990 that covered protection of water resources. In Lebanon, the Ministry of Environment was established in 1993 with mandates for the protection of water resources. Royal decree No. 31 was issued in Oman in 1993 to merge the Ministry of Environment with the Ministry of Municipalities, creating a single ministry with the authority to provide safe and adequate water, and protect water resources. In Qatar, decree No. 13 was issued in 1994 amending law No. 4, which transferred the Environmental and Protection Committee to the Ministry of Municipal Affairs and Agriculture, in order to better protect water resources. Law No. 7 issued in 1993 in the United Arab Emirates provided the foundation for the Federal Environment Agency with mandates for the protection of water resources and the establishment of standards. In Yemen, a law was enacted in April of 1995, calling for the establishment of a national water resources authority with the power to establish water policy, strategies plans, and provide the enforcement needed for further development and management.

These contemporary legislative endeavours have addressed mainly environmental issues. Efforts need to be directed towards the formulation of new laws and regulations that will become part of integrated development and management legislation governing water resources within each of the ESCWA member countries, as well as for water resources shared between them.

## F. Human Resources Development

To many experts, the mismanagement of water resources is attributed to not only to water scarcity, but to a considerable deficiencies in qualified human resources, that should equally cause great concern.

ESCWA is considered a pioneer in addressing this critical situation within its members states in selecting the key issue of "manpower development" as the theme of its current efforts. Human resources development has been recognized as essential for achieving sustainable water resources management. Since then, it has concluded that "training and education have proven to be day capacity-building instruments which support long-term development strategies".

The need for manpower development (MDP) was recognized by the international community much earlier: the Mar del Plata Action Plan in 1977, the New Delhi Statement in 1990, the Delft declaration in 1991, the Dublin Statement of the International Conference on Water and Environment in 1992, and in Agenda 21 from the United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil in 1992.

ESCWA interest in manpower development in the water sector was thus a direct response to recommendations from United Nations and regional meetings as well as surveys and studies conducted by ESCWA itself.

In the period 1985 to 1989, ESCWA was actively involved in organizing regional surveys, publishing technical reports and holding expert group meetings.

Based on these surveys and studies, a report was published in 1987 on "Development of Manpower, Education and Training in the Water Sector in Western Asia" (E/ESCWA/NR/85/14). That report ascertained, without any doubt, the need for regional cooperation and manpower development programmes in the water sector of the ESCWA member countries. The findings of this report, together with many country reports, were discussed in an expert group meeting held during the period 5 to 8 June 1989 in Amman. The main recommendations of the meeting are the following:

(a) ESCWA was requested to:
  (i) Continue its manpower surveys in the region;
  (ii) Survey available education and training institutes;
  (iii) Survey the curricula and syllabi of these institutes;
  (iv) Encourage subregional cooperation;

(b) To prepare a project document for the establishment of a regional network in two phases, namely: Phase I, which is a preparatory stage covering the four recommendations mentioned above; and Phase II, which is an executive phase depending on the findings of the Phase I;

(c) To secure the financial resources necessary to accomplish these activities from potential financing agencies in the region and abroad;

(d) To create preliminary contacts with the countries of the region that have already established good training centres, with the aim of sharing these resources with countries that are in need of them. Similar contacts should be established with regional and international training centres;

(e) To establish a technical advisory committee to assist ESCWA in the establishment of the network and in drawing its action plan;

(f) To shoulder the secretariat business of the network during its establishment stage.

These efforts have been mentioned in an ESCWA report that included a study of four selected countries of the region during the period 23 December 1992 to 10 January 1993. The recommendations of this report supported the idea of the network and followed in many aspects the recommendations of the 1989 expert group meeting.

In the light of the above findings and conclusions, ESCWA investigated various forms of regional cooperation and different modules. It has been concluded that the only open option is the networking approach, in accommodating human resources training in the ESCWA region. In 1993, as a result of an Expert Group Meeting (EGM) a nuclei of regional water training network has established taking advantage of the existing training water institutions in different ESCWA members states. Until now two courses were organized by ESCWA in two water institutions.

### G. Regional Cooperation

Surface and groundwater resources that are shared between the ESCWA member countries and the neighboring countries of Turkey and Israel pose a major obstacle to water resource management. The development and utilization of shared water resources are at a point where disputes among riparian countries could arise from conflicting demands for limited water resources. Efforts have been made in the past to negotiate a water sharing agreement involving the surface water resources of the Tigris and Euphrates rivers shared by Turkey, the Syrian Arab Republic, and Iraq. A trilateral Turkish-Syrian-Iraqi technical committee was set up by the three riparian countries to seek an agreement regulating the share of river water, held its first meeting in June 1990. No formal agreement has yet been reached. Iraq and the Syrian Arab Republic both want to meet their basic water requirements. Recently, Iraq and the Syrian Arab Republic held a meeting to discuss and arrive at a water sharing agreement on surface water from the Euphrates river according to international water law.

In the framework of the Middle East peace treaty, Jordan and Israel signed a water sharing agreement in 1994. The parties agreed mutually to recognize the rightful allocations of both countries to Jordan and Yarmouk rivers flow and Araba/Arava groundwater in accordance with accepted principles, quantities and quality. Jordan and Israel agreed on seven articles dealing with water allocation, storage, water quality and protection, and groundwater in Wadi Araba. The final agreement guaranteed Jordan 215mcm per year, and envisages creating a framework for pursuing joint water projects such as water storage in Jordan and the Yarmouk rivers. The two countries also agreed to hold periodic meetings to discuss the improvement of water sources and promote more efficient exploitation. In view of this, several storage dams on Jordan and the Yarmouk rivers will be constructed, as well as a desalination plant which will treat 20mcm of saline spring water to be diverted to Jordan for drinking water. Other regional arrangements were agreed upon including the storage of water in lake Tiberias during the winter months and diverting it to Jordan during the summer months, as well as exploring new possibilities to supply Jordan with other sources of drinking water.

## III. WATER RESOURCES PLANNING

### A. The Problem of Planning in ESCWA Arid Regions

In arid-semi arid regions the basic problem for water managers and water planners continues to be to balance the available water resources against the reasonably expected demands. This basic problem is of significance in the ESCWA regions because of the following constraints and circumstances.

The most obvious constraint is climatological. Almost all ESCWA countries share an arid climate, which eliminates most opportunities for "supply management ". Mobilizing new natural water resources, or minimizing existing natural losses, are not realistic strategies because those resources and losses hardly exist.

Another constraint is financial. Much of the region depends, directly or through trade and manpower links, on the exploitation of petroleum resources. The market for the latter has lately been rather flat and so has the related regional income. Consequently many local governments have begun to adopt policies that call for moves towards self-sustaining public utilities. This means that utility managers need to consider very carefully whether the production techniques they use are not only technically sound but also economically justified. The expected utility income needs to be able to cover the operation and maintenance of the facilities, without automatic guarantees and subsidies from the government. This circumstance makes many options for "supply management" unattractive.

The ESCWA region does not presently experience major political conflicts. Nevertheless, recent history has seen serious disagreements and any decision-maker should incorporate the probability of their recurrence in his planning. This circumstance throws a dim light over many water importation schemes, most of which rely for their successful implementation on a large measure of cooperation with other nations.

Before considering the issue of economic productivity it is useful to briefly review the traditional tools available to implement water sector management. Traditionally the two approaches to water management have been either to enhance the resources (supply management) or to decrease the demands (demand management). In slightly more detail these approaches encompass several well-researched and applied technologies.

a) Supply management

- The reduction in the statistical variability of streamflow by means of constructing storage reservoirs.
- The reduction of natural losses to sea or desert by means of a timely diversion or storage of surface runoff.
- The increase in fresh water supply by means of converting poor quality water (wastewater, sea water, etc.) into high quality water.
- The increase of precipitation by means of cloud seeding or other induced climate changes.
- The reduction of evaporation losses to the atmosphere from both natural and artificial reservoirs or swamps.
- The reduction of subsurface seepages into water bodies of poor quality, such as seas.
- The importation of water from unconventional sources, for instance by means of the transportation of icebergs from the arctic regions.

- Interbasin transfers from areas of surplus to areas of deficit, for instance by means of the pumpage/diversion of water through pipelines or canals, or by marine transport in flexible containers or tanker ships.

b) Demand management

- The volumetric reduction in the water consumption by various end users in the domestic, agricultural, commercial, services, and industrial sectors.
- The improved matching of water quality with the water requirements of the various end users.
- The reduction of water losses from water supply reservoirs and systems used by water utilities or other major water users.

The issue of reaching a compromise, not based primarily on increasing supply or decreasing demand, but on reallocating existing water resources, which is not the subject to be discussed in this paper.

However, the problem then becomes to design an allocation scenario for the water that is left in an effort to satisfy all remaining feasible demands and claims. In order to ensure that all affected parties are fairly treated such a scenario needs to be based on verifiable, quantifiable, and defensible criteria.

Several countries in the ESCWA region are being guided in their development by national development plans, frequently on the basis of a five-year cycle. Most of those plans, and in fact most governmental pronouncements of a planning nature, contain statements like "the government intends to pursue economic development" of the country in question, or other words to that effect. Since water is one of the ingredients of almost any economic activity there is a clear logic in basing water allocation scenarios on economic grounds. In other words, water should be allowed to flow in the direction (i.e. towards a subsector) where it will make the biggest contribution to the economy. This is often expressed as the pursuit of maximum "water productivity".

Moreover, reasonably accurate records or estimates are required of the actual Water Use on the same time base as the data on Gross Margin. Although the physical flow of water is measured and metered on many occasions, the definition of this parameter may in reality present considerable practical problems. The main reason for this is that many enterprises obtain their water from municipal water systems and the operators of those systems, the municipal water utilities, have no reason to differentiate between domestic, commercial, and industrial customers. However, in order to estimate for instance the water use of the local hotels, one of the main components of the tourism industry, it is necessary to have data for all hotels. It may require considerable research of water meter records to obtain such data.

Even if all data problems can be overcome the approach of basing water allocations on strictly economic grounds has several weaknesses.

The concept of basing the merit water use on the relevant economic contribution of a sector ignores the fact that societies are composed of living human beings, most of whom expect to participate in the activities of that society. In other words, the creation of employment, regardless of the economic benefits, may be an objective in its own right.

Although economic development may be a desirable goal, other factors may enter the picture. For instance, geographical distribution of the population, or strategic occupancy of certain lands, may in certain cases assume as much significance as economic optimization.

In order to accommodate such arguments it would be necessary to develop an evaluation procedure that could override the economic arguments and replace them with others, taking into account that society is not a purely economic creation.

Favourable economic conditions in the past have fostered water policies that focused mainly on the development of water resources in most of the ESCWA members countries. These policies required substantial capital investment in water infrastructure, as well as operation and maintenance of water related facilities, to meet expanding water requirements in different sectors. Currently, the water situation is dramatically different as a result of exploitation of water resources, degradation of water quality owing to development activities and pollution, inefficient use of water caused by increased competition among water users, as well as lack of comprehensive planning.

Comprehensive planning for integrated development and management of water resources, as well as the establishment and implementation of national water plan, is lacking in most ESCWA members countries. A national water plan based on an integrated and holistic approach, would contribute significantly to efficient development and management of water resources in the ESCWA region.

Present trends in the region will respect to policy setting, national plan formulation and implementation, vary between countries. Water resources planning has been given due attention in some countries such as Egypt, Lebanon, Jordan, Qatar, Oman and Yemen, where national water policies were formulated and are being revised to reflect emphasis on water management strategies, and implemented in the context of their national water plans. Other countries such as Iraq, the Syrian Arab Republic, Saudi Arabia and the United Arab Emirates, have formulated water management policies and strategies as part of their five year development plans.

National water policies and strategies differ between countries with respect to development and management of water resources, depending on hydrological, hydrogeological and economic conditions. Egypt, Iraq and the Syrian Arab Republic have given priority to further development and efficient utilization of their surface water, as well as its protection and preservation. Despite previous policies aiming at promotion of self-sufficiency in food, the GCC countries have focused on policies dealing with the augmentation of water supplies through sea-water desalination, and utilization of groundwater sources. The provision of adequate amounts of potable water, as well as improvements in sanitation and preservation of the environment, have been the main goals for all countries in the region. Recently, appreciable efforts have been made by some of the countries to meet these goals by the target date of 2000.

Review of the planning efforts in individual ESCWA member countries reveals diversity among policies and strategies, and the level of planning. Countries with established plans are making headway in the development and management of their water resources, however, the implementation of an integrated approach to water management still seems far in the future. While some countries have yet to formulate national water plans, they have adopted a variety of water resource development and management endeavors in the form of water policies that are incorporated into their respective five-year development plans.

### B. Basic Concepts of National Water-Strategies in the ESCWA Region

Successful national water strategy normally comprises three mains components: (1) Well studied and achievable water-policy within pre-known water potentialities and future demands, (2) alternative scenarios for water plans and programmes, and (3) development of feasible projects within available and financial and human resources. Since these three components are tightly inter-related, any deviation, or ill-definition of any of these may raise major difficulties towards adequate implementation of the strategy. On the other hand long-term water policy and plans may not be appropriate as an ever-lasting water strategy due mainly to the fact that projections of future water demands depend entirely on eventual changes of economical, environmental, social, political, and technological aspects. For example, the U.S. Office of Technology estimates that by the year 2000 about 5/6 of the annual increase of food production will be due to the application of new bio-technologies, while the remainder 1/6 will be due to horizontal expansion of cultivable lands.

In the ESCWA Region, as in many other developing countries, the situation does not deviate much from the above-mentioned, and perhaps the water-situation here is more critical and faces many challenges due mainly to the prevailance of aridity in the Gulf countries in the south, and the sharing of most of the water resources with the riparian countries in the north. Also, it is evident that the countries in the ESCWA Region should focus on and give more emphasis to integrated water management and structural water development. This is rather due to the fact that the present trends prevailing in the region, in respect to water resources usages, are generally in efficiently managed, while the possibilities for additional development of water sources are considerably limited in view of their scarcity. However, these two basic models, water management and water development will continue to be indispensably inter-related and their integration is a must.

In so-far as the implication of the countries in the ESCWA Region with the programme-areas, included in Chapter 18 of Agenda 21, it is believed helpful to review briefly the readily endorsed national water-strategy of each country in order to enable depicting the extent of conformity and harmony between these strategies and the programme-areas of the Agenda.

## C. The National Water-Strategies in Selected ESCWA Countries

### 1. Bahrain

A project entitled "Planning for Water Resources Development" has been endorsed by the Bahrain Center for Studies and Research for the period 1990 to 2010. The main objective of the project is to draw-up a national water management strategy. The project comprises three phases, the main activities of each are as follows:

a. Phase I is devoted to problem identification which includes: comprehensive reconnaissance and review of data and previous work, water resources evaluation, identification of water consumption patterns and efficiencies, projection of future demands, and establishment of water resource data base.

b. Phase II pertains to the development of curative and preventive studies including: alternative scenarios of water problems, impact evaluation, simulation and management models.

c. Phase III is the implementation and monitoring phase in cooperation with the relevant executive agencies.

With this view in action, the project is not to be considered an end-target, however, it will expand ultimately according to the actual result and impacts that will be acquired from the phase of implementation and monitoring.

### 2. Egypt

The need for water resources planning in Egypt has long been recognized. The most recent project pertaining to the development of "National Water Master Planning" which practically started in 1978 and ended in 1980 as phase I, was then followed by a second phase that continued up to 1986. A third phase of the project is still operating during 1995. The framework plan deals with the period up to the year 2000 and on. It contains a detailed and exhaustive statement of the water management and development needs of the country including descriptions, reviews, analyses, plans and recommendations for projects and programmes in all water-related sectors of the economy. It includes investment and implementation schedules, production targets, means of implementation, economic costs and benefits of projects and programmes, rural employment and demographic impacts, and surface and ground water distribution plans. In doing so, high priority was given to planning methods while less emphasis was placed on the preparation of specific projects. This was due mainly to the fact pertaining to the rapid changes in technology and relative economic values which make it more prudent to take right decision on each new potential development than to stick with a rigid plan based on assumptions that may be subject to eventual changes, (Egypt, 1995).

The national water master plan accounts for the presentation and evaluation of three development scenarios:

a. Scenario 1: assumes that water conservation projects be constructed, Deduct projected growth in water-demand for the non-agricultural sector and compute the water balance which can be made available for new lands development.

b. Scenario 2: assumes that there will be a high rate of growth in the agricultural sector (4.9% annually compatible with the national optimistic projections for the economy). Assign some of that growth to the old lands, and the balance to new lands. Determine the water requirements for the resulting increase in new lands (180,000 feddans/year), and add the water requirements for non-agricultural uses to find a total water demand.

c. Scenario 3: assumes that there will be a moderate rate of growth in the agricultural sector (3% annually). Assign some of that growth to the old lands, and the balance to new lands. Determine the water requirements for the resulting increase in new lands (50,000 feddans/year) and add the water requirements for non-agricultural uses to find a total water demand.

The above-mentioned three scenarios imply the provision of water-supplies to satisfy the water demands for each scenario. The major opportunities for increasing the water-sources are drainage re-use projects, improved water management, and water conservation projects in Sudan to reduce evaporation losses in the area known as the "Sudd" or swamps. Minor opportunities, but rather considerable, include waste water treatment and re-use, reduction of water in spills, and ultimately desalination of sea water.

**4. Jordan**

The formulation of a national water plan and of a water resources policy was first initiated in 1976 and was made one of the development programmes within the scope of the 1976-1980 five year plan for economic and social development. The objectives of the plan were in line with the prevailing water problems and constraints at that particular time. These objectives were mainly centered on aspects pertaining to: development priorities, allocation of the water resources, consequences regarding existing development plans, and consequences regarding regional development, (Jordan, 1997).

As a result of many changes revealed since the first endeavour for the establishment of a national water plan, it has been felt necessary to up date the scope and views of th e national wide water sector and to improve its development and implementation. With this view in mind, the Ministry of Water and Irrigation is currently developing a water policy and strategic planning which includes the development of the following main sectors: water management, information system, water monitoring network programme, central laboratory, artificial recharge feasibility study, industrial waste water discharge prevention, irrigation water management, water management education, and public awareness. However, despite the clarity of the water strategic plan presently in action, its implementation remains challenged due mainly to: the sharing of considerable surface and ground water sources with other riparian countries, the non-renewability of some ground water reservoirs, and the exhaustibility of most of the ground water basins, (Jordan, 1995).

Parallel to the national water strategic planning, Jordan initiated a national environmental strategy, the guidelines of which were officially approved by the government in 1991. Further, a proposal for the establishment of a general authority for environmental protection is presently in preparation. At the sector level, priority is given to the issues of water and maintaining agriculturally productive lands since both of which will have serious long-term impacts if they ar e not addressed urgently, (Jordan, 1991).

### 5. Oman

The preparation for achieving a national master water plan has been thought of only recently (1990). Prior to that the national strategy included a number of water conservation projects that have been implemented. However, with the creation of the Ministry of Water Resources in 1991, a systematic and comprehensive water plan has been initiated. The national water will inventory project, which started in 1992, is considered the first of its kind as it covers the whole country. Parallel to that project, a similar project for surface water strategy and only be expected shortly after completion of the above-mentioned two national projects. Meanwhile, a number of recharge and conservation dams are being constructed within the framework of the current five year national economic and social development plan: (UNESCO/Oman, 1993).

At present, the general features of the water policy are governed by a number of decrees issued mainly for the purpose of conservation and protection of water resources. In particular, the 1988 decree implies that the water resources in the country is considered a national wealth, while the 1988/89/90 decrees regulate the water utilization through issuing water well permits.

The aspects pertaining to environmental protection are being objectively considered, and perhaps this country is pioneering in the creation of a specialized institution responsible for the environmental affairs.

## 6. Saudi Arabia

The national water-strategy in Saudi Arabia has been established around mid 80's. This strategy which is considered comprehensive in both scope and nature covers the national water policy in respect to water supplies and demands up to year 2020. The water action plans include the development of the various water resources, i.e. surface and ground water, desalinization of sea water, and re-use of waste water. Also the programmes for the implementation of relevant projects have been detailed. Meanwhile, the national water strategy continues to be subject for revision and up-dating including the issue of supporting legislative laws and pricing of water utilization, (ACSAD, 1986).

## 7. United Arab Emirates

The water resources in the UAE are known to be limited as in the case of the rest of the Gulf countries. The country depends on two main sources for water supplies; desalinated water and ground water, in addition of limited amounts from surface water and re-use of treated waste water. In response to this, the ground water basins are continuously suffering from over-exploitation exceeding by much the natural rates of replenishment. Meanwhile, in the absence of a national water-strategy and inadequacy of water resources management, both surface and ground water are subject to continuous deterioration in quality as well as in quantity. Accordingly, the country is directed towards increasing the capacity of desalination, which renders the provision of water supplies a costly procedure. In addition to the above, the multiplicity of water authorities with overlapping and conflicting functions constitutes a major impediment to efficient water management. In this regard, a reference should be made to a Union Law issued in 1981 for the establishment of a general authority for water resources management to be responsible for all types of water sources in the UAE, which unfortunately has never been put into action since then, (UAE, 1981).

## 8. Yemen

Water is scarce in Yemen, and at present large quantities of ground water are being used to support a growing economy and increasing population. Since the existing laws and regulations are not able to cope with the situation, the ground water sources will remain unrestrained and ill-managed. Accordingly, the government has recently created a national water resources in the country including prescription of national water policy. Meanwhile, a number of studies pertaining to water resources management and economic development have been completed recently 1992. These studies include: water resources assessment, present and future water requirements for all purposes up to year 2010, and assessment of the present status and future development of water supply, waste water and sanitation. Also, environmental issues related to water were studied and the need for environmental impact assessment presented, (Yemen, 1992).

However, the implementation of these integrated studies is virtually unforeseen, at least at the present time, due mainly to the prevailing economic constraints and lack of adequate institutional and policy framework. Therefore, the challenges facing appropriate development and management of the water resources in Yemen will persist unless adequate financial and technical support, are provided.

## IV. REQUIRED ACTIONS

In general, significant progress in water resource development, and to a lesser extent water management, has been achieved in the ESCWA region. However, additional efforts are still needed to achieve efficient water resource planning and management on the national and regional level. Emphasis should be placed on the following areas of concern.

Member states in the ESCWA region are to be encouraged to develop and manage their water resources in an integrated manner in the context of Economic and Social Development Plans and as set forth in Agenda 21. Effective water resources management also calls for the establishment of clearly defined long-term policies and strategies set forth in their national water plans, as well as for the development of enforceable institutional and legal tools for efficient and equitable resource allocation. Transboundary surface and groundwater sources shared between riparian states need to be given high priority in order to reach a binding agreement and treaties regarding water allocation, including quality, according to international water law.

The countries of the region need to be encouraged to implement demand management measures in all sectors in order to slow the rate of increase in water requirements. Demand management measures in the domestic and industrial sectors may include a variety of instruments to manage and control water use and practices through regulation, metering, water pricing, quantitative restrictions, technology and public awareness.

Conservation efforts need to be directed towards the agricultural sector where current consumption is substantially higher than for the domestic and industrial sectors. Reappraisal of agricultural policies and shifting some of the water to other uses would reduce the imbalance between water supply and demand. The application of these tools would require a broad range of incentives and institutional measures. Agricultural subsidies may be used as leverage to implement conservation measures such as improving irrigation efficiency through sprinkler and drip irrigation systems, laser leveling, canal lining, and farmer education and awareness campaigns. Water supply augmentation through artificial recharge, reuse of renovated and drainage water, and cloud seeding, should be further investigated and implemented if such methods are technically, economically and environmentally warranted.

Additional efforts are needed to strengthen institutional arrangements through comprehensive legislation which defines the responsibilities of each organization, and through mechanisms which facilitate the exchange and dissemination of information. Regulations need to include provisions for project coordination on a local, national and regional level, both within each country as well as between countries. Capacity building at all levels needs to be expanded and strengthened through an interdisciplinary program of formal education, as well as training programs, with emphasis in water management. The member countries are encouraged to promote the application of modern technology including remote sensing, GIS, and isotope techniques, for the purpose of improving the state of knowledge concerning their water resources. There is a need to support research and development programs that emphasize minimizing treatment costs of sea and brackish water desalination, as well as waste water, in order to make these sources viable alternatives for augmenting water supply.

# TALKING NOTES

ON

THE ZIMBABWEAN EXPERIENCES AND ASPIRATIONS

IN THE WATER RESOURCE SECTOR

PRESENTED AT

THE EXPERT GROUP MEETING ON STRATEGIC

APPROACHES TO FRESHWATER MANAGEMENT

BY

FINNIE H.M. MUNYIRA, PERMANENT SECRETARY,

MINISTRY OF RURAL RESOURCES AND WATER

DEVELOPMENT IN THE GOVERNMENT OF THE

REPUBLIC OF ZIMBABWE

AT

THE SHERATON, HARARE, ZIMBABWE

27TH JANUARY, 1998

1. **Introductory Remarks**

Of course with this meeting being held in Zimbabwe, it is one of your expectations to hear the Zimbabwean experience in the area of freshwater management and development. It is my privilege to share this experience with you by way of an overview.

My discussion takes cognisance of the following:

1.1 The wide ranging presentations that were made in today's programme.

1.2 The wealth of ideas that is contained in the various papers submitted as background information to this meeting.

1.3 The in depth discussions that have taken place in the various groups so far.

1.4 The statement made by the Minister during the official opening.

1.5 The detailed paper prepared by my Ministry that has been made available to this meeting.

With this awareness, I have decided to avoid boring and bothering you. My discussion will be brief and it will be practical oriented rather than theoretical. The intention is to share with you the Zimbabwean experience by way of picking out those aspects I consider important and relevant to share with you.

2. **Background Information**

2.1 **Developing Country**:

Zimbabwe is a developing country. This means that its socio-economic circumstances cannot be very different from those of other fellow developing countries. It certainly will share certain factors in common even with developed countries. There is therefore a lot in common between Zimbabwe and some countries represented here. Infact this is the premise on which this international meeting is being held.

2.2 **Problems and Strategies**

Zimbabwe acknowledges the fact that there is a problem in the water sector. The increasing demand for water by competing water uses and users coupled with an increasing population and urban expansion impose a severe strain and stress on a resource that is depleting through abuse, overuse, misuse and through environmental degradation and mismanagement as well as through repeated droughts. Zimbabwe is therefore together with the rest of the international community in the search for strategies for freshwater development and management.

2.3 **Rainfall and Storage Capacity**

Zimbabwe's rain season generally extends from November to March. The average annual runoff is 20 billion cubic metres. The country's present storage capacity is 8 billion cubic metres. This means about 12 billion cubic metres of water is lost through run-off due to lack of sufficient storage capacity. If the capacity were fully developed the country could store 30 billion cubic metres.

The tropical behaviour of our rainfall pattern coupled with increasing drought frequency becomes a critical factor to the nature and thrust that the country should take in the development of our water resources. It should be one of the major objectives of our development thrust to guard against the effect of the uneven or erratic rainfall distribution in both time and space.

### 2.4 Shared Water Courses

Zimbabwe is a land-locked country with three major river systems which all flow out through Mozambique into the Indian Ocean. Two of them, the Zambezi and Limpopo, are shared water courses effectively forming the country's northern and southern boundaries with Zambia and South Africa respectively.

The need to observe internationally laid down rules and protocols as guided by the Helsinki Rules on uses of water of International rivers as translated in bilateral agreements or protocols, imposes responsibilities on the country in its plans and practices in freshwater management.

### 2.5 Political - Historical Factors

Zimbabwe was for around 90 years until April 1980 under a series of colonial regimes that upheld the principles of discrimination on racial basis in their administration of the country with serious political and economic deprivation on the part of the indigenous people of this country which found expression in, among other things, the skewed land and water distribution which we still have in this country today. This explains for the reforms in the Water Sector which are currently under way as you will learn later.

## 3. <u>The Approaches</u>

Against this scenario, one is bound to ask for an account of the practical side of the country's endeavours in coming up with sustainable strategies for freshwater management and development. I will give you a snap shot that can be summed up in two parts:

3.1 Reform of the regulatory and institutional framework of the water sector.

3.2 Formulation and implementation of effective management instruments and techniques and development strategies.

Let me provide a bit of flesh to this skeleton.

## 4.0 The Reform

4.1 The current legislation, the Water Act of 1976 will be repealed because of its racially biased intentions and effects which saw water being distributed on a priority system governed by seniority of water rights resulting in its perpetual retention in a few hands at the exclusion of the majority and new entrants. Water, instead of remaining a public good, had been given the concept of a personal private right.

4.2 The new water law will seek to:

- improve accessibility to water by all Zimbabweans on an equitable basis through a permit system in place of water rights.

- Democratise the planning, management and development of water resources by stakeholder involvement and participation through the establishment of catchment councils and Boards.

-Give equal respect and control to both surface and groundwater.

-Strengthen environmental protection by giving the environment its place as legitimate water user.

- Tighten control over pollution by the application of the polluter pays principle on an economic basis.

- Promote responsible and sustainable water use habits and practices through the user pays principle with room for targeted subsidies.

- Enhance bilateral, regional and international co-operation on co-basins or shared water courses.

These are some of the highlights of the new water law.

## 5.0 The Instruments, Techniques or Approaches

5.1 The new law will see the following:

- The creation of a National Water Authority which will directly be responsible for the development and management of the Water Resource. Government will retain the Policy making and regulatory function in relation to the water sector.

5.2 A National Water Resources Management Strategy for Zimbabwe is currently being formulated. The strategy should embody the following principles.

- That water resources, planning and management must cover the full spectrum of sources and users.

- that it must be able to cope with periods of scarcity such as during droughts.

- That it must result in policy development and a plan of action for resource development.

- that international interests shall taken cognisance of.

- that the strategy must be home-grown i.e. developed by Zimbabweans.

On the basis of these principles the strategy must come up with sound proposals on a whole gamut of issues including:

- pricing, cost effectiveness or cost recovery, subsidies, planning principles and methodologies, capacity building, conservation, inventories of water resources, water quality control, subsidiary legislation and the like.

The strategy has to take note of the multi-disciplinary nature of the water resource so that the involvement of engineers, hydrologists, hydrogeologists, environmentalists, ecologists, lawyers, agriculturists, sociologists, economists, professional administrators, politicians and interested parties, pressure groups and water users has to be taken cognisance of.

## 6. SOME OBSERVATIONS

Let me mention a few observations that have been made in our efforts at development and management of the water resources in this country.

6.1 A programme called the Integrated Rural Water Supply and Sanitation Programme whose two pronged objective is to supply clean portable water and sanitary facilities in the way of toilets to our rural folk has demonstrated a large measure of success in the use of the integrated approach or strategy to development programmes.

6.2 The participation of stakeholders in the maintenance of water supply facilities such as boreholes has demonstrated another measure of success in that the villagers are very active through water committees in the repair of their boreholes.

6.3 Two pilot projects which involve stakeholders in catchment management are currently under way and this is within the objectives of our new water law. The signs are that this will be an effective strategy in the development and management of water resources at local level.

6.4 Capacity building must be handled with care so that it does not undermine existing capacity in other areas.

## 7. CONCLUSION

Zimbabwe like any other country realises water is life because all forms of life depend on it. Without water there would be no life.

In Zimbabwe water is crucial to the performance of our economy. One drought sets us several steps backward on the economic recovery path.

There is therefore need due to our climatic circumstances mentioned earlier on to increase our efforts in the area of the development of water resources especially through the construction of dams for use in agricultural production.

Unfortunately the nature of this development requires huge capital outlays at a time when government resources are insufficient to finance the implementation of our development plans at the desired pace. The genuine involvement of the private sector in the area of water resources development and management has become a sine qua non as an alaternative or complimentary funding strategy.

# EXPERT GROUP MEETING

# ON

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

## STRATEGIC APPROACHES TO FRESHWATER RESOURCES MANAGEMENT IN ZIMBABWE

by
S. Mtetwa

Paper No. 15

Prepared for the
Department of Economic and Social Affairs
United Nations

# STRATEGIC APPROACHES TO FRESHWATER RESOURCES MANAGEMENT IN ZIMBABWE

by
S. Mtetwa
Chairman, Zimbabwe Coordinating Committe

## BACKGROUND

Zimbabwe is situated in Southern Africa, bordered by South Africa, Botswana, Zambia and Mozambique. The total land areas is about 390245 km2. The population census of 1992 indicated that there was about 10.4 million people and a growth rate of about 3.1%. The average rainfall is about 270 billion cubic metres of which 20 billion cubic metres is convertible to run off. About 12 billion cubic metres has already been allocated. Ground water is estimated to be 2 billion cubic metres. The three main sub-sectors of water use in Zimbabwe are Agriculture (80%), Urban, Industrial and Mining (UIM) (15%) and Rural/Primary use (5%). It has also now been generally recognised by the Government that the environment is also a legitimate user of water.

Development and management of water is based on the first come first served principle coupled with the riparian doctrine. Government has been in the past the major development agent and private sector the main managers at local level but recently private sector has proved that it can also develop the resource quite extensively. There is now a great potential to develop large dams in the private sector. Of the large dams developed so far the private sector owns about 40% and government 54%.

## INTRODUCTION

The provision of water is core to the development of the country's economy. Every government recognises this and Zimbabwe is not an exception. Population growth and growth of urban centres have resulted in demand for more fresh water, but the incidents of drought have made us to realise that water is finite although its renewable. The central focus of planning these days has been on the finite nature of water resources.

As part of the on-going reforms in the water sector in Zimbabwe, new strategic approaches are being introduced in fresh water resources management as part of formulating the country's Water Resources Management Strategy with an overall objective of achieving sustainable, equitable and economically feasible use of Zimbabwe's water resources. The integrated, also called holistic approach to fresh water resources management has been accepted as a guiding principle. Integrated fresh water resources management implies integration in terms of :

the different physical aspects of the water resources;
its spatial variation;
the competing demands of water users;
the institutional and legal framework;
the complete set of national objectives and constraints.

To those of you who are involved in fresh water resources management, you will agree with me when I say that water resources management is a complex activity. It comprises the full range of activities in the development of water resources from demand analysis through planning, design and construction to operation and monitoring. These activities are highly multi-disciplinary involving engineers, hydrologists, hydrogeologists, environmentalists, ecologists, lawyers, agriculturists, socio-economists, politicians and representatives of interested parties, pressure groups and water users.

The water sector is therefore characterised by lots of players as can be seen from above. Main institution fall into government, private and municipalities government has a number of institution responsible for management. Ministry of local government and National Housing looks after municipalities. Ministry of Agriculture looks after agricultural use and Ministry of Rural Resources and Water Development looks after overall planning and management of the resource. There is also ministry of Health that looks after the quality of portable water.

## PROBLEMS IN FRESH WATER MANAGEMENT

Problems in fresh water management are as diverse as there are diverse uses of the resource. The most common types of water use are :

irrigation;
domestic;
industrial;
commercial;
waste and waste water disposal;
recreation;
hydropower;
fisheries;
wildlife and nature preservation.

Problems can be divided into legal, institutional, financial environmental, social, demographic and so on. Most of these are interrelated producing a cocktail of problems.

For us in Zimbabwe, we have come to realise that there are three principal forces that conspire to create water scarcity and its potential to incite conflict or dispute. These are :

the depletion or degradation of the resource, which shrinks the resource pie.

Population growth which forces the pie to be divided into smaller slices. Since 1931, the population of Zimbabwe has been doubling almost every 20 years.

Unequal distribution or access, which means that some get larger slices than others or in some cases others get nothing at all. This issue has been exacerbated in the past by the concept of priority of application date as a basis for water allocation which seriously prejudiced new stakeholders. As a result, a situation had arisen where some water right holders had large amounts of water when their neighbours had virtually nothing.

Although all the three factors often play a part in inciting competition and conflict, it appears that unequal distribution or access often has the most important role. In some cases, dams and other development projects intended to improve conditions for agriculture or the economy can end up fuelling tensions if newly created access to the scarce resources worsens existing inequalities, further marginalizes the poor or creates opportunities for the rich to capture the resource.

Other problems in fresh water management in Zimbabwe include :

- the introduction of the Economic Structural Adjustment Programme resulted in less government financial support for infrastructural development.
- Reduced capacity in the Ministry responsible for overall fresh water management in the way of human resources and equipment.
- The recurrence of drought in the last decade and this decade has resulted in low run off causing water shortages and more conflicts between users and user groups
- The developed resource in government dams has been characterised by huge subsidies resulting in inefficient water usage and wastage
- uncontrolled ground water development coupled by drought have affected river refines and ground water mining in some areas.

These problem plus others not mentioned coupled with the aspirations of the people have brought about the new strategic thinking to fresh water resources management.

## ASPIRATION OF THE PEOPLE

The Zimbabwean public is beginning to open up with regards to water management. The droughts experienced over the years have contributed immensely to the realisation that water contributes a lot to both social and economic development.

The following are aspirations that people have about fresh water management and are derived from consultative workshops that have been held country wide.

- equitable distribution of water both local and international
- stakeholder participation in both planning and management of water
- provision of adequate financing for development and management of water
- maintenance of good water quality standards of all fresh water, capable of delivering services.
- efficient organisations decentralised to the lowest achievable level.
- introduction of cost recovery principles but making sure water is affordable.

improved access to fresh water for drinking and production.

introduction of efficient water utilisation methods and reduction of losses.

In short the aspirations of the people is that water should be made available at a reasonable price and should be used and managed efficiently.

## PRIORITY ACTIONS

As conflicts over water worsen, many people wonder where we will get water for the future. Expanding the water supply to one user now means taking it away from another. Urban centres scream for more water while commercial farmers cry "Not our Water!". The key challenges now therefore in fresh water management are to establish priorities and policies for allocating water among competing uses and users, to encourage more efficient and productive use of water to protect the resources from pollution, to come up with principles for sharing international waters, to involve stakeholders in the planning and management of the resource and to reshape institutions and the legal environment to better suit the new era of water constraints.

With the main objective " of enhancing the social and economic well being of the Zimbabwean population through improved fresh water management", the strategic approaches for Zimbabwe that are required to meet the above challenges are :

1. Water Resources Management Strategy Programme

Water resources management strategy aims at coming out with strategies for managing our water resources. Specific areas being looked at are ;

efficient water utilisation through demand management

an analysis and recommendation of a water allocation system

an analysis and recommendation of water investment criterion

capacity enhancement through a capacity building of Department of Water Development staff

establishment of catchment planning principle and methodologies

establishment of pricing mechanisms and pricing policies.

This project will produce among other things guidelines to most of the issues outlined above.

2. Demand Management

So what is demand management? This is the development and implementation of strategies to influence water demand for the efficient and sustainable use of our scarce water resources. It aims to:

safeguard the rights of access to water for future generations;
limit water demands;
ensure equitable distribution;
protect the environment;
maximise the socio-economic output of a unit volume of water
increase the efficiency of water use.

The character of demand management is multi-disciplinary. One cannot address demand management purely from a technical angle. Although it is possible to introduce water saving by technical measures, such as drip irrigation, leakage control, canal lining, etc., such technical measures always have financial and administrative implications which introduce economic, legal, institutional and eventually political aspects.

In managing the demand, decisions should be taken on where, in which sector and how water demands can be reduced. For this to be achieved effectively, it is essential to understand the major factors which influence demand. Implicitly, there will be conflicts between competing users and trade offs will have to be made between the benefits obtained by allocating the water to different users in the context of the national economy.

Public awareness campaigns and promotion are important activities in demand management that should be directed to both the water users and to the politicians. Water users should understand the importance and benefits of water conservation and should know in which way they can contribute to water conservation.

3. Integrating Fresh Water Management and Land Use

The manner in which land is managed in the facets of land units of a catchment affects hydrological behaviour. Thus, the percentage of vegetation cover, land use and agronomic practices in a catchment will affect infiltration rates, and consequently, groundwater recharge, sheet erosion, surface runoff and stream discharge. Agronomic practices such as date of planting, the type of crop, tillage system (from zero tillage to deep plough), tied ridges, plough direction and crop rotations are some of the land use systems which are used to manage infield water resources.

However, not all Zimbabwean farms are large enough to allow for the practice of such land use systems as described above to control soil, water and nutrient loss which leads to water pollution. The land tenure system therefore influences the manner in which water is managed in this country. The communal areas show signs of overutilization and carrying three times their potential carrying capacity of livestock and humans resulting in the least sustainable water resources management systems.

Comparison between the large scale commercial farming sector and the communal areas show that the relationship between the environment and the satisfaction of basic human needs reflect a very low degree of needs satisfaction in the communal areas due to low agricultural productivity compared to those in the large scale commercial farming sector. Thus people in the communal areas tend to manage their land resource in a manner detrimental to the whole resource base. In extreme cases, unsustainable land use systems with negative consequences on hydrology such as gold panning and deforestation for commercial purposes are practiced to meet the needs satisfaction of the communal people.

Currently, there is a lack of an inter-disciplinary and integrated land use planning system. The planning unit is the village with land administration at District level. There is thus need to promote the new integrated water and land resources management approach.

4. Environmental Protection

Environmental quality depends to a large extent, on the water quantity and water quality. Any impact on the water quality or quantity has a direct impact on the environment. Water pollution from industrial, agricultural and domestic effluents is one of the serious environmental problems that can quickly turn into a national disaster if it is not arrested. The ecological disaster at Lake Chivero where large volumes of aquatic life, particularly fish were lost due to water pollution, is an example of how far water pollution can affect the environment.

Due to the value of water for both social and economic benefits, a number of infrastructure development projects are undertaken either to capture the water or to distribute it. Construction of water facilities is one way by which man brings about large-scale modification of natural conditions. These activities sometime include negative effects that upset the naturally formed equilibrium and the balance of natural components. The construction of water facilities in most cases take up large areas and cause essential changes to the relief of an area. Some of the negative impacts of water development projects like artificial water bodies are the inundation of land, loss of habitats of ecological communities, loss of plants, displacement of people which might result in social stress as well as increases in water-borne diseases like bilharzia. Downstream impact include reduced water flow for downstream users as well as for the aquatic life.

It is important therefore, for the purpose of environmental protection and sustainability to determine, especially at the design stage of any development activity how the given ecosystem may respond to the change that will be set in train by the proposed project. It is important to stress that water management strategies which do not take the environment into consideration are not sustainable.

5. Management of Water Resources at the Catchment Level

In determining what geographical entity is most suitable for regional water resource management, it is important to recognize that water quality problems are inseparable from water quantity and land management problems. It is therefore necessary to define a geographic unit which can be viewed as a system so that all factors including water utilization, water quality and land resources can be integrated appropriately. This Unit is the river catchment. All water-related activities in a region are linked by the movement of water through the catchment and interdependencies between the various activities can only be defined by examining the catchment as a complete system.

6. Stakeholder Participation in Water Resources Management

A positive thing that has come out of conflicts and disputes in water allocation and management is a recognition that stakeholder participation has a key role in successful water resource management as it enables interest groups to discuss new ideas and to give important feedback relating to specific needs and attitudes.

On the degree of participation, experience to date in our two Pilot Catchment Projects ( Mazowe and Mupfure ) has shown that the nature of the particular issue in water management can deeply influence the efficacy of increased stakeholder participation. Certain issues in water resources management are routine - no major conflicts of interests are involved, responsibility for action is well defined and shifts in social values are unlikely to influence the type of action chosen. In these instances, the locus of responsibility is known, the decision threatens no established interest, and consultation with the stakeholders is normally unnecessary. Problems that might be described as strategic including those where several competing interests are involved and where the outcome of the decision may ultimately affect the lives of specific groups or individuals require direct stakeholder input.

A few things however, are now clear. One is that if stakeholder participation programmes are to enjoy any measures of success, they must have credibility and transparency. They must not be a facade, giving the impression that the public's views are being sought and taken into account but in reality not considered at all. Nor must information programmes be titled participation or involvement programmes. Only where there is a two-way flow of communications is this a valid description.

7. Shared International Water Course Systems

The Helsinki Rules on the Uses of Water of International Rivers of 1967 are utilized as guidelines in international water resources treaties even though they are not very explicit. The fundamental point is that co-basin States must accept the principle of equitable and sustainable use of water resources as a key guiding element. Upstream and downstream States must acknowledge each other's rights to use water resources for national development, as well as each nation's responsibility to the prevent the pollution and degradation of water.

One of the major constraints to an efficient exploitation of international shared waters is the lack of accurate knowledge with respect to the state of the water resources within the basin and the social expectation with respect to the strategic behaviour of the Governments of the basin States. The Basin States' sincerity in revealing true preferences, commitment to an agreement and disclosing all private information are questioned. The Basin State Governments must develop a trust in each other and allow for information acquisition and sharing.

It will be necessary that a co-ordinated approach by all Basin States should lead to the adoption of an integrated utilisation and management strategy. This should be implemented, controlled and managed by a joint commission or authority of some kind. Such a strategy must however, be conceived by the Basin States themselves and must be recorded in an international agreement to which each of the Basins States concerned is party.

8. Changes to the Water Act

At present the main legislation in the Water Sector in Zimbabwe is the Water Act No. 41 of 1976 which is administered by the Department of Water Development on behalf of the Ministry of Rural Resources and Water Development. The Act generally provides a sound basis for managing the water resources of Zimbabwe but it contains some shortcomings that had to be addressed to take account of the socio-political changes that have occurred since it was passed into legislation and also of the growing competition for the available water which exists not only between but also within sectors. Thus the main objectives to be achieved by amending the Water Act of 1976 are to :

improve equal access to water for all Zimbabweans;
improve the management of water resources, surface and groundwater alike;
strengthen environmental protection and
simplify the Act and improve its administration.

9. Institutional Reforms

The formation of the Zimbabwe National Water Authority is a result of the amalgamation and rationalization of the roles and functions of the Regional Water Authority and the Department of Water Development. The authority is necessary because at present there is no separation of Government statutory and regulatory functions for the provision of water management services. Focus has been on constructing more dams, drilling more boreholes, while management and planning of water resources has not been given much attention. The Authority's role is therefore to ensure better use and equity in accessibility of water by all Zimbabweans. This is to be done through the decentralized Catchment Authorities which must fully represent all water users in a particular catchment.

The authority is to operate on commercial lines promoting the polluter pays, the user pays and full cost recovery principles.

10. Capacity Building

For freshwater resources management to be sustainable there is need to build local capacity both in terms of technical and managerial capabilities. On the technical side, resources should be devoted to research and development activities such as establishing the national water information centre, preparation and implementation of regional water management plans and installation/operation of hydrological monitoring networks.

Human resources development should be adopted through an extensive training plan eg. the introduction of an Msc programme in water resources Engineering and Management, and the WRMS project.

## CONCLUSIONS

From the foregoing, it is clear that the strategic approaches presented are dynamic requiring adjustment now and again. If adopted however, the long term vision of freshwater management that emerges is one that will provide greater equity and access to water, improved efficiency of water use and environmental protection. Only then can intergenerational transfer of the freshwater resources be guaranteed.

# EXPERT GROUP MEETING

# ON

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

## FINANCING SUSTAINABLE WATER USE IN ZIMBABWE: INSTITUTIONAL BARRIERS TO APPLYING ECONOMIC SOLUTIONS

by
Peter B Robinson
Zimconsult, Harare

Paper No. 16

Prepared for the
Department of Economic and Social Affairs
United Nations

# FINANCING SUSTAINABLE WATER USE IN ZIMBABWE: INSTITUTIONAL BARRIERS TO APPLYING ECONOMIC SOLUTIONS

by
Peter B Robinson, Zimconsult, Harare

**Abstract:**

In the past, water investments have been largely driven by a supply-oriented approach. Water has been treated purely as a social good and has been significantly under-priced. This has given rise to shortages of funds for investment, which have limited efforts to redress inequitable access to water for household use and productive activities. The beneficiaries of large implicit subsidies have typically not been those that governments would have chosen to target.

Zimbabwe has been no exception to this pattern. This paper summarises key issues relevant to concerns about equity and sustainability amongst 3 main categories of water users:

urban, industrial, mining (UIM);

irrigation (large- and small-scale);

rural households in the communal areas (predominantly subsistence farmers).

Solutions are proposed which are based on economic principles. These involve integrated, holistic planning and economic pricing.

In each case, the legacy of the old approach remains manifest in institutional barriers which are inhibiting the adoption of economic solutions. Institutional reform is thus an essential pre-requisite to putting Zimbabwe's management and development of water onto an equitable and sustainable path.

## 1. Background - Water in Zimbabwe[1]

The main farming areas of Zimbabwe receive 800-1000 mm of rainfall per annum, but much of the country is drier and can be classified as semi-arid. Zimbabwe is very vulnerable to drought, with the economic impact of major droughts extending well beyond the immediate impact of reduced agricultural production. Although the economy is relatively diversified and robust, agriculture remains the backbone, not least because 66% of the population of 11,5 million live in the rural areas. As a result of the segregation policies of the minority regimes which ruled the country prior to independence in 1980, access to water is highly inequitable. In the agricultural sector, almost all irrigation water is used by the large-scale commercial sector. In respect of household supplies, in the urban areas piped water into each house is the norm, whereas in the rural areas a mixture of traditional and upgraded sources (mostly wells and handpumps) is used.

The water sector is presently undergoing extensive institutional reform. A new Water Act, to replace an act which has been in force since 1976, is before parliament, together with the ZINWA Act, which is intended to create a new entity, the Zimbabwe National Water Authority. ZINWA is to be a parastatal, largely replacing the present Department of Water, (now part of the recently formed Ministry of Rural Resources & Water Development), and the Regional Water Authority (a parastatal responsible for supplying irrigation water to the sugar producers and other irrigators in the south-east lowveld). It is intended that stakeholders will be far more involved in the management of water than has been the case in the past. The structure of ZINWA thus incorporates and gives powers to river boards and catchment authorities. The rural water supply and sanitation sector is managed through an inter-ministerial National Action Committee, the secretariat of which is attached to the Ministry of Local Government and National Housing.

## 2. Equity and Sustainability

In the past, the emphasis has been on ensuring expansion of supply to a growing urban population and to meet the irrigation needs of the agricultural sector. The emphasis on supply augmentation, with little reference to underlying economic principles, has led to a number of problems which are documented in subsequent sections. There has been more lip-service than action in respect of improving equity and scant attention has been paid to environmental issues. Inadequate pricing has prevented funds being accumulated for investment and as national fiscal

---

[1] Much of this paper is based on a study into *Water Pricing Options and Implications*, which was completed for the Steering Group of the Water Resources Management Strategy by Zimconsult in May 1996.

pressures have grown the financial sustainability of the sector has been brought into question.

As part of the sector restructuring exercise, much more attention has been given to clear formulation of objectives. Prominence is now given to "economically viable and environmentally sustainable development and equitable distribution of water". Social acceptability and effective stakeholder participation are also now considered important. In addition to changing institutional structures, to make these objectives operational will require a major change in attitudes, with much greater understanding being achieved of the economics of the water sector.

## 3. Urban, Industrial, Mining (UIM) Water

*Issues*

The 1976 Water Act vested the development of bulk water supplies in the national government (the Department of Water). Previously, urban local authorities had been able to plan and implement their own supply augmentation projects, thereby taking full responsibility for the provision of water to their citizens and industries. The rationale for the change was that, as the urban hierarchy grew, competition for water between different urban areas and between UIM uses and agriculture could lead to the sub-optimal utilisation of water resources from a national perspective. In the case of the building of a dam to supply an urban centre, government's role was to be to construct the dam, with the town or city having to provide the necessary infrastructure to bring the water into the urban areas and to purify it.

In practice, governments before and after independence had restricted funds for water supply augmentation, so that competition was bound to arise between different local authorities. There was thus an understandable tendency for urban local authorities to exaggerate the severity of their water situation at any point in time and to make projections of very rapid growth in demand. Given the division of responsibility, the Department of Water concentrated on choosing the best dam site for the supply augmentation[2], while relying on the demand side on the projections made by the urban local authority. There was some degree of recognition in the Department of Water of the likelihood of bias in the demand forecasts, but the underlying philosophy was that the next dam would be needed sometime, so it would not matter unduly if it was built ahead of the time when it would really be required. In the interim, the water could be used for agricultural purposes and would also provide greater security for the urban area in times of drought.

---

[2] It is only in the aftermath of the 1992 water crisis in Bulawayo that the possibility of underground water contributing to supplies of major urban areas is being considered.

This would be all very well if resources were not constrained. In practice, however, the pattern that emerged was highly inefficient and imposed considerable opportunity costs on the national economy. This is because dams were built that were not used or were not needed by the intended beneficiaries (see box on the experiences of Bulawayo and Marondera), while other urban areas were neglected due to shortages of funds and planning/implementation capacity within government. In the case of the Mtshabezi project and Bulawayo, the main problem was the failure of the authorities to involve stakeholders adequately in planning and executing the project. The other main reasons which can be identified for these "mistakes" were as follows:

- failure to recognise the potential of demand management to stave off investments in supply augmentation;

- neglect of possibilities to improve the management of existing supplies, including reduction of losses;

- failure to explore the potential for reusing and recycling water.

A pervasive reason for these negative factors to be so dominant is the lack of adequate **pricing of water**. In the past, water was treated as a social good and was severely underpriced. Consequently, the basic incentive for demand management has been absent, and there has been no cause to improve management of existing supplies, plug leaks in reticulation systems or engage in the reuse or recycling of water[3]. The incentive problems have been further exacerbated by the urban centres not having to find the finance for supply augmentation projects - once accepted into the investment programme, the financing of a dam would be the responsibility of central government.

Thus even if demand management and other measures were much cheaper in absolute terms, for the urban centre it may have been more economical to have government build and pay for a new dam[4].

---

[3] "Reuse" water is being used here to refer to purified water from sewage treatment that is returned to the bulk supply source to be mixed with raw water before being pumped back to the treatment works. "Recycle" water would typically be smaller-scale schemes, for example at the level of a factory, which collects and cleans wastewater and uses it directly again in the production process.
[4] Bulk water would then have to be bought at the UIM "blend price" (this is explained in next section). The urban blend has been so low that it has been treated as an inconsequential element of the final costs of water (in the past of the order of 3% of the price to the consumer).

**Mtshabezi Dam (intended for Bulawayo) & Wenimbi Dam (Marondera)**

**Bulawayo** is a major industrial centre and Zimbabwe's second city (1997 population approximately 900 000). Following independence, against a background of 5,4% population growth, central government failed to mount any water supply projects for Bulawayo. At the same time, under the provisions of the 1976 Water Act, the city was prevented from building its own dams as it had done in the past. The Department of Water investigated possible dam sites for Bulawayo and concluded that Mtshabezi, south of the city, was the least-cost source of supply. The dam was completed in the early 1990s. However, the city did not accept the analysis of the Department, arguing that, whatever the theoretical costings based on yield criteria, to build yet another dam in the same catchment as the other main sources of supply was to make the city unnecessarily vulnerable to drought. The city thus refused to install the infrastructure to bring Mtshabezi water to the city. When the severe drought of the 1991/92 season brought Bulawayo to the point of being evacuated, despite the emergency measures that were taken, it was difficult for the Department to blame the city's unwillingness to install a pipeline to Mtshabezi because at that stage there had not been sufficient inflow for the new dam to conserve any quantity of water.

It was only in the aftermath of the 1992 drought that the premise that catering for rising population implied building new dams came to be questioned. Conservation techniques, leakage reduction, reuse and recycling of water and judicious use of groundwater would be more economic solutions which would obviate the need to build dams and associated pipelines, or require a pipeline to be built from the Zambezi River, for a considerable period.

**Marondera** is a smaller town (1997 population 54 000, but apparently growing rapidly in recent years at nearly 7% pa) in a wetter part of the country. With poor water management and limited investment, the town was also severely hit by the 1992 drought. Marondera impressed upon the Department of Water the need for the town to have a new source of water. Wenimbi, 20 km south of the town, was identified as the least cost dam site. The project was approved by cabinet and work was completed during 1997. An even more pressing requirement for the town was an expansion of its sewage treatment facilities. The sewage project document identified alternative treatment technologies: the biological nutrient removal (BNR) was shown to be no more expensive in capital and operating cost terms than the conventional technology, but BNR would provide up to 8 Ml per day of "reuse water". This was a significant amount in relation to raw water intake of 9,5 Ml per day (in 1997). If it is also assumed that economic pressures will drive the town to increase the price of water, which will be likely to result in some of the conservation habits developed during the drought to be maintained, and that the town improves its reticulation, it becomes clear that the Wenimbi dam will not actually be required by the town until 2010. Like Mtshabezi, the new dam is presently standing unused by the town, a monument to inappropriate planning structures, but unlike Mtshabezi it will eventually come to be used by its intended beneficiaries.

The lack of demand management tended to be aggravated by another factor characteristic of urban local authorities: a reluctance to increase water prices, which it is always invidious to do. Politically, therefore, it may often have been expedient to maintain revenue flows in the water account not by raising prices sufficiently to induce demand management, but instead by *encouraging* water use, so that the increased number of units sold would compensate for relatively low prices. The unfortunate long-term consequence of this tendency is to instil habits of profligate use of water, which then justify the forecasts of very rapid growth in demand which are used to petition for the next supply augmentation project.

*Proposed Actions*

The pressures on the national fiscus are now such that the old approach to UIM expansion cannot continue. Urban local authorities are recognising this and are re-assuming full responsibility for water provision. There is now more widespread realisation that with most of Zimbabwe's urban centres built on the main watershed, future dam projects are bound to be located further and further away from urban areas. The costs of pipelines and pumps are coming to dwarf the costs of building dams. An **integrated approach to urban water management** is needed, this entailing *inter alia* thorough consideration of the following areas before supply augmentation options are explored, much less dams such as Mtshabezi and Wenimbi built:

(1) **Demand management**: a multi-faceted conservation approach covering hardware (adoption of standards for and promotion of water saving fittings) and software (public education), underpinned by higher prices for water.

(2) **Optimisation of existing water**: in most of Zimbabwe's urban centres, the reticulation system is old and the amount of water being lost through leaks is likely to be high. There has been no incentive in the past for municipalities to tackle this issue seriously, and it was only from the mid-1990s that leak detection and control began to be thoroughly examined in major cities. Relatively small investments could, within timeframes much smaller than dam-pipeline projects, produce significant results in terms of improving water availability within urban centres. With more limited scope, but even more easily and cheaply implemented, the optimisation of treatment processes is another fruitful field for increasing water availability.

(3) **Reuse and recycling of urban water**: the most important element of the alternative investment plan for Marondera (see Box) was the credit given for reuse water from the BNR plant which was anyway necessary to cope with an excess of sewage from the town. The technology has long been proven as safe in Zimbabwe (Harare) and elsewhere in the region (Windhoek in Namibia has a very high proportion of reuse water in its supplies). Several other urban centres in Zimbabwe have the potential to reuse effluent water in this way. In addition to reuse at the level of urban centres as a whole, recycling of water by individual plants may also be economic and also now bears investigation.

Ideally, the various possibilities should be fully quantified, allowing a water conservation supply curve (costs against quantities) to be constructed. It is only when all the options which fall below the cost of the next supply possibility have been exhausted that supply augmentation should be considered.

*Institutional Constraints*

Under the new Water Act and ZINWA Act, water resources planning is to be carried out by river and catchment boards. By bringing the supply decisions much closer to the foci of UIM demand, there is less chance of dislocation in investment than the examples of recent Bulawayo and Marondera projects provide. However, until the new institutional structure has been finally agreed and implemented, there can be no assurance that the outcomes will be economically rational.

Economic pressures are such that urban councils will be more likely in future to evaluate alternatives to supply augmentation, in particular to integrate decisions about water and sanitation and stave off the need for new sources of raw water by adopting BNR technology for sanitation. However, really embracing demand management and optimisation of existing supply will require a considerable re-orientation of outlook and the development of skills which at present are somewhat scarce in Zimbabwe.

At the level of the urban councils, the tendency to keep water prices below economic values will remain. Implementing long-run marginal cost pricing would generally require much higher prices for water to be charged. This would give rise to more efficient water use and slower growth in demand, and would also result in funds being accumulated to finance the next supply augmentation when it is eventually needed. It is difficult to convince consumers that their best interests are served by foregoing current consumption to allow a large fund to accumulate in the water account; why not postpone the funding decision until the project is due for implementation and raise prices then, or else borrow, possibly at subsidised rates from government or donors? In addition, there is typically a lack of trust between residents and councils, so that there will also be suspicion that the fund will in fact be used for other purposes or at the very least not be managed to best effect until it is required.

The bias towards lower prices, higher levels of demand and earlier, more regular, supply augmentation projects is thus likely to remain.

## 4. Irrigation Water

*Issues*

The "blend price" is the current method of setting prices for bulk water from government-owned dams. The blend prices are calculated by adding the redemption of the historical capital costs of all Department of Water dams to the actual operating and maintenance costs and dividing by the sums of the yields (10% yield for agricultural water and 4% yield for UIM water)[5]. In an environment of high inflation, which rapidly diminishes the impact of historical capital costs, the addition of the costs of a new dam to the blend price calculation can result in a significant increase. The intention of the uniform national pricing implicit in the blend price approach is to spread the costs of new developments across all users, thereby ensuring that the cost of water from new dams is not prohibitive. This is further justified by the observation that those who already have access to water are the well off; new projects should give water to the poor at prices which they will be able to pay.

The equity objectives of blend pricing are, however, entirely belied by the reality of the application of the system. Inadequate prices in relation to government commitments and collection rates as low as 15% of the water revenues due have severely reduced funds available for investment. For example, in almost all cases of the construction of large dams for irrigation, government has failed to come up with the funds to construct the supplementary infrastructure needed to make the water available to small-scale farmers. Blend prices play almost no role in providing an incentive to use water efficiently. They impose an arbitrary structure of cross-subsidies, with some users paying much more than the costs they impose, while others pay much less. In the agricultural sector, it is the large-scale commercial farmers and a very limited number of small-scale irrigators on government irrigation schemes who have benefited from subsidies. The unseen opportunity cost of the pricing system is that the great majority of households in communal areas do not have access to water to use for productive purposes.

Fiscal constraints are such that even with better pricing and efficient collection of water revenues, government would still have difficulty financing the developments which are needed in the water sector. Private sector participation could and should relieve that constraint. Private partners have been found for various key agricultural water schemes - the Box describes the Tokwe-Mukorsi and Biri Dam projects. In both cases, agreements which were reported to have been reached by the private sector developers and the Minister of Water appear to have fallen away when the Minster's portfolio was changed in a cabinet reshuffle. This is most unfortunate, as the projects would have a major impact on the economy. There can be no excuse for the losses of income and employment due to failure to find some way of ensuring that the projects went ahead.

---

[5] Yields from multi-purpose dams are divided pro rata, using the different levels of risk for agricultural and UIM water. When the Mtshabezi Dam, which was intended for UIM, was rejected by Bulawayo, the Department of Water had to redefine it as "agricultural", and, through including it in the agricultural blend price calculation, the cost of the debacle around the Mtshabezi project was passed on to agricultural users.

### Tokwe-Mukorsi and Biri Dam Projects

The **Tokwe-Mukorsi Dam**, to be built in the south-east lowveld, would be Zimbabwe's biggest dam after Kariba. With a capacity of 1,73 million Ml and a 10% yield of 423 000 Ml pa, Tokwe-Mukorsi would be 70% larger than the Mutirikwi Dam. The building of that dam led to the opening up of the lowveld for the production of sugar, an industry which presently employs thousands of fulltime and seasonal workers, produces US$90m in exports and has led to the settlement of 45 000 people in the towns of Chiredzi and Triangle. Similar enormous direct and indirect national benefits are expected to arise from the building of Tokwe-Mukorsi. The project has been on the drawing board for a long time. As a project to be funded by government, it received cabinet approval in 1993, but no funds were forthcoming. At the end of 1995, government suggested to the two main sugar companies, Hippo and Triangle, that they contribute 30% each to the capital costs of the project, in return for being assured of a proportionate amount of the water for 40 years. The companies proceeded to negotiate with the then Minister of Water on the exact terms and conditions, including provisions relating to the pricing of all of the public water purchased by the companies. The agreement reached was not acceptable to cabinet, however, and the project has not gone ahead. After a cabinet reshuffle in which the Department of Water was moved to a new ministry, it appears that options for financing the project are being reviewed from scratch.

The **Biri Dam** project is located near Chinhoyi, in a premier agricultural area in the highveld. It was conceived and promoted by a group of 64 large-scale commercial farmers, who would be the main beneficiaries, although the project included provision of water to 99 small-scale irrigators and supplies to Chinhoyi and two local mines. The Commonwealth Development Corporation [CDC] expressed interest in participating in the financing of the project. Expected benefits were export revenues of up to US$ 7 million pa, over 2000 new farming jobs, large multiplier effects in and around Chinhoyi and consequent increases in government revenues. Neither the commercial farmers nor CDC were prepared to undertake the project on any basis other than BOO (build, own, operate), while government insisted on BOT (build, operate, transfer). At one stage it was reported that a means of overcoming this impasse had been found, but in the event the project did not go ahead. Failure to reach agreement on Biri resulted in the abandonment of a number of similar irrigation projects which were being prepared for support by CDC.

*Proposed Actions*

The proposed solution to the first of these problems is to do away with the blend price system and replace it with scheme-specific pricing of water. To address the issue of individuals or communities historically deprived of access to water who would have to meet unaffordable charges under scheme-specific pricing, explicit subsidies, paid out of general tax revenues, should be established. Careful justification would then be needed of each subsidy and the problem of generalised cross-cutting implicit subsidies leading to unviable and undesirable schemes being implemented would be obviated.

On the second issue of private sector participation in water supply projects, a transparent framework laying out the parameters within which build-own-operate-transfer projects can be negotiated by private developers should be established as soon as possible. Under the proposed Water Act, government would always retain ultimate control over rights to water. The issue is to provide sufficient assurance to private developers for investment projects to be financed and for government to come to terms with the trade-off between providing that assurance and having projects which provide communities with water and result in higher levels of economic activity, which translate into employment, exports and tax revenues.

*Institutional Constraints*

Implementing scheme-specific pricing would give a windfall benefit to those drawing water from old schemes which are already fully paid for. Government is particularly concerned about the large, multinational sugar companies in tne lowveld, whose price of water would drop dramatically. The companies have only recently been forced to come onto the blend price system: previously they were paying scheme-specific prices for the bulk of their water. It would be a climb-down for government to go back on charging them the blend price for their water.

The prospects for a clearly articulated framework for private participation in the water sector are not good. At a mundane level, there is not the expertise to produce the necessary documents and legislation, but this could be provided through technical assistance. More importantly, government has foregone the opportunity that institutional change in the water sector presented to create a clear separation between regulatory and supply functions. The proposed ZINWA will be both a regulatory agency and a supplier of bulk water to UIM and the agricultural sector and of clear water to smaller urban authorities. Separation of the supply and regulatory functions would have provided the base for a satisfactory framework for private sector participation to be established. At the same time, without private participation, provision of water will lag behind population growth and will increasingly become a constraint on economic development.

## 5. Rural Households

*Issues*

The Zimbabwe Rural Water Supply and Sanitation [RWS&S] Programme is widely regarded as being one of the most successful national programmes since the launching of the International Decade for Drinking Water and Sanitation in 1980, the year of Zimbabwe's Independence. The inter-ministerial National Action Committee [NAC] has managed a programme which has mobilised national and donor funds to implement an integrated project approach involving rural communities and employing robust indigenous technologies. Since 1980, access to safe water in rural areas has improved from 38% of households to around 70%, with similar achievements in sanitation.

The principal technology used for rural water supplies has been boreholes fitted with hand pumps. The pump in question, the bush pump, is a remarkable locally developed pump, well suited to Zimbabwean conditions. Standardising on the one type of pump has had obvious advantages in terms of availability of parts and maintenance. However, until the recent development of an extractable version, the bush pump could not readily be maintained by local communities. They have had to rely on the District Development Fund, a government agency which has been subject to severe budget cuts in recent years. In real terms, the funds available per pump have dropped to one third the allocation available in 1990/91. This has led to a poor level of service and resulting unreliability of supply for the communities. At the national level, this has called into question the sustainability of the overall programme.

Sustainability issues have also been raised from community-level studies. It has been found that the improved sources are often not used on a regular basis, as households find it easier to obtain water from traditional sources, such as rivers or unprotected wells. The boreholes tend to be regarded as back-ups during periods of drought. Consequently, the amount of water used per capita is much lower than the design criteria (8-12 litres per capita per day, as compared with a planned figure of 30 litres per capita per day), and the involvement of the community in maintaining the borehole is limited. Under such circumstances, it is appropriate to raise questions about the projects in respect of community participation, ownership and health education. A more fundamental question is whether there may not be alternative investment strategies which would be more efficient in reaching the objectives of improving water supplies for rural communities.

*Proposed Actions*

One response to the issue of sustainability has been the proposal that communities should contribute financially to the maintenance of bush pumps. On average, the amounts involved would be quite small, so affordability is less of an issue than concern about the justice of making rural people pay when urban people, who are generally better off, enjoy very considerable cross-subsidies. In addition, if communities are to pay they should be able to buy maintenance services from a range of suppliers and not be limited to a monopolistic government agency (DDF). The introduction of an extractable version of the bush pump is changing the parameters of this debate somewhat, in that the improved version of the pump makes it feasible for communities to take on full responsibility for the operations and maintenance of their pumps. Various "community-based maintenance" pilot projects are being watched with interest.

At a more fundamental level, problems in rural water coupled with greater pressure on financial resources is leading to an important re-evaluation of technological choices. An option that has now been well tried and tested, but is yet to be widely adopted in the national RWS&S Programme, is the **upgraded family well**. The basis for this development was the observation that the key to the success of Zimbabwe's sanitation programme lies in the Blair latrine being owned and maintained by the household, rather than by the community. The water supply counterpart is a simple upgrading of the traditional family well, which is very widely used throughout Zimbabwe. The well is lined (often deepened at the same time) and a simple headworks constructed consisting of supports for a windlass, a cover and drainage to remove spilled water (often to a vegetable garden or fruit trees). Experience with this technology has shown that:

- it is widely accepted and appreciated by households - once introduced into an area, the majority of households seek to build their own improved well;

- households are willing to bear much of the initial capital costs, which both gives confidence of their commitment to the technology and allows public or donor finance to be spread over a much larger number of households;

- maintenance requirements are minimal (some structural repairs may be necessary from time to time, plus periodic replacement of bearings for the windlass, which are pieces of old car tyres, and of the chain and bucket for drawing the water);

- experience has shown that households use much higher quantities of water, because of the proximity of the well to the homestead; although water quality may not always be as good as water from a borehole, health studies have shown that the health benefits of improved water supplies have more to do with *quantity* than *quality*;

- many households also use the water from family wells for vegetable gardens and fruit trees, this improving family nutrition and also sometimes yielding a surplus for sale.

The last issue points to another weakness in the approach of the national RWS&S Programme, namely its exclusive focus on household water. Broadening the Programme to include or, indeed, give priority to productive water would not only provide households with the financial means to maintain water supply infrastructure, but more importantly would raise productivity and incomes in the rural areas. Such a shift should not involve support for unviable projects, but rather an opening up to capitalise on opportunities to include productive water which have been ignored in the past. By giving people the means to use water to generate income, many of the problems in the current Programme of lack of ownership and a lack of willingness to contribute to maintenance would be overcome.

*Institutional Constraints*

Taking into account the higher levels of water consumption from family wells, the average lifetime cost (calculated over a 25 year horizon) is around Z$1-$3.50 per cubic metre from family wells and Z$6-$10 per cubic metre from community boreholes (1996 values, Z$10=US$1 approximate exchange rate). In addition to the cost advantages, the externalities associated with family wells and promise of sustainability should make this a flagship technology for the national RWS&S Programme[6]. However, the members of the National Action Committee and the donors appear to be tied into "integrated" projects based on provision of communal boreholes. Resistance to the family well concept has been based on misunderstandings about the nature of the approach, the assumption that water quality would be poor and a less excusable bureaucratic adherence to the established planning criteria, which, it has been claimed, could not readily absorb the family well concept.

It is government policy to decentralise functions from the national level to the Rural District Councils [RDCs]. It is expected that when this process gathers momentum and RDCs control budgets for water provision and work closely with their communities, the family well will be given much more emphasis in rural water supply programmes. In addition, the narrowing of projects to household water may start to give way to water supply for all purposes, including household needs. Putting **productive water first**[7] would provide the resources and the imperative for users to operate and maintain water supply facilities efficiently. The sustainability of the projects would thus be assured.

## 6. Conclusions & International Relevance

In Zimbabwe, water is not as scarce as it might appear to be in such a drought-prone country. Past policies which treated water as a social good rather than an economic resource, coupled with the inequities brought about by settler colonialism, have led to a high degree of inequity in respect of access to water, and serious concerns about the sustainability of water provision in the face of steeply rising costs of future supplies and a highly constrained fiscal situation.

However, solutions based on economic principles would go a long way to removing the constraints and putting the water sector developments onto an appropriate footing. Economic solutions involve integrated, holistic planning and economic

---

[6] While there are family wells in the great majority of communal areas, there are areas were hydrological constraints would require boreholes to be chosen or provided for drought back-up purposes.

[7] R Mbetu *Rural Development: Productive Water First* paper prepared for October 1995 Water Resources Management Strategy water pricing workshop, Harare.

pricing in all sub-sectors (UIM, irrigation water and rural household supplies). In each case, though, the legacy of the old approach remains manifest in institutional barriers which are inhibiting the adoption of economic solutions. Institutional reform is thus an essential pre-requisite for putting Zimbabwe's management and development of water onto an equitable and sustainable path.

Although this paper has dealt with the details of issues in Zimbabwe's water sector, the root cause of the problems identified are to be found in many other countries, developed and underdeveloped. These are a focus on supply without taking due cognisance of demand and a failure to involve stakeholders adequately in the planning and implementation of projects. The approach adopted was well-meaning, but, by flouting economic principles, often led to unintended detrimental consequences. The debates currently in progress in Zimbabwe and the institutional restructuring taking place could well yield some relevant lessons of more general applicability, particularly for other countries in the region.

# EXPERT GROUP MEETING

# ON

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

**27 - 30 January 1998**

**Harare, Zimbabwe**

## WHY IS FRESHWATER AN ISSUE FOR BUSINESS?

**by**
J W OATRIDGE

**Paper No. 17**

**Prepared for the**
**Department of Economic and Social Affairs**
**United Nations**

WHY IS FRESHWATER AN ISSUE FOR BUSINESS

J W OATRIDGE
SEVERN TRENT PLC

Introduction

Water has not been seen as significant an issue as global warming. However water is the key issue. Without enough water or with reducing amounts of water availability economic development is not possible. We all need water for life and water is the resource which drives food production, health, the environment and industry. Water is an issue for business but it is also an issue for all sectors of society. The goal must be to build a sustainable water future and to do so in an inclusive way which avoids competition and conflict between sectors. Business has to play its part in this inclusive approach to sustain water resources. But the overriding need is for all participants in society to recognise that water is the key issue. This paper seeks to identify the issues business perceives as important and to contribute some views on possible solutions, recognising that acceptable solutions can only flow from an improved understanding of what is to be tackled.

Background

The planet seems to be awash with water but the availability of usable fresh water is small. Only 2% of water resources is fresh water, of that 70% is in ice caps and 29% is not accessible for a whole range of reasons. Only around 1% is available for human use. That is broadly the present perspective. The demand for fresh water is growing but in almost all cases the availability of fresh water per person is declining. As populations grow there are parts of the world where fresh water per person is reaching a point of criticality. Increasing demands for water are occurring in four key areas which in aggregate are exerting unsustainable pressure both in developed and developing countries:-

* Human needs for safe drinking water and proper sanitation
* Agriculture needs for expanding production to meet population growth
* Environmental needs to protect endangered species, biodiversity and unique areas of special interest
* Industrial needs to provide more goods and services for a growing population.

Human Needs - World population is growing and will do so over the next 30 years. Estimates suggest upwards of 8 billion people will be on this planet by the year 2025. The World Health Organisation estimates that more than 20% of the world population - around 1.3 billion people - have no safe drinking water and that more than 40% of all population lacks adequate sanitation. But it is not just the growth in population and the need to feed people that is causing water stress. The situation is compounded by the relentless drift from rural to urban areas. Shifting patterns of population suggests that the number of cities with more than one million inhabitants will more than double over the next 30 years. This will place even greater demands on water and sanitation infrastructures - where they exist that is. Relentless urbanisation suggests that during the 50 years from 1970 the proportion of people living in urban areas will increase from about a third to around two-thirds. So the issue of population and urbanisation, the move from rural to urban areas, the growth in large cities all compound the already stressed water positions in many parts of the world. Fresh water and health are intrinsically linked. 4 million children die each year of diseases linked to the lack of potable water. Half the people in developing countries suffer from water or food associated diseases, suggesting water supplies is the single most important step to improving health in the developing world. This is one reason why water is the key issue

Agricultural Needs - Agriculture is the largest water using sector at around 70% of resources. It can be the largest polluter of water in both developed and developing countries. As a result of poor land management practices and over fertilisation water use in agriculture is frequently inefficient. All too often there are no price signals that encourage more efficient and effective use. Agriculture is the largest user of water and has the potential to be the largest "saver" of water that could be redirected into uses having a higher economic/welfare potential.

Environmental Needs - The allocation of water for environmental needs is a growing area of investigation and policy development. The environment requires water of sufficient quality and quantity to maintain a diverse array of eco-systems and biodiversity. Moreover it is becoming increasingly obvious that the environment is not just a sectoral user of water but provides a fundamental role in maintaining the quality and supply of the world's water resources for use by the other sectors. There is a need to give full recognition of the environmental use of water and to establish the appropriate levels to be used in this way.

Industry accounts for around 20% of global fresh water consumption and industrial use of water is growing. Trends suggest by the year 2025 industrial water use will double and industrial pollution may quadruple if no action is taken. Industry can play a much larger part in protecting access to water, bringing technological capability to move, treat and manage water supplies more effectively. Industry has the opportunity to participate in providing sustainable solutions for water management and there is the opportunity to learn from case studies showing good water management practice. There is the need to drive change to have appropriate "best practice" care for water and waste water management.

Climate Change - There is no doubt that there is increasing variability in the climate. Estimates vary about the speed with which climate change will take effect and the consequences for water supplies. Water is at the forefront of resources having to adapt, although so far water has not been seen as a significant issue affected by climate change. Higher temperatures and decreased precipitation lead to increased water demands and decreased water supplies. Deterioration in the quality of fresh water is also likely. Together these factors put strain on the already fragile balance between supply and demand in many countries. Some countries will have positive impacts but most will be negatively effected.

The Management of Water Supplies - Apart from the issues of population growth, health, agriculture, industrial use of water and climate change, there are also issues concerned with the management of water supplies. It has been estimated that 40% of the world depends on water supplies from a neighbouring country and about 300 major river basins and many underground aquifers cross national boundaries. Many of the management problems in water supply are of a local and regional nature, but some require national co-operation. As Dr Chitale, the 1993 Stockholm Water Prize winner has said "in the natural order of things we are really citizens of river basin catchments rather than of politically demarcated territories". Nevertheless the issue of water has to do with both the reality of geography and the reality of politics.

These then are the issues around which the fresh water debate has to take place. Fresh water is the key issue because it is the common strand that links population growth, health, agriculture, eco systems, industry, climate change, urbanisation, to say nothing of social responsibility. Water is the key issue and it is the life blood in all respects. It is against this background that the remainder of the paper will discuss why fresh water is an issue for business.

## Impact of Future Resources on Industry

As has been said, without enough water or with reducing amounts of water economic development is not possible. Demand for water is growing in all sectors including the industrial sector. But industry can also play a large part in protecting water supplies and reducing pollution loads. The business view is that all sectors must play a part and increasingly business will seek to be part of the solution rather than part of the problem. Fresh water could become a limiting factor in future development; sustainable development demands that we use our finite fresh water resources more intelligently and efficiently. Best practice in the use of water is important and there is a need to spread the message more widely. There is rarely an issue of inadequate technology to cope with water issues or to prevent pollution. R&D is not the issue. There is enough scientific knowledge to understand the problems and sufficient technical skills to solve them. Not all water issues are related to quantity, quality is important too. The most sensitive water issue for many industrial sectors is water quality. While the limitations of the future water supply for industry is a growing concern, industry is still sometimes perceived by the public as the worst polluter of water. Although there are many serious examples of point source industrial pollution in the world, pollution control regulations and water charges have generally ensured the trend towards industrial compliance with increasingly stringent limitations on discharge to public waters. The reality is that pollution from agriculture and urban waste water are by far the larger problems - in terms of absolute levels of pollution, the geographical extent of the pollution problem and in the relative difficulty of controlling these non-industrial sources of pollution. Increasingly business people have learned that pollution prevention, especially when building new facilities, is eminently more cost effective than cleaning up dirty water after the fact. The paper will address later some of the ways in which industry has adjusted to change in its use of water.

## Clean Water and Sanitation Management Problems

There are many parts of the world where the management of water supplies and sanitation issues create their own specific problems. Trans-boundary water resources and their use are of great importance to many States. As water scarcities increase there will be the risk of greater conflicts over water. As has been mentioned about 300 major river basins and many underground aquifers cross national boundaries. Many of the management problems are of a local and regional nature, but some do require national co-operation. There is a huge wastage of water from inefficient practices. Decades of under-investment mean that water supply systems all over the world are in a poor state. Leakage from pipes of 50% or more is not unusual. Sanitation pipework is no better. Cracked sewage pipes means pollutants can enter pipes carrying household water for drinking purposes and pollute that water. The World Bank estimates that about 600 billion dollars is needed to be invested worldwide to repair and improve water delivery systems. In addition to pollutants from cracked sewers, the amount of polluted water being returned to the watercourses has tripled since 1950. In many places around the world investment in sanitation is at a standstill. Even in those places where investment has taken place, it has lagged behind that of drinking water. The issue of sanitation is a vast challenge and without grim determination to succeed, is a problem that will never be solved. Aiming for 100% sanitation by 2025 is a "pipe" dream. By that time it is estimated that more than 5 billion people will have to be served by sanitation systems that are currently not there. Universal safe sanitation by 2025 requires 450,000 individuals **every day** to be provided with safe sanitation for the next 30 years. A truly massive task.

Another water management problem is to do with water sharing. This manifests itself not only in terms of the allocation between the competing sectors of agriculture, industry, the environment and supplies to homes, but also of upstream and downstream sharing, where the "downstreamers" are the victims of the "upstreamers". In reality water that moves down a river basin has to be used for several purposes. The more water is cleaned up by users before it is returned into river systems the less is the environmental liability passed on to those downstream who abstract water for their use. The upstream-downstream issue becomes greater where rivers cross national boundaries. The Danube basin for example is the second largest river basin in Europe. It serves a catchment are of over 800,000 square kilometres in which about 75 million people live. The River Danube or its attributaries flows through some 17 countries. Industry has a need for water including those river systems crossing national boundaries. Industry has to find a way to be involved in processes which affect the future basis upon which water is shared.

Possible Actions by Industry

Industry does have an opportunity and the ability to participate in providing solutions to water management and reduce pollution at source. The lack of adequate water resources may be a limiting factor in the development of some countries. In turn this may limit the ability of some businesses to operate in such countries. The domestic and particularly the agricultural sectors are significant users of water resources. The answer cannot be for business to compete with these two sectors for that resource which is available. Business needs to align its strategies to solve problems and not make them worse. The following possible actions by business give some indication as to where business may be able to play its part in contributing to a sustainable future:-

* Sustainable business practice
* Exchange good ideas
* Reduce water use
* Increase conservation
* Reduce pollution
* R&D improvements for water efficient production
* Create wealth (jobs, foreign earnings) to provide resource to improve water and sanitation infrastructures
* Import best practice
* Foster partnerships in communities

The following two case studies provide some real experiences of some of these actions taken by business. In particular they demonstrate ways in which companies have reduced water consumption, reduced effluents, prevented pollution, improved water handling and actively played a part in the community being served.

Case 1 Millar Western - A Zero-Effluent Pulp Mill - CANADA

The most challenging environmental problem for pulp mills involves polluted effluent discharged into natural water systems. When Millar Western decided to build a new pulp mill at Meadow Lake, Saskatchewan in western Canada, the company faced an unusually difficult situation. The area was blessed with high quality aspen pulpwood, access to power, good transportation and a quality work force. But one piece of the puzzle needed to be found. The Beaver River, the only water source available, had an extremely low flow and in winter the entire river froze. The river was virtually a pristine water body which it was judged could not accept effluents from a pulp factory no matter how clean. So the company made a strategic decision to try to close the loop and go for zero effluent discharge. Water recycling is extensively practised in the pulp and paper industry. But the degree to which water systems can be closed is always limited by the build-up of contaminants in the system. The bleached chemi-thermomechanical pulp (BCTMP) used by Millar Western allowed organic extractives and inorganic salts to enter the wastewater at the rate of 200 kilograms per ton of pulp. In order to recycle wastewater, the residues must be removed.

The company chose the evaporation process. Every drop of wastewater is collected and solids removed by sedimentation and floatation. The clarified liquid is then evaporated to produce clean distillate which can be recycled back into mill processes. The solid residue is then concentrated and burned in a recovery boiler. The inorganic fraction, 84% sodium carbonate, is solidified into ingots and stored at a secure land fill. The company is currently working with research organisations to find ways to convert the salt into caustic soda or peroxide which could then be recycled back into the mill.

Millar Western and its consultant, NLK Consultants Inc, chose the evaporative process in 1992. Just 24 months later the plant came on line and within budget. Four months later the plant was producing high quality pulp at an average rate of 710 tons per day, in excess of design capacity of 680 tons per day. Now five years later, production and quality have never been affected by the zero effluent treatment system. Company officials say that reliability of their treatment system exceeds that of biological control systems and that operating costs are competitive with conventional treatment.

The Company takes pride in never having to worry about upgrading their effluent control systems to meet new legislative requirements. As Peter Knorr, Executive Vice President and Chief Operating Officer, says "It's kind of hard to beat a zero effluent discharge rate!" Now NLK and Millar Western are exploring modifications to the process to permit its use in kraft pulping and other non-pulp industrial applications.

Lessons Learned:

i Dedicated management, supported by competent consultants and outstanding staff enabled one company to make a breakthrough and reduce effluents to zero.

ii Such innovation may give the company a competitive advantage or even create new market opportunities.

iii The low flow Beaver River remains pristine despite the siting of a major industrial facility.

Case 2 Danfoss A/S - Managing an Underground Aquifer - DENMARK

Danfoss, a manufacturer of hermetic compressors, pumps, valves, motors and other electrical control units has a major manufacturing facility located on a small island, Als, in the Baltic Sea. In 1983 the company was routinely withdrawing 2 million cubic metres of fresh water from the sole aquifer supplying the entire island which is home to 50,000 residents. This was well within the limit of 3 million cubic metres authorised by local officials.

In 1983, Danfoss discovered a crack in a settling tank in its wastewater treatment system. The company was concerned that polluted water might permeate down into the fresh water supply. The company repaired the leak immediately but began an extensive investigation of the groundwater and the aquifer. The good news was that the leak had not polluted the aquifer; the bad news was that the level of the aquifer had dropped dangerously low. So low in fact that the danger of salt water intrusion had become a real possibility. Danfoss management recognised that they were the major fresh water user on the entire island and as such they had a responsibility to the 50,000 private citizens who used this common resource.

The company initiated a series of water savings programs and completely revised their wastewater treatment system. All pipes were placed above ground so even the smallest leak could be detected immediately. In 1989 the local authorities reduced the permissible water extraction rate from Danfoss down to 2 million cubic metres. Danfoss, however, had already reduced their use rate to below 1 million cubic metres. Despite increasing production levels, Danfoss continued to find ways to reduce water consumption even further. By 1994, Danfoss had reduced its water consumption to 0.4 million cubic metres, a reduction of over 80% compared with 1983 levels. During this same period the level of the aquifer rose by 1.7 metres and the threat of salt water intrusion virtually disappeared. The substantial improved fresh water reserves indicates a consumption level that can be sustained indefinitely. Fresh water supply was assured both for the company, its 7,000 employees and their 50,000 neighbours on the island of Als.

The actions taken by Danfoss to reduce fresh water consumption were:-

* The company's top management gave priority attention to the water situation - including supply, quality, consumption and reuse
* Top management developed a sustainable water policy
* Management sought to motivate and involve all employees in good household practices

for water
* Reviewed all technical installations and processes using fresh water
* Modernised the control systems making it possible to save water and reduce effluents
* Assured quality of recirculation cooling water to enhance co-operation between technical personnel using water and company environmental specialists

Lessons Learned:

i Companies can continue to expand production and remain profitable while reducing fresh water consumption.

ii Reducing fresh water consumption involves basic housekeeping, management attention, technology innovation and commitment from all employees.

iii This company reduced water consumption by 80%.

There is one other issue that perhaps should be mentioned and that is in connection with food production. One of the more contentious and politically sensitive options for regions with major water stress is to import more food. Where water resources are limited it is suggested that it may be more profitable to invest in producing goods that can be exported to buy food rather than to try to grow food at home. Frequent opportunities exist where the economics of this philosophy might point this way but it is understandable that the natural political reluctance for countries who are well off is to increase their dependency on food imports. However attracting inward investment can produce wealth in terms of creating jobs and foreign earnings from exports and the wealth creation can be used to improve basic water and sanitation facilities at home.

Possible Actions from Water Suppliers

Many actions can be taken in the management of water suppliers and sanitation services that can contribute towards improving the overall availability or quality of water and sanitation services. These include:-

* Facilitating sharing arrangements
* Institutional/regulatory advice
* Promoting best management practice
* Demand management
* Leakage remediation
* Awareness raising
* Schools programmes
* New investment/proven technologies
* Tariffs and metering

Water suppliers are able to act in two fundamental ways to increase the availability of water. These two ways are:-

i) Action on the supply side of water management by creating more capacity.

ii) Action on the demand side of water management in order to lower overall demands for water.

The following case study demonstrates a number of the actions that can be taken to enhance water supplies.

Case Study 3 - Trinidad and Tobago

Severn Trent Plc, UK, was invited to help in the management of Trinidad and Tobago's Water and Sewerage Authority from April 1996. A three year interim operating agreement was initially established. The parties involved in the process include:-

* The Islands' Water and Sewerage Authority
* The Government of Trinidad and Tobago
* Trinidad and Tobago Water Services (a JV Company between Severn Trent Water International and Tarmac Plc)
* Funding arrangements by Citycorp Merchant Bank
* World Bank funding

The Water and Sewerage Authority is a statutory body under the Ministry of Public Utilities. It was recognised that the regulatory structure on the island could be strengthened. The charging structures were regulated by the Public Utilities Commission and quality by the Trinidad and Tobago Bureau of Standards (adopting WHO parameters). Historical funding shortfalls had led to a lack of motivation and incentive and World Bank investment was dependent upon a degree of private sector involvement and some initial achievements being realised. The interim operating agreement has achieved a number of objectives:-

* TTWS (the JV Company) has provided a team of managers seconded to the authority plus some short term specialists.
* The Company arranged a loan of 75 million US dollars with Citicorp to fund operating shortfalls and to improve the operations of the Authority.
* Areas of the Islands had faced limited or very poor water supply services; a number of actions had been taken providing an immediate improvement to customers.
* Leakage was high. Under the operating agreement the number of leaks repaired was increased more than 50%.
* When the Company arrived, 20% of electrical and mechanical equipment was missing. Downtime was 59 days on average. Equipment has been purchased and new working practices introduced. Average downtime has been reduced to 3 days.
* This has had a big impact on the continuity of supplies (although investment has still to be made to improve treatment plants).
* Supplies to nearly a quarter of the population have been improved before any significant capital investment has been undertaken.
* Supplies are now getting to areas that have not received them for maybe 20 years.
* There is a general increase in continuity of supplies.

* Around 60% of the population said they thought the water supply was "definitely getting better".

In the longer term major investment projects are needed; there is an agreement in principle to a $60 million refurbishment programmes from the World Bank. The investment programme will include:-

* The design and replacement of over 100 kilometres of pipes in the water distribution system.
* Rehabilitation of 11 services reservoirs.
* Drilling new water wells.
* Installation of 60,000 water meters throughout the country.

The Company's performance will be judged during the three year life of the agreement. Performance indicators include aspects of service improvements, income generation and a need to match income and expenditure within a three year period. Part of the contract has a performance related payment built in, where payments are only released when targets are achieved.

Lessons Learned:-

i) There is a need for a willingness on all parties to work together.

ii) A regulatory/standards framework has to be in place or strengthened as part of the initial agreement.

iii) Progress can be achieved at least initially without necessarily recourse to major capital investment.

iv) There is always scope for improving current operational arrangements.

v) The income issue is important; metering/tariffs have to be addressed.

vi) Financing arrangements can be put in place, particularly where the funder has confidence in:-

* The operator.
* The framework conditions under which the operator will operate.
* If the income issue is addressed.

vii) Government's can produce contracts with performance criteria built in that are acceptable to an operator.

Successful outcome can be achieved with each of the parties, the government, the company, the World Bank, the customers, gaining from the process thus creating a potential win-win-win-win-situation. The contract demonstrates many aspects of managing water supplies and sewerage facilities as well as linking together a whole range of parties and interested participants. Essentially it displays the range of possible actions identified at the beginning of this section of the report. Clearly success depends on a desire and will on all parties to achieve a programme of activity they are all committed to. It also demonstrates that a mixture of good operational experience together with sound investment can deliver real customer improvements. In the case of operational improvements, the customer improvements can be delivered very fast - well ahead of the normal timescale envisaged for major capital investment.

Blockers to Progress

The case studies that have been included in this paper do demonstrate many of the actions that are possible either by business or water suppliers working to improve business use of fresh water or basic services. The case studies demonstrate that actions are possible and delivery can be achieved. But there are a number of conditions that have to be satisfied in order for achievements to be made. These are:-

* There needs to be a willingness on all parties involved to make progress and to share a common view of what objectives should be achieved.
* There needs to exist a government framework capable of introducing, maintaining and enforcing a strong regulatory framework within which water resources are provided.
* The quantity and quality of fresh water use and sanitation have to be regulated and not open to manipulation.
* An appropriate legal system has to in place for a variety of issues including trans-boundary water rights, water abstraction rights and land access.
* The charge/tariff/income issue must be addressed in order to attract investment. Investment will not take place unless this issue is addressed either through government (tax) or through direct customer payments (eg metering) or a mixture of both. This may include transferring responsibility from government to customers on a taper basis over a period of years.

Water is the key issue - solutions have to be found.

Footnote

I am grateful to Millar Western of Canada, Danfoss in Denmark, Severn Trent Plc of the UK and WBCSD for helping make information available for use in the case studies. The way in which the report is pulled together and the words that are used are entirely my responsibility.

Jim W Oatridge
Director of Environmental and Corporate Controls
Severn Trent Plc, UK
Tel: +44 121 722 4903
Fax: +44 121 722 4892
e:mail: ecc@severntrent.co.uk

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

# MAINTAINING FUNCTIONING OF FRESHWATER ECOSYSTEMS: THE KEY TO SUSTAINABLE MANAGEMENT OF WATER RESOURCES

by

GER BERGKAMP, MIKE ACREMAN, LESLEY SAFFORD, TABETH MATIZA
IUCN

Paper No. 18

Prepared for the
Department of Economic and Social Affairs
United Nations

MAINTAINING FUNCTIONING OF FRESHWATER ECOSYSTEMS:
THE KEY TO SUSTAINABLE MANAGEMENT OF WATER RESOURCES

GER BERGKAMP, MIKE ACREMAN, LESLEY SAFFORD, TABETH MATIZA
INTERNATIONAL UNION FOR THE CONSERVATION OF NATURE

## Abstract

Current ideas regarding Integrated Water Resources Management (IWRM) recognize the limitations of supply driven water management approaches. Within IWRM, ecosystems are seen as important users that need water for their maintenance. Although they are seen as important users their role as providers of water resources and other goods and services is paid little attention to. However, ecosystems such as head waters, forests, wetlands, floodplains, riparian zones and coastal areas provide regulation, habitats, resources and information to human society and regulate water resources.

An Ecosystem Based Management Approach is presented that secures the water resources and maintains ecosystem functioning and consequently services and goods ecosystems provide. This approach aims to meet human requirements for the use of freshwater, whilst maintaining hydrological and biological processes and biodiversity that are essential for the functioning of ecosystems, the sustainable use of water resources and the maintenance of services and goods provided by ecosystems. The implementation of this approach is based on four principles: a) improving the assessment of water resources and ecosystem functions, b) strengthening the capacities to manage water resources at different levels, c) improving communication through establishing partnerships and, d) adapting policy and planning to included an equitable sharing of costs and benefits and wise use practices. The Ecosystem Based Management Approach is recommended as the most appropriate strategy to meet current and future water demands in a sustainable way.

## 1. Introduction

The direct economic value of water as a resource, for domestic use, agriculture and industry, and the economic value of the most obvious goods that it provides, such as fish, are appreciated world wide. Consequently, freshwater management strategies have typically been geared to the maintenance of supplies of water and these tangible goods. Until th 1980s, the approaches taken to secure the availability of water and goods were mostly sub-sector based and tailored according to supply driven principles with little consideration of competition for scarce resources between different users. The Integrated Water Resources Management (IWRM) approach that is advocated most recently has recognised the limitation of this approach. In response, it specifically considers the interactions between all components of water resources and water resource users, and is mainly inter-sectoral and demand driven. There is a growing consensus that the IWRM approach could provide a way out of the gridlock that currently faces water resources management and could also have the potential for developing strategies for sustainable water resources management (NEDA, 1997; GWP, 1997).

Within the current ideas of IWRM, ecosystems are seen as important water users that for their maintenance need water that cannot be used for other purposes. The use of water resources to maintain freshwater ecosystems includes e.g. the use of water to maintain wetlands, the use of water to maintain minimal river flows, and the use of water to maintain seasonal inundations. Although ecosystems have now been recognised as important users of water, little attention has been given to their vital role as providers and regulators of water resources. In addition, little consideration has been given to the other services and goods ecosystems provide, such as flood regulation, biodiversity conservation, fish and firewood. However, it is of fundamental importance to the longer term availability and sustainable management of water resources that the maintenance of ecosystems and the strengthening of their role as providers of services and goods is recognised (Laanbrock et al., 1996).

In this paper the relationship between the functioning of freshwater ecosystems and the services and goods they provide will be discussed to substantiate and exemplify this. Based on these considerations, an Ecosystem Based Management Approach is presented that harnesses the functioning of ecosystems and the sustainable management of resources, services and goods they provide. The approach is based on four components: monitoring resources, strengthening capacities, improving communication, and adapting the planning process and policy. These components will be discussed in more detail. Finally, recommendations considering the valuation of functions and services provided by ecosystems and the actions required to improve the monitoring of these functions will be given.

## 2 Functions and values of water based ecosystems

### 2.1 The traditional approach to water management

People need water to drink, grow and prepare food and provide power for domestic and industrial use. These are the direct or obvious uses of water, and policy makers are traditionally driven to manage water to provide people with water for these purposes. In view of the unprecedented rise in human population (from 2.8 billion in 1955 to 5.3 billion in 1990), and the prediction that by 2025 as many as 1,100 million people will suffer severe water stress (Engleman and LeRoy, 1993; Falkenmark, 1989), it is not surprising that governments and water resource managers constantly seek to maximise the volume of water available for direct use.
Consequently, traditional management plans for water resources divert water from original stores and pathways to new stores and pathways that supply it to people for direct use. Groundwater is extracted from stores in aquifers. Artificial dams and reservoirs are created to hold water in convenient locations to supply large populations with power and water. River channels are dredged, straightened, isolated from their floodplains and wetlands, forests are removed from river catchments in efforts to speed water across the landscape to points of consumption. In some cases water is channelled so efficiently for direct use that rivers run dry before they reach the sea.

In view of society's need for water for basic goods provided through agriculture, industry and domestic services, and the highly successful attempts to channel water to meet that demand, the idea that water should be used to support ecosystems rather than withdrawn to support people, may be seen as extravagant and wasteful. Allowing rainfall to 'run away' into underground aquifers, be absorbed by soil or taken up and released into the atmosphere by forests, might appear as bad management of the water resource. Indeed as holders and consumers of water, the landscape and plants and animals can appear as direct competitors with people for water use. However, although it is true that ecosystems may lock up water, for example in wetlands or aquifers, and plants and animals consume water which can not then be used for direct use by people, 'expending' water in this way may per unit volume, provide greater benefits to people than those provided by directly using it for agriculture, industry or domestic use. How can allocating water to the 'environment' provide benefits to people? How can society weigh these benefits against those provided through agriculture, industry or domestic use? How can society decide on a strategy of allocation that will obtain the maximum benefits for the maximum number of people over the maximum period of time?

The first step is to appreciate the 'hidden' benefits provided to people by the environment which requires water for its support. In holding or consuming the water, ecosystems maintain hydrological and biological processes which determine how the environment functions. How the environment functions determines which services the environment provides to people. To explain what these processes, services and goods are, we will describe how water is 'used' by ecosystems and what benefits the environment provides to people in return, both in terms of water resources and services and goods.

## 2.2 Ecosystems as providers of water resources and key-functions

Water forms an essential element for sustaining life on earth. As water travels from moutains to the sea, proportions are used along the way to support the various ecosystems and maintain their functioning. In return for this expenditure of water, the hydrological and biological processes of the ecosystem enable the ecosystems to provide several functions to people both throughout the catchment and globally. Ecosystem functions are defined as 'the capacity of natural processes and components of natural or semi-natural systems to provide services and goods that satisfy human needs (directly or indirectly) (De Groot 1992). Generally, ecosystem functions are grouped into four cateregories (after De Groot 1992): regulation functions, habitat functions, production functions and informations functions.

*Ecosystems as providers of regulation*

Ecosystems function both as regulators of water quantity and water quality. Several types of ecosystems are known to act as hydrological buffers, absorbing water to prevent flooding and releasing it in times of drought. Providing this service increases the quantity of water and protects downstream communities from flood and drought. For example, cloud forests in La Tigra National Park (Honduras) sustain a well-regulated, high quality water flow throughout the year, yielding over 40% of the water supply of the capital city (Acreman and Lahmann, 1995). In a slightly different way, wetland ecosystems are able to reduce rates of water flow and store water above the surrounding water table (for example in a raised bog). The vegetation and hydrology enables the wetland ecosystem to function as a 'sponge' and provide the services of flood prevention and water storage. The value of these services may be considerable. Often technical alternatives to regulate the quantity of flow are much more expensive. New York City, for example, spends only 10% of the costs of building water treatment facilities (US$7 billion) to ensure its water supply through the protection of the biological and hydrological processes of the upper parts of the catchment on which the water supply is depending (Abramovitz, 1997). Ecosystems also regulate the quantity of water resources through taking up water and releasing it into the atmosphere. rain forest tree, for example, can pump 2.5 million gallons of water into the atmosphere during its lifetime (Ehrlich and Ehrlich, 1992) of which most is recycled and not lost from the forest. In the Amazon rainforest, 50% of rainfall is derived from local evaporation.

After forest cover is removed an area can become hotter and drier because water is no longer cycled between plants and the atmosphere. This can lead to a positive feedback cycle of desertification, with an increasing loss of local water resources (Gash et al, 1996).

Results of computer simulations have confirmed these feedbacks play an important role in determining local climate. A global circulation simulation model predicted that if the Amazon tropical forest and savannah was replaced with pasture land, the climatic consequences would included a weakened hydrological cycle, less precipitation (-26%) and evaporation and an increase in surface temperate due to changes in albedo and roughness (Shukla et al, 1990; Lean and Warrilow, 1989). Similarly, modeling the removal of natural vegetation in the Sahelian region of Africa predicts that rainfall would be reduced by 22% between June and August and the rainy season would be delayed by half a month (Xue and Shukla, 1993). These two examples show that forest ecosystems function as water recycling systems. In return for the water they use, they provide the service of regulating both local and global climate and maintaining local water resources.

Ecosystems not only regulate the quantity of water flow but also regulate the quality of the flowing water. On sloping ground, for example, vegetation anchors soil and prevents it from being washed into the water course where it would cause siltation and nutrification and reduce light penetration. This would reduce water quality, the health of aquatic ecosystems and the suitability of the water for aquaculture and other uses. The physical structure of water courses and the organisms that inhabit it also regulate water quality. For example, waterfalls, rapids and aquatic vegetation oxygenate the water, and river banks, river beds and vegetation trap sediment. These hydrological and biological processes enable the water course to function as a water purification unit providing fresh water.

Freshwater wetland ecosystems are also known as important water quality regulators. Within these systems toxins and excessive nutrients are removed from the water both by processes of decomposition and uptake by vegetation (Baker and Maltby, 1995). As wetlands hold water for long periods of time, decomposition processes and vegetation are given enough time to remove nutrients and toxins from the water. For example, vegetation found in the *Melaleuca* wetlands in SE Asia reduces the acidity of polluted water and removes toxic metal ions making the water suitable again for the irrigation of rice (Ni et al., 1997). In this way, the combination of hydrological and biological processes allows wetlands to function as filtration and purification systems and to provide the service of water purification.

Coastal wetlands systems, such as saltmarshes and mangroves, also function as buffers and regulators of water quality (Koch et al., 1992). These systems provide a physical and hydrological buffer between marine and freshwater, while their vegetation removes sediment and nutrients from the freshwater before it flows into the sea. This process allows the coastal wetland to function as a final freshwater filter, providing the service of protecting coastal marine resources, such as coral reefs or seagrass beds from sediment deposition. Coastal wetland vegetation absorbs the energy of winds and waves from the sea, a process that enables the wetland to function as a barrier against saltwater intrusion, marine floods, erosion and wind damage and provide the service of protecting coastal land resources. In recognition of the protective function of the mangrove forest of the uncleared Sundarbans forest of Bangladesh and

India, the Bangladesh government have planted and replanted mangroves to protect embankments and new land (Saenger et al., 1983).

*Ecosystems as providers of habitats*

Floodplains, wetlands, river courses and headwaters of catchments are important for the regulation of water resources. Sustaining the functioning of these ecosystems to keep them providing the regulation service requires the maintenance of many biological processes. These processes are often extremely complex and depend on the maintenance of these areas as habitats for many species of plants, fish, birds and others animals. For example, wetlands in semi-arid and arid areas are known as prime areas for biodiversity conservation and as important nursery and feeding areas for many aquatic and terrestrial migratory species. Wetlands are particularly important for aquatic species whose young require low water flow rates. Consequently wetland ecosystems can provide the service of maintaining fish and shrimp fisheries.

River courses are also important habitats. The vegetation, banks and bottom of wild water courses provide shelter and food for a large variety of animals. In contrast to wetlands, water courses function as habitat for animals that require fast flowing oxygen rich water, and consequently provide the service of maintaining fisheries. Together, freshwater ecosystems support important biodiversity, including over 10,000 species of fish and over 4,000 of amphibians described sofar (McAllister et al., 1997; WCMC, 1992).

Coastal wetlands are also important providers of habitats. They provide food and shelter for marine animals that require freshwater conditions for part of their life-cycle. Consequently, coastal wetlands function as habitat for o.a. crabs, oysters and shrimp, and provide the service of supporting fisheries based on these goods. For example, 90% of the fish harvest of the gulf of Mexico, worth US$700 million per year, consists of species which are dependent upon the mangroves and coastal wetlands of the region at some stage in their life cycle (Dugan, 1990).

*Ecosystems as providers of resources*

Many water based ecosystems provide large quantities of water, food and energy for direct human consumption, agriculture, fisheries, watering livestock, industry and energy production. Water supply in many rural areas within or near wetlands depend largely on water extracted from shallow boreholes. The aquifer these boreholes tap is often recharged directly from the extensive wetland.

Harvesting wetland ecosystem goods while respecting the production rate and the regenerative capacity of each species can generate great benefits to human society. One of the most important products of wetland ecosystems is fish. In many areas the fishing industry related to wetland ecosystems forms a fundamental pilar of the local and national economy. Direct harvest of forest resources of many wetlands and floodplains yields a number of important products, ranging from fuelwood, timber and bark to resins and medicines which are common non-wood 'minor' forest products (Dugan, 1990). Wildlife rich wetlands also provide important commercial products such as meat, skins, eggs and honey. Wetland and floodplain ecosystems often contain substantial grasslands and forests that are grazed by livestock and are important to pastoral communities.

Leaves, grasses, and seed pods are amongst the prime resources these systems provide to these communities. Wetlands also contain a large genetic reservoir for certain plant species, fish and other animals. For example, wild rice continues to be an important resource of new genetic material used in developing disease resistance and other desirable traits.

The importance of ecosystems as providers of many resources is very often underestimated or neglected. However maintaining their role as providers of resources is of fundamental importance for the sustainable development of human societies.

*Ecosystems as providers of information*

Water based ecosystems provide many opportunities for recreation, aesthetic experience and reflection. Recreational uses include fishing, sport hunting, birdwatching, photography, and water sports. The economic value of these can be considerable. For example in Canada the value of wetland recreation was estimated in 1981 to exceed US$ 3.9 billion (Dugan, 1990). Maintaining the wetlands and capitalizing on these uses can be a valuable alternative to more disruptive uses and degradation of these ecosystems. They are important repositors and stores of palaeontological information. Under anaerobic conditions biological material such as pollen, and diatoms and even human bodies can be preserved in peats and lake sediments.

It is up to society to decide how to allocate water to maximise the benefits it provides to society as a whole. The problem is to decide how much water should be used for the maintenance of ecosystems to provide environmental goods and maintain elemental services and how much water should be used to support agriculture, industry and domestic services to provide basic goods. Obviously, the value that society places on these alternative goods and services will determine the pattern of allocation. It is important therefore that the costs and benefits to society of allocating water to maintain ecosystems and to support agriculture, industry and domestic uses is well understood.

Techniques are now available to estimate the economic value of specific biomes. Barbier et al. (1996), for example, have produced guidelines for the economic valuation of wetland goods and services. Costanza, et al. (1997) have attempted to calculate the economic value of 17 ecosystem services for 16 biomes. They used these estimates to determine a value of US$ 16-54 trillion per year (with an average of US$33 trillion per year) for the value of the entire biosphere. This is almost twice the global national product total of US$18 trillion.

## 2.3 Negative effects of current water development practices

Management plans for water systems that focus solely on maximising the quantity of water available for direct use typically only consider costs and benefits of the project in these terms. For example, the economic costs of labour and technology set against the economic benefits of increased agricultural productivity or supply of power. Diverting water from one pathway to another means that new benefits from the water resource will replace old benefits. Society needs to be sure that the new benefits are greater than those provided by the water in its old pathway. It is essential that societies can consider both the economic and the social and cultural benefits of alternative allocation strategies and their sustainability for future generations. If these considerations are not made societies risk making less than the best use of their water resources. The economic benefits of using water to support fisheries, agriculture and fuel wood in wetlands may be many times greater than using it for intensive irrigation. However, these benefits may be overlooked in water resource management plans, as in the case of the construction of Tiga and Challowa Gorge dams on the Hadejia River in Northern Nigeria. The dams reduced inundation of the Hadejia-Nguru floodplains. Inundation is necessary to recharge the groundwater which supplies well-water downstream and to some 100,000 people in the Komodugu-Yobe basin (Hollis *et al.*, 1993). In respect of the importance of this and other functions of the wetland, the Nigerian authorities are making test releases of water from the reservoirs to augment flooding of the wetlands (Acreman, 1994).

The social and cultural costs and benefits people receive from different water allocation patterns are often less visible than economic ones. Consequently the chief aim of hydrological management has been to speed up economic development. In recent years the construction of major dams is seen as a key component of this strategy. Dams store water when river flows are high and release it when needed to supply power and irrigation to urban populations and industry. In many parts of the world, dams have stimulated economic growth and permitted intensification of agriculture, increased yields.

However, in many cases dams have hastened removal or conversion of riverine forests and other floodplain and wetland habitats and also replaced the natural cycle of floods and low flows with a more constant flow pattern related to electricity or irrigation demand. These changes in water flow can lead to changes in the way ecosystems dependent on that flow function, which in turn impacts on societies dependent on these ecosystems. For example, two dams were built in the Senegal River valley in 1986/7: the Diama dam near the river mouth and the Manantali dam in the headwaters. The Diama dam inhibits saltwater intrusion into the river to allow its use for irrigation and regulating water levels to facilitate transport. The Manantali dam was built to generate hydro-electric power and to regulate flows in the river. In addition, embankments were constructed along both banks of the river to prevent inundation. The engineering works had many effects on the environment, some of which created social problems in terms of increased health risk and loss of productivity in agriculture and fisheries. The character of the vegetation in the Djoudj National Park, adjacent to the river, changed significantly as the dry season saline water intrusion into the river was replaced by a regime of continuous freshwater. This led to increased survival of snails and mosquitoes which carry diseases. Before 1987 neither rift valley fever (a mosquito-borne viral disease) nor human intestinal schistosomiasis (an aquatic snail-borne worm parasite disease) had been recorded in West Africa. Following construction of the Diama dam, 200 deaths from rift valley fever were recorded and an 80% abortion rate among sheep and goats. In 1988, there was a 2% prevalence rate of schistosomiasis, by 1989 this had risen to 72%. In addition, there was a 90% drop in the productivity of the fisheries of the Senegal delta which relied on inputs of freshwater from upstream (Verhoef, 1996).

Cultural costs of construction of the same dams include the loss from society of traditional cultures adapted to the dynamics of the Senegal River valleys floodplains. Diversion of water from the floodplains prevented the recharge of nutrient levels and groundwater stores achieved by the previous regular flooding. Of 80,000ha of traditional grazing lands, only 4,000ha could still support vegetation for grazing cattle. The society that had adapted to the floodplains seasonal cycle were forced to abandon its culture, and the knowledge base of that culture lost to society.

More recent thinking has tried to develop traditional approaches to water management which have evolved over many years, often in sympathy with the environment rather than against it. Flood recession agriculture is a prime example, where flooding is seen as a positive process, bringing fresh soil, nutrients, water and fish to the floodplain. Floating rice is often grown during inundation of African floodplains, and arable crops are planted in the wet soil as the flood waters recede. Some soil moisture persists to the dry season and provides essential grazing for migrant herds. Throughout west Asia, much water is stored in alluvial cones at the base of steep impermeable slopes. This has been exploited traditionally by the excavation of tunnels, called kareses, from the alluvium downslope towards the villages or agricultural land, with vertical shafts every few hundred metres to provide water abstraction points. Rather than develop this sustainable technique, many of the kareses have now fallen into disrepair and replaced by boreholes directly into deeper aquifers powered by electric pumps, which have permitted over exploitation of the groundwater.

## 1.Maintaining ecosystem functioning using an ecosystem approach.

### 3.1 Maintaining ecosystem functioning

As described above, the goods and services provided by an ecosystem depend on how it functions. How it functions depends on what hydrological and biological processes occur within it. Which processes are performed depend upon which physical chemical and biological components make up the system. These include the quantity and type of plants, animals, microbes, soil and minerals. The components that make up the system are dependent to a large degree on the quantity and the quality and water moving in and out of the system. This dependency originates mainly from sediment and nutrients brought in by water entering an ecosystem, which bring food for animals and maintains soil fertility for plants.

To maintain the functions and services of an ecosystem, both the key components, and the quantity and quality of water flowing through the ecosystem needs to be conserved. For example, the vegetation of 'Melaleuca' forest in SE Asia will only be able to reduce the acidity of water if the flow of water in and out of the ecosystem is slow enough to give the process time to work. Similarly the papyrus swamps in Uganda absorb sewage discharged from Kampala and purify water supplies, but a certain quantity of water is required within the ecosystem to allow the biological processes to take place. The National Sewerage and Water Corporation recognises this need and is ensuring enough water is allocated to the swamps to maintain their functioning (Dugan, 1990).

Degradation of ecosystem components other than water also often leads to changes in the ability of ecosystems to function and provide services that benefit water resources. For example, forest clearance has had a great effect on the water purifying service of the North Selangor Peat Swamp forest (Khan, 1996). The 75,000 hectare swamp once performed the functions of water storage and water purification, and provided one of the largest rice schemes in Malaysia which borders it with the services of flood protection and provision of high water quality. In recent years the forests have been cleared for agriculture and tin mining. The trees are no longer present to retain soil, sediment, water and toxins. Consequently, the swamp no longer provides the services to the rice scheme. It is forecast that further clearance would result in significant water quality problems in the rice fields.

If society wishes to continue to benefit from the services an ecosystem provides, it must ensure that both the key components of the ecosystem, and the quantity and quality of water resources within the ecosystem are maintained. Society also needs to consider all the ecological, economic, social, cultural and political costs and benefits of alternative management options. The fundamental question is - How can societies decide how to manage water resources and maintain key functions provided by ecosystems and balance the need to support agriculture, industry, domestic use, and natural goods and services? The only sustainable method is for the stakeholders in the water resource to choose which benefits they most want to receive from the water resource, and create a management plan that provides these benefits. To make an informed choice all stakeholders of the water resource need to appreciate both the benefits water can provide through supporting agriculture, industry and domestic life, and through supporting ecosystem processes, functions and services. Stakeholders also need to understand the choice of management actions available to maintain those benefits, and the consequences the management actions would have for alternative benefits.

### 3.2 What is an Ecosystem Based Management Approach?

An Ecosystem Based Management Approach approach aims to meet human requirements for the use of freshwater, whilst maintaining the biological diversity, hydrological and ecological processes necessary to sustain the composition, structure and function of the ecosystems that support human communities. It is a holistic approach that considers all the relevant and identifiable (ecological and economic, social, cultural and political) costs and benefits of alternative management options to all stakeholders, and ensures that the plan which is adopted is that which is most acceptable to all stakeholders.

### 3.3 Spatial and temporal scales of management

The appropriate spatial scale at which to apply ecosystem based management depends upon the relative importance of the components in the system, the scale of natural disturbances (e.g., fires, landslides, floods), pertinent biological processes (e.g. disease, foraging, reproduction) and dispersal characteristics and capabilities of the component populations. The fundamental unit for water-related management issues is normally the drainage basin, as this demarcates a hydrological system, in which components and processes are linked by water movement. Deforestation of headwater catchments can, for example, affect water yield and frequency of flooding downstream. Hence the term integrated river basin management has developed as a broad concept which takes a holistic approach at this scale. However, frequently the underlying aquifer does not coincide exactly with the surface river basin. Thus, where groundwater plays a significant role, a group of basins overlying an aquifer may constitute the appropriate unit of water resource management.

Defining the temporal scales of an ecosystem based management, short, intermediate and long term considerations need to be taken into account. Many of today's practices only consider short and at best intermediate term availability en reliability of water resources. Little attention is paid to the long term sustainability of current practices. For example, mining of non-renewable groundwater resources, that is unsustainable in the long term, is practised in many dryland areas. Another example is the pollution of infiltrated water that will percolate to groundwater at larger time scales (100 - 10,000 years). The long term unsustainability makes these practices inappropriate from many perspectives (National Researach Council, 1997).
An Ecosystem Based Management Approach especially takes into account the long term sustainability of practices. Although some options may be more appropriate from a short time frame perspective, the approach considers practises 'wise' when they are sustainable and thus both meet current and future demands and support ecosystems to provide services and goods at the longer term.

### 3.4 Recognizing the importance of an Ecosystem Based Management Approach

The importance of an Ecosystem Based Management Approach is being recognised, not just by the scientific and conservation community, but also by international environmental instruments. For example, the Convention on Biological Diversity is in the advanced stages of formulating a work programme on inland water systems that recognises the importance of adopting an ecosystem-based approach to achieve the conservation and sustainable use of the biological diversity of inland waters and the fair and equitable sharing of the benefits these provide (UNEP 1997). Consequently the Secretariat of the CBD is seeking to develop a 'modus operandi' to assist Parties to the CBD to implement an ecosystem based approach internationally, regionally and locally.

In general, ecosystem management is still far from being successfully implemented. The rate at which it is implemented, and the success of that implementation depends largely on how well international environmental instruments work together to advise their often shared Parties. In view of the interdependency of biological diversity and sustainable development it is particularly essential that the Commission on Sustainable Development and the Convention of Biological Diversity work together. Both are currently considering the thematic area of fresh or inland water resources. By joining with the CBD in advising Parties to adopt an ecosystem approach as a Strategic approach for the sustainable management of freshwater resources, the Parties of the CSD and the CBD will continue to benefit from the close co-operation between the Commission and Convention.

## 4. Implementing an ecosystem-based approach to the management freshwater resources

The importance of an ecosystem approach is beginning to be accepted. International instruments are beginning to advise that countries adopt it, but what advice is available to Countries on how to implement an ecosystem-based approach to the management of freshwater resources? Most of the questions that we can anticipate countries asking fall into four categories. What are the extent of the water resources and what ecosystem functions do they support? How can we achieve the capacity to design and implement an ecosystem based management plan for water resources? How can the various stakeholders in society communicate, and reach agreement over the design and implementation of development projects? Is policy and planning sufficiently based on a sufficiently diverse disciplinary ground to support implementation of ecosystem based approaches to the management of water resources? To ensure that we can answer these questions we need to assess what is known, identify gaps in the available information, and set about filling those gaps so that high quality is advice is available to countries on demand.

### 4.1 Assessment of water resources and functions and values of ecosystems

*Monitoring of water resources*

Effective management of resources can only be achieved if decisions are based on sound information. Even in developed countries, where there is a dense network of rainfall and river flow measurement stations, the amount of water resources data is still limited and considerable funds are being invested to develop methods of resource assessment for un-gauged rivers. Furthermore, hydrological data on slow flowing or static water bodies and terrestrial ecosystems are very rare (Acreman and Hollis, 1996). It is therefore extremely difficult at present to quantify the water resource used and provided by many ecosystems. We are still largely ignorant of precisely how these ecosystems function in transforming hydrological inputs into ecological, environmental and human goods and services.

With a projected increasing pressure on water resources there is a large need to increase the monitoring of hydrological properties of catchments. As part of water resource planning and management the movement through and storage within key ecosystems must be quantified to enable their crucial hydrological functions to be assessed and used effectively. Water quantity measurement should include rainfall, river flows, infiltration to grasslands, interception and recycling of water within forests, storage of floodwater, recharge of groundwater (within wetlands), and extend of annual flooding. Water quality measurements should include levels of acidity, nutrients (nitrate, phosphate), pesticides, ammonia, BOD, oxygen and heavy metals. Re-vitilising excisting measurement networks and establishing new networks should be encouraged to support these tasks.

*Monitoring and valuing key-functions of ecosystems*

Besides monitoring hydrological aspects, a sound ecosystem based management needs to monitor the functions, services and goods that ecosystems provide. In addition to one-off assessments of the hydrological functions of ecosystems for planning purposes, data collection must be continued through periodic monitoring to ensure that the function continues and is not degraded. The frequency of recording depends upon the variable being measured and the hydrology of the river basin.

To ensure a cost effective assessment of functions, indicators of the performance of functions need to be developed. Currently these indicators are being established for monitoring biodiversity but these need to be expanded to include other functions of freshwater ecosystems. To be able to select between different management options within a IWRM approach, resources and functions provided by ecosystems need to be economically valued. A recent valuation of environmental services and goods provided by the world ecosystems has estimated these to be

US$ 4.5 billion (Costanza et al., 1997). Economic values of ecosystems can be evaluated against economic benefits from outputs under changed conditions. Decision makers will then be able to base their decision on a balanced judgement of economic costs and benefits of projected developments.

## 4.2 Strengthening capacities

*Transferring appropriate technology to local water managers and regional planners*

Current planning practices are often aimed at the implementation of new technologies to improve water resources use. However, often local knowledge and practices need not to be replaced or adjusted. Therefore planners should consider both traditional and modern technologies in the design and implementation of water projects. To ensure balanced implementation of appropriate technologies, capacities need to be build at the various levels ranging from the regional planner to the individual stakeholder (Borrini Feyerabend and Buchan, 1997; OECD, 1996). Whatever the level, institutions need well-informed members who have an appreciation of the wide range of issues facing water resource allocation. Training is an essential element, but training needs to vary with the type of institution. Professional technical advisors require formal training courses, for example, on water resource planning and wetland management, whilst local community representatives may be best trained with involvement in local activities, such as participatory rural appraisal or through visits to demonstration projects.

Furthermore, local circumstances should help determine the choice of appropriate technology. Important in this respect is the change to demand based management. To change demands appropriate technologies and new methods for water conservation, recycling, and maintenance or restoration of water quality need to be pursued. An example of this is the development of non-water based sanitation systems for arid and semi-arid areas. Selected technologies need to be promoted through the use of on-farm trials, farmer-to-farmer and women-to-women contacts, radio-programmes, posters etc. aiming at a replication of successful initiatives.

*Integration of management and development planning*

The management of water resources takes place at many different levels in society ranging from the individual farmer to communities, districts and national water authorities. Most planning of development occurs mainly outside the affected area at district or national level both by national institutes and consultancy firms. To change current practices communities should be involved in the design and implementation of development projects (Borrini Feyerabend and Buchan, 1997). Collaborative management agreements between governments and local communities should be encouraged. Under these agreements, communities assume responsibility for sound management of local agro-ecosystems including their biodiversity in return for the right to use water and involvement in river basin management and planning. The design, implementation and evaluation of water projects should benefit more from community participation. To ensure community involvement in planning, a change in institutions will be needed in many places. To facilitate this change an assessment of current decision making strategies, internal communication structures and organisational capacities of the institutions involved can be a valuable first action.

*Development of strategies for conflict resolution*

With the rise in demands for the many uses of limited water resources, conflicts concerning quantity, quality and allocation will increase. Water related conflicts arise at levels ranging from communities and districts to countries and regions. As freshwater becomes more scarce, users and other stakeholders must reach a consensus on individual needs, negotiate on solutions and collaborate on long term conservation of water resources and biodiversity. Involvement of all interested parties is essential in the process of conflict resolution.

Currently there is a need for strengthening the capacities for conflict management at different levels (community, district, national, international) (Borrini Feyerabend and Buchan, 1997). At local, district and national levels, independent water commissions should have the authority to arbitrate and adjudicate between water users and should ensure equitable distribution of water-use rights. Distribution patterns should support the long term conservation of water resources and ecosystem functions, services and goods for future generations. At the national and multilateral level agreements on shared water resources should be negotiated. These should encompass the current and future rights and responsibilities of users of upstream and downstream surface water resources and renewable and non-renewable groundwater resources.

## 4.3 Improving communication through establishing partnerships

*Using multidisciplinary teams to ensure coherence in planning and management*

Traditional sector based planning and management is characterised by a lack of co-ordinating the allocation of limited resources to different users and harnessing the role of ecosystems as providers of many services and goods. Important reasons for these are the dominance of a single discipline in the supply-based planning and management process and the underestimation of the many functions and values of ecosystems. To ensure improved planning and management, scientific and technical coherence should be advocated by the involvement of multidisciplinary teams. These teams are to be established at local, regional, national and international levels and be aimed at communicating different perspectives on water resources and building consensus on the conservation of water resources and the maintenance of ecosystem functioning as the bases for sustainable development.

*Establishing inter-sectoral teams for development of policy and planning tools*

Current initiatives on IWRM are encountering many new challenges for which traditional sub-sector based solution are often inadequate. The new problems are often less of a technical nature rather then relate to the handling of a broad range of information sources, the integration and synthesis of this information, reaching agreement on facts, alternatives and solutions, the communication of the synthesised information to a wide range of stakeholders and the transformation of this information into adequate policies. To ensure development of adequate policies and planning tools that support the conservation of water resources and ecosystem functioning, inter-sectoral teams need to be established. Within these teams, local user groups should be represented to ensure both their input into the planning process and the communication of outputs to individual users.

*Setting-up multi-stakeholder teams for programme definition and co-ordination*

Local communities are the key-actors in the management of agro-ecosystems and water resources as a part of these. An effective communication with the local communities is required to learn from their experiences and to integrate their views and aspirations into development and management plans. Only with the involvement of local groups plans and policies will be supported and adhered to and a successful implementation be possible. Therefore, a considerable effort should be put in organising local communities in resource user groups with special attention to the formation of women groups given their specific relation and responsibilities in water resources utilisation and conservation. Empowerment of these user groups through their representation in multi-stakeholder teams is essential for the success of these initiatives. The multi-stakeholder teams ensure that meaningful contacts will be established amongst stakeholders and between stakeholders and governmental organisations. The advantage will be that the views of the various stakeholders can be better communicated to policy and decision makers while development and management options can be more easily communicated back to communities.

## 4.4 Adapting policy and planning

*Including environmental and economic costs, and sharing of costs and benefits*

Inappropriate water use can lead to considerable environmental and economic costs. A loss of functions, services and goods through decreased water inputs into aquatic ecosystems can lead to a sharp decline of profits from these areas. Including the environmental and economic costs of reduced flows into these ecosystems and other inappropriate water uses into planning and policy making should be promoted to improve the environmental and economic efficiency of water use. Looking into the subsidies on water and especially their negative effects on both economy and ecosystems could be a valuable action within this realm.

Furthermore, large changes are expected in many areas in the amount and distribution of domestic water use due to changes in lifestyle and increased urbanisation. The impact on environment and rural water use of these changes could be vast, given the need for more water and infrastructure for storage and delivery. Changes in lifestyle and population size and distribution should be incorporated into water resources plans and policies. These should be aimed at safeguarding the maintenance of equitable sharing of water resources and the costs and benefits involved.

*Promoting wise use, best practices and use of appropriate technology*

Within a IWRM framework different options are available for the allocation of water resources to the various users. The selection of best IWRM practices should be based on a sustainable pattern of water use, promote wise use of water resources and safeguard the fundamental role of ecosystems as providers of clean water. Specific attention should be given to supply to and use of renewable and non-renewable groundwater resources.

To promote best ecosystem based management practices in planning, management and water use, regional and on-site operational guidelines need to be disseminated. These guidelines need to be substantiated with regional examples of best practices from case studies that exemplify development options that achieve water management goals, but preserve functioning of freshwater ecosystems. Examples of these include the use of wetlands to improve water quality and the utilisation of floodplains for flood damage control.

To facilitate the change to demand driven IWRM, environmentally appropriate technologies need to be promoted. Whilst technology has clearly brought benefits to many people, to be sustainable it must be appropriate in terms of the ability of local people to maintain the system and appropriate for the environment, as far as possible working in sympathy with it, rather than just against it. Examples of these technologies include non-water based sanitation systems, many forms of traditional rain fed agriculture, indigenous water and soil conservation techniques and riparian zone management.

*Restoring ecosystem functioning to degraded freshwater ecosystems*

Degraded river channels and wetlands are characterised by a loss of structure and functions they formerly fulfilled. Restoration of freshwater ecosystems has only began in recent years and experience is still limited. For river channel restoration the rehabilitation of water quality, flow regime and habitat structure are principal components. Successful restoration of drained wetlands is not merely to obstruct installed drainage but includes damming, flooding or 'irrigating' affected areas. A complex seasonal regime may be required to rehabilitate the original ecosystem.

Restoration of degraded freshwater ecosystems should been seen as an ultimate solution to combat the loss of structure and function. Preference is given to pro-active actions that aim at sustaining these structures and functions. The economic justification of restoration can often be found in the much higher economic output of restored freshwater ecosystems compared to e.g. outputs from large scale irrigation schemes if all products are properly costed (Acreman, 1994).

## 5. Recommendations for further work

It is clear that healthy ecosystems can provide beneficial hydrological functions to assist with water management. Consequently, maintaining the functioning of these freshwater ecosystems is a key element in the sustainable management of water resources.

We recommend that:

1. An Ecosystem Based Management Approach is adopted as the most appropriate strategy to meet current and future water demands and the economic, social and cultural requirements of society in a sustainable way.

2. Initiatives are supported that improve the assessment of water resources and functions and values of ecosystems. This involves quantifying the water requirements of ecosystems and determining the ecological, environmental, economic, health, social and cultural benefits of the functions provided by ecosystems.

3. Research is undertaken to understand ecosystem functioning more fully with the aim of developing rapid and easy to apply methods for functional assessment of ecosystems and the quantification of their water needs.

4. Capacities are build at various levels to ensure a balanced implementation of appropriate technologies. This involves development of training tailored to the requirements at the various levels and on-site development of new techniques related to water use and management through 'learning-by-doing'.

5. Communities are highly involved in the development, implementation and evaluation of water recources management schemes through an adequate representation within the various institutions. This requires a considerable change in decision making strategies, internal communication and organisational capacities of these institutions and improving capacities to resolve conflicts at the various levels.

6. Partnerships are established that support the development of coherence between planning and management of water resources. The establishment of inter-sectoral teams to develop policy and planning tools and multi-stakeholder teams for programme definition, co-ordination, implementation and evaluation are essential elements for this.

7. Analysis of ecosystem functioning, their water requirements and the services and goods they provide are adopted as a key elements of water resource planning and management. This requires a further development of tools such as impact assessments and valuation of ecosystems functions.

8. Social, economic and legal incentives, subsides and policies are analysed on their possible negative effects on both the environment and economies and are either adjusted or further developed and implemented to maintain ecosystem functioning and the sustainable development of societies.

**Acknowledgements**

The authors would like to thank E. Maltby and J-Y. Pirot for their contribution towards producing this document.

**References**

Abramovitz, J.N., 1997. Valuing Nature's Services. In: State of the World. A worldwatch Institute Report on Progress Toward a Sustainable Society. Worldwatch Institute, Washington DC, p. 96-114.

Acreman, M., 1994. The role of artificial flooding in the integrated development of river basins in Africa. In: C. Kirby and W.R. White (Eds). Integrated River Basin Development. John Wiley and Sons, Chichester (UK), p. 35-44.

Acreman, M.C. and Hollis, G.E. (Eds), 1996. Water management and wetlands in sub-Saharan Africa. IUCN, Gland (Switzerland), 249 pp.

Acreman, M.C. and Lahman, E. (Eds), 1995. Managing Water Resources. Parks 5(2), special issue, 56 pp.

Baker, C.J. and Maltby, E., 1995. Nitrate removal by river marginal wetlands:factors affecting the provision of a suitable denitrification environment. In: Hughes, J. M. R. and Heathwaite, A.L. (Eds). Hydrology and hydrochemistry of British wetlands, John Wiley and Sons, Chichester (UK), p. 291-313.

Barbier, E.B., Acreman, M.C. and Knowler, D., 1996. Economic valuation of wetlands: a guide for policy makers and planners. Ramsar Convention Bureau, Gland (Switzerland), 127 pp.

Borrini Feyerabend, G. and Buchan, D. (Eds.), 1997. Beyond fences. Seeking social sustainability in conservation. Volume 1: A process companion. IUCN, Gland (Switzerland), 129 pp.

Costanza, R. et al., 1997. The value of the world's ecosystem services and natural capital. Nature, 387: 253-260.

De Groot, R.S., 1992. Fuctions of nature. Evaluation of nature in environmental planning, management and decision making. Wolters Noordhoff, Deventer (The Netherlands), 315 pp.

Dugan, P.J., 1990. Wetland Conservation: A review of current issues and required action. IUCN, Gland (Switzerland), 95 pp.

Ehrlich, P.R. and Ehrlich, A.H., 1992.The value of biodiversity. Ambio, 21(3): 219-226.

Engleman, R. and LeRoy, P., 1993. Sustaining water - population and the future of renewable water supplies. Pcpulation Action International, Washington D.C. (USA).

Falkenmark, M., 1989. The massive water scarcity now threatening Africa: why isn't it being addressed. Ambio, 18(2): 112-118.

Gash, J.H.C., Nobre, C.A. Roberts, J.M. and Victoria, R.L. (Eds), 1996. Amazonia deforestation and climate. John Wiley and Sons, Chichester (UK), 611 pp.

GWP, 1997. Documents and Proceedings of the Special GWP-TAC Meeting. Copenhagen, October 1997.

Hollis, G.E., Penson, S.J., Thompson, J.R. and Sule, A.R., 1993. The Hadejia-Nguru wetlands: Environment, economy and sustainable development of a Sahelian Floodplain Wetland. IUCN, Gland (Switzerland), 244 pp.

Khan, N. 1995. Protection of the North Selangor Peat Swamp Forest, Malaysia. Parks, 5(2): 24-31.

Koch, M.S., Maltby, E., Oliver, G.A. and Bakker, S.A., 1992. Factors controlling denitrification dates of tidal mudflats and fringing salt marshes in south-west England. Estuarine, Coastal and Shelf Science, 34: 471-485.

Laanbroek, H.J., Maltby E., Whitehead, P., Faafeng, B. and Barth, H., 1996. Wetland and aquatic ecosystem research science plan. European Commission, Brussels (Belgium), p. 26-27.

Lean, J, and Warrilow, D., 1989. Simulation of the regional impact of Amazon deforestation. Nature, 342: 411-413.

McAllister, D.E., Hamilton, A.L. and Harvey,B., 1997. Global freshwater biodiversity: Striving for the integrity of freshwater ecosystems. Sea Wind, 11(3), special issue.

WCMC, 1992. Global biodiversity. Status of the Earth's living resources. Chapman and Hall, London (UK), 585 pp.

NEDA, 1997. Water for the future: Integrated Water Resources Management. Policy Priorities for Netherlands Development Assistance. Netherlands Development Assistance, Den Hague, 54 pp.

Ni, D.V., Maltby, E., To Phuc Tuong, Safford, R. J. and Vo-Tong Xuan. 1997. The role of Melaleuca in tropical wetland soils. In: Samuel, C., Safford, L. and Weir, A. (Eds.). Book of abstracts of 5th Symposium on the biogeochemistry of wetlands. Royal Holloway University of London, London (UK), in press.

National Research Council, 1997. Valuing ground water - Economic concepts and approaches. Prepared by: Committee on valuing ground water. Water science and Technology board, Commission on Geosciences, Environment and Resources. National Academy Press, Washington DC.

OECD, 1996. Capacity development in environment. Proceedings of the IIED/OECD workshop, Rome, 4-6 December 1996, 301 pp.

Saenger P., Hegerl, E. J., and Davie, J.D.S., 1983. Global status of mangrove ecosystems. IUCN-WWF, Gland (Switzerland),

Shukla, J., Nobre, C. and Sellers, P., 1990. Amazon deforestation and climate change. Science, 247, 1322-1325.

UNEP, 1997. Report of the Third Meeting of the Subsidiary Body on Scientific, Technical and Technological Advice UNEP/CBD/COP/4/2.

Verhoef, H. 1996. Health aspects of Sahelian floodplain development. In: Acreman, M.C. and Hollis, G.E. (Eds) Water management and wetlands in sub-Saharan Africa. IUCN, Gland, (Switzerland), p. 35-50.

Xue, Y and Shukla, J., 1993. The influence of land surface properties on Sahel climate. Part 1, Desertfication.

EXPERT GROUP MEETING

ON

# STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

27 - 30 January 1998

Harare, Zimbabwe

## INTEGRATING WATER RESOURCES MANAGEMENT WITH ECONOMIC AND SOCIAL DEVELOPMENT

by
**Peter Rogers**
Harvard University

Paper No. 19

Prepared for the
Department of Economic and Social Affairs
United Nations

**Integrating Water Resources Management with Economic and Social Development** [1]

by
Peter Rogers
Harvard University
December, 1997

## Strategic Role of Water in Agriculture, Industry, and the Health of Humans and Ecosystems

> Scarcity and mis-uses of freshwater pose a serious and growing threat to sustainable development and protection of the environment. Human health and welfare, food security, industrial development and the ecosystems upon which they depend, are all at risk, unless the water and land resources are managed more effectively in the present decade and beyond than they have in the past. (Dublin, 1992)

The closing in of the water cycle; increasing demands, increasing pollution, and increasing uncertainty leads inexorably to the need for new paradigms for strategic assessment of the resource and its use. This paper explores a few of the components of such a strategic view integrating all of these points of view starting with methods to assess the macro-economic implications of water policy, followed by a way to look at costs and values in such a way as to help elicit sensible pricing and tariffs that would ultimately lead to sustainable use of the resource, then a discussion of the complexities of the uncertainties inherent in managing water resources, and finally a short section on what new institutions will be needed to deal with all of these complex issues.

Water resources have come under increasing competition worldwide as burgeoning populations with increasing affluence demand more water in the form of agriculture, industry, domestic and hydropower needs. The problem is exacerbated by decreasing supplies of clean freshwater. System resilience has dropped for many river basins as the systems are less able to absorb shocks caused by natural variability under these conditions of increased demand and decreased supply. Reservoirs are under stress due to the constraints placed on them that cannot be satisfied. Increasing competition in water use is a fact of life in many countries and is inevitable for others in the near future. Water has become a major bone of contention both among different users and regions in a state or country and also across international borders.

In recent years, many international organizations have become heavily involved in water policy (UN, World Bank, Asian Development Bank, the Interamerican Development Bank, etc). This interest has been primarily in domestic and agricultural water supply, and rural and urban sanitation. Not much attention has been paid to other aspects, such as industrial water, until now because water had always been considered of minor importance to most industries and, hence, of little concern for the governments. But recent facts, speak otherwise. Although it is true that agriculture accounts for most water withdrawals (69% worldwide), industry is fast catching up, accounting for 23% of all withdrawals (Table 1). This varies tremendously for different countries

---

[1] Prepared for the Department of Economic and Social Affairs, Division for Sustainable Development, United Nations, Expert Group Meeting on *Strategic Approaches to Freshwater Management*, Harare, Zimbabwe, January, 1998.

and regions depending upon their size, population, stage of development, economic opportunities, and national priorities. For example, Pakistan, with a per capita withdrawal of 2000 $m^3$ has a ratio of 98:1:1 for agriculture, industry, and domestic uses, whereas the United states, with approximately similar annual per capita withdrawals of 1900 $m^3$ has a ratio of 42:45:13. Many of the developing countries are on the path of rapid industrialization and industrial water use is rising.

Despite the overall apparent shortage of water, there are few incentives for efficient use of water in many regions. This is because most countries have not developed instruments (either regulations or economic incentives) and related institutional structures for reallocating water between sectors, or for internalizing the externalities which arise when one user affects the quantity and quality of water available to another group. Water tariffs are typically based, at best, on average cost pricing (rather than marginal cost pricing or market clearing prices) and typically ignore the opportunity cost of water (i.e., benefit foregone in alternative uses). Similarly, the effects of damages caused by industries in polluting surface and groundwater are ignored in determination of water tariffs and typically there are no pollution taxes and/or effluent charges to be paid by industrial polluters in developing countries. As a result, excessive quantities of water are used, and excessive pollution is produced. Industrial pollutants can have major environmental and health effects particularly in areas where pollution loads are high compared with the low-flow in rivers in some months.

Many countries are now realizing just how much is being spent on subsidizing irrigated agriculture (United Nations, 1992). This is leading to a rethinking of strategies to manage resources, such as water, with such a vast differences between the price charged and the real opportunity costs foregone. Allocative efficiency implies the utilization of a scarce resource like water in sectors that generate the most value-added from the water use. This usually means that industrial and urban uses be given priority over agriculture in water-scarce regions, although actual shifts in allocation may be beset with political and social problems.

Just as industry is catching up with agriculture as a primary withdrawer of water, another quiet revolution is occurring. The concern regarding water quality in many water sources is shifting from biological to chemical contamination. Yet another revolution that is occurring is in the options open to regulators to deal with the problems caused by water use - both due to water consumption and due to effluent discharge. The number of options available to the regulators has increased tremendously. Traditional command and control approaches involving quotas on water withdrawal, limits on discharges, and mandating technologies for processes and treatment have now been augmented with more innovative approaches involving both quantity-based (e.g. bubbles, offsets, tradable permits) and price-based (e.g. effluent charges, more effective water pricing, taxes, and privatization) incentives. This has added more instruments in the regulator's arsenal in order to effect the desired changes taking into account various technical and economic factors. This necessarily involves a paradigm shift in the approach to water and wastewater regulation - from expensive standards that provide little incentives for innovation to more comprehensive performance standards that achieve the same ends at lower costs to society.

**Demands on Physical Resource**

Table 1 shows a regional and sectoral breakdown of water withdrawal uses worldwide (Gleick, 1993). The total amount of 3,240 $km^3$ represents about 27% of the estimated 12,500 $km^3$ of relatively easily accessible runoff[2]. Postel et al., (1996) added another approximately 3,000 $km^3$ for reservoir losses and instream water uses claiming that fully 54% of the accessible water is already fully utilized. This wide range of estimates of the stress on the aquatic system reflects judgements on the use of different technologies for wastewater treatment that may, or may not, be in place now or in the future. 54% seems as though human uses are rapidly approaching the limits, but 27% sounds reasonable. Suffice it to say, however, that even the Postel et al., paper claimed only 18% being used consumptively. So with good management we still will have on average plenty of maneuvering space. This does not offer too much solace to those countries already withdrawing high percentages (in some cases over 100%) of available water.

**TABLE 1: Sectoral Breakdown [3] of Annual Water Withdrawals (in $Km^3$)**
(sectoral percentages in parentheses)

| Region | Sector | | |
|---|---|---|---|
| | Agriculture | Industry | Domestic |
| Africa | 127 (88%) | 7 (5%) | 10 (7%) |
| Asia | 1317 (86%) | 123 (8%) | 92 (6%) |
| N.&Central America | 912 (49%) | 782 (42%) | 168 (9%) |
| South America | 79 (59%) | 31 (23%) | 24 (18%) |
| Europe | 118 (33%) | 194 (54%) | 47 (13%) |
| U.S.S.R. (former) | 232 (65%) | 97 (27%) | 25 (7%) |
| Oceania | 7.8 (34%) | 0.5 (2%) | 15 (64%) |
| World | 2236 (69%) | 745 (23%) | 259 (8%) |

[2] The "accessible 12 500 $km^3$" figure found most commonly in the literature refers mostly to surface water runoff for basins, where sufficient data are available during sufficiently long time series, that is for major surface water bodies of the industrialized countries, including former USSR.

[3] A distinction must be made between measured and derived data - many of the data used in water resources planning are derived from an examination of related parameters; agricultural water use is rarely measured - it is often estimated by assumptions about the crop types, planting patterns, water consumption rates, regional climatology and method of irrigation (Glieck, 1993).

**Demands on Economic and Financial Resources**

Data on the investment requirements for the water sector are very unreliable for industry and irrigation and may be slightly better for urban water supply. For example, the World Bank (Jones, 1995) claims that there are no reliable statistics on global irrigation investment and Rogers and Harshadeep (1996) came to the same conclusion for industrial water investments.

Predictions of city growth over the next 25 years in the developing world imply for the urban water supply and sanitation services the financial needs will be much greater than at present. Currently in large urban areas 30% of the population lack access to safe water supply and 50% lack access to adequate sanitation, and as a result there are currently 510 million urban residents without access to water and 850 millions without access to sanitation. If we look to the year 2020, then an additional 1900 millions will be in need of water and sanitation services. This implies a total capital cost of US$ 24 billion per year for water supply and, if conventional wastewater disposal technology is to be applied to the additional population needing services, another US$ 82.5 billion per year. The World Bank estimates that on average developing countries spend 0.5% of their GDP on water and sanitation. This implies that currently they are spending US$ 26 billion per year. We calculate that a fourfold increase in annual spending would be necessary to achieve full coverage by 2020. Multilateral lending for this area was around US$ 1 billion per year at the beginning of the 1990s (Rogers, 1992). Examining these rough estimates, one can now begin to understand the expressions of alarm emanating from the water managers and the professional staffs of the MFIs.

Given the lack of a data base estimating irrigation expenditures is more approximate, but irrigated area is expected to grow at 1% per annum over the next few decades. At a capital cost of roughly $5,000 per ha, a 1% increase on a world installed capacity of 225 million ha, would lead to annual capital expenditures of $11.25 billion. For industrial water investments, the capital cost of water and wastewater disposal are typically less than 2% of the total industrial capital investment. For 1996 the total foreign capital flows to developing countries was $224 billion. Assuming that this met fully 50% of the investment needs of those countries implies that as much as $400 billion would be invested in industry giving about $8 billion per year as the capital expenditure on water and wastewater by industries. These admittedly shaky numbers, do help, however, to help put the relative expenditures for water by sector in perspective. They show that urban water investments will be several times the costs of irrigation expenditures during the coming decades, and that industrial expenditures will be slightly less than those for irrigation. These projections have serious implications for how countries should structure their management resources to deal with the water sector.

**Demands on Management Resources**

Even if the economic and financial resources were forthcoming the institutional and management resources in the water sector around the world is sadly lacking. Moreover, there is a tremendous asymmetry in the staffing and competencies of the existing institutions. Many countries have large, some would say bloated, irrigation institutions with competencies in designing, building, and operating large-scale surface irrigation systems in old fashioned supply directed ways. The International Irrigation Management Institute (IIMI) has been working diligently for more than a decade to change the emphases of these institution towards demand directed management. Some notable improvements have been achieved, but these are coming at a time when the major water management issues in most countries is now moving away from irrigation toward domestic and industrial water supply management.

The experiences in municipal water management, particularly private sector involvement, are the subject of many papers and monographs (World Bank 1992, ADB, 1996, ESCAP, 1997). Encouraging results are now appearing for the water supply side, but little success is reported in the much more complex and much more expensive wastewater treatment and disposal side of the problem.

Industrial and commercial water management seems to be the Cinderella department of water management. Rogers and Harshadeep (1996) reviewed the subject for the United Nations Industrial Organization (UNIDO) and concluded that there was a need for more concerted government action via pricing, effluent taxes, and environmental monitoring in this area. Most governments, particularly local governments who are most often charged with the regulation of industrial water and wastewater, do not have the manpower nor the regulatory tools to effectively manage this part of the water sector. This is an area in great need of capacity building involvement of the multilateral and bilateral agencies.

**Incorporation of the Water Sector into Nation-Wide Economic Planning**

All of the recent literature on the water sector calls for a need to integrate water resources planning and management into the national economic framework. This is leading to research on new ways to assess water in the overall macro-economic scene. Bouhia and Rogers (1997) reviewed the literature in this area and have formulated a multi-disciplinary tool which highlights the flows linking water and the economy. They have developed a methodology based upon Leontief's Input-Output Analysis, which is a widely accepted approach to study the interdependence of economic sectors and agents in a nation or a region.

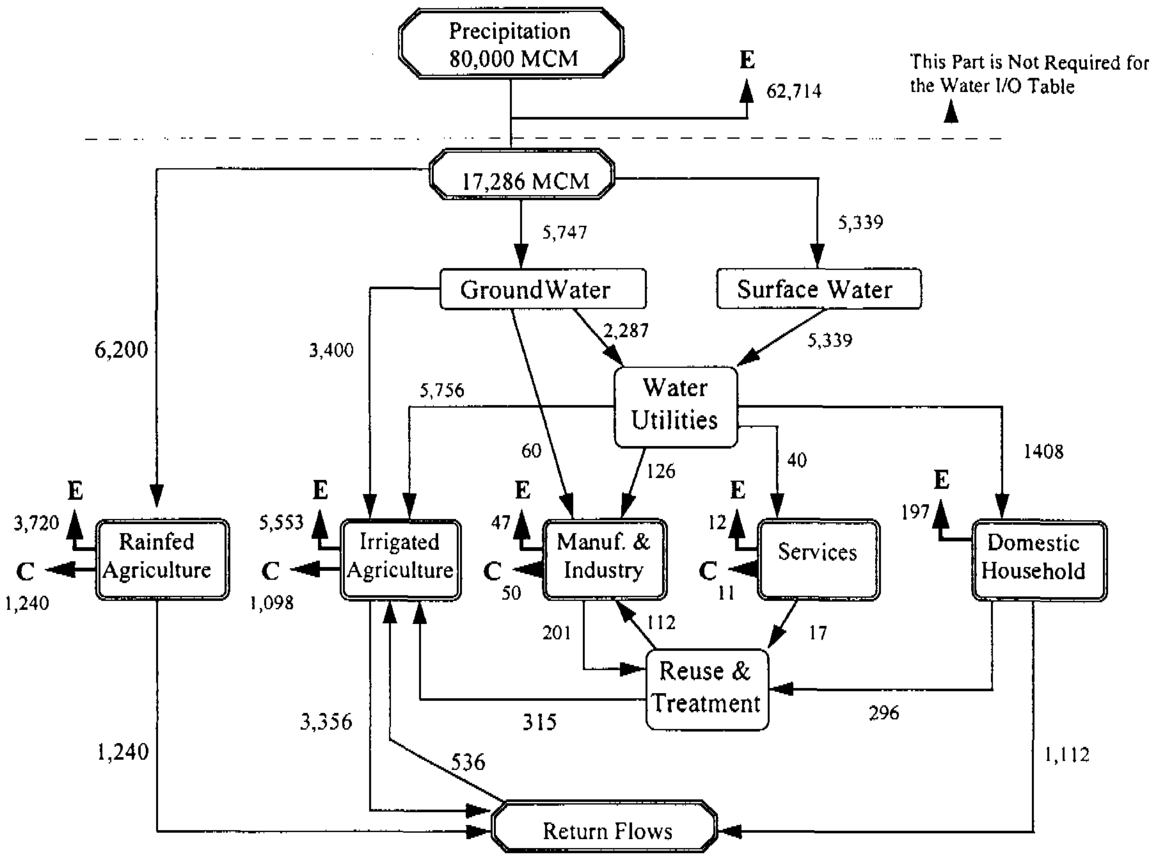
The use of water in the Input-Output methodology highlights the availability of water at the macro-economic level and the examination of the sectoral value-added provides a reliable guide to water resource decision-making. This approach enables the determination of the economic value of water, shadow prices, overall demand curves, subsidies, strategic sectors impacted by water policies, and generally examines the impacts of water resource management decisions on the macro-economy and vice-versa.

**Accounting for Water in the Economy**

Precipitation, groundwater, rivers, lakes, fresh water, polluted water are all part of the same unitary resource. Yet, they appear in different parts of the hydrological cycle, and are often used by different economic sectors. Surface and ground water that has already been used can be treated and clarified for reuse, while unused surface water can recharge the groundwater for later use. Therefore, the entire hydrologic balance must be considered, not just part of it; we call the resulting framework the *hydro-economic balance.*

Consider a country with a GNP of $1,100 per capita, where the agriculture sector represents one of the most important sectors of the economy; it consumes 85% of the total water available and provides 40% of the total number of jobs. This sector is heavily effected by water variability, and the effects reverberate throughout the economy. Figure 1 shows the hydro-economic balance for such a hypothetical country. The hydro-economic system includes both the hydrological cycle and the national economic system. Water is accounted in this newly defined closed system: either in one of its physical forms or embedded in the economic products. In order to capture the characteristics of water, for each sector of the economy, the water balance of Figure 1 illustrates the input to the system, as well as the output in terms of quantity and type of water (in this figure, E stands for evaporation, and C stands for consumption that goes out of the system).

**Figure 1: Hydro-Economic Balance**



**Impact Studies**

To address direct and indirect effects, parameters that depend on the final I/O table coefficients, such as employment, pollution, etc., can be computed as a table of multipliers for the sectoral outputs. These multipliers and ratios give numeric measures to the relationships among the component sectors of the economy. The multipliers take into account the fact that the total effect on output depends on the sectors that are affected by the initial changes in the final demand. The multipliers most frequently used to estimate the economic changes (Miller and Blair, 1985) are:

- Output Multipliers: change in outputs of the sectors in the economy. This multiplier represents the ratio of the direct effects and the indirect effects (from the Leontief inverse matrix).
- Income Multipliers: change in income earned by households (as a result of the change in output). These multipliers are determined from the coefficients of the Leontief inverse, which measures the direct and indirect effects on household income.
- Employment Multipliers: change in employment in physical terms (to be generated as a result of the change in outputs). By determining the relationship between the value of the output in a given sector (such as agriculture) and the total employment (physical terms), we can determine the effect of the change in output on the level of employment, using the same method as the income multipliers. For example, this would help us determine the effect of water or macroeconomic policies on agricultural employment.

Using the new methodology we can also compute:

- Water Use Multipliers: representing an indicator of the effect of water on the output of each sector, by looking at the total quantity needed of the different water qualities and both primary inputs (bulk water) and intermediate inputs (water supply) of water in value terms as part of the total output of a given sectors. Using the employment multipliers, the impact of water availability on employment could be evaluated through employment and water use multipliers.

This set of multipliers represents tools for deciding upon the level of investment in the different economic sectors, as well as the supplied water. These multipliers also give a hint regarding which are the most strategic sectors of the economy. Depending on the objectives and constraints, in terms of meeting a national goal, such as an increase in the GDP or creation of new opportunities for employment, the best alternatives and options could be evaluated using these multipliers. Also, in order to highlight the relationship between the initial effect (own sector income effect) and the total effect (including the consumption induced effect).

Due to the mixed units, one of the innovative approaches of this approach is that each one of the multipliers and each one of the ratios are of two categories, one corresponding to the effects related to the economic sector in dollar terms, and the second category related to the effects from the water related activities in cubic meters.

Table 2 illustrates the relationship between initial or own sector effects, indirect and consumption induced effects for income, employment and water use.

**Table 2: Income, Employment and Water Use Ratios**

| | Income Ratio | Employment Ratio | Water Use Ratio |
|---|---|---|---|
| Rainfed Agriculture | 0.99 | 2.47 | 0.10 |
| Irrigated Agriculture | 2.42 | 2.35 | 3.01 |
| Manufacturing | 2.36 | 1.49 | 6.42 |
| Services | 0.88 | 1.09 | |
| Water Supply | 0.88 | 8.03 | 0.23 |
| Sanitation | 0.64 | 20 | |

These ratios can be used as a measure of the impacts of water policy, for example, each dollar of household income accruing in the manufacturing sector is associated with $2.36 in household income in sectors which have direct and indirect impacts from manufacturing. Similarly, the employment effect for both rainfed and irrigated are similar and higher than the other sectors, since up to 40% of the employment of this example is in agriculture, although the total output of this sector contributes much less than manufacturing to the GDP. However, the water use ratios show that each cubic meter of water used in the manufacturing sector is associated with 6.42 $m^3$ of water used by all sectors of the economy, through the indirect and consumption induced effects, while for the case of agriculture, it will cause only 3.01 $m^3$ of water to be used in all the sectors. This set of ratios reflects the macro-economic impact of developments in the water sector

**Management Approaches to Reconcile Demand with Supply: The Concept of Sustainable Water Management**

The potential role of economic tools in providing socially acceptable public decisions is not widely appreciated, particularly in many highly regulated situations. Furthermore, contrary to the public perception, with the improvement of the use of economic tools, the role for government regulation in managing water as an economic good is increased, not decreased.

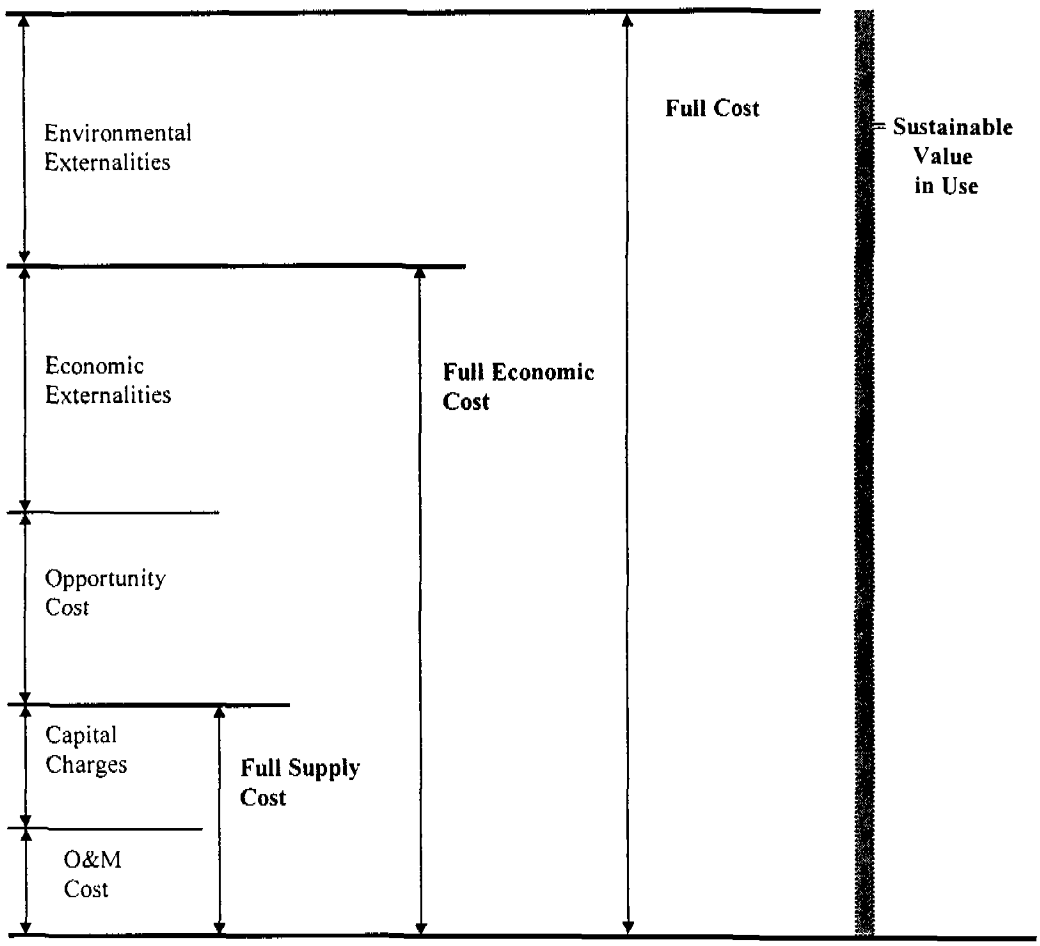
There are several general principles involved in assessing the economic value of water and the costs associated with its provision. First, an understanding of the costs involved with the provision of water, both direct and indirect, is key. Second, from the use of water, one can derive a value, which can be affected by the reliability of supply, and by the quality of water. These costs and values may be determined either individually, as described below, or by analysis of the whole system simultaneously. Regardless of the method of estimation, the ideal for the sustainable use of water requires that the values and the costs should balance each other; full cost must equal the sustainable value in use.

Of course, the value in alternative uses and opportunity costs are determined simultaneously when water supplies match water demands for user sub-sectors over time and space. Water markets, if functioning properly, will perform the function of matching water demands (both for quantity and quality) with supplies if appropriate policies (regulatory and economic incentives) are used to take care of externalities. In the absence of such well-functioning water markets, efficient water allocations (and resulting values and costs) can be approximated by government actions based upon systems analysis models (Sinha, Bhatia, and Lahiri (1986); Anandalingam, Bhatia and Cestti (1992); and, Harshadeep (1995)).

**Components of Full Cost**

Figure 2 shows schematically the composition of the various components that add up to make the full cost. There are three important concepts illustrated in this figure: the Full Supply Cost; the Full Economic Cost; and the Full Cost. Each of these is composed of separate elements that are explained in more detail in Rogers, Bhatia, and Huber (1997). We have chosen to split the externalities into economic externalities and environmental externalities. The environmental externalities are costs associated with the effect on public health and ecosystem maintenance. The economic externalities deal with the more conventional up-stream down-stream impacts of one user on the production function of others.

Figure 2. General Principles for Cost of Water



**Components of the Value of Water**

For economic equilibrium the value of water, which we estimate from the value-in-use should just equal the full cost of water. At that point, the classical economic model indicates that social welfare is maximized. In practical cases, however, the value-in-use is typically expected to be higher than the estimated full cost. This is often because of difficulties in estimating the environmental externalities in the full cost calculations. However, in somecases it may be lower than Full Cost, Full Economic Cost, and even below Full Supply Cost. This is because often social and political goals override economic criteria.

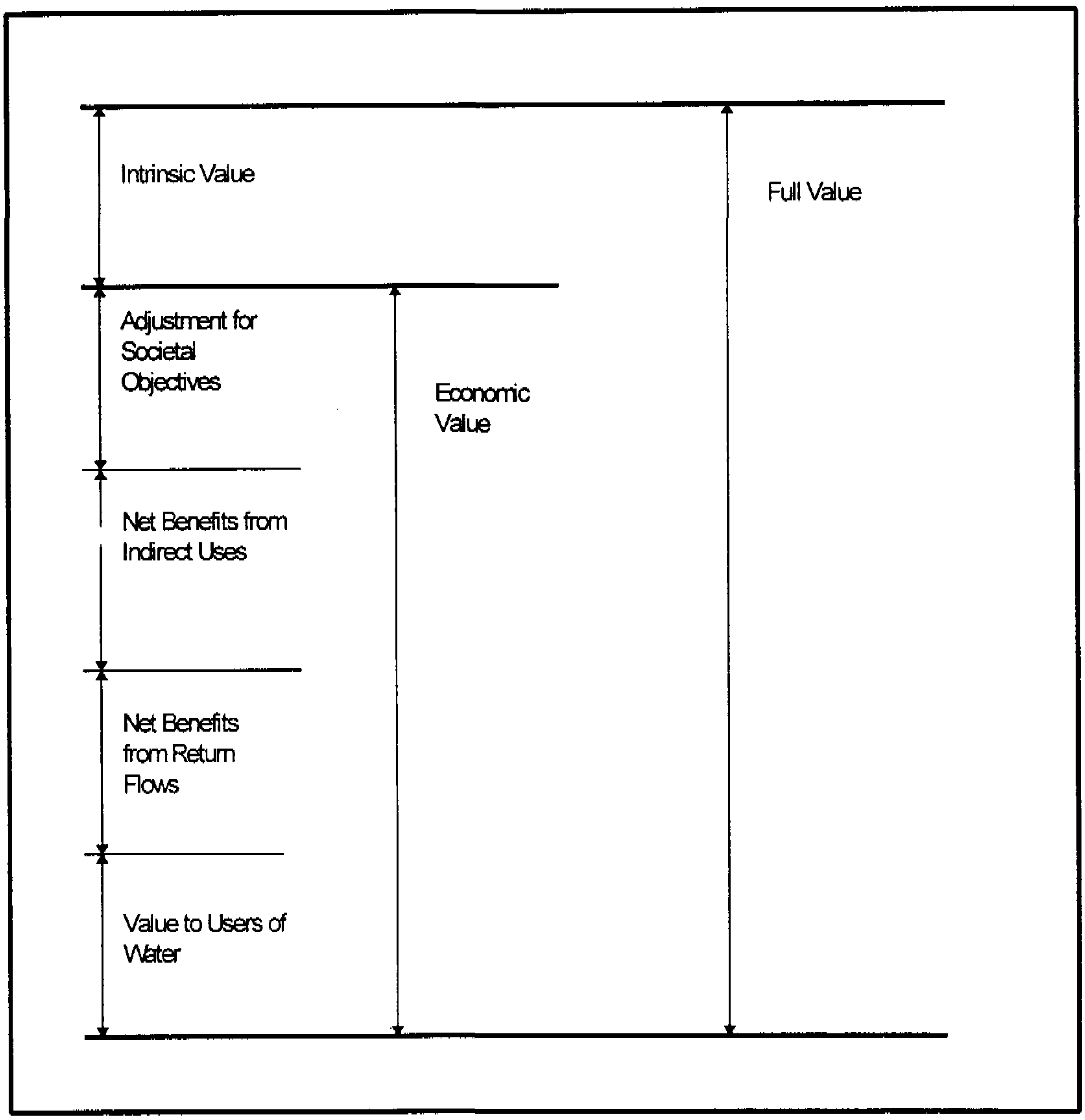
The value of water depends both upon the user and to the use to which it is put. Figure 3 shows schematically the components of the Value-in-Use of water, which are the sum of the Economic and Intrinsic Values. As shown in the figure, the components of Economic Value are:

- Value to users of water
- Net Benefits from Return Flows
- Net Benefits from Indirect Use
- Adjustments for Societal Objectives

For domestic users the value represents the willingness-to-pay of the consumer; while for agriculture and industry, the value to users correspond to the marginal value of product, meaning the additional value of an additional unit of water.

If we are able to calculate the components of full cost and full value we would be well on our way to being able to assess realistic tariffs on water that would lead ultimately to the sustainable use of the resource. It is difficult, however, to complete the calculations, but Rogers, Bhatia, and Huber (1996) show how it is possible to derive reasonable estimates of most, if not all, of the components.

Figure 3. General Principles for Value-in-Use



**Inter-Sectoral Water Reallocation**

Water reallocation among different sectors appears to be one of the options that governments typically avoid due to the social and political implications that would result from it. An example of such a reallocation is between urban use and irrigation. Cities require such small quantities of water, that any small increase in the price charged to agriculture would, under normal economic behavior, free up sufficient water for urban uses. Also loss reduction programs to increase the efficiency in the agriculture sector would also make this small volume of needed water available.

As an example, Rogers and Bouhia (1997) looked at a small region in Morocco in the vicinity of Casablanca, located downstream of the Oum Er Rbia river basin. There are two main demands in the region, the urban use by 9 million people concentrated in the city of Casablanca and the 70,000 ha of the large scale irrigated area at Doukkala, to which water is transferred from the Oum Er Rbia river, upstream of Casablanca. Water is supplied from the Oum Er Rbia River through two main reservoirs; 240 Million Cubic Meter (MCM) is allocated to Doukkala, for each year, while only 12.8 MCM is allocated to Casablanca per year. The population in the region is estimated to double over the next 15 years, while the irrigated area will be expanded only slightly. Assuming that water will be supplied at the same price as it is today (\$0.32 per $m^3$ for urban water and \$0.04 for irrigation water), this would result in an increase of water demanded by the city of Casablanca to 25.6 MCM and to 264 MCM for Doukkala by the year 2020.

In order to accommodate the 12.8 MCM increase in the urban demand, it will only necessitate a \$0.005 increase in the price of water for agriculture; agricultural water demand could be cut to 227.2 MCM, with a price increase of \$0.045 per $m^3$ representing a 12% increase in the price of water for agriculture.

If, in addition, by undertaking water conservation measures in agriculture and urban uses, the water saved could be reallocated to urban use. There is a large range of actions that can be taken to reduce water losses in the system for both urban supply and irrigation. In the case of Casablanca and the irrigated area, in order to meet the extra 12.8 MCM demand in Casablanca, a 14% increase in the efficiency of the irrigation system will make it possible to provide water to Casablanca until the year 2020. Also, if 15% of the losses are reduced in the urban supply system in Casablanca, a 12% change in efficiency will suffice for agriculture.

A combination of methods could, therefore, be used to ensure water to Casablanca until the year 2020, either by increasing water efficiency in the system or applying a small change in the water pricing. A mix of this two options could be adopted to reallocate the water between Doukkala and Casablanca. Table 3 summarizes the different possible options for both urban and agriculture.

Table 3: Reallocation Measures

| MEASURES | URBAN | AGRICULTURE |
|---|---|---|
| Pricing | | 12% increase |
| Conservation | 15% loss reduction | 12% loss reduction |
| Mixed - pricing and conservation | | 6% price increase<br>7% loss reduction |

**Establishing the Value of Water Resources Under Hydrological Variability and Economic Uncertainty**

Incorporating uncertainty in the planning for water resources is particularly important for countries where the economy is highly intertwined with water. Either because of too much water or too little water, water availability is a major challenge for development. Water catastrophes, floods or droughts have for a long time gained the attention of water resource planners worldwide, and today there is a conscious effort to take them into consideration while formulating their nationwide strategy. In many developing countries, water is central to economic development and hydrologic uncertainty (in the form of droughts and floods - two sides of the same coin) translates itself into economic swings. As decision-makers have to internalize hydrologic uncertainties, they also have to consider relative risks in terms of not meeting some "requirements".

There are several type of uncertainties: hydrologic, economic, objectives, decision making, methodologies, etc. This type of analysis would assist decision makers in looking at water fluctuation as part of their formulation of water resource strategy. This will provide to the policy analysts, an assessment of the risk undertaken in the targeted actions.

Many studies, going back as far as James, Bower, and Matalas, (1966), and Schwarz, (1977), attempt to assess the relative impacts of various parameters affecting water resources decisions under uncertainty on the Potomac River. This classic paper by James, et al., clearly demonstrates that the major source of uncertainty in river basin planning is not the stochasticity of the hydrology, but rather the uncertainty in the economic parameters. They found that the uncertainties in the economic variables were by far the most important determinant of system behavior followed by variability in the political variables. Trailing far behind these were the environmental variables and with the uncertainty in the hydrological variables being the least important. Even though the James et al., study was a theoretical exercise, subsequent events clearly validated their predictions.

In 1963 the U.S. Army Corps of Engineers recommended that 16 major reservoirs costing $400 million and 418 headwater reservoirs costing a further $100 million be built in the Potomac Basin (U.S. Army Corps of Engineer District, 1963). Nine of the new reservoirs were recommended for immediate authorization in order to meet the flow requirements and water quality improvements by 1985-90. The details of the actual implementation of the Potomac Plan are given in Scheer (1986), but the important point is that eventually only one small water supply reservoir was built. The water supply goals and the greatly improved water quality goals were met mainly by operating the existing separate systems more efficiently as one large system, and by implementing the Federal Clean Water Act of 1972. This is a cautionary tale that should be closely examined by those who would have us make important decisions before we have fully understood the implications of the relative uncertainties in the overall system.

This caution should become particularly useful when dealing with one of the current concerns with climate change and its potential impacts on water resources. Several books (Waggoner, 1992, Frederick, 1994, Frederick, Major, and Stakhiv, 1997), numerous conferences, and a multitude of papers have been written on the subject of climate change and water resources since the 1977 National research Council study entitled, *Climate, Climate Change, and Water Supply.* Over these twenty years the basic data and the models have improved but the conclusions of the early studies have not changed radically. At the geographic scale of interest to water planners, the new findings have done little to narrow the regional uncertainties; even the direction of the changes in rainfall and precipitation are uncertain. Essentially, we are still warned that climate change may increase or decrease the wetness of a region. More promising results are available in predicting snow melt and sea level rise, but one still needs to ask the question raised by the James et al., study if these uncertainties are not swamped by the economic and political uncertainties?

The interaction between economic uncertainties and the hydrologic uncertainties have been nicely demonstrated by Bouhia (1997) when she used a stochastic river basin model to assess the shadow prices on the water used for different economic sectors under different levels of supply uncertainty. She considered precipitation and runoff in a country with very variable rainfall, Morocco. Table 4 shows how the shadow prices for urban and irrigation water varied as the supply became more uncertain. The 75th percentile refers to the lower tail of the distribution, that is those flows that are exceeded 75 percent of the time, the 50th percentile refers to the median flow conditions, and the 35th percentile refers to the upper tail of the distribution.

Table 4. Shadow Prices ($\$/m^3$)

| | Reliability in the Flows | | |
|---|---|---|---|
| **Shadow Price in $/m3** | 75% | 50% | 35% |
| **Urban** | 0.52 | 0.5 | 0.48 |
| **Agriculture** | 0.26 | 0.12 | 0.08 |

Given the nature of the willingness to pay for water, the shadow prices for irrigation water are much more sensitive than those of urban water. Note that the shadow prices for both over the entire range are still substantially higher than the actual tariffs applied in Morocco. The existence of *stochastic shadow prices* raises some interesting philosophical issues about the use of shadow prices in setting tariffs. Which should be used and when?

**Needed Changes in Institutions and Human Resources Development**

The discussion of the earlier sections of this paper all point towards the need for developing better institutions and trained human resources to staff them. We have said little about the current drive for private sector participation in urban water supply and wastewater management. How this plays out will have important consequences for overall water management. We have also said little about integrated river basin management because there is a large amount of material on this subject and most, if not all water professionals are committed to implementing the concepts. We have, however, stressed the strategic role of water in the overall economy and stressed the relative magnitudes of the urban and industrial water sectors in comparison to the more traditional agricultural water uses. We believe, however, that the importance of getting water resources properly assessed in the broader economy should take precedence over even important issues such as integrated river basin planning.

Even for river basin planning itself there is a need to ret' ink many of the transboundary issues which plague international river basins as well as inter-jurisdictional boundaries within nation states. Multi-facet approaches will be needed to promote the adoption of the proposed UN Protocols on International Watercourses and at the same time devise acceptable river basin committees or commissions that will be able to deal with the inherent upstream-downstream conflicts in fair and acceptable ways. This is no easy task since many of the international rivers flow across particularly contentious borders.

In order to implement such assessments it will be necessary to create new institutional ways of doing things. Not only do we need staff training, we also need new more flexible institutions into which the staff can fit and function effectively. Given the complexities of the institutional issues, the economic issues, and the technical issues it is important that these new and improved institutions ensure that there is adequate disciplinary inputs to ensure that no major contributors are left out. Similarly, every effort must be made to ensure citizen participation at every stage of the decision-making process. Bad experiences world-wide occur when citizen groups are excluded from informed participation. This is a great challenge in many societies where large parts of the population are illiterate, but this does not have to be the case as successful consultative processes in some southern African countries demonstrate.

EXPERT GROUP MEETING

ON

STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT

**27 - 30 January 1998**

**Harare, Zimbabwe,**

**THE DUBLIN PRINCIPLES:**

**CURR=NT ISSUES ARAISING FROM A COMPARATIVE ASSESSMENT OF INSTITUTIONAL AND LEGAL ARRANGEMENTS FOR INTEGRATED WATER RESOURCES MANAGEMENT**

By

Miguel Solanes

Paper No 20

Prepared for the :
Department of Economic and Social Affairs
United nations

## Contents

## OVERVIEW

### Water is a Finite and Vulnerable Resource...

1. The principle has been interpreted as a requirement for integrated management, responsive to the characteristics of water resources. Integrated within this context implies technically appropriate water management (surface and groundwater, quality and quantity, water and soil, etc.) and also consideration of social needs, economic soundness and environmental requirements. The ultimate goal is sustainable use and development of water resources.

2. The review shows that there are water policies and legislation concerned with integrated water management; water quality protection; flow and landscape considerations; ecological requirements; rational and guided water use; integration among soil, water, and other natural resources; protection of water supplies; water planning; recognition of the river basin; groundwater protection; mandatory assessment of water policies, plans, programmes and projects and mandatory assessment of water related subsidies.

3. There are also examples of legislation specifically concerned with the needs of all citizens, the common interest, the benefits of individual users and the livelihood of the population. Concrete examples of social concerns in water legislation are the preference often found for drinking water supply and sanitation, and the requirement of public access and availability of British law.

4. The link with development is also a tenet of water law. Legislative requirements for optimal use and full realization of the economic benefits of water were found. Some systems relate water planning to economic improvement and economic regions. Economic considerations are, in some countries, the main normative criteria for decision-making and program and project evaluation.

### Water Development and Management should be based on a Participatory Approach...

5. Legislation relating to this principle was analyzed under the assumption that water related activities are not confined to the interests of limited groups of users, geographical boundaries, sectional institutions, or national jurisdictions. Participation, and venues and opportunities thereof, were the criterion informing the analysis.

6. Generally, meaningful participation is associated to well-defined national policies, for which water is either a main component or a relevant input. Policy implementation is usually associated to socially acknowledged, relatively well-informed, government organizations, with adequate capabilities and appropriate legal mandates. These institutions are evolving from sector-oriented to resource oriented, with strong indications that the concept of the river basin is steadily, albeit laboriously, coming into the institutional scene.

7. The review of experiences strongly suggest that the institutional dimension of water management is a system, where relatively successful water management experiences (success in this context is contingent to what a system knew and sought at specific times) have included a balance of government institutions and policies and stakeholders participation.

8. Such experiences, drawing from places as far apart as California and South Africa, indicate that meaningful stakeholder participation requires at the least a certain degree of government overseeing, and sometimes support. Such support may consist of dissemination of information, and

promotion and encouragement of involvement. Otherwise there is an ever-present risk of participation becoming co-opted by well-informed, intent-specific, special interests groups.

9. Conciliation of interests, public consultations, and hearings are some of the manners in which interested parties and stakeholders, not necessarily having a conventional (in the sense of typical) proprietary interest in water, are able to participate. More formal structures include advisory boards, integration within government bodies and associations and districts with field goals and responsibilities.

10. Interestingly, some legislations acknowledge the globality of water issues, and corresponding affected interests, through references to international treaties and obligations.

11. Some laws recognised the intimate connection existing between participation and information at all levels.

12. Some systems, where agricultural and other subsidies have traditionally coexisted with relatively strong participation, seem to indicate that a main, although not necessarily exclusive, prompt to participate, is economic self-interest.

13. Finally, on account of Mexican experiences, it seems relevant to notice that technical needs, opportunities for economies of scale and scope, and other factors need to be taken into account when applying the concept of the lowest appropriate level. Also, lowest appropriate level, and private sector are not synonymous: Water corporations purveying water services are private, but many of them are global.

## Water as an Economic Good

14. In Western, Roman-based legislation, the economic aspects of water resources were relevant enough for them to be included within public or private ownership (water was not res nullius neither res communis) and for systems of rights on water to have existed since Roman times. However, a full "econominization" of water resources may be a complex task in countries with a Muslim, Hindu, or traditional Chinese background.

15. At present most legislations recognise, and protect the property aspects of rights to use water, which is the manner in which law reacts to the economic concept of scarcity.

16. At the same time, water law systems acknowledge the social and environmental dimensions of water through norms intended to protect third parties, the environment, and the resource base.

17. An important social dimension of water rights, closely associated to the economic dimension of the resource, is a definite intent in most legislations, to prevent water hoarding, speculation, monopolies and waste. With world-wide privatisation of water related services, monopolistic control of water rights configures a typical case of barrier to entry. Therefore the requirement of effective and beneficial use of water rights as a universal principle of water law, both at national and international level.

18. In the single known case of non-existence of this provision, Chile, the system has resulted in speculation, hoarding, and impaired water management, to the detriment of water sources. Proposals to amend the system are presently before Congress. However, the manner in which the rights were granted may make legal change extremely laborious. Proposals to tax water rights in order to promote their more efficient and equitable use by holders, have been attacked on Constitutional grounds. ENDESA, the now-private electrical utility, argues that since original water rights were not conditioned to effective and beneficial use, the use of taxes to induce behaviour other than the one

unilaterally fitting the company would be an infringement of its property rights, which are constitutionally protected as granted.

19. A corollary of the economic character of water is the existence of water markets. They are a useful tool to economically optimise the use of water. However, since the many roles of water and its peculiar features, make it a very special commodity, mature systems of water marketing regulate its performance in light of social, economic, and environmental considerations.

20. Finally, there are proposals to charge for water according to its opportunity cost. Examples of this approach are not abundant. However there are examples of charges intended to recover costs, pay for treatment of wastes, cover administrative expenses and induce environmentally sound behaviour. Two examples relating charges to value are discussed: Mexico and Spain. However, more analytical work seems to be required in order to refine criteria for inception, procedures for application, and consideration of issues of opportunity and equity.

## INTRODUCTION

21. The report identifies manners in which the Dublin principles about water reflect, coincide, or agree with practices and principles accepted by water legislation and institutions in a number of countries.

22. Although the report covers a wide range of issues, it does not purport to be exhaustive. There are important subjects that have not been dealt with due to limitations of time and space.

23. The Report is organised according to the four guiding principles for water resulting from the Dublin Statement. It is based on the review of several systems of national water law, on experiences provided by on going processes in countries such as Chile, Mexico, South Africa, and Zimbabwe. Cases selected were mostly chosen as representative of trends or situations, and not necessarily as models to be followed.

24. The Dublin Statement and Conference Report express a holistic, comprehensive, multi-disciplinary approach to water resource problems world-wide. It is based on four "guiding principles" which cover environmental, social, political, and economic issues:

> ". Fresh water is a finite and vulnerable resource, essential to <u>sustain</u> life, development, and the environment..."
>
> ". Water development and management should be based on a <u>participatory</u> approach, involving users, planners, and policy-makers at all levels..."
>
> ". <u>Women</u> play a <u>central</u> part in the provision, management, and safeguarding of water..."
>
> ". Water has an <u>economic</u> value in all its competing uses and should be recognised as an economic good...."

25. The Report relates each principle to actual law. Four main themes inform the principles: environment, economics, social needs, and the role of women, under a paramount goal of sustainability.

26. Information is organised according to the four themes, with the exception of women: it was not possible to locate relevant water legislation specifically related to women.

## A. FRESH WATER IS A FINITE AND VULNERABLE RESOURCE, ESSENTIAL TO SUSTAIN LIFE, DEVELOPMENT, AND THE ENVIRONMENT

### 1. Water Policies

27. Several countries state the purposes and objectives of their water policies in their water legislation. The statement of policies is relevant to the interpretation, application and enforcement of legislation. Several of the statements reflect awareness of the interrelationships resulting from the principle.

28. Several laws include policy principles where the multiple roles of water are recognised. Thus, the Canadian Water Act of 1970 encourages optimum use of water resources for the benefit of all Canadians (art.1). The Water Law of Germany (as amended on 23 September 1986) requests that water (both, surface and groundwater) be managed in a manner that serves the common interest, benefiting individual users while preventing avoidable harmful impacts (art. 1 a). The Netherlands' "Policy Document on Water Management" sets up a policy of integrated water resources management which includes the quantitative and the qualitative aspects of water management.[i] The policy of the Water Law of China of 1988 is to ensure the rational development, utilisation, and protection of water resources, fully realising the benefits of water, for economic development, and the livelihood of the population. The policies of the Mexican Water Law of 1992 include the preservation of water quality and the promotion of sustainable development.

### 2. Quality Controls and Environmental Concerns

29. The environmental dimension of water is rapidly becoming a major component of water legislation. As water becomes scarcer, relative to demand; as externalities increase, and as knowledge improves, the need to control the deterioration of water quality is translated into more detailed and demanding legislation. Permits, prohibitions, and charges are used to curb the deterioration of water and related natural resources and environmental assets.

30. The Canadian Water Act provides for the designation of water quality management areas and the implementation of water quality management programs. (art. 11). Water quality management agencies shall plan, initiate and carry out programs to restore, preserve and enhance the quality of the waters within the water quality management area (art 13).

31. The German Water Law imposes a general duty to prevent water contamination and detrimental changes of its properties, requiring "an economical use of water in the interest of natural water resources" (art. 1 a). Discharges into water are subject to maximum loads and technological requirements. Hazardous wastes must be treated using the best available technology (art.7). Art. 22 provides for strict, joint and several liability resulting from damages caused by introducing or throwing any substances into water. Discharges causing not merely insignificant detrimental changes, shall only be allowed when overriding public interest thus require. Waters can be subject to characterisation parameters issued by the Federal Government. (art. 36b). The law also provides for proper flow conditions, maintenance of navigation, ecological requirements, landscape features, protection of banks, and self purification (art. 27) .

32. The policies on environment and water of the Netherlands aim primarily at having and maintaining a safe and habitable country and to develop and maintain healthy water systems which guarantee sustained use.[ii] Three "screens" are established: 1) Reduction of pollution at the source; 2) Hydraulic design; 3) Rational or "guided" use of water resources, in particular groundwater. Quality objectives and monitoring methods and procedures have been established. The system includes licensing of discharges into water and, for specific industrial sectors, into sewers; payment of pollution charges and the preparation, every five years, of action plans to combat water pollution.[iii] The

policies do also address diffuse pollution, like atmospheric deposition, tars (utilised on protection materials for wooden shore and bank facilities), and agricultural run-off and leachates. Some pesticides have been absolutely prohibited, others are restricted, and some are subject to application according to best environmental practices. Additional measures, intended to control environmentally negative effects, include friendly environmental design, and sedimentation and eutrophication control.

33. The Water Act of England of 1989 provides for the classification of water quality, in relation to controlled waters (sect. 104), the establishment of water quality objectives (sect. 105), controlling and remedying pollution (sect. 107), protection from sedimentation and refuse or waste vegetation (sect. 109), protection against pollution (sect. 110), creation of water protection zones (sect. 111), establishment of nitrate sensitive areas (sect. 112), establishment of minimum acceptable river flows (sect. 127), enactment of codes of good agricultural practices, with a view to protect water resources (sect. 116). The Water Resources Act of 1991 imposes conservation and enhancement duties on the Ministers and the National Rivers Authority, with a view to protect amenities, flora, fauna, historical places and other environmental interests. Public access and public availability are also taken into account. These duties are also to be considered when dealing with undertakers and their proposals for the management of waters and lands (sect. 16). Additional duties refer to environmental concerns for sites of special interest and for the enactment of codes of practice with respect to environmental and recreational duties (sects. 17 and 18).

34. The Water Law of China creates a state duty to protect water resources and adopt effective measures to protect flora, conserve water sources, control soil and water losses and improve the ecological environment. Water pollution is to be prevented and controlled, with a view to protect and improve water quality. Supervision and management of prevention and control of water pollution is to be strengthened. (arts. 5 to 7). Agriculture must be practised with a view to promote stable and high agricultural yield (art. 15). Hydropower development is to be done in accordance with protection of the ecological environment (art. 16). Fish ladders must be constructed when needed (art 18). Adverse environmental impacts in the implementation of interbasin transfers (art. 21) must be prevented. Additional rules control disposal of refuse, mining activities, land reclamation, construction of projects, and creation of management and safeguard zones (arts. 24 to 29).

35. In some systems environmental concerns are the basis on which existing water rights can be amended, restricted, subjected to prorata, or cancelled. The French Water Law of 1992 authorises changes in water rights when public health, or safety so requires, or when water environments are threatened (art. 10. iv). In the United States the public trust doctrine has been utilised to limit prior appropriation rights when the full exercise of such rights would have dry up a lake.[iv]

### 3. Protection and Management of Water Supplies

36. The protection of water sources has been a traditional concern of water law. Increasing demand and externalities have strengthened this concern. The Mexican Water Law reflects this dimension of water legislation through the regulation of the use and development of national water resources.

37. The German Water Law provides for the creation of water protection areas, within which certain activities cannot take place, or certain measures have to be tolerated (art. 19). The law requires the licensing of pipeline systems conveying substances constituting a hazard to water. These licenses are subject to conditions that can be changed even after a license has been issued (art. 19). Use of, and discharges into, groundwater are subject to permit and licensing (arts 32 and 34).

38. Groundwater is increasingly controlled and protected. A number of countries have enacted legislation requiring permits, creating administrative devices to control the use of groundwater in special management areas, and restricting the expansion of high consumption activities, like irrigation.

Management measures include the issuance of certifications of assured water supplies, which are required for the approval of subdivision plats, registration and recording of wells, control of water storage and recovery, control of well drillers, protection of pre-existing uses, use of groundwater charges, measurement of withdrawals, estimations of supply and demand, stopping and reducing withdrawals in order to allow replenishment, granting emergency powers in case of drought, granting of permits at the discretion of water administrators (except in cases of clear abuse of discretion), deadlines for waterworks and activities, monitoring, possibility to amend and forfeit water rights (previous hearing), conjunctive use of surface and groundwater, control of discharges into groundwater and allocation of groundwater to preferred uses like drinking water supply.[v]

39. The Water Resources Act of England of 1991 provides that the National Rivers Authority has a general mandate of proper management, which includes conserving, redistributing, augmenting, and securing the proper use of the water supplies of England and Wales. Water resources management schemes can be entered into for this purpose.

4. Water Planning and River Basins

40. The development of water resources is no longer amenable to isolated action. Water legislation is rapidly evolving towards integrated water planning, to satisfy environmental objectives, economic requirements and social concerns.

41. The German water legislation requires a prior plan approval procedure before approving any substantial modifications of water bodies and their banks (art. 31). River basins and economic regions shall be subject to water plans, in order to safeguard the water resources needed for economic improvement and protection of the quality of life. Plans must consider available water resources, flood control, and protection from pollution, integrating water planning with regional planning. Plans are subject to adjustment and updating. They are implemented through a variety of means including, inter alia, administrative requirements, revocation of permits and licenses, (art. 36b).

42. In Europe, there is trend to implement a double level of water resources management: a regional level for water basin plans, legal enforcement and incentive policies, and a local level for operation of services, and for implementation of innovative policies, like urban hydrology. The German (Ruhr) organisations and the French model are known world-wide. However, the Ruhr system seems to be strictly related to the socio-economic characteristics of its area of origin, and therefore non-replicable. On the other hand, the performance of the French river basin agencies has drawn some criticisms, resulting from excessive reliance on a "give and take" approach and also from argued shortcomings in integrated water resources planning and lack of clearly defined police powers.[vi] Interestingly, this kind of criticism is the same that could be levelled out at attempts to incept river basin institutions in Latin America.

43. An other well known international example is the Tennessee Valley Authority in the United States. However, its unique policy foundations, political support at the time of inception, and complex gamut of economic, social and managerial objectives would be very difficult to successfully replicate elsewhere.

44. While the role of regional and basin planning, control and management has been strengthened in Europe, the lack of adequate mechanisms for intersectoral planning and co-ordination at basin level seems to be negatively affecting water management in some countries. According to Dellapenna a constraint to water planning stems from the split between planning and regulation.[vii]

45. The Water Law of China requires that the development and utilisation of water and the prevention of disaster be planned in a comprehensive and systematic manner, with all the aspects taken into account, for multipurpose development and maximum benefits, allowing full consideration of the

multifunction of water (art.4). There are comprehensive plans for the basins of major rivers and speciality plans for sectors. Comprehensive plans shall be co-ordinated with the National Land Plan considering the demands of different regions and sectors. They are prepared by the Departments of Water Resources of the different levels of government. Speciality plans are sectoral, to be prepared by the concerned departments (art. 11). Remedial measures or, alternatively, compensation are required in cases of interference with existing developments (art. 20).

46. According to recent research the river basin would be the most sensible unit within which to implement water transfer-strategies.[viii]

## 5. Assessment of Water Projects and Programs

47. Water related programs and policies are, in some countries assessed according to their impact on the environment and other national concerns.

48. Decision making in Australia, as required by the Intergovernmental Agreement on the Environment, must include economic and environmental considerations; considering that strong, growing and diversified economies enhance the capacity for environmental protection; applying the precautionary principle; looking for intergenerational equity; conserving biological diversity and ecological integrity.

49. More than twenty years ago the National Water Resources Council of the United States prepared a set of "Proposed Principles and Standards for Planning 'Vater and Related Land Resources" which are a good example of multidisciplinary assessment of water plans. The principles call for the implementation of a system to display the relevant beneficial or adverse effects of water plans. Consequently, water development was to be assessed according to the effects that alternative plans would have on objectives of national economic development, environmental quality, regional development and social factors.[ix]

50. The United States National Environmental Protection Act (NEPA) of 1969 requires that federal agencies include an Environmental Impact Statement for every major federal action significantly affecting the quality of the human environment. NEPA has been used to bring water related cases to the courts (dam and reservoir construction, dredge and fill, flood control, ocean dumping, rivers and harbours projects, and wetlands and water pollution).

51. In the Netherlands activities requiring environmental impact statements include, inter alia, discharges into surface and groundwater; or interfering with the groundwater table; construction of navigable waterways or widening or deepening them; diverting navigable waterways when it is a river; construction of naval ports; construction of main water pipelines; construction of marinas, dikes, dams; land reclamation; and construction of water reservoirs.[x]

52. Norway has environmental impact statements procedures requiring that possible impacts on the environment, natural resources, and society of all major physical developments be assessed.[xi] Some countries have established areas within which projects or programmes are presumed to have significant environmental effects. In Finland they include a number of areas in the Wild and Scenic Rivers Conservation Act; groundwater protection areas; the criteria of sensitive areas is also utilised in land planning. Poland lists the disturbance of water regime and intakes as one of the factors likely to produce environmental alterations.[xii]

53. The Canadian Environmental Assessment Act of 1992 aims to assure that environmental effects of projects are carefully considered; that sustainable development is promoted for a healthy environment and a healthy economy; to ensure that projects do not cause significant adverse environmental effects and to ensure public participation. The Act applies to projects where the Federal

Government has decision making authority. Assessments are to be carried out as early as possible (art. 11). The Act is to be implemented through four regulations: Inclusion List, (Physical Activities); Exclusion List (Insignificant Environmental Effects); Law list (Functions, Powers and Duties whose exercise requires assessment); and the Comprehensive Study List (Significant Environmental Effects). The Law List includes several water related enactment, like the Navigable Waters Protection Act; the International Rivers Improvement Regulations, etc.

54. The Comprehensive Study List includes, inter alia, water related activities like dams in national parks and protected areas; hydroelectric generating stations with more than 300 MW of production capacity; certain categories of water projects; off-shore oil, gas and minerals projects; and certain transportation facilities.

55. It has been possible to identify at least one court case where an environmental impact assessment was requested for subsidies in irrigation. A federal judge in California, USA, ordered an environmental review of rules setting up how many acres farmers in the West can irrigate using subsidised federal water. The Bureau of Reclamation must study the effects of a set of rules and regulations that it enacted in 1987 to put into effect the 1982 Reclamation Reform Act. The rules were challenged by environmental groups which argued that they allow large farms to continue using subsidised water, defeating the purposes of the reclamation project to provide cheap waters to family farms, and not properly assessing their environmental impact. The Reclamation Policy of 1902 provided water, below market prices, with a view to increase agricultural output and encourage the creation of family farms. Leasing arrangements and other devices were used to escape the limitations on acreage intended to promote family farming. Subsidies were in fact granted to very large farming operations. The 1992 Act required that water provided to agricultural holdings exceeding the legal limit pay the full cost for water. The Bureau of Reclamation enacted regulations to implement the Act. These regulations were found to have no significant impact, and were, therefore, not subjected to Environmental Impact Statement. This finding was challenged in court, which found that the regulations were a major federal action with a potential to significantly affect the human environment. The court objected the use of purely economic notions like "rational utility maximizer", which it found theoretical, far from reality and in violation of the regulations, which require an interdisciplinary approach. An environmental impact review was therefore requested.[xiii]

56. It has been found that subsidising water for some activities and uses cause "an unnatural excess of demand", with impacts on water uses, the environment and water reserves. Some countries are considering, and implementing, legislation to lower subsidies to irrigation water.[xiv]

## B. WATER DEVELOPMENT AND MANAGEMENT SHOULD BE BASED ON A PARTICIPATORY APPROACH, INVOLVING USERS, PLANNERS, AND POLICY-MAKERS AT ALL LEVELS

### 1. Vesting Responsibility for Overall Water Management

57. The functional organisation for policy-making, water allocation, water management, and monitoring of users plays an important role in the implementation of a sustainable water development system. Where these functions are vested in institutions with functional responsibilities for specific water uses, or for discrete economic activities, water planning and management might not be

objective. In these cases each concerned party may tend to support projects or allocations of waters according to vested functional interests, without regard to the source of supply or the soundness of investments and projects.

58. To avoid such problems, many jurisdictions allocate responsibility for policy-making, water allocation, and programme and project evaluation to a non-user-agency or ministry. A recent publication of the World Bank emphasises the need to separate policy, planning, and regulatory functions from operational functions at each level of government. In so doing the Bank agrees with the United States National Water Commission, which in 1972 was already recommending that "Policy planning and sectoral planning must be separated from functional planning, design and construction, and operation by action agencies".[xv] Other important consideration is that, due to the complexities of water management, a number of countries tend to defer to administrative judgement on technical issues: "... findings of fact must be determined in the first instance by the officers charged with the administration of the stream...this finding of fact is final...unless it appears unreasonable or arbitrary..."[xvi]

59. Yet, other systems, like Chile, have chosen to limit administrative roles in water related matters. As a result, Bauer argues that many water conflicts have gone to higher courts, whose performance have been quite uneven.[xvii] At least one working paper has suggested that the administrative set up in Chile be given greater powers, as exemplified by the case of Mendoza in Argentina.[xviii] In California, it has been suggested that increases in the effectiveness and neutrality of overseeing institutions is one of the conditions leading to the formation of water markets.[xix]

60. In a majority of the American states water planning and allocation are separate from functional, discrete, sectoral activities.[xx] A similar pattern is found in Canada and its provinces.[xxi]

61. Some Middle East countries, like Oman, have created Ministries of Water Resources, in an effort to improve the management of scarce and imperilled water resources. The Ministry is separate from functional, sectoral, water activities, its main function being overall water management.[xxii] Other Middle East Countries, like Yemen, have followed a similar pattern. A Yemeni authority states that "... responsibility for water management at national level is not to be delegated to a water using sector, but to an independent authority".[xxiii]

62. The Chinese water law entrusts national long-term water planning to the Ministry of Water Resources. The Ministry was created as a response to the problems created by a fragmented institutional system, where water was managed by sectoral ministries, including, inter alia, Agriculture, Industry, Communication, and Construction. This fragmented-use-oriented institutional system resulted in imbalances between supply and demand, water pollution, reduced flood discharging capacities, overdraft of groundwater, intractable and protracted water disputes, and ecological deterioration. Water resources units have also been created at the local level.[xxiv]

63. In The Netherlands the central government manages the most important surface waters (state-waters) and determines the general policy, while local authorities and public bodies are responsible for regional waters, drinking water supply, sewer systems and municipal waste water treatment. There is a process of transfer of functions to the regional level (police power and planning) as a tool to foster a more integrated approach to water resources management. Therefore, water planning in the Netherlands is a multiparty process which includes the central, regional and local levels of government, both for surface and groundwater and for quantitative and qualitative aspects.[xxv]

64. In Mexico, the National Water Commission is the institutional focus for water resources. Guatemala, has recently created a Water Resources Secretariat. The Secretariat has overall responsibilities for water planning and policy making. Brazil is considering the implementation of a National Water Management System. The system would include, inter alia, a National Water

Resources Council, responsible for the national water policy, arbitration of conflicts, national water planning, amendments to water legislation, and other functions. The main purpose of the process is to overcome the traditional conflicts and limitations imposed by a system where main water sectors have so far been entrusted to different functional ministries fragmenting water management. The proposed system strongly relies on the river basin as the appropriate unit for water management.[xxvi]

## 2. Conciliation of Interests and Consultations

65. Governments are resorting to conciliation mechanisms and preventive strategies in order to manage water related differences and co-ordinate activities, with a view to achieve the several objectives, and satisfy the multidemands, usually associated to water resources.

66. The Federal Government and the states of Australia have recently signed an "Intergovernmental Agreement on the Environment" (1 May 1992). The Agreement intends to provide a co-operative national approach to the environment, a better definition of the role of the respective governments, a reduction in the number of disputes, greater certainty and better environmental protection. The agreement acknowledges the role of state governments in developing national and international policies; the global character of environmental concerns; the need for ecologically sustainable development; the need to conserve and improve biota, soil and water resources; the relationship between efficiency and clear definition of the roles of different levels of government; the need to have explicit accounts of costs and benefits; the relationship between effectiveness and Cupertino and the need for accountability.

67. The Agreement determines the responsibilities and interests common to all levels of government and those which are the concern of specific levels of government (The Commonwealth, the States, the Local Governments). It also states procedures for the accommodation of interests.

68. The German Water Law provides for the reconciliation of rights and authorisations to use water when either the qualities or the quantities of existing supplies do not allow the satisfaction of all uses. Compensations can be paid (art. 18).

69. The Water Law of China provides for the settlement of disputes among districts through consultations, in adherence with a spirit of mutual understanding and mutual accommodation, solidarity and co-operation. Only after consultation fails disputes are referred to the next level of government. Projects cannot be implemented while a dispute is not settled, unless there is an agreement between the parties, or an approval is granted by the next higher level of government (art. 35). Consultations are required for projects with intersectoral or interregional impacts (art. 22). There are provisions for the relocation of populations displaced by water projects (art. 23). Lacking agreement on mediation and consultation, or if they are not successful, the dispute can be referred to adjudication by either the administration or a court. Administrative decisions can be referred to court when a party refuses to accept the administrative decision (art. 36). The water regime cannot be unilaterally altered pending a decision. Temporary measures can be authorised by government.

70. The Canadian Water Act establishes a system of agreements between the federal government and the provinces for the management of any waters where there are significant national interests. The agreements shall include the responsibilities of the parties; the allocation of costs, and the terms of payment; the provision of labour, land and materials to be done by each party; the proportion of any compensations to be paid by each party; the conditions of loans, if any; the responsible authorities; and the general terms and conditions of the program. There are also references to the conditions of the boards, commissions or other bodies to be created under the agreement, where applicable (art. 7). Water quality management agreements are also provided for (art. 9). Under special circumstances the federal government can create federal water quality management programmes for interjurisdictional waters (art.11).

### 3. Concern for International Issues

71. Growing scarcity, competing demands, and transfer of externalities occur not only within national boundaries, but also at international level. In addition, in common market areas differing regulations might either curb imports or give a competitive advantage to exports. With the world wide privatisation of water-related services there are world-wide possibilities for advice and provision of services.

72. Therefore, countries are increasingly referring to extraterritorial factors or elements in their national water legislation.

73. The German Water Law provides for refusal of pipeline licenses when there are concerns about parts of the pipeline which are constructed or operated outside the area of application of the act (art. 19). Specific water management schemes shall be drawn up in order to fulfil international obligations (art. 36b).

74. The 1989 Water Act of England authorises the Authority to provide international assistance, training, and advice. (sect. 144). The appropriate Minister is granted powers to issue regulations to give effect to any community obligation, and to any international agreement to which the United Kingdom is, for the time being, a party (sect. 171). The activities of water service companies are affected by the requirements of the EC directives, such the ones on drinking and bathing waters.

75. Chinese water legislation anticipates the possibility of conflict between national water law and treaties to which the People's Republic of China is a party. In these cases the provisions of international treaties or agreements shall prevail (art. 51).

### 4. Stakeholders Participation

76. There is process to democratise water decision making and water related activities. It takes place through public hearings, stakeholders involvement in administrative bodies, organisation of user's associations and, for general environmental concerns, a greater permissiveness in the rules governing standing to act in either administrative or judicial fora. Thus, stake holders may participate in policy making, legislative discussion, general water administration, and field level activities. In Mexico, participation includes the establishment of formalities for the transfer of water rights within irrigation units and irrigation districts. The system intends to promote participation, while facilitating water transfers.

77. Stake holders and water users can participate in public hearings or consultations intended to discuss policies, programs, projects or legislation. While the mechanism is fundamentally apt to open venues for participation, its sole inception does not necessarily mean that every stake holder will necessarily participate.

78. In fact, some argue that government can encourage empowerment of interested parties by providing access to data, standing in meetings and, generally, providing opportunities for interested parties to express opinions and positions.[xxvii] This suggestion of an active government role in promoting participation seems to be confirmed in practice, by a recent experience in South Africa: in a public consultation on forthcoming water legislation industries submitted comprehensive responses, while a number of organisations and individuals did also respond in a positive manner. Yet, it was noticed that no comments were submitted by community based organisations, rural communities or village-level water committees. Very few submissions came from NGO's.[xxviii]

79. Representatives of the public and of consumers can integrate advisory bodies, such as the Water Board, which advised the Ministry of Agriculture in Israel. In Mendoza, Argentina,

representatives of the water users integrate the Tribunal and the Council of the Department of Irrigation, with important functions in relation to work plans, budgets, tariffs, and appeals. Representatives of agricultural users sit at the Directive Council of the Ecuadorian Institute of Water Resources. The Spanish Water Law of 1985 provides for users participation in Basin Authorities, and, through them, in the National Water Resources Council. Representatives of users, local communities, and the central administration integrate the river basin committees of France.[xxix]

80. Water users also participate at field level. Both, the European and the American experience, coincide in that the most effective institutional manners of users involvement are the ones taking place through some sort of public organisation. They assure economies of scale and mandatory dispute resolution processes, essential were a large number of diverse water users are involved.[xxx]

81. In a number of places where public participation is relevant it is associated to institutional environments where water is an important part of national policies and public water related organisations have an established and acknowledged role. In addition, in some countries such as Chile, the United States, the Western Provinces of Argentina, France, and South Korea, where participation is relevant, it has been possible to identify present or historical subsidies to water development and use.

5. Information

82. To be effective, a system of participatory planning and management of water resources must be able to provide timely information on what kind and quality of water is available where, and on who is using the water and for what purposes. Therefore, effective water management systems require adequate official surveys, inventories and cadastres of water sources and water-supplies, as well as up-to-date registers and records of water uses and discharges into waters, water rights, and beneficiaries of such rights, with their respective water allocations.

83. The Water Law of England of 1989 provides for registers with information on water quality objectives, applications, consents, certifications, water samples. The registers shall be available for inspection by the public, free of charge. The members of the public can obtain copies of entries paying a reasonable fee (sect. 117). English legislation also requires that the Authority and every water undertaker keep records of underground works, maps of water mains and sewers, and that this information be made available to the public free of charge (sect. 165). The Water Resources Act of 1991 creates registers of abstraction and impoundment licenses, pollution control, and discharge works; and also mapping systems of freshwater limits, main rivers, and waterworks (sections 191 to 195).

84. The objective of information is to allow appropriate decisions by policy makers, administrators, managers, users and the public. Therefore, legislation requiring the submission of information by managers to policy makers, users and the public at large, and by users and the public to managers is becoming part of modern water law. The English Water Resources Act of 1991 requires the National Rivers Authority to provide information to policy makers and undertakers and also to the public (sects. 196-197). The Authority does, in turn have powers to obtain information about surface and groundwater. Information shall be timely and adequate, and there are provisions on the kind of information to be collected and the manner in which the information must be organised. (sects. 197-203). The English system is complemented with norms on confidential and reserved information and penalties for false statements (205-206). Public participation is sought through a system of enquiries (sects. 213-215).

85. The Water Act of Canada sets up public information programmes under which the public is informed about water conservation, development and utilisation (art. 27). The Act also requires that

the Minister responsible for water informs the Parliament on the operations carried out under the Act, each fiscal year (art.36).

### 6. The Lowest Appropriate Level

86. In Germany water plans are produced by the Lander, according to federal directives (art. 36). Water management schemes, to be produced by the Lander, shall consider the role of water within ecosystems, the rational use of groundwater, and the requirements of different uses (art. 36 b).

87. In at least one country (New Zealand) the river basin has become not only the unit for water planning and management, but also the main focus of Regional Councils having the greatest responsibilities for the implementation of sustainable management. They are responsible for water resource development, water and soil conservation, geothermal resources, pollution control, and regional hazard mitigation.[xxxi]

88. Levels lower than provinces, regions, or states, have been the focus of particular water related services, like drinking water and sanitation. However, in countries such as Mexico vesting of these systems on municipal governments have drawn severe criticism: it resulted in a fragmented water industry, unable to take advantage of economies of scale; local governments were afraid of political reactions to raising charges; and financing, management and other skills were in short supply. This prompted a major change in the water industry.[xxxii]

89. Changes in the European context include the reorganisation of water management in England, separating water services from planning, control, and regulation. Water services are produced by private limited companies, while water management and control are reserved to public organisations like the National Rivers Authority and the Office of Water Services.[xxxiii]

## C. WATER HAS AN ECONOMIC VALUE IN ALL ITS COMPETING USES AND SHOULD BE RECOGNIZED AS AN ECONOMIC GOOD

90. In this paper the expression economic value of water refers only and exclusively to water as a natural resource, without addressing the issue of water related services, and connected added value and expenses. This distinction is important to clearly focus the issue of the economic value of water and its legal implications.

91. Property is to law, what scarcity is to economics. Law and economics are not separate and mutually exclusive, but interdependent regarding form and content and ends and means.[xxxiv]

92. Traditionally, law has not been interested in granting rights to the use of resources plentiful enough not to have any economic value. In European-based western law, as resulting from Roman law, these resources were known as "common resources".[xxxv] The typical examples were the high seas and the atmosphere: of such magnitude that they were deemed nor appropriable, neither vulnerable; of such abundance that they were owned by nobody because no restrictions applied to the use of unlimited supplies, which were free for all.

93. Apparently, in China water was an element within the concept of universal harmony, subject to public control. Fulfilment of individual duties in relation to water would satisfy the greatest good for the social system.

94. In earliest Muslim Law, water was the common entitlement of all Muslims.[xxxvi] Similarly, in early Hindu law water had a fluid and purifying nature, and could not become an object of appropriation.[xxxvii]

95. Curiously, in Roman Law, terrestrial waters were not included within the concept of common resources. They were either public or private. The distinction was based on magnitude, perenniality and the opinion of local inhabitants (*existimatio circumcolentium*).[xxxviii] However, whatever the categorisation of any specific body of water, the main fact for the purpose of this discussion is that in Roman Law water was considered important enough, scarce enough, and useful enough, to be publicly or privately owned. Here we find an early indication that water was granted, albeit implicitly, an economic value.

96. However, water is not an ordinary commodity. The peculiar characteristics of water resources stem from its polyvalent environmental, economic and social roles. They include, inter alia, public good aspects; external effects; imperfect competition; risk, uncertainty, and imperfect information; potential for social and environmental inefficiencies and inequity, and vulnerability to monopolisation.[xxxix]

97. These peculiarities have resulted in water rights systems which are hard pressed to strike a balance among the different demands and requirements resulting from polyvalence and unique physical chemical and biological attributes.

## 1. Water Rights

98. While in most countries water belongs to the public domain, water use rights granted to private individuals or corporations are protected under the property provisions of national and, in the case of federal countries, state or provincial constitutions. The Mexican Water Law of 1992 has incepted a system of water rights, their registration, and transfer, with a view to promote security and stability in water management and use.

99. Thus, stability of water rights is an important principle in water law, which some authorities have traced back to Roman law.[xl] The impossibility to grant stable water rights negatively affects development. In Zimbabwe, difficulties in acquiring reliable water rights are a main constraint to new viable agricultural investment.[xli]

100. A system of stable water rights is an incentive to invest in the development and conservation of water resources. Stable water rights are useful collaterals, assets, or appurtenances for credit purposes, and also important elements when assessing properties for taxation. Additionally, the stability and certainty of water rights and appurtenant uses provide recognition to existing economies and prevent social unrest.[xlii]

101. A water right usually is a right to use, and ownership of a water right does normally means a usufructuary power, and not ownership of the corpus of water itself. In some legislations the usufructuary power can be traded.

## 2. Effective and Beneficial Use

102. The relevance of water rights as property assets is related to the availability of the resource. The scarcer resource is the most valuable. Therefore, most water laws have provisions that require the effective use of water entitlements, either for a right to be born and kept, or for the maintenance of a valid water right.

103. The principle of effective and beneficial use is widespread. While the terminology is not uniform the notion that water rights risk forfeiture if not used, or if not used according to the terms of a license or permit, is found in the German Law, as amended on 23 September 1986, the Spanish law of 1985, the Mexican water law (art. 27. III), the legislation of most Argentinean Provinces, and the laws of the states of the American West. The legislation of Zimbabwe specifically considers the economic aspects of applications for water rights.[xliii]

104. The rationale behind the principle has been precisely and clearly constructed by the authorities, judges, and legislation of the United States. A typical statement of the rule of beneficial use is: "Beneficial use is the basis, the measure, and the limit of all rights to the use of water in this state"..."consistent with the interest of the public in the best utilisation of water supplies".[xliv]

105. The tenets of the doctrine of effective and beneficial use are: a) water is not to be obtained for speculation or let run to waste (reality of use); b) the end use must be a generally recognised and socially acceptable use; c) water is not to be misused (reasonable efficiency); d) the use must be reasonable as compared against other uses.

106. A common idea was that the quantity of water was to be no more than needed, the concern being with the possibility of "vesting an absolute monopoly on a single individual".[xlv] This antimonopoly- antispeculation concern where claimants do not have an specific use in mind continues today.

107. For a long time it was difficult to assess what happens in practice when water legislation does not have a requirement of use. The reason being that national systems of water legislation did not normally grant exclusive-non riparian-based water rights, without adding the requirement of effective and beneficial use.

108. At present, the state of flux of water legislation in general, and legislation related to water-based public services in particular, has prompted specific research on the subject of water rights and on the consequences of creating water rights severed from the requirement of effective and beneficial use. It has helped that assessments of the Chilean experience (where water rights are not conditioned to effective and beneficial use) are becoming widely available.

109. Natural resources economists notice that non-use, if not penalised with forfeiture may result in "sleeper rights" which increase uncertainty on the quantities of available waters.[xlvi]

110. The Chilean experience on the issuance of non-conditioned water rights is an apparent validation of the foreboding behind the requirement of effective and beneficial use. A study on the impact of the legal system for water allocation in Chile has found that:

"It is also common a state-owned monopolies that benefited from exclusive rights be privatised with them, creating legal barriers to entry that maintain the monopolistic characteristics of the sector"... "As mentioned above the regulatory framework [for electricity] is based on the existence of competition in the generation of electricity"..."However, competition practically does not exist in Chile"... "The water rights of the main hydroelectric projects belong mainly to...[a single corporation]... "The implication of this is that the largest generator has an incentive to appraise projects considering the effects that they will have on the profitability of its intramarginal capacity. It can obtain the monopoly equilibrium overtime by postponing investments. New entrepreneurs will be unable to enter [into the generation market] because they do not have the water rights to undertake the more efficient projects"...."Water rights should have been returned to the state prior to privatisation, which in turn could have granted them subject to the conditionality of their timely development ...[through new projects] by existing producers or new comers".[xlvii]

111. Thus, the actual operation of the Chilean system appears to confirm the rational behind the requirement of effective and beneficial use.

112. Monopolisation through the creation of barriers to entry resulting from the control of essential production inputs and natural resources, are standard fare in economics literature.[xlviii] The existence of water markets does not alleviate the situation since in fact "crucial inputs of this kind are not usually traded on competitive markets".[xlix] Also, water markets do not reallocate large quantities of water. To the contrary, the amounts historically traded are limited enough for these markets to have been identified as "thin" markets, by a leading expert on the subject.

113. Furthermore, for large institutional users the incentives to sell water rights, absent the penalty of forfeiture for non-use, are minor, if compared against the strategic advantages that control of a key production input represents within the market power policies of corporate practices.

114. Hence, it appears that the absence of a requirement of effective and beneficial use does have a negative effect on water transactions, on water markets, and on efficient water allocations. Empirical evidence on the actual working of water markets in Chile shows that with a few local exceptions market transactions of water rights in Chile have been limited.[l]

3. Conditionalities on Water Uses

114. In addition to the requirement of effective and beneficial use there is general trend to condition the use of water. This conditioning includes formal (obtaining a permit) and substantive requirements (i.e. no harm to third parties, environmental protection, efficiency).

115. German Water Law, which provides a good example of trends, attaches a number of conditions to water use, permits and licenses. They include effective use, prevention of detrimental effects, payment of compensations, preventive assessment, appointment of caretakers, remedial measures, and payment of common control costs (art. 4). A particular feature of the German legislation is the possibility to impose new conditions after a permit or license has been granted. Ex-post conditions may refer to the environmental or the economic requirements of water resources management (art. 5). A water right can be revoked for non use, lack of need, change of use by the permittee, use beyond the allocation under the permit, etc. (art. 15). Permits are required to either withdraw water or to effect discharges into them. However, as far as it regards the relationships between the Administration and a water user, a water right is not an entitlement to any specific water quantity or quality (art. 2). Applications can be rejected and permits and licenses are granted for specific purposes, in a specific manner, and to a specific extent. They are revocable. (arts. 6 and 7). Use of water by property owners and riparians shall not adversely affect other persons, cause detrimental change to water, adversely alter water balance, or substantially reduce water flows (art. 24).

116. A common feature of water law is to establish preferences among uses in order to allocate water at times of scarcity, or to grant water rights in case of competing applications. An example of this feature, which incidentally is a major element in Muslim law ("right to thirst"), is article 58 of the Spanish Law of 1985 granting a preference to drinking purposes.

4. Water Markets

117. Marketing of water rights is being paid increased attention as a useful, and economically efficient, alternative for the improvement of water allocations. As supplies diminish relative to demand markets become not only an efficient alternative, but also a necessary solution to problems of water scarcity. Thus, new legislation, such as the Mexican Water Law, allows water transfers, subject to administrative authorisation, should such transfers affect the rights of third parties, the environment or the regime of water resources. Absent such impacts, or should the transfer not change the conditions of the original title, or existing regional agreements so authorizing, water rights may be transferred by registration in the Public Water Rights Registry. Thus, the formalities of water transfers are

established by regional regulations established by the National Water Commission according to the requirements of individual regions. However, countries such as the People's Republic of China, while acknowledging the need to develop water markets, emphasise the need for macromanagement of water resources, to avoid harmful impacts on the environment and social development.[li]

5. The American experience

118. Water markets are an important feature of the legal system of the states of the American West. A review of their experience is important to the understanding of the subject and its complexities. In the United States reallocation of water rights may be "with the possible exception of water quality ... the most pressing matter facing the arid west".[lii]

119. For a reallocation to be legally valid some requirements must be fulfilled: a) water must have been beneficially used, and must continue to be beneficially used after the reallocation; b) such reallocation must not affect other users and must be in the public interest; c) in many jurisdictions, interbasin transfers or transfer outside the area-of-origin can only take place with due consideration to local interests; b) in some jurisdictions appurtenance statutes prevent water reallocation.[liii]

120. Marketing of water rights is a complex process, which is affected and influenced by several factors, including: a) the priority of the transacted right; b) the profile of the parties;
c) geographic flexibility; d) size and economic value of the transaction; e) reliability of the marketed water right; f) buyer characteristics; g) volume of water transferred; h) changes in regional economies; i) system for water administration; j) availability of infrastructure to effect a change; k) environmental impacts.[liv]

121. While water rights markets are strongly advocated by reputable experts, there are also reservations. Conflicts over water transfers occur in the American West as large metropolitan areas look for the water supplies of rural areas. The public values at stake include the economic development of urban areas, culture, way of life, environment and the future of rural communities built around agricultural uses. "It is becoming increasingly apparent that current water law and water market oriented behaviour are incapable of solving this conflict in an equitable manner". Therefore, according to some authorities, oversight and regulatory approval for water transfers and markets is required.[lv] A result of the complexities of water marketing is that the activity has been subjected to regulations in the interest of third parties and the public.[lvi]

122. Broadly stated, regulations include: a) the appurtenacy principle, which prohibits the transfer of water rights if not as an appurtenance to the land where they are used. Its purpose was to prevent land speculation; b) transfers are to be approved by judicial, legislative or administrative authorities (the approving authority varies according to the law of each state); c) public notice of the intent to transfer, with the possibility of filing protests granted to either any interested person or only to holders of water rights (again standing to oppose varies according to the legislation of each state); d) administrative recording of the transfer and filling with the authority for water management; e) issuance of permits to reallocate and use subject to existing or new conditionalities, including proof of completion of work and beneficial use; f) forfeiture of water right, (and in some states charges for misdemeanour), if prior approval is not obtained; g) limitation of transferable entitlement to historic consumptive use; h) requirement that transfer does not injure other appropriators who, even if junior, have a right to the substantial maintenance of the stream conditions existing at the time of their appropriations. Injury might result from changes in volumes, timing, storage, means of diversion, quality, deprivation of return flows, point of diversion, or a combination thereof; i) accommodation of uses through conditions intended to mitigate or prevent injury; j) compensation and payment of expenses;

123. In addition to the above mentioned regulatory examples, there are also considerations of public interest which apply to the review of applications to transfer water rights. They apply to the review of public value externalities. They include: a) effects of the economic activity resulting from the application; b) effects on fish and game resources and on public recreation; c) effects on public health; d) opportunity cost of the use; e) harms to other persons; f) intent and ability to use; g) effects on access to public and navigable waters; h) needs for water conservation; i) factors of local relevance.

124. Accordingly, a reallocation would not be allowed if it results in the violation of minimum health, environmental, or safety standards. However, the public interest element can be accommodated by conditioning a requirement for reallocation to measures to mitigate public interest concerns.

125. While there are no questions on the substantive legitimacy of public interest concerns questions on the appropriate fora and means for their consideration have been raised. While there is always an administrative and judicial role, for some authorities such means and fora should include water planning and public participation.

126. Additional considerations may include the assessment of the impacts that a transfer may have on the environment, and the tax base or the local economy of the area of origin of the water allocation to be transferred.

127. Finally is worth to notice that research on water markets in the Am. ican West, California and Chile have concluded that requirements of effective and beneficial use of waters encourage water transfers;[lvii] that the existence of subsidies to specific activities affects water transfers;[lviii] and that the absence of requirements of effective and beneficial use negatively affects water markets.[lix]

## 6. Charging for water

128. Charging or pricing water is a vexing problem. For starters there are technical complications about what is the price that would best reflect the value of water. Economists specialising in water resources notice that water has a relatively low economic value at the margin. While the value of the first unit of water to be used by a city may be very high, the value of additional units may be quite low.[lx]

129. Additionally, it seems that by nature water markets are thin markets, with a relatively low number of transactions performed in each one of them. Moreover, water markets are not classical markets in the sense of having quick and clear agreements, anonymity, instant exchange, and no further dealings among the parties.[lxi]

130. Therefore, it is argued that water markets are not perfectly competitive, consequently not necessarily reflecting full costs of transactions.[lxii]

131. Many systems charge for the cost of administering water resources. There are also charges for water related services, and to protect and recover water when affected by environmental deterioration.

132. Thus, the German Water Law requires payment of common control costs (art. 4). Also in Germany, the Act on Waste Water Charges, of 6 November 1990, provides for water charges to be paid for water pollution. Charges are based on noxiousness levels, which depend on oxidizable substances, phosphorous, nitrogen, mercury, cadmium, chromium, nickel, lead, copper, and their compounds; as well as on toxicity to fish. (arts 1 to 3, Act of 6 November 1990). They also consider the classification of particular river basins and the number of units of noxiousness in the water body

downstream the river classification basin. Water charges are to be paid by anyone discharging waste water. The revenue resulting from water charges shall be used in measures to improve water quality (arts. 9 and 13 Act of November 6, 1990).

133. The costs of pollution control and environmental protection in the Netherlands are financed through the general budget (tax payers) or through a special budget financed with specific levies or charges. Pollution levies and charges are raised from polluters.

134. Examples like these cases, where charges are used to recover costs, or to promote environmental protection are relatively numerous.

135. However, legislation charging for water as such, is not so abundant. A recent case is the Mexican Water Law of December 1, 1992, which charges for the exploitation, use, and enjoyment of surface and ground waters. Payments are also established for discharges into water bodies. (art. 112). Water prices and values are established according to regional water availability. The goals of the system are a) to relate water charges to benefits resulting from services and water works; b) to integrate the financial system within an overall strategy for water resources management, including, the solution of structural problems; c) to promote rational water use and conservation; d) to adjust water price to cost; e) to strengthen the National Water Commission, which collects and manages water related revenues. The system intends to charge according to the opportunity cost of water, allowing adjustments according to regional conditions, and taking into consideration the social and political situation of different groups of users. The charge is a main source of financing for the activities and investments of the National Water Commission.

136. The Spanish Water Law of 1985 provides for the payment of fees for the use or occupation of public waters. The base value to calculate the charge is the value of the capital asset which is utilised by the user. Such value is estimated on the basis of the economic returns generated by the asset. The rate to be collected is 4% of the base value. Revenues are collected and managed by the Water Confederations, which are the water authorities at basin level (arts. 104 y 105)

NOTES

i. "Water Management in the Netherlands: Policy, Measures, Funding", November 1991, No Author or Place of Publication, p. 4.

ii. See footnote 1/.

iii. See op. cit. 1/, pp. 8-9.

iv. Mono Lake. National Audubon Society v. Superior Court of Alpine County, 33 Cal.3d 419, 189 Cal. Rptr. 346, 658 P.2d 709 (1983).

v. Space limitations prevent a full listing of laws and countries in the text. However, more detailed information about current practices in groundwater management can be found in "Water and Water Rights", 1991, Robert E. Beck, Editor in Chief, The Michie Company, Charlottesville, Virginia; and in "Groundwater Legislation in the ECE region", Economic Commission for Europe, ECE/WATER/44.

vi. Barraqué, Bernard, "Water Management in Europe: Beyond the Privatization Debate", Flux No. 7, p.13,20,21; March, 1992; Paris, France.

vii. Bauer, Carl J., "Derechos de Propiedad y el Mercado en una Institucionalidad Neoliberal: Efectos e Implicancias del Codigo Chileno de Aguas de 1981", Documento para Discusion, Santiago, Chile, Agosto 1993, p.3-4; Dellapenna, Joseph, "Regulated riparianism", pp. 413-579 in Beck and Goplerud, op. cit., Vol.1.

viii. Haddad, Brent Michel "Evaluating the Market Niche: Why Long Term Rural-to-Urban Inter-regional Markets for Water Have not Formed in California", Ph.D Dissertation in Energy and Resources, University of California, Berkeley, 1996 p.383.

ix. Water Resources Council: "Proposed Principles and Standards for Planning Water Management and Related Natural Resources", Federal Register, December 21, 1971, Washington D.C., Volume 36 No 245. p. 24145-24146

x. Economic Commission for Europe, Environmental Series No 4: "Policies and Systems of Environmental Impact Assessment", ECE/ENVWA/15, p. 39.

xi. See op. cit. footnote 10, p. 9.

xii. See op. cit. footnote 10, p. 28.

xiii. Natural Resources Defense Council v. Duvall, United States District Court, E.D. California, (777 F.Supp. 1533 E.D.Cal 1991). Also "Federal Judge Orders Review of Rules on Irrigation Water". The New York Times, August 1, 1991. New York, USA. p. A14.

xiv. Turan, Ilter. "Politics of Water and the Role of International Organizations: The Middle East", in Proceedings of the International Symposium on Water Resources in the Middle East: Policy and Institutional Aspects. Urbana, Illinois, USA, October 1993, p. 152. Also Henry Kamm "Israel's Farming Success Drains it of Water", in the New York Times, New York, USA, Sunday April 21, 1991, p. Y-7. Also Rehinhold, Robert, "New Age for Western Water Policy: Less for the Farm, More for the City" in the New York Times, New York, USA, October 11, 1992.

xv. "Water Resources Management", A World Bank Policy Paper, p. 45, The World Bank, Washington, D.C., 1993; also see PB-211921 "Water Resources Planning", p. 46 National Water Commission, June 1972, NTIS, U.S. Department of Commerce, 5285 Port Royal Rd., Springfield Va. 22151

xvi. Supreme Court of Nebraska, as quoted by Trelease, Frank, in "Water Law, Resource Use and Environmental Protection" West Publishing Corporation, Minn. USA,1974, pp. 97

xvii. Bauer, Carl "Water Markets and the Principles of Dublin", Berkeley, California, September 1996.

xviii. Briscoe, John "Water Resources Management in Chile: Lessons from a World Bank Study Tour" Working Paper, The World Bank, January 1996, p. 9.

xix. Haddad, op. cit. p. 390/91

xx. See Beck, op. cit., Vol 6, on State Surveys.

xxi. "Major Water Related Legislation and Institutions in Canada", p. 20. Prepared for UN Secretariat, Committee on Natural Resources of the ECOSOC, by the Economics and Conservation Branch, Environmental Conservation Service, Environment Canada, Otawa, Canada, October 1993.

xxii. Oman'90, p. 115 Sultanate of Oman, Ministry of Information, Oman 1990.

xxiii. Mohammed Al-Eryani, "Policy and Institutional Aspects of Water Resources Management and Development in Yemen", in "Water Resources in the Middle East: Policy and Institutional Aspects", p. 159 Urbana, Illinois, October 1993.

xxiv. Ke Lidan, "Water Resources Administration in China", also Water Law of the People's Republic of China, January 21, 1988.

xxv. "Water Management in the Netherlands: Policy, Measures, Funding", November 1991. Also Barraque, op. cit., p. 16.

xxvi. Brazil: Law Proposal No 2249-A, 1991, and substitutive, of June 1993.

xxvii. Haddad, op. cit., p. 389;

xxviii. South Africa: Report to the Minister of Water Affairs and Forestry on the Water Law Review Panel: "Fundamental Principles and Objectives for a New Water Law in South Africa" pp.3-4.

xxix. Solanes, Miguel, "Decentralization of Water Management: The Case of Water Users'Associations" discussion paper prepared for the 14th World Bank Agricultural Symposium, Agriculture in Liberalizing Economies: Changing Roles for Governments, New York, 1993, p. 4.

xxx. Hellinga F, "Local Administration of Water Control in a Number of European Countries", H. Veenman and Zonen, N.V. Wageningen, The Netherlands, 1960, p.13 y 38; also Davidson, John, "Distribution and Storage Organizations" in "Water and Water Rights" Robert E. Beck, Editor in Chief, The Michie Company, Va. Vol. 3, p. 469.

xxxi. Furuseth Owen, and Cocklin Chris "An Institutional Framework for Sustainable Resource Management: The New Zealand Model", Natural Resources Journal, University of New Mexico School of Law, Vol. 35, No 2, Spring 1995, p. 243 to p.272.

xxxii. Casasus, Carlos "Privatizing the Mexican Water Industry", Journal of the American Water Works Association, March 1994.

xxxiii. Bernard Barraque "Water Management in Europe: Beyond the Privatization Debate", in Flux, January - March 1992, p. 7, Paris, France, and also Laws of England (4th Edn) Supp, Vol 49, para 201-218

xxxiv. Gray, Lee and Nobe, Kenneth "Water Resources Economics, Externalities and Institutions in the United States", paper discussed at the Interantional Conference on Global Water Law Systems, Valencia, Spain, 1975. p. 1

xxxv. The concepts of common, public and private goods in Law, do not strictly coincide with the concepts of common, public and private in economics.

xxxvi. El-Charani, le Cheik, "Kitab al Mizan" (Balance de la Loi Musulmane", Translation of Perron, Algiers, 1898, p.388 quoted by Caponera in Principles of Water Law and Administration.

xxxvii. Wohlwend, B.J. "Hindu Water and Administration in Bali", Proceedings of the Conference on Global Water Law Systems, Valencia, 1975.

xxxviii. Bonfante, Pedro "Instituciones de Derecho Romano" trad. de la 3a ed. ital, de Bacci, Luis y Larrosa, Andres, revisada por Campuzano Horma, Fernando, Madrid, 1929 p. 313-314.

xxxix. See, generally, Colby-Saliba, Bonnie and Bush David, " Water Markets in Theory and Practice: Market Transfers, Water Values and Public Policy", Studies in

Water Policy and Management, No 12, Westwiew Press, Boulder, Colorado, USA, 1987.

xl. Lex Coloniae Genetivae Iulae, 43 A.D. according to which waters in public lands open to colonization were subjected to the same uses and charges existing under previous ownership, according to Costa Le Acque nel Diritto Romano, Bologna, Italy, 1918 pp. 16-18, according to quotation by Caponera, Dante in Principles of Water Law and Administration, Balkema, Países Bajos, 1992 pp. 30 and 50.

xli. Mpofu, Thomas P.Z., communication to Ms. Beatrice Labonne, UNDDSMS, August 1, 1995.

xlii. United States Supreme Court 1984, Syllabus and Opinions, No 80; Argentinean Supreme Court, La Pampa Vs Mendoza, 1987, L-195-XVIII; Francoise Conac "Land and Water Rights Issues in Irrigated Schemes in Sub-Saharan Africa: Conflicts to be Avoided", DVWK Bulletin No 16, Verlag Paul Parcy, Hamburgh, Berlin 1989; Beck and Goplerud: Waters and Water Rights Vol. 1 pp.366 and following.

xliii. See Mpofu, op.cit.

xliv. See Beck Robert and Goplerud, "Waters and Water Rights", The Michie Company Charlottesville, Va. USA, 1991. Vol. 2 pp. 106 and following.

xlv. See Beck and Goplerud, Vol. 2 pp. 107-108.

xlvi. See Livingston, op. cit. endnote 62 "Designing Water Institutions..." p. 8-9.

xlvii. Bitran, Eduardo and Saez, Raúl, Privatization and Regulation in Chile, Brookings Institution Conference on the Chilean Economy, Washington DC, April 22-23, 1993, pp. 50-55, permission to quote verbally requested.

xlviii. Sullivan, Lawrence Anthony, "Antitrust", West Publishing Co., St. Paul, Minn, USA, 1977, pp. 25, 31, 77, etc.

xlix. Armstrong Mark et al, Regulatory Reform: Economic Analysis and British Experience, The MIT Press, USA, 1994 pp. 117 and footnote 22/.

l. See Bauer, Carl Against the Current: Privatization, Markets, and the State in Water Rights, Chile, 1979-1993, Berkeley, California, USA, 1995, p. 2 "Private bargaining and exchange cannot coordinate overlapping resources without continues State intervention, through the courts, if not through other political organs"; p. 57..."these features [of the law] stimulate speculation..." they have been favored [by supporters of the law] saying that speculation improves market operations and price signals"..."they deny criticisms that speculation might distort prices through unequal bargaining power or monopoly control"... p.171 ..."the government virtually guaranteed the under-valuation of water rights [resulting in relatively few transactions] when it privatized them without imposing any taxes, fees, or other obligations to the public interest".

li.. See China: "Capacity Building on Law and Institutions for Water Management", p.21, note submitted to UNDDSMS on August 23, 1995.

lii. Beck and Goplerud, Vol. 2 p. 234.

liii. Beck and Goplerud, Vol. 2 p. 234.

liv. Colby Bonnie G. et. al, "Water Rights Transactions: Market Values and Price Dispersion" in Water Resources Research, Vol. 29, No. 6. June 1993 p. 1565-1572.

lv. Ingram Helen M. et al. The Trust Doctrine and Community Values in Water, III World Conference on Water Law and Administration, Alicante, Valencia, Spain, 1989, p. 10-11.

lvi. See generally Anderson L. Owen et. al, "Reallocation", in Beck and Goplerud, op. cit. Vol. 2 pp. 234 and following.

lvii. See Colby-Saliba, op. cit. p. 81; also G.D. Weatherford and S.J. Shupe, "Reallocating Water in the West", American Water Works Association Journal 78: 63-71, October, 1986.

lviii. See Haddad, op. cit., p. 393.

lix. Bauer, op. cit., pp. 10, and 11; also Haddad, op. cit., pp. 389, 390.

lx. Young, R.A. "Why are There so Few Transactions Between Water Users?", American Journal of Agricultural Economics, Vol: 681143-1151, December, 1986., also Colby-Saliba, op. cit., pp.1-6.

lxi. Haddad, op. cit., p. 379.

lxii. See, generally, Livingston M.L. "Normative and Positive Aspects of Institutional Economics: The Implications for Water Policy", Water Resources Research, USA, Vol. 29, No. 4, Pages 815-821, April 1993; also "Designing Water Institutions: Market Failures and Institutional Responses" Originally prepared for the World Bank Policy Paper of 1993, no place of, or printing, date.

**UNITED NATIONS** **NATIONS UNIES**

**Division for Sustainable Development**
**Department for Economic and Social Affairs (DESA)**
**Room DC2-2270, United Nations, New York, N.Y. 10017**
**Telephone: (212)963-4800 • Telefax: (212)963-1795**
**E-mail: najlis@un.org**

file to library



17 March 1998

Dear Mr. Visscher,

Please find enclosed the final report of the Expert Group Meeting on Strategic Approaches to Freshwater Management, held in Harare, Zimbabwe January 27-30 1998. The report, which was submitted in full by the Government of Zimbabwe, was well received by the Ad-Hoc Intersessional Working Group of the Commission on Sustainable Development held in New York, February 23 - 27, 1998, The Working Group invited Governments, in formulating and implementing policies and programmes, to consider the key recommendations of the report.

Please also find enclosed the final list of participants and the advance unedited copy of the co-chairpersons' report of the Ad-Hoc intersessional working group of the Commission on Sustainable Development on strategic approaches to freshwater management.

I would like to take this opportunity to thank you for your active participation in the meeting and your valuable contribution to its successful outcome.

Yours sincerely,

Pierre Najlis, Chief
Natural Resources Branch

Mr. Jan Teun Visscher
Interim Director, IRC
International Water and Sanitation Centre,
PO Box 93190, 2509 AD The Hague, The Netherlands.

**Advance unedited text**

# CO-CHAIRPERSONS' REPORT OF THE AD-HOC INTERSESSIONAL WORKING GROUP OF THE COMMISSION ON SUSTAINABLE DEVELOPMENT ON STRATEGIC APPROACHES TO FRESHWATER MANAGEMENT NEW YORK, FEBRUARY 23 - 27, 1998

## I. INTRODUCTION

1. The Ad Hoc Intersessional Working Group on Strategic Approaches to Freshwater Management met in New York on 23-27 February, 1998 in preparation for consideration of this issue at the sixth session of the Commission on Sustainable Development (New York, 20 April - 1 May, 1998). The discussions were based on the recommendations and proposals for actions contained in the reports of the Secretary-General E/CN.17/1998/2 and Add. 1 and E/CN.17/1998/3, as well as in the report of the Expert Group Meeting on Strategic Approaches to Freshwater Management held in Harare, Zimbabwe 27-30 January, 1998 (E/CN.17/1998/11). The discussions also benefitted from national presentations by the Kingdom of the Netherlands and the Russian Federation describing their efforts in achieving integrated freshwater development and management.

2. The participants noted the forthcoming Ministerial Meeting on Water Resources and Sustainable Development (Paris, France, 19-21 March, 1998) that is expected to provide an additional opportunity for further consideration of various aspects of strategic approaches to freshwater management in preparation for the sixth session of the CSD, in particular the need for improving knowledge of water resources and water users; promoting human resources and institutional capacity building; and identifying appropriate financial resources. Similarly, a contribution to the sixth session of the CSD is expected from an international forum "Global Water Policy - Cooperation in Transboundary Water Management" (Bonn, Germany, 3-5 March, 1998).

3. The outcome of the Working Group meeting is not a negotiated text, although its contents were thoroughly discussed. In accordance with the expert nature of the Working Group and the functions assigned to it, the report focuses on key issues and conclusions and suggests elements and policy options for further consideration and negotiation during the sixth session of the Commission on Sustainable Development.

## II. BACKGROUND

4. Water resources are essential for satisfying basic human needs, health and food production, and the restoration and maintenance of ecosystems, as well as for social and economic development in general. Agriculture accounts for the majority of the global freshwater uses. It is imperative that water resources development, management and protection should be planned in an integrated manner, taking into account both short- and long-term needs.

5. The priority to be accorded to the social dimension of freshwater is of fundamental importance. This should be reflected in an integrated approach to freshwater in order to be coherent with the objectives aimed at achieving a truly people-centred sustainable development.

6. The objectives of sustainable development and the links among its three components - economic development, social development and environmental protection - were clearly articulated in Agenda 21 and the Rio Declaration. The specific decisions and policy recommendations concerning freshwater development, management and use in Chapter 18 of Agenda 21, and the identification of the seven key programme areas contained in that Chapter, continue to be a basis for action.

7. There is evidence of progress in improving some aspects of freshwater resources management since 1992. Marked improvements in water quality have occurred in a number of river basins and groundwater aquifers where pressures for action have been strong. However, while many lessons have been learned, overall progress has been neither sufficient nor comprehensive enough to reduce general trends of increasing water shortages, deteriorating water quality and growing stress on freshwater ecosystems. Water need not become a limiting factor for sustainable development and human welfare. A series of potential crises can be averted if vigorous action is taken now toward an integrated approach to freshwater resources development, management and use.

8. Competition for limited freshwater increasingly occurs between agriculture, urban, industrial and environmental uses. In adopting the Programme for the Further Implementation of Agenda 21, in particular its paragraph 34, the United Nations General Assembly articulated the multiple dilemmas and challenges associated with the management of freshwater. They recognized, inter alia, the urgent need to formulate and implement national policies of integrated watershed management in a fully participatory manner aimed at achieving and integrating economic, social and environmental objectives of sustainable development. In addition to agreeing to these strategic principles, the General Assembly also recognized an urgent need to strengthen international cooperation to support local and national action, in particular in the fields of environment and development, safe water supply and sanitation, food security and agricultural production, and flood and drought control through efforts in areas as information exchange, capacity building, technology transfer and financing.

9. In accordance with the Programme for the Further Implementation of Agenda 21, Governments called for a dialogue under the aegis of the Commission on Sustainable Development, beginning at its sixth session, aimed at building a consensus on the necessary actions, and in particular, on the means of implementation and on tangible results, in order to consider initiating a strategic approach for the implementation of all aspects of the sustainable use of freshwater for social and economic purposes, including, inter alia, safe drinking water and sanitation, water for irrigation, recycling, and wastewater management, and the important role freshwater plays in natural ecosystems. This intergovernmental process will be fully fruitful only if there is a proven commitment by the international community to the provision of new and additional financial resources for the goals of this initiative.

## III. KEY ISSUES AND CHALLENGES

10. The process called for in the Programme for the Further Implementation of Agenda 21 should focus on fostering and supporting national and international action in those areas where goals and objectives have been defined; identification of existing gaps and emerging issues; building global consensus where further understanding is required; and promoting greater coordination in approaches by the United Nations and relevant international institutions particularly in support of national implementation policy and development.

11. Numerous gaps can be identified in the path towards integrated water management, which need to be addressed by governments with support from the international community. Areas that require further attention include, among others: awareness of the scope and function of surface and groundwater resources; the need for human resource development and participatory approaches, notably including women; the role of ecosystems in the provision of goods and services; balancing structural and non-structural approaches; explicit linkages with socio-economic development, including sound economic policies, for equitable and efficient freshwater allocation and use; improved sanitation and waste water treatment; conserving biological diversity of freshwater ecosystems; understanding hydrology and the capacity to assess the availability and variability of water resources; and the mobilization of domestic and international financial resources. Strategic and integrated actions are still needed in order to adapt to ever changing social and environmental circumstances and to address

fundamental concerns for combating poverty, ensuring adequate provision of public health, food security and energy, and better to protect the environment.

12. International cooperation and action needs to effectively address the above issues building on existing consensus for the successful implementation of integrated water resources development and management.

13. The implementation of integrated water development and management strategies requires action at all levels. However, most decisions and actions related to integrated water management need to take place at the local and national level. These actions should be closely related to other areas of natural resource management, including land, forestry and mountain development. Effective integrated water resources management should incorporate river basin, catchment, watershed and ecosystem approaches.

14. There is a need to ensure that local and national management plans are in a position to bring about productive and sustainable interactions between human activities and the ecological functioning of freshwater systems. There is also a need to minimize impacts from human activities on coastal areas, estuarine and marine environments, and in mountainous areas, and to reduce potential losses from droughts and floods, erosion, desertification and natural disasters. Furthermore, pollution prevention, sanitation and the treatment of waste water need to be addressed.

15. Riparian States are encouraged to co-operate among each other on matters related to international watercourses. This important issue requires further consideration in the CSD and other relevant fora.

## IV. ACTIONS AND MEANS OF IMPLEMENTATION

16. Governments are invited to intensify efforts to develop local and national integrated water resources development and management programmes and policies as recommended in Agenda 21. Governments at the appropriate level should set and publish target dates for the adoption, or up-dating of local or national action programmes for implementing such programmes. The implementation of local or national programmes should form an important part of the Local Agenda 21 approach.

17. In formulating and implementing integrated water resources management policies and programmes, there is a need to take into account actions to implement relevant conventions in force, in particular Conventions on Biological Diversity, Desertification, Climate Change, Wetlands (Ramsar) and International Trade in Endangered Species (CITES). In addition, consideration should be given, as appropriate to relevant recommendations and/or programmes of action emanating from a number of major international conferences and events, including the Global Programme of Action for the Sustainable Developments of Small Island Developing States, the Global Programme of Action for the Protection of the Marine Environment from Land-Based Sources of Pollution, the Mar del Plata Action Plan, the International Drinking Water Supply and Sanitation Decade, the International Conference on Water and the Environment: Development Issues for the 21st Century (Dublin, 1992); the World Summit for Social Development (Copenhagen, 1995); the fourth United Nations Conference on Women (Beijing, 1995); the HABITAT II (Istanbul, 1996); and the World Food Summit (Rome 1996). Furthermore, in formulating such policies, Governments are called upon to address the need for achieving universal access to water supply and sanitation, including through poverty eradication, taking into account, in particular chapter 18 of Agenda 21, the Global Consultation on Safe Water and Sanitation for the 1990s (New Delhi, India, 1990) and the recommendations of the 1994 Noordwijk Action Program on Drinking Water Supply and Sanitation.

18. The holding of the Expert Group Meeting on Strategic Approaches to Freshwater Management (Harare, Zimbabwe, January 27-30 1998) and its report are noted with appreciation. In formulating and implementing policies and programmes, Governments are invited to consider the key recommendations of the report.

**Information for decision making**

19. Governments are encouraged to establish and maintain effective information and monitoring networks and further promote the exchange and dissemination of information -- including related socio-economic and environmental data, gender differentiated where appropriate -- needed for policy formulation, planning and investment decisions and operational management of freshwater resources, and encourage the harmonization of data collection at the basin/aquifer level. Public access to this information should be facilitated. This includes the need to improve the understanding of hydrology (surface and groundwater) and the function of ecosystems and to strengthen relevant information systems to better foresee and manage resource uncertainty. Such efforts on the part of developing countries, particularly the least developed countries, require support from the international community.

20. Governments are encouraged to implement and monitor national water-related indicators of progress in achieving integrated water resources management, including water quality and quantity objectives, taking into account ongoing work of the CSD on indicators of sustainable development.

21. In addition, in accordance with their policies, priorities and resources, Governments may find it useful to carry out national water quality and quantity inventories for surface and groundwater, including the identification of gaps in regard of available information.

22. Governments are invited to establish or strengthen mechanisms for consultations on drought and flood preparedness and early warning systems and mitigation plans at local and national levels. Governments are encouraged to consider the establishment of systems, which may take the form of emergency funds where appropriate, to ensure that individuals and communities can be compensated for the damage that they suffer from such extreme events. At the international level, there is in particular a need to maintain support of these activities following the end of the International Decade on Natural Disaster Reduction (IDNDR) (1999).

23. The international community should support national efforts in the areas outlined above. The United Nations system is called upon to play a central role in the development and coordination of relevant data and information networks, strengthen regional and global monitoring systems, carry out periodic global assessments and analyses, and promote the broadest exchange and dissemination of relevant information, in particular to developing countries.

**Institutions, capacity building and participation**

24. Governments are urged to establish national coordination mechanisms, as already envisaged in the Mar del Plata Action Plan, providing for the involvement of all relevant parts of government and public authorities, in the formulation and implementation of integrated water resources development and management plans and policies. Such mechanisms should also provide for consultation with major groups. This involves the participation of water users and the public in planning, implementing, and evaluating water projects.

25. Governments are invited to take the necessary steps to establish legislative and regulatory frameworks, and to improve such frameworks where they exist, to facilitate integrated water resources management and strategies, including both demand and supply management, taking into account the need

to improve capacity, to apply and enforce such legislative and regulatory frameworks. In this context, each Government needs to define its relevant functions and distinguish between those related to standard and regulation setting and control on the one hand, and the direct management and provision of services on the other.

26. In view of the complexity of implementing integrated water resources development and management strategies, Governments should strengthen institutional and human capacities at national and local levels. At the local level, this could be done through local Agenda 21 processes where they exist. Effective water resources management and protection requires appropriate tools for educating and training water management staff and water users at all levels, and for ensuring that women and youth have an equal access to education and training programmes.

27. Governments are encouraged to establish an enabling environment to facilitate partnerships between public and private sectors and NGO's, aiming towards improved local capacity to protect water resources, through significant outreach, educational programmes and improved public access to information. The pivotal role of women should be reflected in institutional arrangements for the development and management of water resources. In this context, there is a need to strengthen the role of women who should have an equal role with regard to water resources development and management and sharing of benefits

28. In support of national efforts in this field, the international community, in particular the organizations of the United Nations system, should strengthen capacity building programmes, taking into account the special needs of developing countries, in particular the least developed countries and the specific circumstances of SIDS, including in such areas as training, institutional development and the participation of women.

**Technology transfer and research cooperation**

29. Governments are encouraged to stimulate and remove impediments to research and development cooperation, together with the development of technologies for sustainable water management and use; to increase efficiency, reduce pollution and promote sustainable agriculture and food production systems. This involves the adaptation and diffusion of new and innovative techniques and technologies, both private and public, and the transfer of technologies to developing countries, including on concessional terms, as mutually agreed, taking into account the need to protect intellectual property rights. The use of local and traditional technology and knowledge should be promoted, and South-South cooperation should be encouraged.

30. Governments, industry and international organizations should promote technology transfer and research cooperation to foster sustainable agriculture practices that integrate efficient water use and prevent pollution of surface and groundwater. These technologies should include improvement of crops grown on marginal sites, erosion control practices, and the adaptation of farming systems. They should also improve water efficiency in both irrigated and rain-fed areas and improve adaptation and productivity of drought tolerant crop species. Farmer participation in farm research, irrigation projects and watershed management should be encouraged. Research results and technologies should be available to both the small and large producers.

31. In order to help increase the supplies of freshwater, research cooperation and technology transfer to developing countries are desirable in areas of desalination, brackish water treatment, wastewater treatment, desert dew catchment, the use of remote sensing techniques and other relevant modern technologies.

32. Water management provides an opportunity for technology cooperation projects involving partnerships between the public and private sector. Government are urged to promote innovative approaches.

33. CSD should call upon all relevant parties to develop and implement best practices and appropriate technologies in the area of water development and management. Codes of conduct, guidelines and other voluntary agreements can enhance the positive role that industry and agriculture can play and should address activities of companies operating and investing outside their home countries.

34. Governments are encouraged to make the best use of national, regional and international environmentally sound technology centers.

35. Donor countries and international organizations are urged to intensify their efforts to facilitate their transfer of environmentally sound technologies, including publicly owned technology, and also to accelerate their technical assistance programmes to developing countries, aimed at facilitating the choice and acquisition of appropriate technologies and their transfer and diffusion, and to promote exchanges of know-how. The United Nations system has an important role to play as a clearing house in putting those in need of assistance in contact with those able to provide it.

**Financial resources and mechanisms**

36. As stated in the Programme for the Further Implementation of Agenda 21, the intergovernmental process under the aegis of the CSD on freshwater will be fully fruitful only if there is a proven commitment by the international community for the provision of new and additional financial resources for the goals of this initiative.

37. New and additional financial resources for developing countries, in particular least developed countries, will need to be mobilized for the development and management of freshwater resources if the broader aims of sustainable development are to be realized, particularly in relation to poverty eradication. Existing resources, currently allocated to the freshwater sector, should be used effectively which should help mobilize additional finance from all sources, both public and private.

38. Official Development Assistance should complement, and focus on, programmes aimed at meeting basic human needs, including freshwater development and management, structural reform, protection of ecosystems, sustainable management of resources and promoting participation and capacity building. Donors, including multilateral donor institutions, should further be ready to continue, or even reinforce, the support for programmes and projects in the water sector where they will reduce or eliminate poverty. In addition, donors should persist in trying to meet international development targets. Projects supported by donors need to be capable of becoming financially self-sustaining, once the initial investment is complete. Donors should also consider support for the freshwater sector in the light of cross-sectoral interests such as desertification and climate change.

39. The private sector represents an important new source of investment in the water sector. Local and national water management systems should therefore be designed in ways which encourage and support public/private partnerships. It is important to ensure that water management systems are organised so that they are robust and, once established, can support themselves. The introduction of enabling financial framework conditions will be of paramount importance if private sector finance is to be mobilized.

40. Governments are urged to strengthen consultative mechanisms aimed at improving donor/recipient schemes for the mobilisation of financial resources in a well-targeted and predictable manner based on

local and national programmes of action with a special focus on integrated water resources management which recognises the needs of vulnerable groups and people living in poverty.

41. All costs must be covered, whether by water users or the public-sector budget, if the provision of water is to be viable. Costs recovery needs to be gradually phased in by water utilities or the public sector, taking into account the specific conditions of each country. Subsidies for specific groups, particularly people living in poverty, are required in some countries. Governments could benefit from sharing experience in this regard.

42. In the light of commitments on resources in relation to water made at the World Summit for Social Development in Copenhagen and the 4th United Nations Conference on Women in Beijing, initiatives should be undertaken to help identify and mobilize more resources - human, technical (know-how) and financial - and take into account the 20/20 initiative in accordance with national policies. Resources should be focused on local and national programmes that are consistent with the key issues. A fundamental aim must be to promote the generation of the resources needed for proper water supply, sanitation and water management systems, and their efficient and effective deployment. Governments are invited to allocate sufficient public financial resources for the provision of water supply and sanitation to meet basic human needs and for waste-water treatment.

43. Governments, when using economic instruments for guiding the allocation of water, are urged to take into account considerations of environmental requirements, efficiency, transparency and equity, taking into particular account the needs of vulnerable groups and people living in poverty.

44. International financial support will continue to be important, particularly in helping to find ways of removing constraints on the development of local and national water management systems. Existing international financial support arrangements should be reviewed to see if they can be made more effective in this task. Governments, with the support of the international community, needs to promote and conduct research and analysis to examine the economic, social and environmental values provided by ecosystems and the cost of their degradation.

45. The international community could give consideration to creating a financial mechanism to promote developing countries' efforts in the development, management, distribution and use of water resources. Such a mechanism could draw upon existing funds and be supported by existing administrative arrangements. The discussion of this proposal should include consideration of the following challenges/issues:

(i) promoting more effective donor coordination and more effective and creative use of existing resources:

(ii) generation and allocation of new and additional financial resources from all sources;

(iii) the inclusion of resources in the form of direct grants and loans in concessional terms;

(iv) a quantified resources programme, in accordance with the needs of developing countries;

(v) resources contributions by industrialized countries, as well as international financial institutions including regional institutions;

(vi) formulation of financial strategies which include possible partnerships with NGOs and the private sector, as well as promote conditions for increased private financial flows;

(vii) the strengthening of consultative mechanisms by Governments and the international community aimed at making freshwater a development priority and at improving dialogue between industrialized and developing countries in a well targeted and predictable manner, based on national actions and plans, with a special focus on integrated water resources management that recognizes the needs of vulnerable groups and people living in poverty. This could include exploring the potential of new financial arrangements.

## V. FOLLOW-UP AND ASSESSMENT

46. Governments are invited to report to the CSD in the year 2002 on actions they undertook towards the development and implementation of national integrated water resources development management policies. The Secretariat is invited to continue collecting, analyzing and disseminating national information, promote exchanges of such information and further develop relevant databases.

47. To facilitate progress at the national level, interested Governments and organizations are strongly encouraged to organize, in support of the work of the CSD, meetings and activities aimed at exchanges of experiences and best practice on specific issues proposed by Governments. Such meetings, inter alia, should promote exchanges of information on local and national action programmes and community based efforts to implement provisions of Agenda 21 relevant to freshwater, especially advances in integrated water resource and watershed management.

48. CSD should give consideration to possible specific modalities of an intergovernmental dialogue on freshwater to take place after its Sixth session. The goal would be to take stock of progress achieved at all levels and give further guidance to various activities leading to a more comprehensive review in the year 2002. Possible options include:

(i) addressing the issue of freshwater during one of the ad hoc inter-sessional groups of the CSD which will meet in 2000;

(ii) consolidating the work and functions of the Committee on Natural Resources into the Committee on Sustainable Development to provide the capacity for continuing intergovernmental dialogue on freshwater issues, subject to the outcome of ongoing discussions in the context of follow-up to General Assembly resolution 50/227 on the reform of ECOSOC's subsidiary bodies;

(iii) organizing a special inter-sessional meeting in the year 2000 to be funded through extra-budgetary resources or sponsored by interested Governments.

49. The United Nations system, in support of the intergovernmental dialogue in the CSD acting through the ACC Subcommittee on Water Resources, and working in collaboration with international institutions outside the system, is invited to elaborate, for consideration by Governments through the Commission on Sustainable Development in the year 2000, an International Implementation Programme containing action oriented recommendations on ways and means to enhance coordination within the United Nations system to accelerate the implementation of Chapter 18 of Agenda 21 that will outline ways and means on international support for national actions. Such recommendations should:

(i) systematize various objectives identified for the United Nations system in Agenda 21 and other relevant international declarations and programmes of action;

(ii) suggest, on the basis of analysis of experience gained in the UN system, ways and means to enhance coordination in order to raise the effectiveness of support to the implementation of objectives identified in Chapter 18 of Agenda 21;

(iii) suggest, practical ways and actions aimed at reaching such objectives through various services offered by international institutions, including in such areas as capacity building, infrastructure development, research, policy advice etc. This should include the implementation of recommendations to the United Nations system contained in this report (see paragraph 23, 28 and 35);

(iv) define effective division of responsibilities and consider ways of increasing efficiency in programme delivery, including through avoiding unnecessary overlap and duplication, as well as possibilities for joint programming;

(v) explore the potential of basin level arrangements, where appropriate, drawing upon the experience gained in existing regional programmes in the UN system;

(vi) identify bench-marks and time-frames for implementation, as well as necessary actors, both within and outside the UN system;

(vii) identify all possible sources of finance for its implementation.

50. The United Nations Environment Programme should, in collaboration with other members of the ACC Subcommittee on Freshwater, provide an effective contribution to the work of the CSD and the ACC through the provision of policy, technical and scientific advice on environmental aspects of sustainable development of freshwater resources. The potential of the Global Environment Monitoring System and other relevant global monitoring networks should be fully utilized.

51. At the country level, the UN system - through the UN Development Assistance Framework, as appropriate, and the resident coordinator system - must enhance coordinated efforts and programmes in the area of freshwater. Better coordination is needed between the work of UN agencies and bi-lateral donors and international financial institutions. Possibilities should be identified for joint projects and missions.

52. Furthermore, the organizations of the United Nations through the ACC Subcommittee on Water Resources, are invited to develop a consolidated United Nations Guidebook on Integrated Water Resources Management to replace existing sectoral guidelines, and to submit such guidelines to the Commission on Sustainable Development at its session in 2002.