DEPARTMENT FOR INTERNATIONAL DEVELOPMENT

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WATER POLICY ISSUES

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Introduction

This paper discusses the principles underlying sound water policies, examples of good practice in applying those principles, and suggestions for the approaches that could be followed by the Department for International Development (DFID) in the future. In a paper of this length, some knowledge of the factual situation and problems of the water sector in developing countries will be assumed. The paper first considers the underlying principles that form water policy and then outlines some of the issues and controversies. Water policy aims and options are then examined and approaches that might be followed by DFID are suggested.

1. Principles for Water Policy

In recent years, a number of agencies, governments, and meetings of interested parties have expressed *desiderata* for water policy reforms [amongst others, World Bank, 1993; FAO, 1995; ODA, "Water for Life"]. One authoritative statement of widely-held views was that of the Dublin Conference in 1992.

There would be widespread consensus on the following principles to govern the formulation of a national water policy:

- **water is a holistic resource**. To get the maximum benefit for society, all sources and consumers of water should be taken into account when planning and - so far as possible - in operating water systems. The complexity and interdependency of different parts of the hydrological system should be considered.

- **water is a scarce commodity**. A sense of the economic value of water is necessary in order to induce the requisite shifts of consumption towards higher value uses, and the reduction of waste and loss.

- **it is an environmental asset**. Providing, using and disposing of water has drastic effects on the environment. Conversely, water is a key feature of the natural environment, with an inherent value as such which should be recognised in the event of potentially competing uses.

- **it has many stakeholders**. The interdependency of different parts of the hydrological system creates many stakeholders (e.g. upstream-downstream users, users of polluted water). Groups representing the environment are increasingly asserting their claim on the resource. Potential users in neighbouring countries may have a legitimate stake. Future generations, and "passive" users are also, in some eyes, stakeholders.

- **water is a basic need**. Huge numbers of people still lack access to safe drinking water and sanitation. The cost of underprovision is revealed in disease, and the human and financial costs of people making their own alternative arrangements. Many of these costs fall on women and children. Providing basic water supply and

safe sanitation to those currently lacking them should be the first priority of any country's water policy.

- **participation, delegation and subsidiarity**. Whatever the theoretical advantages of centralised public provision, there are many situations where this is not, in practice, efficient. The notion that water should be managed at the lowest appropriate level is a sound general principle, often driven by imperatives of maintenance and cost recovery.

- **financial self-sufficiency**. Shortages of funds because of poor cost recovery plagues all kinds of water systems, at every scale. This is commonly caused by a timidity to fully charge for water, inefficiency in collecting what is due, sometimes corrupt collusion between users and collectors, and a relentless growth in the demand for services. Whatever institutional model is chosen, it needs to have a better financial performance in future.

2. Issues and Controversies

Although there would be a wide measure of agreement on the above mentioned principles, a number of contentious issues remain. These are: the appropriate scale for planning and management; the desirability of national self-sufficiency in water; the choice of institutional model; the scope for prices and markets; the relative importance of demand management versus supply augmentation; and the type of ownership to be encouraged in the sector.

2.1 Appropriate scale for planning and management

Many professionals are attracted to the concept of the river basin (RB) or major catchment as the most appropriate geographical entity for planning and managing water resources. They cite the following factors in favour of the RB: its hydrological unity; interdependence of different parts of the RB; the RB as a natural forum for conflict resolution; an obvious focus for data collection and analysis; many externalities are internalised within the RB; economies of scale in tackling problems at the RB level; opportunities for optimising water development and operation at the RB level, etc.

In view of these advantages, it is surprising that there are relatively few examples of successful RB management. (the Tennessee Valley Authority, the French River Basin Authorities are the most commonly quoted in developed countries: elsewhere, the Namadar River Authority in India, and the looser Mekong River Commission are also cited in this connection). But there are many failures (e.g. in Nigeria [Adams, 1985], and even the Indus Basin leaves much to be desired as an example of integrated management [Kirmani, 1991]).

Some of the reasons why the RB is not more prominent in practice are: the lack of coincidence with administrative or political boundaries; the excessive cost of resolving disputes between parties; the RB cuts across other sectoral agencies; pre-emptive actions by sectoral interests; many RB agencies have a single problem focus; the RB is an unsuitable scale - either too large or too small - for solving the water problems of its member parts; etc.

A pragmatic stance towards RBs seems to be called for. They may be appropriate foci for the collection of data, for the assessment of available water resources, and for modelling future demands under different scenarios. Beyond that, the usefulness of RB agencies will depend on the presence and relative power of other regional or sectoral agencies, the scale of water requirements of different users, whether there is an international dimension, etc. [FAO, 1996].

2.2 National self-sufficiency

It is perfectly feasible to convey water across international boundaries, in natural rivers, pipelines, canals or even by road tanker. Longer distance sea transport is also feasible in tankers, and imaginative schemes for moving icebergs are constantly being touted. [Allan, 1992] reminds us that countries such as Egypt conceal their growing water deficit in the form of imports of food ("virtual water").

It is clear that there is nothing sacred about self-sufficiency in water, any more than there is about self-sufficiency in food (the two aims may even conflict). Each country must decide how much water it is politic, and economic, to bring in. Water can, of course, be a dangerous hostage to the goodwill of neighbouring countries, which many

countries will wish to avoid. The attractiveness of "virtual water" depends heavily on the future of food aid, and of subsidised export surpluses from the EU, USA and elsewhere.

2.3 Choice of institutional model

There is a broad choice between two rival paradigms: the keynotes of the first are planning, integration, centralisation, and prescription; the second is characterised by decentralisation, devolved authority, reliance on market mechanisms, and participation. The first might be caricatured as "supply led" and the second "demand-led". Actual systems contain elements from both types, though in general terms they tend to gravitate towards one or the other.

Most developing countries probably incline towards the first paradigm, though the lines between the two types are softening, and the stereotype is breaking down in the face of growing demands and limited financial resources. Because water supply tends to be a natural monopoly, even market-based systems tend to be centralised, and rely on a high degree of government regulation. Recent thinking on the role of governments in the water sector, especially by the World Bank, has favoured the concept of the "enabling environment", with governments concentrating on setting the right legal and institutional framework, and stepping back from actual operation [Winpenny, 1994].

2.4 Scope for prices and markets

In its general sense, there is now much more widespread acceptance of market mechanisms and disciplines in the water sector, though there remains resistance to charging for water like a commodity. Many authorities (e.g. currently Zimbabwe) are exploring the feasibility of more active pricing of water supply. The usual motive is improved cost recovery, driven by the need to expand systems in the face of financial pressures, rather than conversion to the arguments of economists! A few countries are undergoing privatisation (see **ownership**, below), which represents a more permanent conversion to market processes.

The metering of domestic urban water supplies is fairly common in developing countries, though charge rates tend to be well below the level necessary to cover operation and maintenance costs, let alone investment outlays. There are also hardly any cases of economic marginal cost pricing, where prices are fixed according to future average incremental cost of supply (Abidjan is a rare case of a city where water prices may have been set too high by the private concessionaire, in order to cross-subsidise rural networks [Triche, 1990]). In most cases, it is probably more realistic to ask authorities to raise prices to the economic cost recovery level, before taking the further step to marginal cost pricing.

Although equity and poverty concerns are often cited as arguments against more rigorous pricing, in practice the water tariff can be structured (with minimum, "lifeline" blocks) so as to relieve small or deserving users of serious financial burdens.

In the last few years **water markets** have been widely advocated as supply solutions. The archetypal situation is where there is a pressing need for more water, where new supply schemes are very expensive, where existing water is inefficiently used, and

where water rights are fully allocated to existing owners. The sale of water rights from holders who use water inefficiently (wastefully, or for low value purposes) to other users who can make better use of it has powerful attractions in these circumstances. Moreover, markets are popular with existing holders, for obvious reasons.

Despite these attractions, water markets are uncommon in practice. There are extensive groundwater markets in India and Bangladesh which are effective in distributing water to farmers who need it most. Their major shortcomings are, firstly, that they consolidate the power of large and rich landowners with superior access to water, and secondly, that they tend to deplete the groundwater aquifer. Where regulation is necessary in the public interest, it is best visualised as an aspect of groundwater regulation, rather than of water markets per se.

Surface water markets are rarer, being largely confined to parts of the Western states of the USA, South-East Australia, and Chile. The markets in the USA and Australia tend to be highly regulated to protect third parties and the public environmental interest. The greater the regulation, the higher the "transaction costs" and the more restricted the scope for markets to work effectively. One of the most widely studied and admired schemes, the Colorado-Big Thompson project, actually obtains its water from a different river basin across the mountains, and the project retains ownership of return flows. In this way, third party and environmental objections are sidestepped, but in the more normal case water sales would cause diversions and interruptions to return flow which would have to be cleared (or not) in the courts.

The Chilean experience, though generally successful, is probably not as widely replicable as is claimed [Rosegrant & Gazmuri, 1994 and Hearn & Easter, 1995]. Water rights are widely held following the land reform of the 1970s, and the typical valley is short, hence upstream-downstream effects are more easily contained. One aspect of the Chilean case that has been criticised is the light regulatory touch, which has facilitated the creation of water monopolies in certain cases [UN ECOSOC, 1996]. However, proposals to tighten regulatory control, e.g. by stricter definitions of "beneficial use" and by applying the "use it or lose it" principle to water rights holders, could fatally cramp market development, or lead to the wasteful use of existing water.

Permanent transfers, e.g. through cities acquiring farmland outright, and diverting the water for urban use, are subject to similar considerations. There are cases, embarrassing to the agencies concerned, of recently completed irrigation schemes being deprived of water by such transfers [Rogers, 1990]. Equally, there are "win-win" cases where a city is able to acquire water from the savings resulting from assisting irrigation projects to reduce the level of their waste or leakage [Wahl & Davis, 1986].

2.5 Demand management

The sharply rising cost of new supply schemes, and the sense that there is great scope for making better use of existing supplies, are the basis of demand management (DM) as an alternative thrust of water policy. However, there is resistance to DM by many politicians and professionals in the sector. (It is significant that the NRA, predecessor to the UK's Environment Agency, set up a Demand Management Centre 3-4 years ago, and DM is now the centrepiece of UK policy). DM seeks to maximise the services

provided by water from a given volume, mainly by curbing inessential or low value uses through price or non-price measures.

The full menu of DM measures would include: enabling conditions (institutional and legal changes, utility reforms, privatisation, macroeconomic and sectoral economic policies affecting major water users); market-based incentives (water tariffs, pollution charges, water markets, auctions, water banking); non-market incentives (restrictions, quotas, norms, licences, public information, exhortation, demonstration projects); and direct projects and programmes (canal lining, leak detection and repair, modernisation of water works, investment in recycling, etc.) [Winpenny, 1994].

DM is not to be automatically preferred to supply-side investments in every case. However, taking DM seriously does entail a systematic identification of all DM options as part of water strategy, and a comparison of all options using a common methodology and criteria, e.g., the cost of a unit of water supplied or saved.

2.6 Ownership

The last decade has seen a reaction against the state as the preferred owner and operator of water services in many countries. There is now wider appreciation that the traditional public utility/water department mode of supply is only part of a spectrum of options. For urban water supply and sewerage, other options are autonomous, commercialised utilities, private managers, private concessionaires, build-own-operate-transfer schemes, and outright private ownership. For rural water supply, co-operatives, communal ownership, NGOs and private companies are alternatives. In irrigation, farmer-financed projects have a respectable pedigree, and there are cases of co-operatives and user groups sharing responsibility with hitherto monolithic public supply agencies.

Outright private ownership of urban supply has attracted the headlines, and the UK has become known as an exporter of this model, embodied in its own private water companies. There have been few takers, however. Current research indicates that the full divestiture of assets to the private sector is not being followed anywhere else in the world [DAG, 1995]. A number of countries have preferred the French Model, involving private management and operating concessions, with assets remaining in the public domain. The World Bank is also believed to favour the French over the British variant, on the grounds that it retains the public ownership option, and keeps a sanction against an unsatisfactory operator. The British model requires sophisticated regulation deploying a vast amount of data. Even with that, regulation is becoming more and more complex and difficult. The policy dilemmas facing the regulator are mounting, not least because of changes in the control of the monopoly companies.

3. Policy Aims and Options

This section considers what the policy aims should be, and what options are available, in the various parts or facets of the water sector. These are: urban water supply; urban sanitation and sewage disposal; rural water supply and sanitation; industrial use; environmental preservation; water pollution; and irrigation. In each case there is some discussion of the balance between the options, with relevant examples of good practice where they are available.

3.1 Urban water supply

Policy aim:

> to extend and complete coverage of growing urban populations with adequate, safe, convenient and affordable drinking water.

Options:

- research and development on appropriate hardware and systems;
- public investment;
- institutional reform to allow private and community solutions;
- pricing and cost recovery based on thorough willingness-to-pay surveys.

The provision of household water to urban populations is probably the least difficult challenge in the water sector. The main problems reside in the social, institutional, and financial realms, rather than in technical or product areas. The main challenges in supplying water to the large cities of the developing world lie in keeping up with the demand for piped supplies by a rapidly increasing population, often poor, with an acceptable and cost-effective product, and recovering costs to generate the resources to do this without the need for subsidies. Many cities have long since exhausted, or are fully exploiting, local sources of supply, and are seeking water from further afield at sharply increasing cost (in financial and environmental terms). This is inevitable, but costs can be minimised by the adoption of demand management measures.

Demand surveys incorporating willingness-to-pay (WTP) questions uncover local preferences for products and standards of service, upon which the financial health of the system can be planned. Such surveys reveal a widespread demand for private household connections, rather than public or communal sources, and a WTP for them.

Institutional reforms have been much slower to happen in the water sector than in other public utilities [DAG, 1995]. There are a number of cases of privatisation based on the French model of concessions and/or management agreements (a recent, and large one, being Buenos Aires). However, there is great scope for achieving major efficiency gains without privatisation, through public utilities using best practice in the private sector as a benchmark for their own performance. There are encouraging examples in southern Africa [DAG, 1995].

3.2 Urban sanitation and sewage disposal

Policy aim:

to increase coverage of growing urban populations with appropriate and affordable household sanitation and wastewater disposal.

Options:

- research and development into appropriate products and systems;
- public investment;
- cost recovery;
- institutional changes - de-nationalisation, co-operative and community solutions, privatisation of sewerage and resale of treated water.

A review of experience of the International Drinking Water Supply and Sanitation Decade concluded that continuing progress depended crucially on responding to consumer demand. Managers must convert to the idea that they are selling a product, not providing a service. Consumers must be offered a range of choices, and be allowed to choose the one they prefer and are willing to pay for. The obstacle to increasing coverage of safe sanitation is no longer the availability of technological options, but the interest of potential users [Cairncross, 1992].

Sanitation is the less glamorous side of water services, and is often a taboo subject. Politicians will not press so hard for it as for freshwater supplies. Hence it has to be marketed, and billed, on the back of freshwater systems, by offering something that is acceptable and affordable. The rural sanitation programme in Zimbabwe, based on the VIP latrine, is regarded as very successful [Cairncross, 1992].

The growing interest in economic Willingness-to-Pay (WTP) studies for water and sanitation is fully in the spirit of the new approach, since it focuses on users' preferences and effective demand. In what is now a classic study of Kumasi, Ghana, it was demonstrated that WTP for a VIP latrine was sufficient to justify its introduction, without subsidy, to the majority of households [Whittington & Lauria, 1990].

In the next stage, the centralised collection and treatment of household sewage, it is clear that locally-organised initiatives, responding to demand and involving local communities in planning and management, can deliver sewerage at a fraction of the cost of normal centralised public systems. The Orangi Project in Karachi and the Condominial System in North-East Brazil are, in their different ways, tributes to innovative local thinking and action in providing large-scale low-cost sewerage in low-income urban areas [Serageldin, 1994].

3.3 Rural water supply and sanitation

Policy aim:

to increase coverage of the rural population with adequate, safe and conveniently located water, and to upgrade standards of sanitation.

Options:

- research and technological development into appropriate products and systems;
- public investment in rural water programmes;
- enabling activities, e.g. loans, advice, materials for local construction by communities and NGOs;
- improved cost recovery and financial independence for local schemes.

The experience of the UNDP/World Bank's Water and Sanitation program is an epitome of the evolution of thinking in this area. In its early years, the Program focused on the development of low-cost technology, especially handpumps and latrines. It learned the hard way that "..rules which favour highly centralised decision-making about service allocations and the level and intensity of local demands have not produced either efficient or sustainable services" [UNDP/World Bank, 1996, p. 8].

Keynotes of the new preferred approach are: water as an economic good; management at the lowest appropriate level; involvement of users in planning and implementation; main role of government to create the "enabling environment" via institutions, regulations and processes. Services should follow, rather than precede, community initiative in seeking the improvement. Communities should be fully involved in choosing the level of service from a range of options offered. Cost sharing should be accepted as a basic principle, and community responsibility for specific costs made clear.

Some of these principles and approaches are being tested in the Karnataka Rural Water Supply and Sanitation Project. Amongst other aims, the project examines the roles and performance of Village Water and Sanitation Committees and NGOs in appraisal, planning, financing and operation of water schemes in 1200 Indian villages.

Special considerations apply to water pricing policy in rural areas. Rural water supply is often an aspect of regional development policies, in which social and political objectives are important. There is often a desire to maximise the rate at which rural water supplies are taken up, so that the health and social benefits can be achieved at the earliest possible stage. Connection fees are kept low to prevent them from deterring entry, and often charges are subsidised for some period. Lifeline blocks may be set more generously for rural than urban users.

Because of the relative poverty of many rural populations, and the high unit cost of supply, it is often assumed that rural water supply must inevitably be subsidised. However, subsidies, especially cross-subsidies between urban and rural users, must be implemented carefully if incorrect and perverse incentives are not to arise. Moreover, there is growing evidence of a sizeable willingness to pay for improved water services, even amongst low-income village households. Subsidies can, however, be an effective inducement for households to switch from their previous unsafe water sources to the improved supply.

A high proportion of rural water supply schemes fail or develop serious problems. The most common causes of this are the choice of unsuitable technology, the choice of systems which are not those that consumers really want, the absence of clear responsibility for technical and financial follow-up, and the absence of a proper system of cost recovery.

The likely success of a rural water/sanitation scheme can be judged by how far it adheres to the following canons of good practice; water sector agencies should be granted financial autonomy and operated on a commercial basis; investment scale and technology should be appropriate to the local context to ensure cost-control; willingness to pay should be the basis for determining tariff policies; tariff levels should be fixed at a level which ensures liquidity; and consumers should provide part, if not all, the cost of

supplying their water and sanitation, subject to their willingness to pay and the need to achieve an equitable and acceptable distribution of social and economic benefits.

3.4 Industrial use

Policy aim:

to encourage water conservation (including recycling and reuse of treated effluent) and discourage the release of untreated wastewater in public water bodies.

Options:

- more active pricing of bulk water supply;
- fiscal incentives for investment in recycling and treatment equipment;
- direct investment in state-owned plant or parastatals;
- create opportunities for firms to sell treated effluent.

Thanks largely to the energy and ingenuity of the private sector, the technology of commercial water treatment and recovery is thriving, and there is a huge market for relevant equipment. The challenge is to give more industrial firms and parastatals incentives to install it, thereby conserving freshwater intake, and improving the quality of their effluent. In cases where it is feasible, it may also be economic for freshwater suppliers to buy treated wastewater from companies, rather than develop new supply sources.

There are many examples of private and/or co-operative industrial initiatives involving the recycling or reuse of wastewater. The common starting point is the increasing cost or growing scarcity of public supplies. Chilean companies compete for the right to treat municipal effluent for their own use. A consortium of Mexican companies have set up a profitable venture to treat municipal wastewater and reuse it for cooling and processing in their own plants. There is evidence from India and Brazil of increased conservation by firms in response to rises in the cost of raw water, in combination with effluent charges. Israel and China have achieved sizeable industrial conservation with their combination of norms and penalty charges. The acceptability and success of these policies is generally improved if the revenues from prices and charges can be returned to industry through subsidies for investment in recycling and treatment [Bhatia, Cestti & Winpenny, 1995].

3.5 Environmental preservation

Policy aim:

to ensure sufficient water, of the right quality, for "environmental" purposes, including amenity, recreation, wildlife.

Options:

- regulation, e.g. minimum flows;
- investment, e.g. in captive water sources for conservation areas;
- markets, e.g. allowing conservation agencies to buy water rights;
- appraisal, e.g. making proper allowance for preservation values.

In the past, the environment has been the last claimant on scarce water. Habitats, such as wetlands, lakes and estuaries, have been lost or degraded as their water has been diverted for use in agriculture or other sectors. In developed countries the tide is turning, and the value of environmental water use is increasingly recognised and protected (e.g. the minimum flow regulations in the UK). In developing countries environmental water values need to be monetised in some way to "empower" the environmental authorities in their dealings with other cogent interests. In practice, the two obvious sources are eco-tourism and international conservation funds (e.g. WWF, GEF).

One arena where the issue arises with particular force is the water flowing through the Kruger National Park in South Africa, which is affected by serious competition from industrial, household and agricultural users upstream. It would be possible to demonstrate that the in-stream and environmental value of this water exceeds the value of water in some of its other uses.

3.6 Water pollution

Policy aim:

> to reduce water pollution and to prevent contamination of potential freshwater supplies.

Options:

- public investment in abatement (e.g. parastatals), improved treatment (e.g. of sewage works) and collection (e.g. sewers for household wastewater and trade effluent);
- better regulation, monitoring and enforcement;
- pollution charges.

Much water pollution is caused by the effluent of municipal sewage works and publicly-owned industries and utilities. This is especially true of Eastern Europe and other countries in transition. The remedies lie in a combination of institutional reforms and investment in modernisation and expansion of treatment facilities, and improved collection systems. However, much pollution, especially from non-point sources, is from private sources and needs to be addressed by a combination of regulation and incentives.

There are very few successful schemes for controlling water pollution using prices. This applies both to developed countries, and even more so to developing ones lacking the necessary monitoring and enforcing structures. Malaysia is a rare exception, with an effluent charge going back to the 1970s, applying to discharges from palm oil mills. A similar scheme was later applied to rubber factories. Both schemes were successful in dramatically reducing polluting discharges and forcing the pace of technological development in the treatment of waste [O'Connor, 1995].

Korea also has a long standing emission charging system applying to both air and water pollution. Facilities that exceed mandated emission levels are penalised by a levy based on the concentration of pollutant. The emissions charge is thus more akin to a

fine reinforcing a regulatory standard than a pure incentive. Its incentive effect has been diluted by the low level of the charge, and the basis of charge, namely the pollutant concentration, has encouraged dilution rather than abatement [O'Connor, 1995]. China's pollution charges are also, in effect, non-compliance fees, the revenues from which are recycled to finance pollution control investments (the problem with this system is that it gives the pollution control authority a perverse incentive to allow pollution in order to collect the fines).

3.7 Irrigation

Policy aim:

> to encourage farmers to make better use of their water, to add more value to their existing supplies, and to release water for more pressing uses elsewhere.

Options:

- devolved responsibility, (e.g. to user groups);
- farmer-financed schemes;
- sale or gift of irrigation systems to farmers;
- higher prices for water (e.g. marginal pricing plus free quota);
- allowing markets to develop;
- investments in canal lining, drainage, water-efficient irrigation systems.

The sheer volume of water taken up by farming means that in many countries no solution to water can be sought that does not involve reforms to the way it is used in this key sector. However, an apparently low "efficiency" in irrigation is compatible with much higher utilisation in the river basin as a whole, since the losses, leaks and return flows from one project provide the source for other schemes downstream [Frederiksen, 1996].

One solution to the serious financial and operational problems of public irrigation agencies is to delegate more of the responsibility for water supply - including cost recovery - to users and their representatives. Water user associations, or water clubs, have arisen to fulfil this function. In some case they act as "retailers" of water, buying supplies from large public irrigation agencies, and undertaking to recover costs from their members. Privatisation (farmer-financed irrigation schemes) is the culmination of this process.

Decentralisation of irrigation services in the Philippines has attracted much attention [FAO, 1993]. Since the 1970s the National Irrigation Administration has transformed itself from a traditional top-down public irrigation agency into a quasi-autonomous service body, leaving farmers and their water user associations much more responsibility for planning, managing and funding their water supplies. It is considered that irrigation service has improved, the expense of operating the system has fallen, and the recurrent cost burden on the national budget has been eliminated. Water supply has become more equitable. Water user associations have also played a central part in water pricing reforms in Chilean agriculture [Rosegrant & Gazmuri, 1994]. As part of the 1973 land reforms, the ownership of irrigation infrastructure was handed over to water

user associations, along with land and water rights.

A different approach is called for where farmers own their water, enjoy the legal right to use it, or have contractual rights to receive it at a fixed price. In these cases farmers' rights are akin to a valuable property right. If they are entitled to sell these rights, water markets may develop, allowing existing users to capitalise on their rights. They tend to be more popular with farmers than the volumetric pricing of irrigation water, though are unpopular with the communities affected and with downstream interests.

Despite their theoretical attractions, the development of water markets depends on a number of exacting pre-conditions. Water rights need to be exclusive, secure, well-defined, non-attenuated, transferable and enforceable. In addition, for markets to operate in the public interest, two further conditions should be present: externalities should not be substantial, and transactions costs should not be excessive. Finally, and fundamentally, the water transfers should be technically and hydraulically feasible. There needs to be suitable natural conditions, plus infrastructure (canals, pipelines, pumps, drains) to enable water to be moved around.

One of the best known, and most commonly cited, example of a successful water market is the Colorado-Big Thompson scheme. Its success was helped by the fact that its water was widely held throughout the area. Since it had the lowest transaction costs, it represented the easily tradeable margin. Moreover, return-flow externalities were not an issue in this case, since the district owned return flows. The development of the market for allotments was supported by a majority of users from the outset. In addition, making more efficient use of existing supplies avoided the costs of developing new supply sources, including compensating the basins of origin, and avoided the increasingly high cost of conflict resolution in western water issues [Howe, Schurmeier & Shaw, 1986].

The markets for **groundwater** in Gujarat, India have existed for 70-80 years, and they are also well developed in Punjab, Uttar Pradesh, Bangladesh and elsewhere in Asia. Owners of wells to all intents and purposes have ownership rights over the water they draw, and sell surplus water to other farmers. Although the typical transaction is on a temporary basis, there are a number of large scale water dealers selling large quantities to regular buyers through a highly-capitalised network of pipes.

It is common for farmers to be both buyers and sellers of water at different times or even at the same time in different locations. From a static viewpoint, the existence of the groundwater markets contributes to the efficiency of water use: water tends to find its way into the hands of those farmers who can use it to its highest value, and the knowledge that water is available for purchase discourages farmers from investing in their own wells at uneconomic cost. The distributional effects of these markets are not clearcut. Large farmers predominate as sellers, small farmers as buyers, but the latter avoid having to make their own investments, and prefer to buy in rather than depend on unreliable public surface supplies.

The major problem with groundwater markets is the environmental effect of aquifer depletion. The existence of profitable outlets for water encourages greater pumping. If aggregate pumping exceeds the recharge rate of the aquifer, water "mining" occurs, with environmental costs. There are signs of this happening in parts of Gujarat. This is a

classic case of "market failure" due to excessive use of a common property resource - the underground aquifer.

Water **auctions** are an extreme type of market development, though are rare. There have been auctions in Victoria State, Australia, and it is a long standing practice in Alicante, Spain. The auction enables users to reveal their valuation of the water and enables the public supplier to extract the surplus (or rent) from the sale. If market prices are a reasonable echo of economic benefits, an efficient auction would also maximise the social benefit from using the water. Potentially, an auction could score highly on economic efficiency grounds, provided there is no collusive or monopolistic behaviour on the part of the bidders.

Most of the evidence on **surface water markets** has been derived from the Western States of the USA. Within the USA, states differ in the degree to which users may legally transfer water amongst themselves and to other parties. The Bureau of Reclamation, after a period of antagonism, is now relatively permissive in its attitude to the resale of its own water. It authorises such transfer provided third parties and the environment are not harmed, and that the transfers do not harm the federal government financially, operationally, or contractually.

Water markets in the Western States function well in allocating water to higher value uses within agriculture, and between agriculture and urban/industrial sectors. The process is efficient and - at least as between the parties to the transaction - equitable, since sellers are compensated at market prices. For a transaction that is efficient in private terms (net benefits after transactions costs) whether it is socially optimal depends crucially on whether third party and environmental effects are taken into account.

In the cases considered in one assessment [Saliba & Bush, 1987], third party interests were largely incorporated into market decisions (though with some transaction costs). These include downstream users, whose entitlements would be affected by increased upstream diversions. There are also effects on the neighbourhood and region from diminished water supplies, offset by gains to the area receiving the waters. These effects are more difficult to evaluate. The environmental effects of water market transactions are often left out of account in the values that are struck between the parties. The impact on in-stream values (fishing, recreation), water quality, wildlife habitats, amenity etc. is felt by parties who are usually "underrepresented in the market place" [Saliba & Bush, 1987].

Banking is an elementary method of storing water at a time when it is not needed in order that it can be drawn upon later, or in the meantime by someone whose need is greater. The simplest kind of banking is allowing unwanted surface water to replenish the underground aquifer, where it is available to be pumped in future. Other types of bank allow other parties to use the water on a temporary or permanent basis. There are several water banking initiatives in the Western States of the USA, of which the best known is the California Drought Water Bank. Outside drought emergencies, banking has had a very small impact on water allocation, largely because of alleged negative third-party impacts on rural communities and the regional economy [Frederiksen, 1996].

Pricing is a more promising approach, though a clumsy attempt to raise charges to economic levels would risk the livelihoods of many farmers. Some of the most successful efforts to make farmers pay more for their water are built around incentives for more efficient use.

Studies of California and other states in Western USA produce estimates of price elasticities for irrigation water in the range $0.37 to $1.5, with $0.65 being typical. This implies that the demand for irrigation water in California is highly responsive to price changes [OECD, 1987].

In practice, charging systems for irrigation water fall into one of two categories. The first is the flat-rate or fixed charge, based on area, crop, season, method of application and/or number of irrigations. The second is volumetric, and is based on either actual, or authorised use, which may also vary according to season, and may comprise single rate or block tariffs. A very rare example of the use of marginal cost pricing for irrigation water is to be found in Provence, in southern France [OECD, 1987].

In the Broadview Water District in the San Joaquin Valley, California, the authorities have introduced a policy of charging farmers significantly more per unit for marginal units of irrigation water. Motivated by the need to reduce loads of boron, molybdenum and selenium in agricultural drainage water entering the San Joaquin River, the district discovered that the last 10% of consumption was responsible for a disproportionate share of the volume of drainage, and thus pollution loadings. Farmers are set a level c. 90% of average historical usage of water for each crop, to attract the normal unit price. Usage in excess of this is charged at significantly higher levels. The volume of drainage water collected in the district in 1990 was only 75% of that for the average of 1986-88.

The scarcity of water facing all sectors in Israel has led the Government to adopt measures to encourage the efficient use of irrigation water. Farmers receive fixed annual allocations of water based on efficient norms for the area cultivated, the crop mix, and the water requirements of each crop. Each farmer is metered. Charges for water are on a progressive block rate structure: the first 80% of quota is sold at $0.125/cu.m., the remaining 20% at $0.2/cu.m., and consumption over quota at $0.26/cu.m. A 40% premium on these rates applies during months of peak demand. The Irrigation Efficiency Unit of the Water Commission conducts research on water saving devices and farm systems, and low-interest loans are available for installing more efficient irrigation equipment and water application control devices. As a result of these measures, from 1951 to 1985 irrigated area rose fivefold, but water use only three-fold: water use per hectare fell by about 40% [Arlosoroff, reviewed in Bhatia, Cestti & Winpenny, 1995].

Both these cases rely on charging substantially more for marginal increments of water than for "normal" consumption. Such are the volumes taken by agriculture, that relatively small savings squeezed from this sector may release large amounts for use elsewhere.

3.8 Opportunities and constraints

Opportunities and UK assets that are available include:

- UK research and training institutions in the forefront of all major aspects of the subject;
- consulting engineers with an international reputation and track record;
- private water companies with excellent experience of operating water systems, with substantial financial resources available for investment overseas;
- experience of OFWAT and the Environment Agency respectively with economic and environmental regulation;
- a large and active market for all relevant types of technology;
- a thriving NGO movement involved in the sector overseas.

The constraints include:

- a bilateral aid programme that is being squeezed by unavoidable growth in multilateral commitments, and is less able to take on major capital projects;
- concerns over the general application of the UK's privatisation model, and the growing complexity of regulating this sector.

4. A Water Policy for DFID

This section aims to define the keynotes to be considered in the UK's assistance to the water sector, following on from the immediately preceding discussion, and then set out some general policy guidance. More specific conclusions relevant to sub-sectors are contained in section 3 above.

4.1 Keynotes of policy

The UK's assistance has comparative advantage that arguably lies along the following lines:

- **avoid large capital projects,** which tie up major portions of aid;
- focus on **replicability** through promoting research, the development of technology and products, institutional reforms, and innovatory systems which are potentially widely applicable;
- use aid as a **catalyst** to enable the involvement of other interested parties, e.g. NGOs, the private sector, local communities;
- be prepared to take risks by backing **innovations** (whether of products, systems, finance or institutions);
- stress the **diversity and specificity** of solutions, and avoid imposing categorical blueprints, especially those with ideological overtones;
- **flexibility over aid criteria;** assistance to the water sector should not be tied down too narrowly to specific countries, regions, or target groups. In view of the fluid "state of the art" in water policy, it is important that managers are allowed freedom to intervene across a range of situations. It is probably in the interests of aid recipients that the supplier has access to as wide a range of relevant experience as possible;
- **monitor water developments in all countries,** including Europe, Australasia and North America, for experience relevant to its client countries.

4.2 Policy guidelines

Certain common themes emerge from the discussion of the sub-sectors:

- setting the right "enabling environment" through institutional, economic and legal reforms;
- concern for managing the demand for water; the systematic search for all relevant solutions, and application of common appraisal criteria to them;
- attention to what users want (rather than "need") and are prepared to pay for; use of willingness-to-pay surveys for urban and rural consumers;

- tolerance of a variety of institutions, and willingness to work with NGOs, co-operatives and the private sector; co-operation between central authorities and locally-organised initiatives;

- delegation and "subsidiarity" over operation and management of systems;

- solutions to be sought less in technology and products, and more in social, institutional and financial domains; cost recovery to be central; subsidies to need exceptional justification;

- devolution of a large part of the task of water conservation to private firms and households, by creating effective incentives; this would include both price and non-price measures.

4.3 More work needed

The subject matter of this paper is fluid, and rapidly evolving. Universal policy blueprints are not applicable. Locally-generated solutions will be sought in most cases - though successful models will be widely scrutinised, and elements in them emulated by others. In these circumstances, there is a heavy premium on research, evaluation, analysis of case studies, and the development of methodology. A few examples are given below (drawn from the social sciences, which is the author's interest).

- generation of economic values for water in alternative uses/sectors, including the environment;

- application of environmental economic valuation to water projects;

- development and testing of a consistent methodology for appraising various kinds of water projects, including supply-augmentation, leak detection, and the full range of demand management options;

- study, evaluation and comparative analysis of innovative and apparently successful cases of water policy reforms, institutions and projects;

- critical analysis of the performance of different institutional models in the water sector, including public utilities with and without commercialisation, and the various types of privatisation. One key criterion is the impact on poorer groups of consumers;

- the political economy of reforms: how reforms can be successfully implemented: coalitions for reform; the design of programmes; how to enlist necessary support: gainers and losers. etc.;

- survey of consumers' preferences for different kinds of products and services, using willingness-to-pay surveys.

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