The Socialist Republic of Vietnam

Ministry of Construction (MOC)

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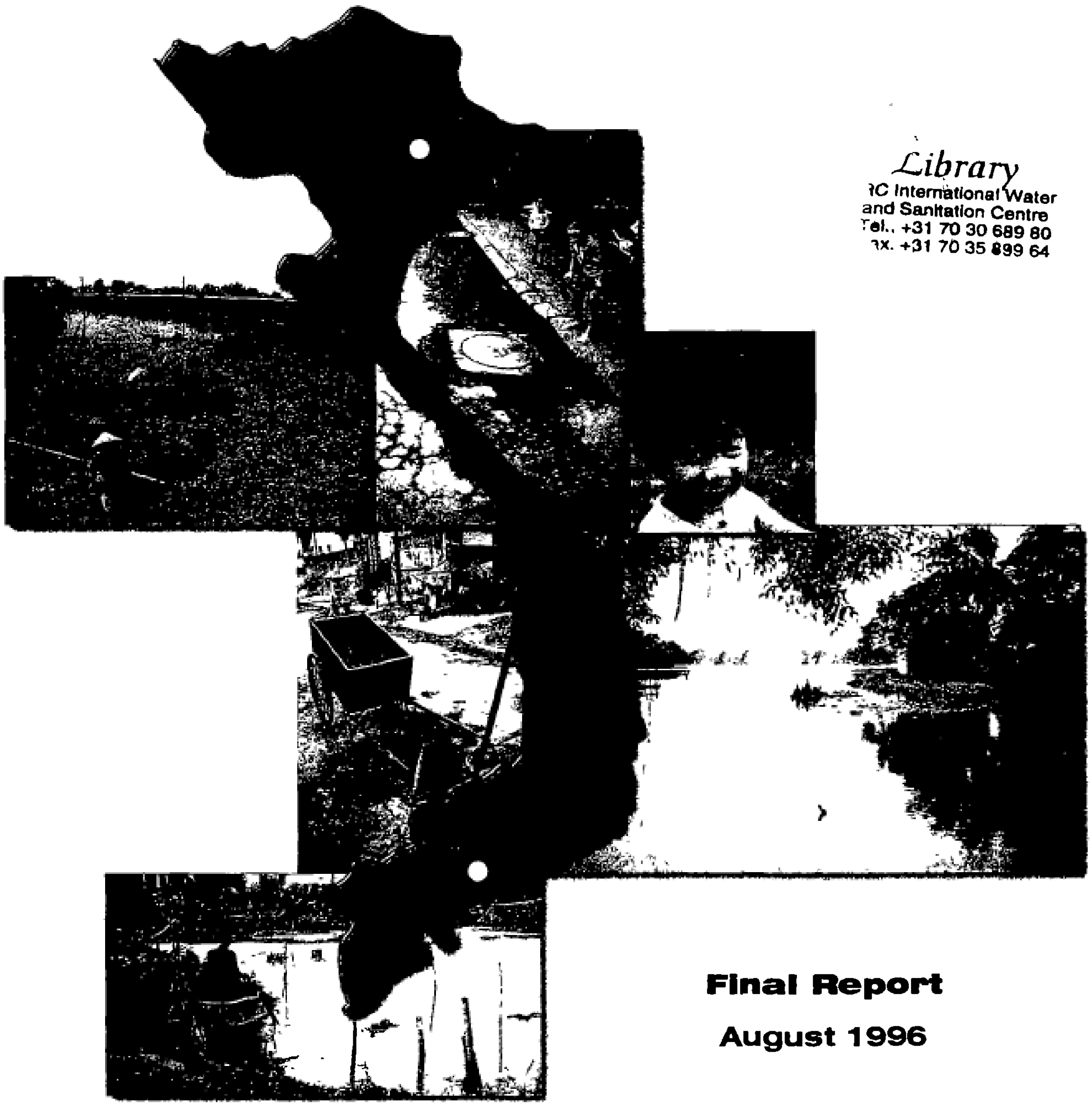
SOIL AND WATER

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY STUDY



Final Report

August 1996

SOIL AND WATER LTD
Consulting Engineers

VIWASE
Vietnam Consultant on Water Supply, Sanitation and Environment

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Volume 1

Main Report

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SUMMARY

General

The Study Team wants to thank the Governments of Vietnam and Finland for having the change to participate in the preparation of the National Urban Wastewater Collection and Sanitation Strategy for Vietnam. It has been a great opportunity and a big challenge for the Study Team. The Team also wants to extend its sincere thanks to the members of Steering Committee, especially Dr. Pham Sy Liem, Mr. Vu Kim Quyen, Mr. Pham Tri Minh and Counsellor of Embassy of Finland Mr. Pauli Mustonen for the fruitful co-operation and guidance throughout the study.

This *Final National Urban Wastewater Collection and Sanitation Strategy Study* report has been finalized based on the comments made on the Final Draft report published in November 1995, and the presentations made in the National Seminar arranged on April 12th 1996 in Hanoi. The Study Team wants to extend its sincere thanks to the participants of the National Seminar, especially Vice Minister Nguyen Tan Van.

The Study Team has carefully studied the comments and incorporated the relevant comments to the Final Report. The written comments are annexed into the *Annex IV in Volume 1.*

We hope that the Final Report of the Study will be useful for the Government of Vietnam in finalizing the National Urban Wastewater Collection and Sanitation Strategy for Vietnam.

Scope and Objectives of the Study

Presently Vietnam is undergoing a rapid change in the national economy, and trying to convert from an agricultural nation towards an industrialized country. This change will result in urbanization and require development of infrastructure. In order to guarantee coherent development of urban environments and to attract foreign and local investments, national urban development strategies need to be formulated. As a consequence this study, State Research Programme on Science and Technology Project KC-11-08, for the development of National Urban Wastewater Collection and Sanitation Strategy, was commenced in the beginning of November 1994.

The study was entrusted to the Vietnam Consultant on Water Supply, Sanitation and Environment, VIWASE, (earlier Design Company for Water Supply and Sanitation Systems,) under the Ministry of Construction. The Government of Finland and the Socialistic Republic of Vietnam agreed on technical assistance for the formulation of the strategy, and SOIL AND WATER LTD *Consulting Engineers* was appointed to provide a multidiciplinary consulting team for the assistance of the local company.

The Strategy is concerned with the provision of sanitation in urban areas (excluding Class V cities) in Vietnam. In this connection sanitation refers to the safe collection, treatment, and disposal of human excreta and of wastewater from domestic, commercial, and institutional establishments. It does not include solid wastes management or storm drainage, except to the extent that these other elements of overall environmental sanitation have to be considered in order to achieve satisfactory or cost-effective sanitation solutions. Similarly, it does not include the disposal of industrial liquid wastes or other hazardous and toxic wastes, unless these are discharged within urban areas, and have to be handled by urban sanitation systems.

The principal objectives stipulated in Terms of Reference for the study are as follows;

- to update knowledge of the status of urban sanitation in the country;
- to determine sustainable sanitation solutions appropriate to different environments;
- to review and propose improvements for the institutional framework of the sector; and
- to set priorities in the provision of improved service.

Presently the Sector has a very low priority in the Government financing and the Sector does not operate efficiently. This has resulted in:

- The investment capital for water supply and sanitation sector has been only 5%, and out of which some 15% is estimated to be allocated to the sanitation sector, thus the facilities are suffering from long underinvestments;
- sanitation services are provided almost totally by Government subsidies;
- the Sector is suffering from overlapping and unclear sharing of responsibilities,
- poor enforcement of environmental laws and regulations has lead to haphazard waste disposal and pollution; and
- the coverage of public sewerage systems is low, and without proper O&M.

If the present policies and practices are not changed, as recommended in the proposed Strategy, the facilities will continue to deteriorate and environmental pollution will accelerate. According to the proposed Action plan:

- Clearly define the roles and responsibilities of MOPI and other line Ministries:

- MOC to be the key agency in urban management, and to have main responsibility for policy and strategy formulation; urban master planning, development of technology, technical guidelines, standards, and codes of practice; technical appraisal and approval, and collection of sector information.
- MOC should divest itself of commercial activities
- The mandate for issuing licenses for industrial effluent discharges should be transferred from MOARD to MOSTE.
- The mandate for regulating the monitoring of waste treatment of industries should be transferred from MOH to MOSTE.
- Management Board of Water Supply and Sanitation Development Projects should re-orient its role from a project oriented focus to a more holistic responsibility for the Sector development.

- ♦ Decentralize authority from central to local levels, from administration to utilities, and from public sector to private sector.
- ♦ Commercialize the various sewerage and sanitation undertakings and progressively convert them to autonomous utilities
- ♦ Establish the proposed Financing Facility for sanitation improvement investments.
- ♦ Generate demand by promotion, public awareness campaigns, and education, e.g. through the proposed Sanitation Promotion Units
- ♦ Utilize Technical Assistance in the Sector's Capacity Building process.

By doing this, the actual investment up to year 2010 could amount to about 2 billion USD, and the majority of the urban population would be provided with satisfactory sanitation facilities and services.

Present Sector Status Assessment

The operational power, as well as implementation of minor investments which do not need central level allocations, is decentralized to the provincial/city level. This is a major strength, but although the roles of various organizations have, to some extent, been clarified and streamlined in the past few years, there is still **overlapping in the duties and responsibilities** of the Sector authorities at the ministry level as well as at the provincial/city level. The project preparation, appraisal, and approval procedures are particularly complicated, involving many organizations and maneuvers.

In spite of positive statements concerning sanitation improvements and environmental protection, little has been done so far to raise the **status/priority** of the Sector. The ongoing restructuring of the state economic sector has started slowly in sewerage and sanitation, and the target degree of self-financing of utilities is still unclear. The officially accepted policy that the polluter pays has not yet materialized. The government has shown little interest and attention to the Sector requirements, and has taken only a few measures for overall improvement of the Sector operations and cost recovery.

The **enforcement** of the present environmental laws, regulations, and standards was found to be unreasonable and impossible. This may, and most probably will, reduce the credibility of these and other regulations. The enforcement in general is still weak, probably due to transition from one system to another, relatively weak position of the enforcing ministries and agencies, lack of basic facilities, and low priority given to environmental and sanitation issues when aiming at rapid economic growth. As a result there appears to be a serious lack of management, control, and enforcement for disposal of wastewater from public and private facilities, industries, and hospitals. Wastewater that is discharged from public sewerage systems to rivers, lakes, and other wetlands without treatment causes serious **pollution**. A large part of households with flush toilets discharge sullage and sewage directly to streets, open drainage systems, natural water bodies, or on the ground.

The Sanitation Sector is not explicitly listed in budgetary classifications and for planning purposes, and the portion of sewerage and sanitation of the government's capital budget is estimated to be only 0.5 - 1.0% in 1994. This is one of the main reasons for the **poor condition and coverage** of sewerage systems at the moment. Apart from **insufficient budgetary financing**, the Sector utilities have been unable to raise funding from other sources. Reasons are both structural and managerial. The **Financial market** consists essentially only of 4 commercial banks which are now in transition, operating inefficiently, and unable to extend long-term loans for the investment purposes of private people and utilities.

Improvements in **private sanitation** facilities have taken place at a very rapid pace in the largest cities, particularly during the latter part of the last decade. This process is expected to continue and to accelerate in the smaller cities, provided adequate water supply is provided, but there is still a fairly large portion of households that do not have proper toilet facilities of their own. The preference is obviously for flush or pour flush toilets. Investments in public infrastructure have not followed at the same pace as in the private sector. Consequently there is now a large demand for infrastructure improvement, including construction of water supply and wastewater collection systems. A very rough estimate of the total investments (sewerage and drainage with secondary treatment) for the present population of all urban cities within the scope of this study is 2.5 - 3.0 billion USD.

Household Demand for Improved Sanitation

Approximately **70%** of urban households in Vietnam valued the benefits of improved sanitation facilities by revealing their **positive WTP amount**, which was normally **greater than their current spending** for existing sanitary conditions. However, the estimated average WTP is only 1% (at most 1.5%) of monthly household income. In the first and second class cities, average WTP as the percentage of income is close to 0.8% to 1.0%, and in the third and fourth class cities, the average WTP amount seems to be slightly lower (0.6% to 0.8%). On the other hand about two thirds of households having poor sanitary conditions voted that renovating toilet facilities is the first or second priority investment in the near future.

The WTP amount for a **separate sewer** is greater than that for a combined sewer. Also, survey results show that people prefer a separate sewer system to a combined sewer. This preference is consistently represented by their environmental concern about reducing ground water contamination by developing a separate sewer system. **Flood control gets very little attention** at the household level, though more than 30% of the respondents had experienced flooding during the last year. This distribution confirms that people generally prefer a separate sewer system to a combined sewer service.

Sector Objectives

Based on the present status assessment, household preferences, economic possibilities and restrictions, and technology options, the Study Team has formulated a proposal for Sector Objectives for three periods.

The **Short Term Objectives** (1996 - 2000) and the action plan mainly aims at the development of the **Sector's capacity** to face the increasing needs for improvement of sanitation in a sustainable way. The main emphasis is on **rehabilitation** of existing systems and development of policies and strategies and institutions to cope with new market oriented system. Simultaneously **effective demand** should be developed, and applicability of a participatory approach to improve the situation should be tested in already built-up areas.

The **Medium Term Objectives** (2001 - 2010) are more **implementation** oriented, and the construction of sewerage systems is projected to speed up due to increased funding to the Sector and an improved Sector capacity. The **internal financing capacity** of sanitation utilities will be raised and the need for subsidies gradually decreased.

The **Development Objectives** of the Sector are general, aiming at provision of sewerage and drainage with good service levels in an economically and environmentally **sustainable** way.

Proposed Strategy in Brief

Institutional Aspects

Based on the demand-driven policy, provision of services in the sanitation sub-sector, as well as in other sectors, must respond to the needs and demands of the users of the services. Organizations that are as close to their clients as possible are more responsive to the clients' expectations than more remote organizations. Similarly, services and goods are usually more efficiently and responsively provided by private sector organizations than their counterparts in the public sector. Competition between suppliers is supposed to maintain the quality of goods, high services and low prices. However, this mechanism does not apply to such situations where the competition is non-existent or restricted, for example in the provision of piped water supply and sewerage services within certain localities.

Emphasis in the institutional consideration of the proposed strategy is in **decentralization** of activities from the central level to the **local level**, and from the public sector to the **private sector**. Decentralization sets new requirements for the central level authorities and to the public sector. Measures need to be taken to regulate and control the local and private sector activities. Furthermore, human resources requirements in a decentralized model are much higher in terms of number, and also in terms of quality at the local level.

The Study Team proposes that **MOC** continues to be in the leading position in the sector development, and that its leading role is made even stronger in relation to other central level organizations. MOC as the lead agency is proposed to be responsible for: policy and strategy formulation; sector planning; establishment and maintenance of a sector data base; preparation of technical guidelines, standards, codes of practice, forms of contract, etc. for the sector; definition of professional qualifications, coordination of human resources development, and development of qualification procedures for enterprises on professional basis; coordination and prioritization of research and development activities; coordination of central level financial support to sector investments, determination of investment priorities and financing criteria, and supervision of sector financing; and monitoring and supervision of the sector performance.

MOC's role in the coordination of central level financial support to sector investments is proposed to be strengthened. MOC could direct central level financing to investment projects, within the limitations of its budget allocation. MOPI would influence the sector policies and strategies through the recently established National Steering Committee of Clean Water Supply, Sanitation and Environment, it would review the sectoral financing plans of the line ministries, and agree upon the overall development allocations to the line ministries.

The Study Team recommends that environmental matters be clearly administered by **one ministry**, i.e , MOSTE. Many of the stipulations lack **clarity, realism, and enforceability**. The regulations should be realistic, and focus on the most urgent **priority measures**, with a possible schedule for measures to be taken in various **priority categories**. The regulations should also clearly define sanctions for violations, and the sanctions should be enforced and strong enough in order to encourage pollution control measures, not payment of fines.

The Study Team recommends that the core functions to be **decentralized** to the provincial/city level organizations, including integration of development of wastewater management and sanitation to overall infrastructure and social development of the city/town; integration of master planning of water supply and sanitation to overall urban planning in the city/town; regulation and management of land use and construction; monitoring and enforcement of environmental standards; implementation of legal and regulatory measures to promote, encourage, and enforce development and operation of urban water supply and sanitation, taking into account environmental, economic, public health, and other relevant requirements; promotion, supervision and support of water and sanitation utilities in development and operation; promotion, supervision and support of communities and households in water supply and sanitation; and coordination of local level financial support for investments.

It is recommended that the operation of the wastewater collection and treatment systems would be the responsibility of the utilities, under the supervision of the provincial/city People's Committees. Each wastewater (as well as water supply) utility is proposed to be controlled by a **Board**, established from representatives of the institutions most affected by the service.

The Study Team believes that the public utilities need to be developed to operate in a much more **commercial** way. The key to more efficient utility management and performance is that the utilities should have sufficient autonomy both to generate and retain adequate revenues for its needs under the control and supervision of the People's Committees or the Board. The utilities would need to reconsider their role by identifying the **key functions** that they can efficiently undertake, the functions that they would preferably contract out, and functions that they would simply let other institutions undertake.

The core functions most naturally provided by waste and wastewater utilities are those which directly make use of the highly **capital-intensive infrastructure system**: wastewater collection network and wastewater treatment plants, and to some extent also waste treatment and disposal systems. These functions have a monopolistic nature; it can hardly be anticipated that development of two or more competitive collection and treatment systems could be feasible.

As long as sewerage is actually part of drainage, it is quite natural to combine the duties related to waste and wastewater (and drainage) management. Separate wastewater collection systems are more clearly customer-oriented, with property connections providing service to a registered clientele. At this stage, a natural institutional set-up would be **merging** the wastewater function with water supply functions. This would also facilitate efficient collection of wastewater surcharges together with water revenue collection.

It is proposed by the Study Team that the utilities would encourage communities, households, and the private sector to undertake all functions that they are willing and capable of doing, under supervision of local authorities and/or utilities. Households and communities would be the key initiators of development at the household level in general and at the neighborhood level in built-up areas.

Secondary functions, such as maintenance of equipment, laboratory services, transportation functions, catering, cleaning, etc., could probably be more efficiently and economically provided by private sector enterprises. The real benefit from privatization of such functions would come from the impact of market forces and competition between the suppliers of the services.

It is anticipated in the strategy proposal, that the People's Committees continue to have their present position and, consequently, be the key decision-taking institutions, also in the sanitation sub-sector. It is recommended that the provincial/city People's Committees who aim at rapid and sustainable development of sanitation, would establish **Sanitation Promotion Units** directly under their control. The main duties of these units are proposed to include promotion, supervision, and supporting of communities and households in water supply and sanitation development.

Regulation and management of land use and construction are considered by the Study Team as one of the most efficient tools in the development of wastewater management and sanitation, particularly in the new development areas. The **Chief Architect** or **Construction Service** can set conditions and requirements for sanitation in the planning certificate and in the construction permit. Reasonable legislation for effective control of land use and construction is more or less in place. The relevant authorities just need determination and adequate human resources.

The Study Team proposes that the definition of duties between MOSTE and local governments concerning the **appraisal of EIA reports** be reconsidered. The present division of responsibilities has little to do with the potential of environmental risks associated with the projects. MOSTE should focus its limited resources on the most critical projects, and such projects whose impact assessment calls for higher professional competence.

While environmental regulations need polishing and updating, the most critical measures to be taken are related to the **enforcement** of these regulations. The gap between the regulations and the actual measures taken is wide, and obviously reduces the **credibility** of the management of pollution control.

Financial Aspects

The basic principle of the proposed Strategy for cost sharing is, as the government has indicated, that the polluter should pay. Provision of sanitation and particularly drainage are commodities, whose explicit beneficiaries are very difficult to determine, therefore, exact cost sharing between different levels of government organizations and private people is normally done on a political basis. The Study Team proposes the following **cost sharing** and sanitation financing systems.

Households pay in advance, partially or fully, the investment costs of providing on-site facilities. A full payment is expected from wealthy families using their savings and own borrowings, whereas the strategy proposes for the support of lower income families a specific funding arrangement and savings schemes for investment purposes. In addition, households should pay the annual O&M of on-site facilities, and a sanitation tariff charged by a utility for a centralized service.

At the **neighborhood level**, the residents of the area collectively make a full or partial payment for feeder pipes and other additional investment costs. A partial payment, say at a minimum of 10% of the cost, should be made as a down payment (to be collected from residents) if there is loan financing available as suggested by the Strategy. Residents will also pay recurrent costs when collecting and transporting the wastes from houses and blocks to the boundary of the neighborhood, including possible debt service of a loan.

Because of the high capital cost of **centralized collection** (and treatment) systems, the Strategy proposes that local government should pay the equity, say 10-30% of the cost, whereas utilities are expected to prepare financing plans and identify sources which would enter into an agreement with the utility directly or through local government.

The proposed Strategy recognizes decentralization of decision making and, thus assumes that local authorities (provinces, cities, districts) are responsible for the recurrent costs of utilities through revenues and for investment financing of local projects. Central government extends budgetary financing and finds other sources for large scale projects of national interest, particularly when there is a need for setting up of a wastewater treatment plant or other nationally important sanitation projects.

The proposed financial Strategy recognizes that there is no instant solution to phase out subsidies, and therefore it recommends a **gradual improvement in cost recovery** and a progressive replacement of subsidies with user charges and revenue financing. It also found necessary to introduce **connection and development charges** for sanitation services. Development charges would be applied to new housing construction works and to expansion or renovation of old buildings.

The Strategy proposes that sanitation services should be considered a commercial service with a certain fee rather than a social service financed from the budget. The pricing of sanitation services with tariff structures and policies need to be created by conducting a national study as a guidance for provincial municipalities while developing the Sector utilities for financial independence. Apart from the basic **sanitation tariff** itself, other possibilities for revenue raising should be investigated in the study, such as the basis of connection and development charges.

While promoting domestic and foreign financing resources, the Study Team proposes that a special **financing facility** would be established to foster the Sector's restructuring and to accelerate its sustainable development. It would operate on a project basis which is expected to facilitate the lending procedures and accelerate the rate of investment for sanitation. The Facility is meant to be a **transitional measure** to provide financing with favorable conditions and technical assistance on a grant basis until the revenue base of sanitation services is stabilized and the Vietnamese capital market is better equipped for the needs of the Sector.

The funding of the Facility is expected to be received from international financing institutions and donors as concessional credits for on-lending. Bi-lateral donors have been assumed to provide grant financing for the TA-component of the arrangement.

The funds of the Financing Facility would be divided into the **Credit Line** (75 %) for utility financing and the **Revolving Fund** (25%) for households or a group of households. The financing arrangement calls for technical assistance for the establishment of a **Support Unit** for coordination, implementation, and supervision of lending and support activities. The main tasks in the start up phase would include establishment of standard procedures, for example, for on-lending procedures, project preparation, and eligibility criteria of a loan acceptance.

It is expected that there will be more demand for the loans than can be satisfied with the Facility. As a result, utilities, communities, and households will have to **compete** for the limited financing of the Facility, and financing decisions will be based either on an application review (small loans) or on an appraisal (big loans) covering all relevant aspects of the project.

While there are several alternative methods to carry out regional development policies, the Study Team proposes that **loan terms** (interest, grace, maturity) could be differentiated to match the debt service cost with income levels and payment capacity in various towns and households case by case.

Budgets will remain, however, the most important source of public sanitation financing in the foreseeable future. To improve the sustainability of **budget financing**, the Study Team recommends that the funds now allocated by the central government to local governments and to projects on a grant basis, would be divided into two components. The first one would be for the support of the local government's equity investment in the restructured utilities, and the second part of the funds would be channeled as a loan on a project basis through the banking system including the proposed Facility.

The proposed Strategy aims at increasing **managerial and financial autonomy** of the Sector utilities through establishment of reliable revenue sources with an effective user fee system. The idea is that higher internal cash flow and cost recovery will lead to smaller subsidies and give managers more motivation and incentive to focus on improvement of financial viability of the utility.

Technical Aspects

According to the Draft Vietnam Urban Sector Strategy, the main emphasis will be to mobilize the economic strength and growth potential in the major cities, and to place first priority on development in three "development poles" or corridors. This approach is proclaimed by the NUSS-Strategy as well and it is proposed that implementation of sewerage systems will be started in these areas.

Due to public and private sector economic constraints, it will be necessary to **prioritize** sanitation developments, to invest in those areas where the benefits would be greatest, and to the largest possible extent allow market mechanisms determine where the investments should go. But the government can and should provide the necessary guidance, regulations, and incentives, and be instrumental in developing suitable financing mechanisms. It is therefore, recommended that:

Export/Industrial Processing Zones (EPZ, IPZ), commercial centers, tourist resorts, and high income estates in the **growth corridors** are identified by the government as first priority development areas. Infrastructure in these areas will be developed to recognized international service and environmental standards, i.e., separate sewerage and drainage systems with state of the art treatment plants.

Rehabilitation of the most deteriorated and vital parts of existing combined systems in the old city centers should have also a high priority in the development of infrastructure. In many cases only by improving the operation and maintenance capacity of the utilities can considerable improvements be achieved.

It is envisaged that developments will spread out from the present city centers into areas that are now **partly developed**, and then slowly expand into suburban areas, such as new housing estates, industrial developments, and commercial centers, which are considered to be second priority areas.

Upgrading of existing systems in the old city centers should have third priority, because such investments would be less cost effective than for new poorly serviced areas.

The proposed Strategy gives guidelines for suitable technology options in different environments, but leaves the final decision making, within the established requirements by higher authorities (MOSTE), to the beneficiaries and local authorities. Generally, **separate sewer** systems should be favored and other infrastructure such as water supply, electricity etc. should be **simultaneously** constructed prior to housing development in new development areas.

The present waste management practices, and law enforcement, are not adequate to protect the environment. Pollution of many urban water resources is already critical. It is recommended that a waste management strategy is adopted that will result in no additional pollution. The following steps should be taken to accomplish this:

(i) Collection and treatment of wastewater from areas already built-up with combined sewer and/or septic tanks in 1996 will mainly remain as they are until year 2010;
(ii) Provide a minimum of primary treatment level for wastewater discharged from all new sewerage developments, starting 1996;
(iii) Adopt properly designed and operated on-site disposal facilities for approximately 20% of the population in Class I and II cities, and for about 40% in Class III and IV cities;
(iv) Establish a regular and compulsory septic sludge emptying system, and sludge treatment facilities before year 2000; and
(v) Between year 2000 and 2010 upgrade to secondary treatment all plants installed after 1996 and require secondary treatment for wastewater from all new developments.

It is recommended that a strategy for water conservation and reuse of wastewater is adopted. As a means of reducing the cost of waste management and pollution control, reuse of wastewater for irrigation and aquaculture should be promoted and explored. It is suggested that the Engelberg Microbiological Quality Guidelines developed by WHO, WB, and the International Reference Center for Waste Disposal are adopted in Vietnam.

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

VOLUME 1

MAIN REPORT

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ACRONYMS

ADB	*The Asian Development Bank*
AIDAB	*Australian International Development Bureau*
BOD	*Biological Oxygen Demand*
BOO	*Build - Own - Operate*
BOT	*Build Operate and Transfer*
C : N	*Carbon and Nitrogen ration*
CC	*Central Coast*
CDC	*Consultants, Designers and Constructors*
CH	*Central Highland*
CS	*Construction Services*
CV	*Conveyance*
Doi moi	*Open Door Policy*
DS	*Disposal*
EIA	*Environmental Impact Assessment*
EPZ	*Export Processing Zone*
ESD	*East Southland Delta*
EU	*European Union*
FDI	*Foreign Direct Financing*
GDMH	*General Department of Meteorology and Hydrology*
GDP	*Gross Domestic Product*
HCMC	*Ho Chi Minh City*
HEC	*Hanoi Environmental Committee*
HH	*Household*
HRD	*Human Resources Development*
ICOR	*Incremental Capital Output Ratio*
IDA	*International Development Association*
IPZ	*Industrial Processing Zone*
IRCWD	*International Reference Centre for Waste Disposal*
MIS	*Management Information System*
MOARD	*Ministry of Agriculture and Rural Development*
MOC	*Ministry of Construction*
MOD	*Ministry of Defence*
MOE	*Ministry of Education*
MOFA	*Ministry of Foreign Affairs*
MOFI	*Ministry of Finance*
MOH	*Ministry of Health*
MOHI	*Ministry of Heavy Industry*
MOI	*Ministry of Industry*
MOLWISA	*Ministry of Labour, War Invalids and Social Affairs*
MOPI	*Ministry of Planning and Investment*
MOSTE	*Ministry of Science, Technology and Environment*
MOWR	*Ministry of Water Resources*
MRD	*Mekong River Delta*
MSMU	*Water Supply Management Unit*
MUSD	*Million United State Dollars*
MVND	*Million Vietnamese Dongs*
NB	*Neighborhood*
NC	*North Central*
NCNST	*National Center of Natural Science and Technology*
NGOs	*Non-Government Organizations*
NMM	*Northern Mountain and Midland*

NPK	*Nitrogen - Phosphate - Potassium*
NSC	*National Steering Committee of Clean Water Supply, Sanitation and Environment*
NUSS	*National Urban Wastewater Collection and Sanitation Strategy*
O & M	*Operation and Maintenance*
ODA	*Official Development Assistance*
OOG	*Office of the Government*
OS	*On-site*
P/F toilet	*Pour Flush Toilet*
PACCOM	*People's Aid Coordinating Committee*
Phuong	*Ward*
PPC	*People's Committee*
Quan	*Urban District*
RRD	*Red River Delta*
SCCI	*State Committee for Cooperation and Investment*
SCPA	*State Council for Project Appraisal*
SOE	*State Owned Enterprise*
SPC	*State Planning Committee*
SWOT	*Strength, Weakness, Opportunity and Threat*
TA	*Technical Assistance*
TM	*Treatment*
TOR	*Terms of Reference*
TUPWS	*Transport and Urban Public Works Services*
UN	*United Nations*
UNDP	*United Nations Development Program*
URENCO	*Urban Environmental Company*
USD	*United State Dollar*
VIWASE	*Vietnam Consult on Water Supply, Sanitation and Environment*
VND	*Vietnamese Dong*
VUSS	*Vietnam Urban Sanitation Strategy*
VWSA	*Vietnam Water Supply and Sanitation Association*
WASECO	*Water Supply and Sewerage Construction Company, HCMC*
WASENCO	*Construction Company for Water Supply and Sewerage, Hanoi*
WB	*World Bank*
WHO	*World Health Organization*
WSS	*Water Supply and Sanitation*
WTP	*Willingness-To-Pay*

1. GENERAL BACKGROUND

The study report is submitted in four volumes, and their content is briefly described in the following.

Volume 1, Main Report

i.e. this volume, gives a summary of the main findings, recommendations for the proposed Strategy, and an immediate action plan including pilot studies and projects.

Volume 2, Present Status Assessment

Includes the assessment of the present status of the Sector's institutional and financial framework, and presents recent developments in wastewater and sanitation services.

Volume 3, Household Demand for Improved Sanitation Systems

Summarizes the findings of socio-economic household surveys carried out in Haiphong and Ho Chi Minh City by the Study Team, and some other relevant socio-economic studies in provincial cities in Vietnam.

Volume 4, Technology Options

Compares and presents the technical options that may find application in Vietnamese conditions. The options and their cost implications are used as the basis for the institutional and financial strategy recommendations, and for the overall sector objectives.

1.1 BASIC DATA ON VIETNAM

1.1.1 Population

Vietnam's estimated total population for 1994 was 72.5 million of which 14.1 million and 57.3 million were considered to reside in urban and rural areas respectively, reflecting an average annual growth rate of 2.1%.

Unlike many other developing countries which have experienced a significant shift from rural to urban population, Vietnam has a rather low rate of urbanization. However, the current economic reforms will probably change this situation, and so the country may in the near future be faced with high urbanization rates and, with them, overtaxing of infrastructure and exacerbated environmental health problems. The share of urban population of the total population is expected to grow from the present 28% up to 34-48% by the year 2010 as projected in the Draft Vietnam Urban Sector Strategy Report[1].

The urban population of the towns included within the scope of NUSS Strategy (Class I - IV) is projected to increase from the present 10.8 million up to 15.2 - 20.0 million for the year 2010.

1.1.2 Water Supply Situation[2]

Water supply coverage varies widely in big cities; probably 60-70% of the population receive water from piped systems, while in medium cities the coverage falls to 50% and in small cities to 30%.

Per capita daily water consumption is not equal; in areas close to water plants, pumping stations, and water transmission mains, the daily consumption can be as high as 600-1000 l/c/d while in areas further away it may fall to 50 l/c/d or less. The main reasons for these large variations are excessive leakage in the old systems and wastage of water due to non-metering and low water tariffs.

Shortage of water and intermittent supply are usual and about 80% of water supply networks cannot meet the drinking water quality criteria.

1.1.3 Sanitation Situation

Based on the findings of the study team, private households have improved their sanitation facilities substantially since 1989. Double vault and bucket latrines have almost totally been replaced with flush and pour flush toilets in the South, while in the northern cities some 19% of households are still using double vault latrines and as much as 26% use bucket latrines. The number of households that are without toilet facilities or relying on such devices as overhang toilets remains at 23% in the North, but is only 9% in the South.

The improvement of sanitation situation of the public sector has not followed the development of private households. Most of the pour flush or flush toilets discharge wastewater straight into streets, drainage ditches, and natural water bodies, which is an obvious health risk. Management of septic sludge is not done properly in any of the studied cities, and it is expected that serious problems may arise in the near future.

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[1] These figures are based on the new determination of the urban population proposed by the Vietnam Urban Development Study Team i.e. both the urban and rural population components for Vietnam's cities, towns, and townlets should be taken into account when estimating the total urban population

[2] This chapter is mainly based on the *National Urban Water Supply Strategy for Vietnam,* which was submitted for approval in November 1994, Ministry of Construction/Finnish International Development Agency

Combined sewer systems are mainly serving central parts of the towns, and were built during the French regime. Thus the sewer pipes are aged and in very poor condition. Their transmission capacity has been reduced considerably due to clogging and sedimentation. Several collapses of sewers have also been reported. In new development areas, built after 50's, construction of sewer pipes has either been neglected or has been minimal. Therefore, floods are common, resulting in serious economic losses and causing health problems. It is estimated that the coverage of households served by public sewers in Class I cities is 48 %, in Class II cities 44%, and in Class III cities only 25%.

In most cases the wastewater collection system consists of sewer pipes which discharge wastewater through open channels and ditches to lakes and ponds. No treatment is done before discharge to the receiving water bodies. Lack of treatment facilities has led to pollution or euthrophication at the receiving waters in most towns. Due to the usage of on site infiltration technologies, the shallow ground water resources are reported to be polluted in many places.

Industries are mainly outdated and using technology that requires large amounts of water and raw materials. No pretreatment of wastewater is used, thus the environment is polluted. Especially in Ho Chi Minh City the water bodies are heavily polluted.

The O&M of sewer systems is suffering from lack of skilled personnel, proper equipment, and funds in all the cities, and the responsibilities for the sanitation activities are normally shared with different authorities and utilities. For instance in Hanoi and Ho Chi Minh City, Sewerage and Drainage Companies are responsible for sewers with a diameter over 400 mm and district authorities are responsible for smaller pipes. The URENCO (on request of private households or housing co-operatives) is responsible for emptying of septic tanks. The responsibilities of sanitation are more unclear in smaller cities, and in general the O&M of the systems is neglected.

Recently the Government has promulgated the Environmental Law, but the follow up and monitoring of the enforcement is poor. The local authorities, i.e. in most cases Environmental Committees, do not have enough trained personnel nor equipment to be able to fulfil their responsibilities.

1.2 NATIONAL DEVELOPMENT CONTEXT[3]

New developments in political, social, and economic spheres have taken place in Vietnam since the latter part of the 1980s. "**Doi Moi**" (renovation) or open door policy to trading and investment with other countries marks a new stage in the economic development of the country, since its aim is to transform the failed command/control economy to a market-oriented one.

The key elements of the "Doi Moi" policy include:

(I) decentralization of state economic management, giving greater autonomy to state-owned enterprises in making decisions related to production, distribution, and financing;

(ii) replacement of administrative measures and controls by economic ones and, in particular, the use of market-oriented monetary policies to control inflation;

(iii) adoption of an outward-oriented policy in external economic relations. Key elements of this policy were the adoption of realistic exchange rates and a liberal foreign investment law;

(iv) adoption of agricultural policies which allow for long-term land use rights and greater freedom in the marketing of products; and

(v) reliance on or acceptance of the private sector as the engine of economic growth.

The first years of "doi moi" have been a success. Inflation has been brought down from more than 700% in 1986 to 18% in 1992, and to 14.4% in 1994. Also the exchange rate has stabilized, fiscal revenue has improved, etc.

The gross domestic product (GDP) grew 8.7% in 1992 and 8.1% in 1993. According to the latest report of the General Department of Statistics, the GDP growth in 1994 was estimated to be 8.5% based on increasing investment rates. By sector, the highest growth (17.5%) was recorded in construction and the lowest (4.5%) in agriculture.

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[3]This section is mainly based on two documents *Vietnam ; A Development Perspective*, Hanoi 1993; Document presented to the international community at the Donor Conference in Paris, 1993, and a book named *"Vietnam's Dilemmas and Options - The Challenge of Economic Transition in the 1990's"*, edited by Mya Than & Joseph L.H. Tan, ASEAN Economic Research Unit, Singapore 1993 The former gives an official insight to the development of the country while the latter presents observations and comments of foreign "Vietnam-watchers"

The present policy is to concentrate the economic growth geographically in **three development corridors**. Thic policy is also followed in the preparation of this Strategy, although the weak point of this development strategy is that the gap between big and small/medium size cities will continue to grow from the present.

Vietnam is also facing the side-effects of a market economy: social disparities, corruption, rent-seeking activities, and inadequate "rules of the game". A major challenge for the government will be its ability to introduce the **legal and institutional framework** necessary to support a dynamic economy. The political dimensions of this task include reduced party control, closing of numerous bureaucratic rent-seeking avenues, establishment of an independent judiciary, and letting the people become rich.

Vietnam's reform program will continue restructuring the state enterprise sector, e.g. by creating a proper environment for all economic sectors to cooperate, compete, and develop on an equal footing. Efforts will also be made to improve market mechanisms, as well as to increase the effectiveness of macroeconomics management and to strengthen the planning capability required for a market economy.

Continued attention will be paid to developing an open economy in Vietnam, as well as strengthening and diversifying the country's relations with other countries. Vietnam needs to further develop its legal system, reform public administration, and train public service personnel at all levels.

1.3 SOCIO-ECONOMIC CONTEXT

The economic viability of the urban as well as the nation will affect the feasibility of improving urban sanitation situations and financial sustainability. Also, the social context of the Vietnamese way of living will influence the future direction of sanitation user behavior. Since Vietnam has been carrying out its doi-moi policies, its socio-economic context has benefited at both macro and micro levels.

At the macro level, the new economic reform has positive effects in opening **new economic opportunities**; hence, the non-state sector is expanding its production rapidly. The chosen development policy will direct the nation toward a system of "open-economy", and it is expected that urban areas of any size will play a major role as the center for economic, cultural, and social development within each region. The economic development strategy of Vietnam brings the economic opportunities as well as the constraints and challenges to the people who are facing the dynamic economic situation.

However, there are a lot of hardships during the transition period. When the economy is restructured, many weak state enterprises halt their operations, resulting in increasing **unemployment**. Also, the rapidly growing work force, the reduction in the size of the armed forces, and the return of a large number of workers from the former socialist countries increase the unemployment problem still further. The official unemployment rate was about 20% of the total labor force in 1990. The expansion of the private sector during the last couple of years compensated the state sector employment, but has not been sufficient to reduce the unemployment rates substantially. Besides, it is estimated that each year more than one million new workers will enter the job market. The unemployment problem will create a short-term constraint for conducting economic reform. On the other hand, this labor reserve could provide international companies an opportunity to participate in economic investment in Vietnam.

The **present capacity of social and physical infrastructure services** in Vietnam is not strong enough in terms of quantity and quality to meet the requirements of the fast growing economy. The strategy toward an open market economy requires basic physical infrastructure to facilitate industrial development and trade. At present and in the near future, **massive requirements for capital** improvements exist for the infrastructure in transportation, ports, telecommunications, energy, water supply and sanitation to support the national development policy, because urban areas of any size will be used as the coordinating center of the administration and joint venture of investments in economic activities, although development poles will have a high priority.

At the micro level of socio-economic context, the **traditional background of agricultural society** and the life style of rural areas are still intermixed with the social texture of urban areas. Considering that fifty percent of GDP is from the agricultural sector, and at the same time, eighty percent of the total population lives in rural areas, the sanitation practices of urban areas are still interconnected to the needs of agricultural production in the suburban areas; or people's attitudes and needs for a clean and improved sanitary environment may not have been enhanced as much as overall economic development process.

The problems in the social-economic sector that Vietnam confronts, in general, are: a large part of the population remains in poverty, malnutrition exists in some areas, and many people lack access to safe drinking water and basic health care services. The **rapid population growth** threatens to undermine the gains that have been made in national economic development.

Especially, **economic disparity** between the north and the south is widening, which may be seen at the micro level as well. For example, the investment in HCMC produces over 30% of tax revenue[4], which may create a possible future dissatisfaction and dispute on both sides. The World Bank estimates that there is a fivefold difference between the poorest and the wealthiest region in Vietnam.

Vietnam suffers from inadequate and increasingly deteriorating physical infrastructure systems. Although some of them have been rebuilt since the turn of the century, the vast majority have been poorly maintained and are very old. In order to support the fast economic growth, urban infrastructure needs to be provided in time. Due to the fact that 20% of the Vietnamese national budget still relies on foreign aid, and that local governments do not have enough revenue sources of their own for providing urban infrastructure, it is difficult for the governments to secure appropriate **financial sources** to provide the improved infrastructure. Besides, state-owned-property rights, land-ownership, together with the state-owned banking system, make the access of private investors (who want to improve the sanitation conditions for their own housing) to capital or lending very limited.

On top of the State controlled banking systems, the real interest rate fell in 1990, and consequently the informal credit market collapsed[5]. The collapse of the informal credit market posed a hardship for ordinary people, who need to borrow money for their economic activities. The improvement of housing will be difficult for ordinary regular income class households, if the **credit market** is inaccessible. Therefore, from both governmental and private users sides, the access to financial sources is limited and thus discouraging any further improvement in urban infrastructure.

The new economic policy has allowed individual private household units to explore **opportunities of private business ventures**. This household-economy will play an important role in developing socio-economic textures of the society, and this fundamental economic unit will utilize its household assets, capital, and manpower. Support of these economic activities through the provision of appropriate social and physical infrastructure will greatly enhance the overall economic performances of the nation.

[4] *Vietnam Transition to Market Economy, page 202*
[5] *The Double Transition From Underdevelopment and From Socialism in Vietnam*, Andreff, W , Journal of Contemporary Asia, Vol. 23, No 4, 1993

2. PRESENT SECTOR STATUS ASSESSMENT

The Sector status assessment was carried out by reviewing reports and studies made available by VIWASE and through the NUSS Information Collection Survey carried out in 11 cities by VIWASE staff. A separate report with detailed assessment of the present Sector status is presented in *Volume 2, Present Status Assessment*.

Here the main findings of the present status assessment are presented in the form of **SWOT-analysis** and **Main Issues**. The first two letters S&W stand for strengths and weaknesses, which are internal matters limited to the Sector only, and the two latter letters O&T refer to opportunities and threats depending on the overall development in the country. The Strategy formulation should utilize the found strengths and opportunities, and try to cope with the found weaknesses and threats.

2.1 INSTITUTIONAL FRAMEWORK

2.1.1 SWOT-Analysis on Institutional Issues

The SWOT-analysis on the institutional and HRD-issues is presented below.

Table 2-1 SWOT-Analysis on Institutional Issues.

STRENGTHS	WEAKNESSES
♦ Long tradition of decentralization of operations to local level. ♦ High-level policy statements support the development of the sub-sector. ♦ New institutional arrangements, laws and regulations form a good basis for improvements.	♦ Weak enforcement of laws and regulations. ♦ Weak environmental standards. ♦ Overlapping and ambivalent roles of government authorities. ♦ Complicated project preparation procedures involving numerous organizations at various levels. ♦ Restricted access to available data. ♦ Dependence of sub-sector utilities on subsidies. ♦ Salary structures do not provide incentives for commitment and efficiency.
OPPORTUNITIES	**THREATS**
♦ Doi Moi policy creates favorable conditions for sanitary improvements. ♦ High potential for the private sector in development and operation of certain functions. ♦ Increasing awareness sets pressure on prioritization. ♦ Sanitation and environment improvements attract external financing. ♦ Potential for involvement of communities, e.g., Phuong in sub-sector development.	♦ Low actual priority of sanitation in central and local decision-making and budgeting. ♦ Brain drain and low attraction of the sector in the labor market ♦ Lack of overall commitment to the implementation of policies.

2.1.2 Institutional Issues

Low Priority of the Sector

There are positive statements concerning sanitation, public health and environmental protection in long term development strategies of the Government. However, these issues do not seem to enjoy a very high priority. Sustainable sanitary improvements are not possible without clearly indicated demand for these improvements. Sanitation is a commodity much more difficult to sell to customers than, e.g., drinking water. Therefore, the demand needs to be generated by social marketing, social pressure (solidarity), legislation, regulations and enforcement, and government incentives or budget allocations. This structure for demand generation is still very weak.

Overlapping Responsibilities and Duties

The roles of various organizations have, to some extent, been clarified and streamlined in the past few years. There is still overlapping in the duties and responsibilities of, e.g. health, environmental, and water resources authorities at the ministry level as well as at the provincial/city level. Project preparation, appraisal, and approval procedures are particularly complicated, involving many organizations and maneuvers. Project initiators need to intensively follow up the progress and lobby in the involved agencies.

Operational power, for instance operation of utilities, as well as implementation of minor investments which do not need central level allocations, is decentralized to the provincial/city level. This is a major strength and a good basis for client-oriented management. However, this approach calls for skilled and motivated staff in every province, and local financing through revenue collection.

At the utility level, a special problem is the limited and unclear authority of drainage and sewerage authorities. For instance, small sewers are under the control of Quans and housing cooperatives, and emptying of septic tanks is sometimes under a separate waste utility (if such exists). Such division of duties may hamper efficient management of the system.

Poor Enforcement of Laws and Regulations

The legal system already provides reasonable means for relevant authorities to take measures against pollution and potential risks to public health. In fact, laws, regulations, and standards are partly too strict, in comparison with the existing situation in the country. It is impossible and unreasonable to enforce and apply all stipulations. This may, and most probably will, reduce the credibility of these and other regulations. The enforcement in general is still weak, probably due to the transition from one system to another, the relatively weak position of the enforcing ministries and agencies, the lack of basic facilities, and the low priority given to environmental and sanitation issues when aiming at rapid economic growth.

Lack of Sector Database

A major constraint for efficient sector development is the lack of a centralized sector statistics library and database, where data and information would be freely available to all parties involved in the sector development. It is often very difficult to obtain adequate and consistent data, especially when data is required from agencies not directly controlled by the executing agency.

Human Resources

Human resource planning has paid little attention to the emerging situation in the labor market brought on by the new economic order. One of the shortcomings of current human resources approaches has been inadequate economic analysis of human resources.

Implicit in the inadequacy of sector institutions is the non-recognition of an incentives structure for professional and skilled workers. The likely future scenario will feature stiff competition for available skilled staff among the sectors; between the public and the private sector; and among the developed and less developed areas. Labor export and foreign migration may also come into play. The sector institutions stand to lose skilled personnel ("brain drain") if this issue is not addressed in a holistic manner. The public sector, particularly state enterprises, are viewed as the source of skilled and semi-skilled labor by domestic and foreign investors.

There is difficulty in attracting and transforming operating staff into trainers with good teaching and technical skills. There is a need for more trainers who are skilled at using innovative methods.

In the context of appropriate technologies and multi-disciplinary, community-based approaches, HRD delivery systems are seldom organized to reach field staff and communities efficiently and effectively. Some NGOs have successfully ventured into community-level training. Their approaches need to be studied with the end view of long-term, country-wide replication by enabling the government to undertake similar methods.

Statements of sectoral and institutional priorities, performance indicators, and human resources assessments have generally lacked clarity. This has made the planning and evaluation of the HRD contribution to the attainment of sector goals difficult.

Locally, reliable evidence on the effectiveness of training as a developmental response in the sector is still scant. Inappropriate measurement indicators, limited follow-up of training, lack of investigation of outcomes, and poorly-understood interrelationships between skill development and institutional strengthening all limit our understanding in this area. Thus, the expectations of sector, project and utility managers and policy makers on the impact of effective training is low.

Dependence on external funds to finance training activities is a growing cause for concern. While external agencies have been increasing their support for training and development activities, internally-initiated and internally-funded HRD activities have unfortunately declined further or become non-existent.

2.2 FINANCIAL ASSESSMENT

2.2.1 SWOT-Analysis on Financial Issues

The financial assessment of the sanitation sector is summarized below.

Table 2-2 SWOT-Analysis on Financial Issues

STRENGTHS	WEAKNESSES
♦ Present indebtedness of sanitation utilities is low. ♦ Efficient local administrative system (Quans/Phuongs) is in place and could support financial arrangements of on-site and neighborhood sanitation development. ♦ Central government has committed itself to the Sector's restructuring and development after having accepted "the polluter-pays" principle in 1989.	♦ Resources of the financial market are limited and borrowing cost high. ♦ The Sector is not explicitly listed in budgetary classification and for planning purposes. ♦ Sewerage and sanitation cost recovery is low and utilities have to surrender depreciation funds. ♦ Balance sheet values of utilities are understated meaning insufficient depreciation and internal financing capacity. ♦ Low autonomy of financial management does not support efficiency and effectiveness of operations. ♦ Financing ability is rising but households' willingness to pay for sanitation is low
OPPORTUNITIES	**THREATS**
♦ Low or non-existing sewerage and sanitation fees offer potential for revenue expansion ♦ Donors and international financing institutions have shown their interest to increase concessional financing for the support of environmental protection. ♦ Foreign direct investment can benefit the Sector in selected cases. ♦ Economic benefits from improved sanitation ♦ New financing mechanisms for households can increase demand and pressure for investment in public sewerage and sanitation systems. ♦ Accountancy reform of state owned enterprises has been launched in 1995.	♦ Sewerage and drainage networks and equipment continue to deteriorate accumulating eventual funding needs. ♦ The Sector's investment financing will remain overshadowed by water supply and other infrastructure projects. ♦ Counterpart funds for investment and operations will not be in place. ♦ Local authorities will remain reluctant for political reasons to raise/establish charges and to increase sanitation costs to households. ♦ Poor families will remain outside sanitation development if support and incentive systems are not created.

2.2.2 Financial Issues

Lack of Financial Objectives and Revenues

The ongoing restructuring of the state economic sector has started slowly in sewerage and sanitation, and the target degree of self-financing of utilities is still unclear. The officially accepted policy, that the polluter pays, has not materialized, as yet. The government has shown little interest and attention to the Sector requirements, and has taken only a few measures for overall improvement of the Sector operations and cost recovery. Therefore, clear and urgent decision making is required for financial objectives, strategies, and policies, together with establishment of a sustainable revenue base for the Sector.

Tariffs for waste management and sewerage are too low or either totally missing in all the utilities in Vietnam. Only in Hanoi is there a surcharge levied in water billings for drainage and sewerage cost coverage. The connections to public sewers are not charged at all, which has led to an increase in government subsidies for operation and investment purposes. Even in those cases when a fee has been levied on a particular service like sludge collection, revenues have been usually disproportionally low in relation to the real cost of the service.

Low Priority in Budgetary Allocations

In 1994, the share of water supply projects, including sewerage and sanitation, was about 5% of the government's capital budget or 490 billion VND, out of which the assumed portion of sewerage and sanitation is only 10 - 20%. The central government has strong control on local investments, regardless of the stated policies that underline devolution of decision making and administration. Even if in case decision making was decentralized, local authorities would have very limited financial potential for investments and knowledge to identify and negotiate external financing.

Due to substantial and lengthy underinvestment, the physical facilities of utilities are often in poor condition and wearing out without replacement, let alone new investment. Utilities have also remained behind in managerial development and skills, contributing to the high cost but low revenue operations.

Constraints in Funding Availability

Apart from insufficient budgetary financing, the Sector utilities have been unable to raise funding from other sources. Reasons are both structural and managerial. The Financial market consists essentially of only 4 commercial banks which are now in transition, operating inefficiently, and unable to extend long term loans for investment purposes. New and usually foreign supported banks and their branches are being established at increasing numbers (currently about 60), but they are mainly for short term financing needs of high growth sectors like industry, commerce, tourism, and foreign trade. Another structural constraint is that savings mobilization in Vietnam is low, and other specialized financing institutions like insurance companies and pension funds are either non-existent or unable to fulfill expanding needs for long-term finance.

As for managerial limitations, utilities themselves are not responsible or experienced in raising foreign or local capital for investment. Instead, they have been waiting for help from local governments, which are also inexperienced and dependent on central government, when mobilizing finance from various sources. As a result, the Sector has not succeeded in competing for foreign development assistance.

Poor Financial Management and Low Autonomy

Utilities' financial responsibilities are often limited to basic book-keeping and periodical reporting for government and statistical purposes, whereas the core financial functions (such as tariff setting, staff remuneration, asset and depreciation management, capital budgeting, investment financing) have remained in the hands of urban and provincial authorities. Under these conditions, managers consider themselves as civil servants without initiative and motivation to improve the revenue base or cost efficiency of operations.

The present accountancy system does not fulfill modern management requirements, and internal cost accounting and capital budgeting are insufficient or non-existent. The large number of financial reports currently prepared are mainly for the centralized planning, various authorities, and statistical purposes. Inadequate and unreliable accounting practices, together with lack of audit requirements, mean also a serious obstacle for obtaining financing from international financing institutions and many other sources as well. To correct the situation, the Ministry of Finance introduced in 1995 an accountancy reform to be adopted by state owned enterprises. Its application also to the Sector utilities is urgently required and a precondition for improved financial management procedures and practices.

Undervalued Assets

In spite of the asset revaluation done in 1992 and the Ministry of Finance's instructions to keep the fixed asset values updated, the Sector's assets seem to be highly undervalued. This is partially due to the insufficient transfer pricing of new assets and partially due to inadequate cost accounting and auditing systems.

The government regulates depreciation rates, but local authorities have different policies to implement them in practice. In some cases depreciation is not made in full, because in any case utilities have been instructed to surrender the depreciation funds fully or partially to the government. These depreciation funds are not necessarily used for replacing a utility's fixed assets, but converted into a source of general budgetary financing. This policy has led to insufficient O&M and sustained deterioration of operating facilities.

Financing of Private Sanitation

Traditionally, investment plans of government utilities have not included on-site needs, nor have the financiers (i.e. government) of the utilities included provisions or financing means for on-site purposes. In spite of it, households have upgraded their sanitation systems by relying on savings and borrowings from the informal financial sector and private people. Borrowing costs from private lenders is high (2.5-4 %/month) and its availability is occasional.

Due to financial constraints, many of the households who prefer better sanitation condition may not be able to improve the situation as needed. Almost all the respondents in socio-economic study answered that they prefer a monthly payment method to a lump-sum payment in order to install the improved sanitation systems. At the same time, respondents wanted to get financial support from the government for improvements of their sanitation facilities.

2.3 WASTEWATER AND SANITATION SERVICES

2.3.1 SWOT-Analysis on Technology Issues

The assessment of the wastewater and sanitation services can be summarized as follows;

Table 2-3 SWOT-Analysis on Technology Issues

STRENGTHS	WEAKNESSES
♦ Substantial private sector investments/ improvements are being made for upgrading sanitation facilities. ♦ Flush toilets have almost totally replaced dry type toilets in the South. ♦ Water for flush toilets seems to be abundant.	♦ Development of public sewerage has fallen seriously behind private sanitation. ♦ Low coverage of public service provision. ♦ Effective pollution control and waste management are lacking. ♦ There are no operational wastewater treatment plants in Vietnam. ♦ Septic tanks are not being desludged. ♦ Solid waste is thrown onto streets and carried with wastewater in the gutters into the combined sewers resulting in flooding ♦ Operation and maintenance of sewerage and drainage systems are inadequate. ♦ Quality of concrete pipes produced in Vietnam is poor. ♦ Trenching and pipe laying workmanship is inadequate and construction methods dangerous.
OPPORTUNITIES	**THREATS**
♦ Availability of appropriate technology options. ♦ Updated planning and design standards ♦ Improved pollution control and monitoring. ♦ Improved public health and urban environment. ♦ Protection and conservation of natural water resources. ♦ Improvement of manufacturing and construction standards. ♦ Increased useful lives of higher quality pipes and construction methods.	♦ Public health risk if uncontrolled discharge of wastewater continues. ♦ Pollution of surface and groundwater resources. ♦ Unsightly street littering, open wastewater flows in street gutters, and polluted surface water do not encourage international tourism and business. ♦ Existing pipes deteriorating at faster rate than replacements and repair.

2.3.2 Technology Issues

Disparity in Public and Private Service Levels

The development of wastewater and sanitation services has followed different paths in North and South Vietnam. This has lead to a significant disparity in the standard and coverage of services provided. The South has a better developed public wastewater system, and the dry type toilets have almost entirely been replaced with private, flush or pour flush toilets.

The smaller cities in the North and the South have not so well developed water supply and wastewater systems as the larger cities. Households have consequently invested less in wet type toilets, because these are not appropriate without a readily available water supply, and these households have lower incomes. The sanitation standards therefore are generally lower in the smaller cities, although there are significant differences from one city to another.

There is still a fairly large portion of households that have no toilet facilities or are using primitive facilities such as overhang toilets. These may possibly be households living in temporary housing, and the poorest that cannot afford the needed investments to improve their housing and sanitation facilities. Therefore, there is need:

(i) to develop financing mechanisms - subsidies and credits - that will enable also the poorest families to improve their sanitation conditions; and
(ii) for the local governments to upgrade existing facilities and to build new communal and public toilets.

Improvements in private sanitation facilities have taken place at a very rapid pace in the largest cities particularly during the latter part of the last decade. This process is expected to continue and to accelerate in the smaller cities, provided adequate water supply is provided. The preference is obviously for flush or pour flush toilets. Investments in public infrastructure have not followed at the same pace as in the private sector. Consequently there is now a large demand for infrastructure improvement, including construction of water supply and wastewater collection systems.

Lack of Waste Disposal Management

There appears to be a serious lack of management, control, and enforcement for disposal of wastewater from public and private facilities, industries, and hospitals. Wastewater that is discharged from public sewerage systems to rivers, lakes, and other wetlands without treatment causes serious pollution. A large part of households with flush toilets discharge sullage and sewage directly to streets, open drainage systems, natural water bodies, or on the ground. Only a small part dispose wastewater on-site by ground infiltration, and those systems that use "sealed" septic tanks with open bottoms are bound to fail over time. There is an urgent need to take steps to improve the management, control, and enforcement of discharge from septic tanks.

A satisfactory functioning system for collection and disposal of sludge and nightsoil from septic tanks and latrines is not in place. Sludge is dumped into drains, water courses, landfills or on the ground in a haphazard manner. Untreated nightsoil is spread on farm land without control. A system for collection and safe disposal of septic tanks sludge and nightsoil needs to be put in place.

Solid waste from households is dumped in the street where it mixes with wastewater and storm water before it is manually swept up, collected, and disposed of in open, burning dumps. As much as 40 to 50% of the waste is not collected, and much of it finds its way into the combined sewers and drains, where it causes clogging and adds to the already very serious flooding problems. A better solid waste collection system that reduces the amounts of waste thrown onto the streets, and eliminates direct exposure to waste collectors, needs to be introduced.

The public health is seriously affected by exposure to liquid and solid wastes. Natural water bodies have become so polluted that they are unsuitable for all other beneficial uses than as recipients for wastewater. The urban environment has in many places become most unpleasant due to littering of public areas, polluted and foul smelling lakes, rivers, and canals. This is not only a loss of valuable resources, but detrimental to tourism and international industrial commercial developments. A system for better protection of natural water areas needs to be developed, possibly by controlled use of existing wetlands for waste treatment and/or introduction of more conventional treatment methods.

There is a serious lack of properly prepared land for new industries The city authorities are under pressure to give permission for new establishments, and industrial expansion is taking place within the already developed areas without the necessary infrastructure to handle industrial wastes, and without adequate enforcement of environmental legislation. This contributes to the already uncontrolled and serious water, soil, and air pollution problems from the existing industries. Therefore, mitigating measures to reduce and prevent industrial pollution should be taken, and measures to establish new industrial parks with properly designed and constructed infrastructure, and then possibly to relocate existing polluting industries to these areas.

Lack of Operation and Maintenance

Many of the present shortcomings and deficiencies in provision of public water supply and environmental services can be reduced or eliminated if better and more appropriate operation and maintenance systems had been in place, such as enforced, regular emptying of septic tanks, appropriate systems and equipment for flushing and cleaning of combined sewers, including installation of pumping stations and sandtraps, containerized collection of solid waste, and controlled landfilling with simple arrangements for safe disposal or reuse of septic sludge, nightsoil, and certain types of hospital waste.

Inadequate Design Standards, Production and Construction Methods

There is an obvious and urgent need to develop new and more appropriate design criteria and guidelines, as well as production and construction standards, materials and finished systems testing, and quality control procedures and standards. Draft final report on design guidelines was submitted to MOC in May 1995, but until now the guidelines are not yet approved nor their implementation into practice started.

Concrete pipes presently used for sewers and drains are not of a sufficiently high quality. Better production methods and quality control should be encouraged.

Construction methods are sometimes dangerous. Construction quality is substandard, for example, pipes are laid without the necessary attention to vertical and horizontal tolerances. Measures need to be taken to introduce the necessary construction safety codes, quality control and assurance procedures, improve construction management and workmanship, and enhanced government supervision.

3. DEMANDS AND POSSIBILITIES FOR WASTEWATER COLLECTION AND SANITATION

Demand for wastewater collection and sanitation is mainly derived from economic and urban population growth, which in turn will lead to environmental deterioration and a worsened health situation, if preventive measures are not taken. The urbanization of Vietnam is expected to grow, and the share of urban population of the total population will grow from the present 28% up to 34-48% by the year 2010 as projected in the Draft Vietnam Urban Sector Strategy Report.

Households' Willingness-To-Pay (WTP) for sanitation improvements is mainly based on the findings of the socio-economic household surveys carried out in Haiphong and Ho Chi Minh City. The detailed results of these surveys are presented in *Volume 3, Household Demand for Improved Sanitation Systems.*

The draft National Urban Development Strategy report gives overall framework for the future urban development and management to the year 2010. The needs and possibilities for improved wastewater collection and sanitation are estimated, taking into account the development forecasts of the national economy and the assumed physical development of the urban infrastructure.

For convenience the key issues which create demands and possibilities for wastewater collection and sanitation are listed below;

(i) economic growth and investment;
(ii) urbanization and population growth;
(iii) environmental and health needs;
(iv) economic benefits; and
(v) household demand for improved sanitation.

3.1 ECONOMIC GROWTH AND INVESTMENT

3.1.1 Economic Framework and Outlook

After having suffered from a rapid collapse of trade and aid by the former Soviet Union, the Vietnamese economy recovered rapidly and the gross domestic product (GDP) grew 8.7% in 1992 and 8.1% in 1993. A contributing factor was that the country started to re-establish her relations with donors and the international financial community in general, leading to increasing western aid flows to Vietnam. According to the latest report of the General Department of Statistics, the GDP growth in 1994 was estimated to be 8.5% based on increasing investment rates. By sector, the highest growth (17.5%) was recorded in construction and lowest (4.5%) in agriculture. The target set for GDP growth in 1995 is 9-10%.

Despite strong growth, Vietnam still belongs to the poorest countries in the world, relying on agriculture with low productivity. On average, the GDP per capita in the country was estimated to be 240 USD in 1994. Economic disparities between low and high income people are wide and they are growing between rural and urban areas. In the most backward regions of the country, the per capita income is considerably below the average, whereas income levels of 810 USD and 620 USD in HCMC and Hanoi, respectively, are reported.

Over the last few years Vietnam has been rapidly moving away from a centrally planned economic system towards a market economy. Although there are concerns about macro-economic stability, it is generally accepted that the followed strategy and policies have succeeded in many regards for reducing imbalances and removing constraints when lowering fiscal deficit and inflation in the mid-1990s, and when stabilizing the foreign value of the Vietnamese currency. On the other hand, external debt is high and foreign currency reserves are low. Also the control of inflation appears to be difficult. Although low compared to late 1980s (390-770%), inflation in 1994 still reached 14.4% and may stay around the same level in 1995 in spite of the government's lower targets.

A serious economic constraint also affecting the Sector's investment possibilities is the relatively low domestic savings rate. High private savings have been one of the keys to rapid growth in neighboring countries. When the average savings rate in ASEAN and other East Asian countries has been about 25%, it was in Vietnam about 11% in 1992 and 15% of GDP in 1994. One of the basic problems of low savings rate in Vietnam is lack of confidence in the financial institutions, and inflation of VND. It is estimated that the banking system serves only some 7% of the population. However, there is good potential in Vietnam to increase "official" savings. Households are known to have substantial liquid savings, but the funds or assets are not channeled in a sufficient extent into investment purposes of the economy.

The government of Vietnam approved in 1991 its "Socio-Economic Stabilization and Development Strategy to the Year 2000". An important objective of the national strategy was to move towards stabilization and development by doubling GDP during the 1990s, meaning an average annual growth rate of 7.2%. The estimated actual growth to date has exceeded expectations with an average annual growth rate of 7.5% from 1991 to 1993 accelerating to 8.5% and an estimated 9-9.5% in 1995. As a result, the national strategy's target has now been revised to double **per capita** GDP during 1991-2000. The government's own target for growth is around 8 % p.a. over the rest of the decade, and even higher projections have been presented. However, the country's absorptive capacity of foreign financing is still low, and investment and savings rates have to be increasing considerably along with institutional changes in various sectors, before higher projections of growth can be fulfilled.

3.1.2 Investment Capital for Sanitation

The investment requirements of private and public sanitation are estimated in Section 3.2.2. This Section attempts to assess the total amount of investment capital likely to be available for the sanitation sector. The assessment can only be indicative because sanitation has never been treated as a separate and classified sector in the budgetary classification of expenditure or in the categories of investment planning. This means that there is simply no "official" data or statistics on the Sector's investment and financing status, let alone on future development.

As mentioned earlier, in 1994 the capital investment budget of the government was equivalent to about 845 MUSD representing 7% of the GDP, which is about 20% of the government total expenditure and about 27% of the gross domestic investment. The budgeted funds for water supply were 44 MUSD (5%), out of which it is estimated that some 15% or less than 7 MUSD, was allocated to sewerage and sanitation. The 1994 budget also included a lump sum of 91 MUSD as the government's contribution to foreign funded projects. The leverage of those funds is high because the combined share of foreign loans and grants may cover the major part of the project costs. In selected sectors like water supply this share can be 70-80%. As a result, the counterpart funds (if 1 MUSD for sanitation) could attract another 4 MUSD from foreign resources and raise the total capital investment up to about 11 MUSD/year for the Sector.

Instead of basing projections on the government budget, which requires major structural changes and target setting for the fiscal deficit[6], the capital investment projections below are based on alternative scenarios for macro economic development of Vietnam. The major assumptions of the **baseline** projection in 1996-2010 are the following:

(i) The average growth of GDP will be 8% p.a. in 1996-2010 based on increasing savings and capital productivity i.e. on increasing incremental capital output ratio (ICOR);
(ii) Gross domestic investments will increase from the present 20% to 30% of GDP by the year 2000, and remain constant thereafter;
(iii) Investments in infrastructure will be 50% of total gross investments;

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[6] *World Bank Viet Nam Public Sector Management and Private Sector Incentives, An Economic Report*, September 26, 1994, page 23.

(iv) The present share of sanitation in water sector capital investment is unproportional (10% in 1994) compared to the needs, and therefore it is assumed to be doubled by 2010, and

(v) The projections include capital investments for drainage to the extent that they support viable sanitation solutions.

The high and low growth scenarios have been reached by applying 10% higher and lower targets for GDP, gross investment of GDP, and the share of sanitation in water sector capital investment. The results of this exercise are illustrated in Figure 3-1 below.

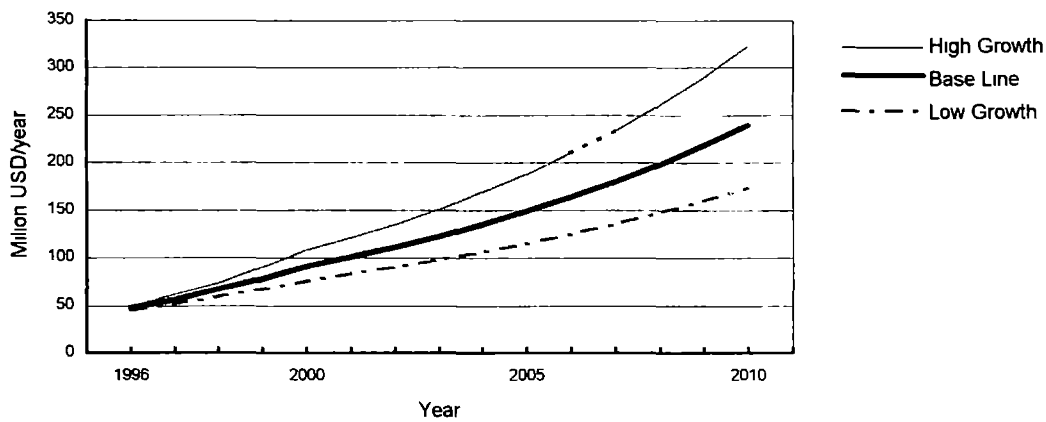


Figure 3-1 Annual capital investment scenarios for sanitation in 1996-2010.

Based on the above assumptions, the total investment in the Sector is projected to be about 2 billion USD in 1996-2010. If the economy is developing faster in terms of investment and production, the combined capital investment in sanitation would be about 2.5 billion USD (High growth scenario). When using more conservative assumptions, the respective investments would amount to about 1.5 billion USD (Low growth scenario). The capital to be allocated for sanitation is very sensitive to the decisions about the share of the Sector in the water supply investment frame. Because the projection is based on the country's economic capacity rather than on a survey of future funding volumes, it cannot include possible financing arrangements by donors.

Should the projected baseline capital investment in sewerage and sanitation be realized, its share of the GDP would increase from 0.1% in 1994 to 0.4% by 2000 and thereafter. The respective percentages out of the gross investment would be 0.5% and 1.2%. These proportions will continue their growth up to 1.5% of gross investment by the end of the period. The projected capital

investment volume will stay at a relatively low level in 1996-2000 because of the present low absorptive capacity of the Sector institutions.

In the beginning of the period, more emphasis is placed on institution building, policy reforms, finance mobilization, and technical assistance in various forms. In later years, when the operating environment has become more conducive for investment, its growth is estimated to be higher than the general investment development of the country.

Table 3-1 Projected capital investment for water sector in 1996-2010

	1996-00	2001-05	2006-10	Total
Sanitation, Million USD				
High Growth	383	763	1,677	2,2467
Baseline	340	617	1,283	1,1956
Low Growth	299	492	964	1,534
Water Supply and Sanitation				
(WSS)	2,148	3,516	6,737	10,830
Baseline Sanitation, %/WSS	16	18	19	18

The rising share of total water supply and sanitation capital investment in the GDP (from 0.9 % in 1994 to 2.3 % in 2010) reflects under investment in previous years. According to the World Bank, public investment of developing countries in water supply and sanitation accounted for about 0.6 percent of GDP [7] in previous years.

3.1.3 Principal Sources of Financing

The estimated major financing sources of the baseline capital investment of about 2 billion USD in 1996-2010 are shown in Figure 3-2.

[7] World Development Report 1992, p 106.

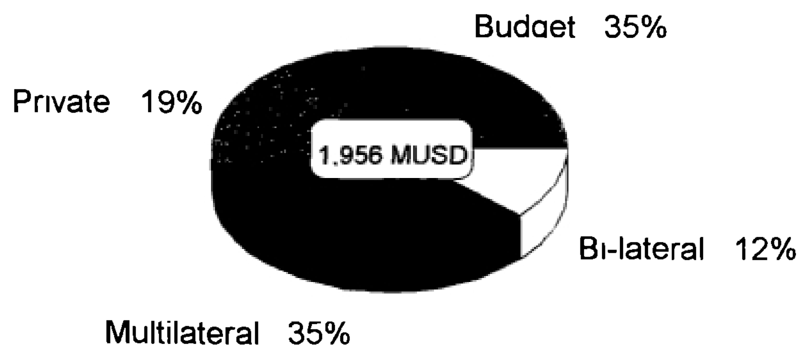


Figure 3-2 Financing sources for sanitation capital investment, 1996-2010.

Budget financing, together with multilateral agencies is assumed to be the major source (70%) for sanitation investments in 1996-2010. During the first part of the period, government financing is required in particular because the mobilization of international funding is usually a lengthy process. Chances for budgetary financing seem to be there, because government has stated as its future investment policy to prioritize the development of infrastructure with a limited revenue base. Multilateral agencies mean in the first place the World Bank and the ADB, which are expected to expand their operations to sanitation and drainage, although they are presently emphasizing more on the financing of urban water supply projects. There are also other agencies and sources like UN-agencies and the European Union, for example, which are potential supporters of the Sector. Some of the external financing limitations are, first, that concessional financing may be tied to procurement from the lending country and, second, that international institutions may undertake only the foreign exchange portion of project financing.

Private sources, 19 % of the financing, consist mainly of informal and formal household borrowings and savings for on-site and neighborhood level investments. Their share will somewhat decrease in later years, because new financing mechanisms will be created utilizing foreign financing sources. The financial Strategy assumes that bi-lateral donors (12%) will provide financing particularly for training, technical assistance, and institution building of the Sector.

Foreign aid priorities were negotiated and agreed upon for the first time at the 1993 Donor Conference in Paris as follows:

(i) there is an urgent need to rehabilitate and expand economic infrastructure;
(ii) to support the social sectors; and

(iii) to strengthen the process of economic renewal and institutional reform.

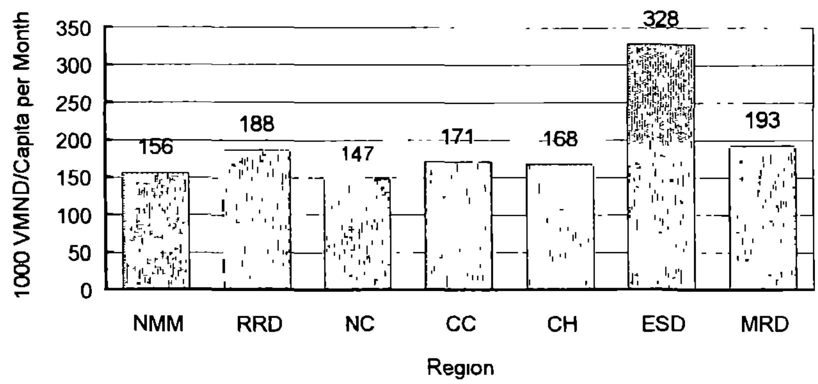
Water sector was in particular mentioned in the government report to the 1994 Consultative Group Meeting:"...donors are ready to provide aid to upgrade water supply system in the large cities, towns, districts and villages, and in some high priority rural and mountainous areas."[8] Expectations of the Strategy for increased financing by donors are therefore justified.

3.1.4 Urban Income Levels

Urban sanitation sector development is a result of a large number of contributing factors. But from the economic viewpoint, the key determinants are (i) local financing capacity for investment and (ii) income levels to pay for the service. Financing capacity for investment is largely determined by the economic base, like the presence of industries, commerce, and services in town, and eventually by the central government. Only if revenues exceed the budgeted expenditures, the local government may then use the surplus according to its own plans. In general, local governments (provinces/districts) in Vietnam have very limited revenue potential and it widely differs within the country.

Figure 3-3 illustrates urban per capita incomes of regions. If excluding East Southland Delta (HCMC), the income differences are small. Compared to North Central with the lowest income levels (147,000 VND/capita/month), the highest incomes of Mekong River Delta are only about 30% above it.

[8] Report of the Government of the Socialist Republic of Vietnam to the Consultative Group Meeting, Paris, 15-16 November 1994, Hanoi, October 1994, page 22



Source. Vietnam's Socio-economic Development, No 2, Summer 1995

Key:

NMM.	N-Mountain & Midland	RRD:	Red River Delta
NC.	North Central	CC.	Central Coast
CH:	Central Highland	ESD.	East Southland Delta
MRD:	Mekong River Delta		

Figure 3-3 Average monthly income per capita of urban households in 1993.

The findings are important for sanitation development as they mean, for example, that the need for differentiation of interest rates of sanitation loans for affordability reasons is rather low. This is not to say that income distributions would also follow the same pattern. In the Mekong River Delta, the combined share of high and "rich" income levels were in 1993 about 18% of the total incomes, but only about 7% in the North Central.

3.2 URBANIZATION AND POPULATION GROWTH

The major impetus for urban development is population growth, which may be from a natural increase through birth or migration from rural areas to urban areas Vietnam's estimated population for 1994 was 72.5 million of which 14.1 million and 57.3 were considered to reside in urban and rural areas, respectively[9].

Urbanization as such requires physical improvements to the infrastructure i.e. water supply, wastewater collection and disposal, electricity supply, telecommunication networks, well developed networks of roads, housing etc. Compared with the present status of this basic infrastructure, the present and future needs for improvements are huge. In order to attract foreign investments, the condition and supply of the mentioned basic infrastructure must be satisfactorily developed and functioning.

3.2.1 Population Growth

Prior to the relaxation of the residence registration system in 1986, the interval migration in Vietnam was mostly controlled by the Government. Nowadays it is easier to find employment and housing without registration. Institute of Economic Research has reported in a recent study that the pace of migration has increased and the share of migrants who register themselves has declined during the past years in Ho Chi Minh City. It is expected that most of the unregistered residents will settle permanently in the cities, and that the spontaneous migration will increase in the future. The consequences and causes of this factor should be addressed in the Vietnam Urban Development Strategy (VUSS).

The population growth trends are drawn from the Draft Vietnam Urban Sector Strategy Study Report. The Report proposes a new way of analyzing the urban composition of Vietnam's population, i.e. both the urban and rural population components for Vietnam's cities, towns, and townlets should be taken into account when estimating the total urban population. This approach is in contradiction with the TOR of NUSS-Study, and on the other hand the technology options for rural districts are in most cases different than for urban districts. Therefore, the demand projections in NUSS-Study are based on the presently used official urban population, and the population growth trends are calculated using the same growth rate scenarios as in the draft VUSS-Study Report, as shown in Table 3-2.

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[9] The *Draft Vietnam Urban Sector Strategy*, September 1995 The population figures do not include military nor police living in temporary quarters

Table 3-2 Population growth rate scenarios by Administrative Unit and Classification.

ADMINISTRATIVE UNIT CLASSIFICATION	GROWTH RATE (%)					
	1993 - 1995		*1995 - 2000*		*2000 - 2010*	
	Low	*High*	*Low*	*High*	*Low*	*High*
Centrally Administered						
Class I	3.0	6.5	3.0	6.5	5.0	6.75
Class II	3 0	6 5	3 0	6 5	5 0	6 75
Provincial Capital-City						
Class II	2.5	5.5	2.5	5 5	4.25	6.0
Class III	2 5	5 5	2 5	5.5	4 25	6 0
Provincial Capital-Town						
Class III	2.0	3.0	2.0	3.0	2.5	3.5
Class IV	4 0	5 5	3.5	5 5	4 5	5 75
Provincial Town						
Class III	2.25	3.0	2.0	3.0	2.5	3.0
Class IV	1.75	2.5	1.75	2.5	2.0	2.5

Based on Draft Vietnam Urban Strategy Study Report

The Low growth scenario is based on the past trend of the urban population growth, and the High growth scenario is the Government's population growth projection.

The urban population of the towns included within the scope of NUSS Strategy (Class I - IV) is projected to increase from the present 10.8 million up to 15.2 - 20.0 million under the two growth scenarios for the year 2010 (Figure 3-4).

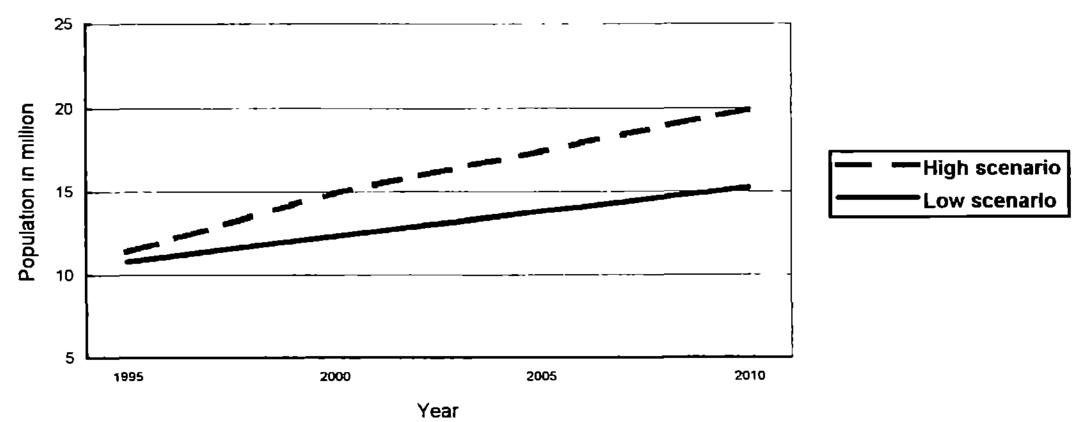

Figure 3-4 Urban population projections of Class I - IV towns, 1995 - 2010.

3.2.2 Wastewater Collection

The present coverage of wastewater collection systems is generally low, varying from 48% in Class I cities to 25% in Class III cities, and in Class IV cities the situation is estimated to be even worse. The combined systems serving the central parts of the cities, mainly built during the French regime, are in bad condition due to aging and poor maintenance. The need for rehabilitation and expansion of the systems is evident and in some cases urgent.

Private households have improved their sanitation facilities substantially since 1989 by replacing dry type toilets with flush or pour flush toilets, and this trend is assumed to continue in the future as well. Management of septic sludge was not done properly in any of the cities visitedmby the Study Team. Thus development and improvement of public sewerage systems and septic sludge collection are eminent; unfortunately financial resources to cope with the needs are limited.

Depending on technology and its coverage, the costs of improving the sanitation situation vary considerably. In order to get a rough idea on the total cost of sanitation improvements for an imaginary situation, where all the present urban population would be provided with a separate sewer and drainage system with secondary treatment, the estimated cost would be approximately 2.5-3.0 billion USD. This is based on the unit costs presented in *Volume 4* and on the assumption that 50% of existing sewerage systems would be replaced. It is obvious that this kind of development is not feasible, and the objectives should be set at an achievable and realistic level.

3.2.3 Estimated Organic Loads

As projected the urban population will increase by 40-85%, depending on the growth scenario. Already the discharges of the present population have caused serious pollution of receiving water bodies in many urban cities. In the future the pollution and deterioration of water resources will expand and become more serious if measures towards the reduction of loads are not taken.

Based on an average per capita discharge of 60 gBOD/day, the estimated production of organic material from urban populations will increase from the present 650 tons/day up to 900-1200 tons/day. These figures do not include organic and chemical loads of industrial wastewaters, which may without treatment cause even higher loads than domestic wastewaters.

3.3 ENVIRONMENTAL AND HEALTH NEEDS

From the environmental and public health point of view excreta and wastewater disposal should be implemented in a way that has minimal negative effect on the environment and human life. The basic technical options are:

(i) on-site sanitation;
(ii) on-site treatment of industrial wastewaters;
(iii) centralized wastewater treatment;
(iv) safe waste water and excreta reuse in agriculture and/or aquaculture; disposal to waters with a high natural purification capacity and low risk to public health; and
(v) a combination of the above mentioned technologies.

In the following sections the needs for improved sanitation are referred only with regard to environmental and public health issues. The economic consequences and implications are estimated in *Section 3.4*.

3.3.1 Present Legislation

The present laws, regulations, and local bylaws state that private people are prohibited from stooling freely on the street, and institutions and industrial enterprises from polluting the environment. Private people, institutions, and industries are requested to construct, operate, and maintain their facilities properly in order to ensure compliance with environmental standards and to prevent and combat environmental degradation, environmental pollution, and environmental incidents.

MOSTE has published the collection of the Provisional Environmental Criteria consisting of 20 standards in 1993. These standards define only concentrations, not allowable total loads for polluting activities, and hardly take into account the local conditions. Consequently, polluters may comply with the standards by dilution. Domestic municipal wastewater standards could be met virtually without treatment during wet season, and by dilution during dry season, with an exception of ambitious coliform limits. On the other hand, the standards for maximum permissible concentrations of toxic chemicals in wastewater are very strict.

As described above and in *Volume 2, Sections 6.1 2 and 6 1.3*, the legislation system gives a good basis for improvements of sanitation, but at the moment public and private compliance of legislation is missing.

3.3.2 Environmental Pollution

Properly planned and managed excreta and wastewater schemes can have a positive impact on the environment. By introducing measures which decrease pollution of surface and ground waters, the environment can be protected from pollution. In this connection, pollution refers to excessive depletion of dissolved oxygen, eutrophication, fish kills, foaming, and chemical deterioration of ground and surface water quality. The need for corrective measures should be determined based on the self purification capacity and its variations in time, and the use of the receiving environment.

At the moment the data on the self purification capacity of the receiving waters in Vietnam is limited. Generally speaking, when effluent of a big city is discharged into a small river, the risk of pollution is much bigger than in the case where a small city or a townlet is located next to a big river with a big flow. It is projected that the total load of domestic wastewaters to natural water bodies will increase from the present by 40-85%. Therefore, the need for proper wastewater collection and disposal is eminent.

A prevailing practice in Vietnam for thousands of years has been to use human excreta and wastewater in agriculture and aquaculture. It is very likely that this custom will continue in areas surrounding most of the urban cities in the future as well. Several studies have shown that excreta application and irrigation with raw wastewater or treated wastewater increases the yield considerably and improves the soil conditions for better crop production. Therefore, strictly from an agricultural and economic point of view, treatment of wastewater is not always needed, and in some cases should not even be favored. (The public health risks are discussed in *Section 3 3 3*.)

The recreational, scenic, touristic, and other values of the environment are very difficult to measure in terms of money, but it is obvious that they increase the need for improvements of urban sanitation. These special needs for sanitation improvements should be estimated case by case.

Thus the Study Team recommends that standards and regulations for effluent discharges should be site specific and be based on the local climatological and hydrological conditions, type of receiving waters and total daily/monthly nutrient loads. The standards based only on concentrations should be avoided. The algorithm for determining the need for wastewater treatment based on the receiving waters, and estimated load is presented in Figure 3-5.

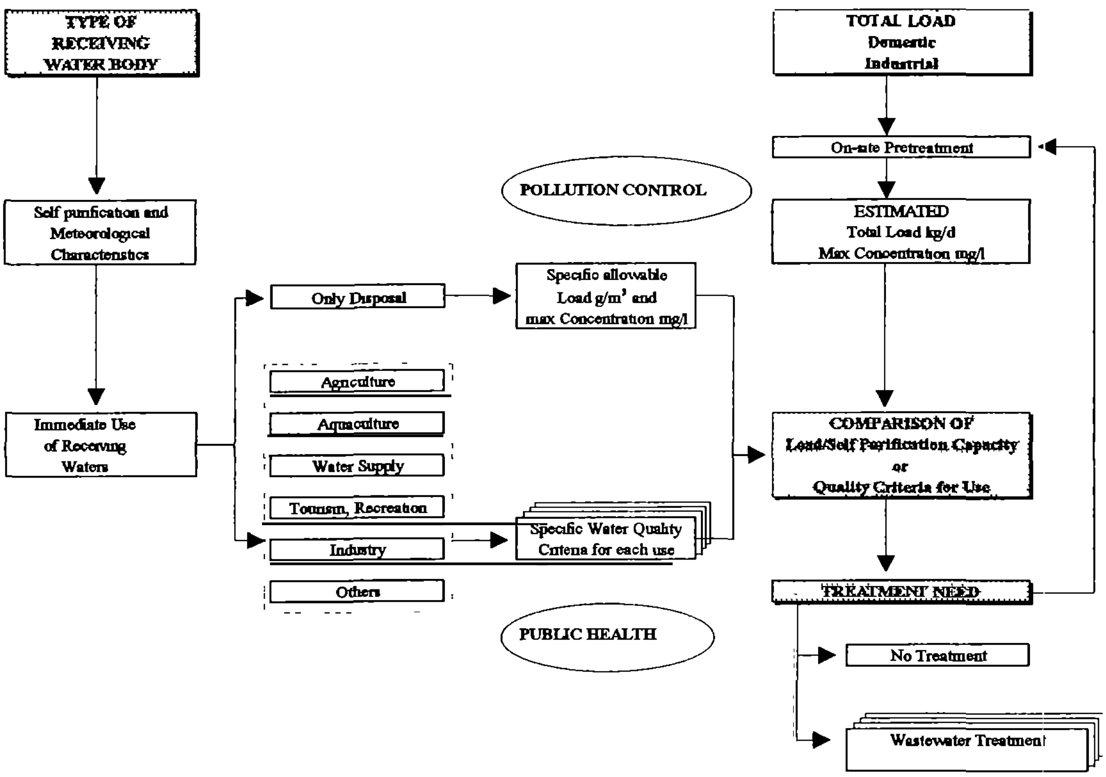

Figure 3-5 Pollution control and need for wastewater treatment.

3.3.3 Public Health[10]

As described in *Section 3 3.2*, the use of excreta and wastewater may have a positive impact on the environment, but on the other hand health risks prevail in these practices. Excreta-related diseases are rather common in Vietnam, especially in areas with low standard of sanitation facilities and habits. An actual risk to public health results only if all of the following become true:

(i) either an infective dosage of an excreted pathogen reaches land/water or the pathogen multiplies in land/water to form an infective dosage;
(ii) the infective dose reaches a human host;
(iii) the host becomes infected; and
(iv) the infection causes disease or further transmission.

If (iv) does not occur, the former steps can only be a potential risk to public health. If this sequence of events is broken at any point, the potential risks cannot combine to constitute an actual risk to public health. Therefore, safe sanitation practices from the immediate environment i.e. household level to final disposal or possible use of human excreta and wastewater should be provided so that routes for possible transmission of pathogens is cut.

The use of flush toilets with septic tanks has increased significantly during the recent years. Septic tanks create their own public health problem if not correctly designed or operated. The anaerobic digestion in tank does not reduce bacteria and virus pathogen levels by more than 50% of influent levels. Soakage fields from septic tanks can create saturated flow conditions through coarse soils to groundwater providing substantial pathogen contamination for human contact via wells which extract from the same groundwater aquifer. In fine texture soils wastewater may not drain vertically, but come to the soil surface increasing health risks.

Septic tanks can reduce eggs, worms, protozoa, and amoeba via settling. However septic tank sludges require periodic collection from septic tanks and correct treatment prior to application to land. Proper sludge collection and treatment systems should be implemented to ensure sanitary conditions prevailent within the reticulated urban area and rural areas where composted or raw sludges are applied to land to improve crop growth.

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[10] This chapter is mainly based on the *Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture*, Duncan Mara and Sandy Cairncross, WHO in collaboration with UNEP, 1989

Excreta Use in Agriculture

In Vietnam more nutrients are applied to agricultural land as organic fertilizer (manure) than as chemical fertilizers. A portion of the used manure is from human excreta origin and it is often applied to rice paddies and agricultural crops before it has been fully composted or treated to remove pathogens and stabilize the nutrient compounds and C:N ratio. This leads to a great deal of pathogen transfer and increased disease risk for workers and people contacting the resulting soil, water, and crops. Composting practices need to be improved to include aerobic methods which create high temperatures in the compost and kill pathogens.

Shuval[11] has reviewed all available epidemiological studies on wastewater irrigation and concluded that:

(i) crop irrigation with untreated wastewater causes significant excess intestinal nematode infection in crop consumers and field workers. Field workers, especially those who work barefoot, are likely to have more intense infections, particularly with hookworms, than those not working in wastewater-irrigated fields;
(ii) irrigation with adequately treated wastewater does not lead to excess intestinal nematode infection in field workers or crop consumers;
(iii) cholera, and probably typhoid, can be effectively transmitted by irrigation of vegetable crops with untreated wastewater; and
(iv) there is limited evidence that the health of people living near fields irrigated with raw wastewater is negatively affected, either directly by contact with the soil or indirectly by contact with farm workers.

Using untreated wastewater to irrigate crops causes a high actual health risk from intestinal nematodes and bacteria but little or no risk from viruses.

The International Reference Centre for Waste Disposal (IRCWD) has reviewed epidemiological evidence on the agricultural use of excreta and concluded the following:

(i) crop fertilization with untreated excreta causes significant excess intestinal nematode infection in crop consumers and field workers;
(ii) there is evidence that excreta treatment can reduce the transmission of nematode infection;
(iii) excreta fertilization of rice paddies may lead to excess schistosomiasis infection among rice farmers; and
(iv) cattle may become infected with tapeworm but are unlikely to contact salmonellosis.

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[11] Shuval, ET AL., *Wastewater Irrigation in Developing Countries: Health Effects and Technical Solutions*, Washington DC, World Bank, 1986.

Aquacultural Use

The IRCWD's findings on aquacultural use were less conclusive than those concerning agricultural use because of the limited quantity and quality of available data. Clear epidemiological evidence exists for transmission of certain trematode diseases, and excreta-fertilized ponds pose a major potential risk to workers. There was no transference of pathogens by fish and aquatic vegetables, although this remains a potential risk as well.

Microbiological Quality Criteria for Irrigation and Aquaculture

Based on the epidemiological evidences concerning agricultural use of human wastes, experts recommended in Engelberg, Switzerland, in 1985, the following guidelines for the microbiological quality of treated wastewater for irrigation use:

Table 3-3 Tentative microbiological guidelines for treated wastewater reuse in agricultural irrigation and aquaculture.

REUSE PROCESS	**Intestinal nematodes**[a] (arithmetic mean no. of viable eggs per liter)	**Faecal coliforms**[b] (geometric mean no. per 100 ml)
Restricted irrigation[c] Irrigation of trees, industrial crops, fodder crops, fruit trees[d] and pasture[e]	≤ 1	not applicable
Unrestricted irrigation Irrigation of edible crops, sport fields, and public parks[f]	≤ 1	≤ 1000[g]
Fish culture	0[h]	$< 10^4$
Aquatic macrophyte culture	0[h]	$< 10^4$

[a]Ascaris, Trichuris, and hookworms.
[b]In fish and aquatic macrophyte culture this guideline assumes that there is one $\log_{10}$ unit reduction in faecal coliforms occurring in the pond, so that in-pond concentrations are < 1000 per 100 ml. If consideration of pond temperature and retention time indicates that a higher reduction can be achieved, the guideline may be relaxed accordingly.

[c]A minimum degree of treatment equivalent to at least a 1-day anaerobic pond followed by a 5-day facultative pond or its equivalent is required in all cases.
[d]Irrigation should cease two weeks before fruit is picked, and no fruit should be picked off the ground.
[e]Irrigation should cease two weeks before animals are allowed to graze.
[f]Local epidemiological factors may require a more stringent standard for public lawns, especially hotel lawns in tourist areas.
[g]When edible crops are always consumed after cooking, this recommendation may be less stringent.
[h]Clonorchis, Fasciolopsis, and Schistosoma consideration need to be given only in endemic areas.

The guidelines are applicable also to agricultural use if excreta, in the form of liquid nightsoil for example, is applied to the field while crops are growing.

Wastewater that has been treated according to the Engelberg quality guidelines for unrestricted use can be used to irrigate any crop, without any further health protection measures. If this standard is not fully met, it may still be possible to grow selected crops without risk to consumers. Some additional measures are needed to protect field workers and crop handlers. Possible measures for health protection are as follows:

(i) treatment of wastewater and excreta;
(ii) crop restriction;
(iii) human waste application methods; and
(iv) control of human exposure.

In each case compliance with the Engelberg guideline and the reuse of wastewater should be carefully considered. For instance, in normal circumstances the compliance with only the helminth guideline would require about 50-70% of land area for wastewater treatment plant compared with the compliance with fecal coliform guideline.

3.4 ECONOMIC BENEFITS

Economic benefits of wastewater collection and sanitation are difficult to estimate accurately. In the following only the economic benefits of improved health and increased crop yields from the reuse of excreta and wastewater are quantified. The calculations do not take into account indirect benefits such as decreased costs of health care, improved nutrition, improved productivity due to improved health situation, or other derived benefits. The calculations are based on the present income level and market values of agriculture products, which may undervalue the real economic benefit due to distorted pricing.

Other benefits such as increased property values, amenities, scenic values, an improved environmental situation, well being etc. are not quantified because their values completely depend on time, location, and mostly on the evaliator. These values have increased considerably in developed countries during the last decades, due to deterioration of the environment, so that big investments for pollution control have been done or are being implemented.

A town with a population of 50,000 inhabitants is used as a basis for comparison of options. The calculations of economic benefits are presented in *Volume 4, Section 1.6.*

For the example town the quantified part of economic benefits of wastewater collection and sanitation vary from 4 to 660 MVND per year, depending on the end products produced. These quantified values are rather small, and those unquantified may be much bigger.

3.4.1 Improved Public Health

The actual public health importance of reuse can be assessed only by determining whether it results in an incidence, prevalence, or intensity of diseases measurably in excess of that which occurs in its absence. If it does not, its public health importance is negligible. On the other hand, if it does, the magnitude of its importance will depend upon the balance between the public health significance of the measured excess incidence, prevalence, or intensity and its public health benefits. Benefits may include

- (i) improved nutrition situation;
- (ii) improved health situation and reduced health care costs;
- (iii) low risk of epidemics;
- (iv) less absence from work and higher productivity;
- (v) etc.

Epidemiological studies to measure the actual excess incidence, prevalence, or intensity of diseases are methodologically difficult; relatively few well designed studies have been carried out. The Vietnamese health statistics clearly show that the incidence rate of sanitation related diseases correlates with service coverage, physical environmental factors, and reuse of incorrectly treated or composted night soil and septic sludge.

Based on limited available data it is impossible to calculate the exact total economic benefit for the provision of different types of sanitation technologies. The rough estimate based on value of lost working time is only 3.5 MVND for a city of 50.000 people i.e. 70 VND per capita per year. This figure does not take into account the indirect economic benefit of health care or risks for any outbreak of serious health epidemics such as cholera etc. The economic losses of those kind of epidemics are extremely greater than those estimated.

3.4.2 Increased Crop Yields[12]

Wastewater and excreta can be treated to meet the Engelberg criteria and thus reduce risk of the transmission of excreta related diseases resulting from reuse. Also system design and precautions can be provided where the Engelberg criteria do not need to be met to achieve low disease transmission risk. The quality of the wastewater itself is not determining disease transmission alone, but also how the wastewater is handled or contacted, that results in disease transmission. A pragmatic approach to improving public health in Vietnam would suggest that urban collection alone will significantly improve public health, and a low level of wastewater pretreatment and land application system will further improve public health compared to in plant treatment or land application system. However, better wastewater treatment prior to land application or reuse may be ideal and practical in the long term.

With proper management of such systems, the crop yields can be increased and environmental pollution reduced. Only the increased crop yields were quantified based on the literature and knowledge on the Vietnamese conditions. The environmental improvements were not evaluated. Similarly, the indirect benefits of improved nutrition, public health, and increased productivity were not taken into account.

Wastewater Reuse in Agriculture

Many studies from around the world show that crop yields are significantly increased by application of wastewater and waste solids. For instance in India long term field experiments showed that irrigation with wastewater produced 28% to 47% higher yields than irrigation with freshwater and NPK fertilizer (Table 3-4).

[12]In this chapter references are mainly made to the book: Duncan Mara, Sandy Cairncross (1989), *Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture*, WHO in collaboration with the UNEP

Table 3-4 Results from long term field experiments on crop yields with different types of irrigation water in India.

Irrigation water	Crop Yields (tons per hectare per year)			
	Wheat	Rice	Potato	Cotton
Raw wastewater	3 34	2.97	23.11	2 56
Settled wastewater	3.45	2 94	20.78	2.30
Stabilization pond effluent	3.45	2.98	22.31	2 41
Fresh water+NPK	2.70	2 03	17.16	1 70
Ratio of Stabil./Fresh.+NPK	1.28	1.47	1 30	1 42

In Vietnam paddies are commonly irrigated with a mixture of fresh water and untreated sewage. Therefore, the yields of rice crops already include some degree of the fertilizing obtained from wastewater irrigation.

Rice crops vary as a result of many factors including, among others, climate, sunlight temperature, pests, fertility of soils, know how, and genetic quality of plants. Based on reported yields of paddies, it is estimated that the economic benefit of the example town is approximately 105-525 MVND/year, which amounts to VND 2,100-10,500 per inhabitant per year or 210-1050 man-months, using the average income of the Haiphong household survey.

Wastewater Reuse in Aquaculture

The mean yield of fish ponds containing Chinese Grass Carp is 3,200 kg per hectare per year, while well managed ponds containing several species of fish can yield up to 7,000 kg per hectare per year. Most of the lakes and ponds in Hanoi receive high amounts of wastewaters, and the mean annual yield in those waterbodies vary from 2,800 to 3,200 kg/ha.

Fish can be successfully raised in the maturation ponds of a series of waste stabilization ponds, and annual yields of up to 3,000 kg/ha have been observed.

The estimated economic benefit of fish farming in the maturation ponds of a town of 50,000 inhabitants is estimated to be 660 MVND/year, which clearly exceeds the estimated O&M costs of a stabilization pond treatment plant.

Excreta Use in Agriculture

Excreta use in agriculture is very common in Vietnam and experience has been gained over thousands of years. It is very likely that these practices will continue near the towns during the design period. Excreta contains nutrients and when added to soil increases the humus and total organic matter content of the soil, which can improve soil structure and waterholding capacity leading to improved plant growth and nutrient retention and cycling.

Experiments in China have shown that with application rates from 15 to 40 tons/ha of excreta-derived compost can substantially increase crop yields: maize 29%, millet 48%, potato 89%, sorghum 85%, soya bean 23%, and wheat 39%.

The economic benefits depending on the cultivated crops can be as follows:

maize (5,000 VND/kg)	**MVND 20 - 50 per year**
soya bean (12,000 VND/kg)	**MVND 20 - 60 per year**
sweet potato (2,000 VND/kg)	**MVND 35 - 100 per year**

This amounts only to VND 400-2,000 per inhabitant per year or 40-200 man-months, using the average income of the Haiphong household survey. This amount is much lower than the other calculated benefits. One of the reasons may be that these crops are not valued by the consumers as much as the other crops. Another reason may be that wastewater supernatant contains high amounts of nutrients, which can be applied to the fields, but are not taken into account in the calculation.

3.4.3 Other Benefits

Amenity impacts such as a clean environment are appreciated for their esthetic values as well as for their positive contributions to human health, productivity, and ecology. The intrinsic value of national, historical and cultural heritage constitutes an amenity value as well.

The existence of a collection system will create favorable conditions for such benefits that are difficult to quantify, such as convenience, increased property values, decreased nuisance problems, etc.

The above mentioned values are difficult to be quantified and they are dependent on personal opinions, time, and location. Some people are willing to forego expenditures on other goods and services to the protect environment and enjoy the benefits of a pristine environment for themselves and for future generations. This has already happened in developed countries where so called "Green products" are widely preferred, although they are more expensive than the "Non-green" products. The NUSS household survey revealed that environmental concerns are arising in Vietnam as well, where people were willing to pay more for a sewer connection with wastewater treatment than without treatment as described in *Section 3.5*.

3.5 HOUSEHOLD DEMAND FOR IMPROVED SANITATION

There are three major reasons why effective demand was investigated during the NUSS formulation. First, the development of urban areas along with national economic policy will increase the need for improved urban infrastructure to support economic activities and to protect the urban environment. Identifying the **prospective demand** for improved sanitation infrastructure **from the perspective of the individual household** is necessary to support national economic as well as urban development policy.

Second, currently the sanitation situation in cities is generally uncontrolled. Urban environments are dirty, a huge amount of household wastewater is discharged into roadside ditches and drains, and local streams are highly polluted. Sanitation improvement projects may be commonly accepted, based on the assumption that everyone needs to have a clean, healthy environment and that an improved sanitation system is a public good; thus, providing even a costly sanitation technology can be justified. However, if users of the provided sanitation facilities prefer low cost sanitation technology and are satisfied without costly technology, this will result in inefficient allocation of scarce resources. Identifying **consumers' preferences and needs** will provide insightful information for efficient use of the resources.

Third, according to the National Urban Development Strategy, one of the objectives for the project is that all households have a proper wastewater disposal system in order to protect public health and the environment. With scarce financial resources within local governmental units, this objective is unlikely to be accomplished. At the same time, the central government lacks the financial resources to provide a complete sanitation system. If individual private households are the major beneficiaries of improved sanitation conditions, the beneficiaries themselves must pay a significant portion of the cost. If improved sanitation services provide substantial public health improvements and environmental benefits, government will have to consider heavy **subsidization** for the public benefit. Estimating how much **consumers value the benefits** (willingness-to-pay) of an improved sanitation system is essential for formulating the financial Strategy.

These three factors imply that in planning a strategy for the future, the conditions of a specific urban locality and the demand of its residents in detail should be integrated into the provision of improved sanitation systems. The approach should be able to incorporate the effective demand concerning who is going to pay for what type of sanitation service, how much, and what might be an adequate level of government subsidy, if necessary. Individual households have their own private needs and priorities for spending. If they are going to pay for a significant portion of the improved sanitation services, then the beneficiaries' opinions and needs should be incorporated into the strategy formulation.

3.5.1 Relative Priority of Sanitation

Approximately 75% of urban residents in Vietnam have already solved their private sanitary problems by installing individual P/F toilets and septic tanks. More than 20% of existing individual P/F toilets in each urban area have been installed during the last 5 years in the studied areas. This increasing trend of installing individual P/F toilets with a septic tank indicates that the demand for improved sanitation has been strong. In the future, those who have not improved their individual sanitation systems may follow the same trends; thus a quick action is needed from the government to make the National Urban Sanitation Strategy as effective as possible.

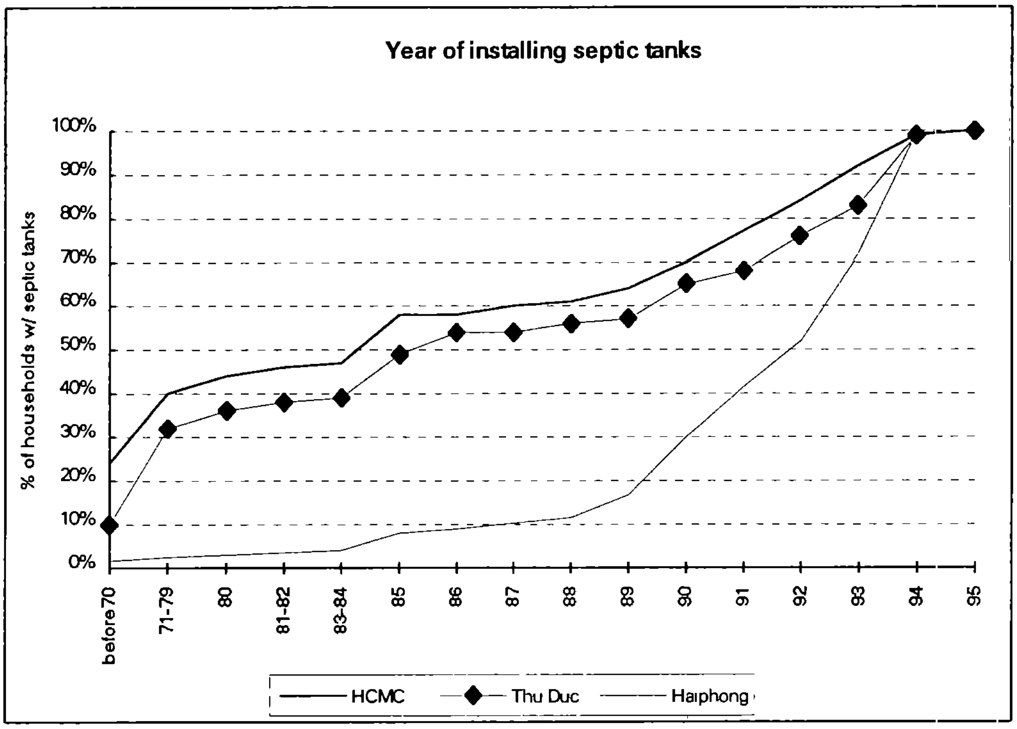


Figure 3-6 Trends in P/F toilet and septic tank installation over the last 25 years in HCMC, Haiphong and Thu Duc.

As shown in Figure 3-6, many individual households in HCMC, Thu Duc, and Haiphong have installed individual P/F with septic tanks since the Housing Census in 1989. In HCMC and Thu Duc, more than 30% of individual P/F toilets were installed during the last five years, and in Haiphong, almost 70% of P/F systems were built during the same time period. Also, in Hanoi, individual P/F toilet users have increased by 20% while users of dry-type latrines have decreased by a similar magnitude for the last three years[13].The

[13] *The Study on Urban Drainage and Wastewater Disposal System in Hanoi City, Progress Report* appendixes (results of interview survey), Feb 1994, Nippon Koei Co., LTD. & CTI engineering Co

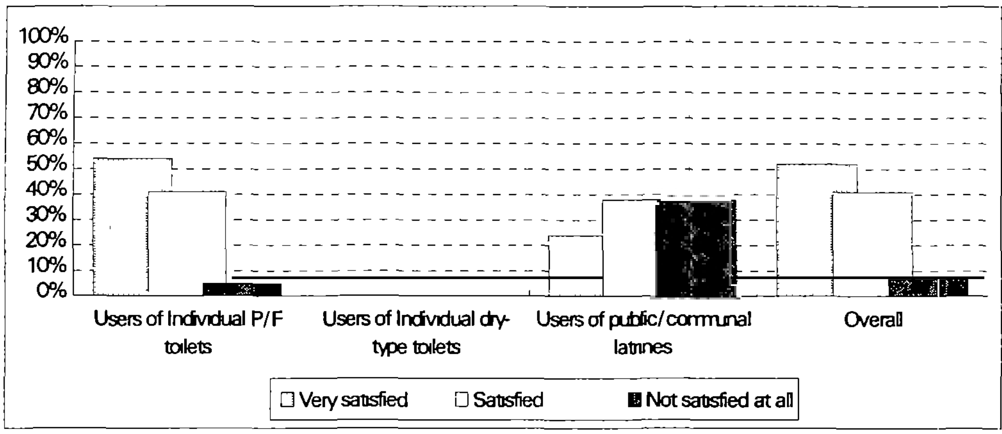
increase in P/F toilet use and the decrease in use of dry-type latrines compared to the 1989 housing census indirectly supports the view that the practice of composting and using nightsoil for agricultural purposes may become obsolete, if not totally abandoned. Both the providers and the users of fresh nightsoil are declining in the larger cities.

Satisfaction Levels

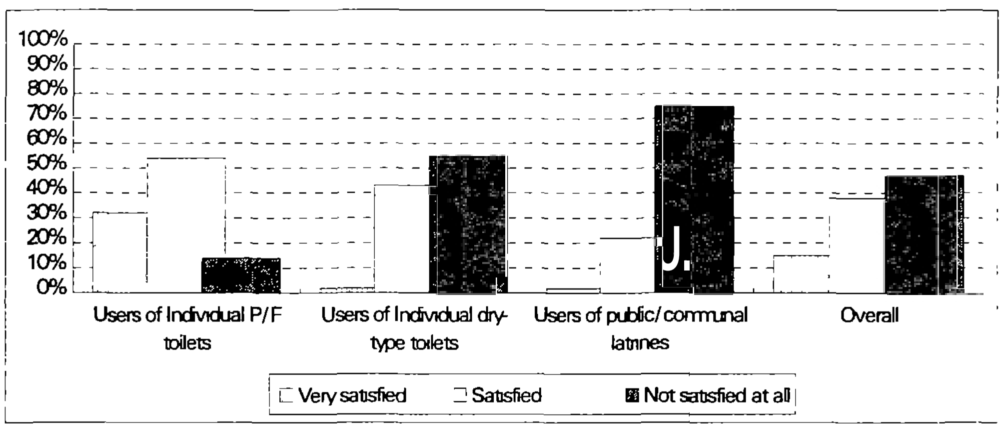
Figure 3-7 (A, B, and C) summarizes satisfaction levels for existing sanitation systems. In all the urban areas studied, the levels of satisfaction of the public/communal latrine users are substantially lower than that of the individual P/F toilet users. While the majority of respondents using public/communal latrines answered that they are not satisfied at all (e.g., over 70% in Haiphong and suburban HCMC, and about one-third in urban HCMC), only about 10% of respondents using individual P/F latrines indicated they are not satisfied at all. As individual households invested a lump-sum for the improvement of their own latrines, they tended to be content with the system, even if the facility might have a negative impact on public health in their area.

LTD , for Japan International Cooperation Agency, and from a small household survey in Hanoi Feasibility Study, 1995

A. Ho Chi Minh City.



B. Haiphong.



C. Thu Duc District.

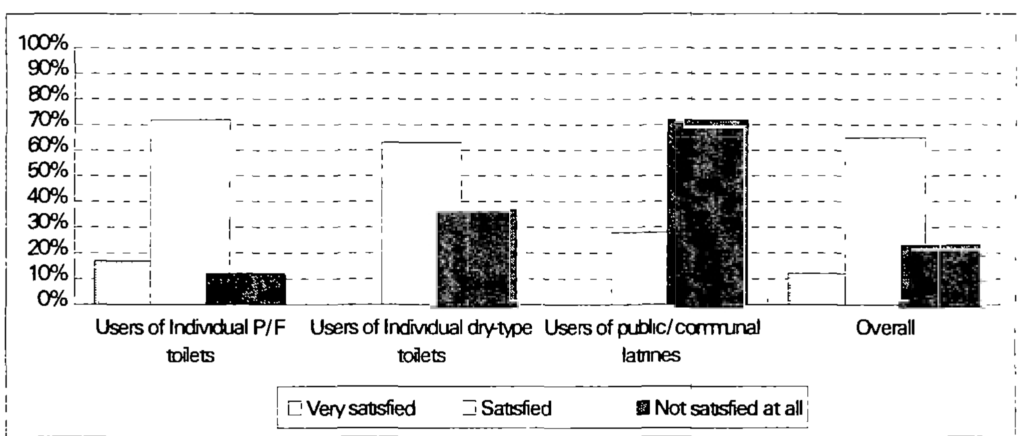


Figure 3-7 Satisfaction Levels for Existing Sanitation Facilities.

Relative Priorities

The relative priority of sanitation improvement compared to other domestic needs at household level was estimated in the NUSS household survey. Figure 3-8 summarizes the domestic investment priorities by each urban area. Within each urban area, the percentages of households who listed each problem as their first investment priority are plotted as a bar chart.

The problem that gets the highest vote for the first priority is different depending on local conditions. However, across all three urban areas, the problem of "installing water tap inside of a house" gets about 20% of votes as the first priority for domestic investment. From both Haiphong and Thu Duc respondents, "renovating toilet facility" gets the highest percentage of votes as the first priority of domestic investment, while from HCMC respondents, it gets only 6% of votes as the first priority. More than 90% of households in HCMC have been using individual P/F toilets, while less than 50% of households in Haiphong and Thu Duc still have to rely on individual dry-type or public/communal latrines. Thus, the residents of an urban area where the P/F toilet is not common would put a high priority on "renovating toilet facility" as their domestic investment concern.

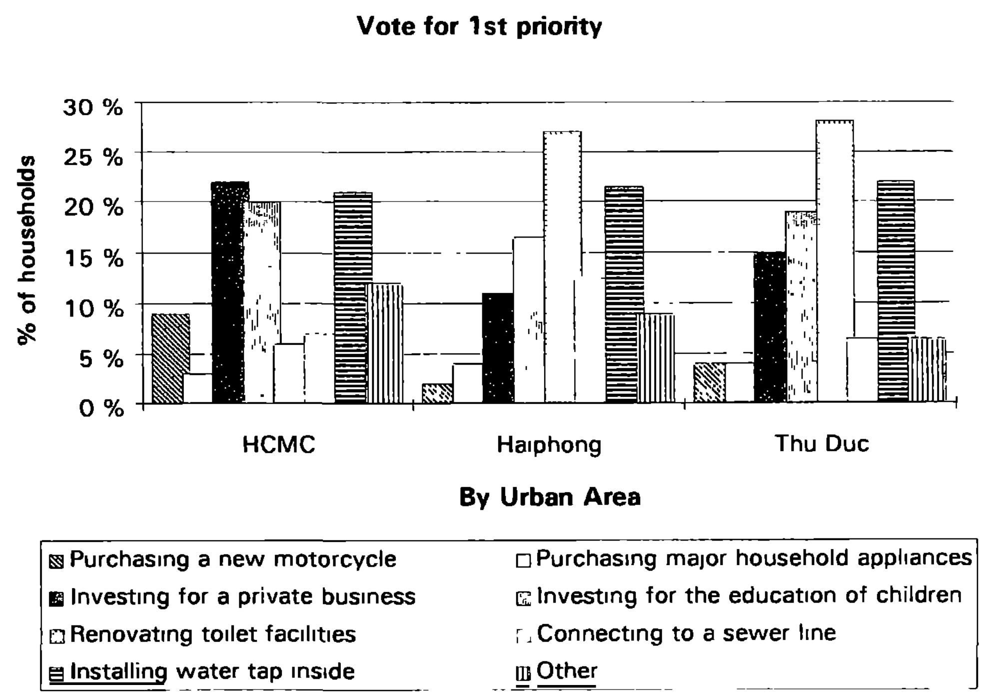


Figure 3-8 Relative Priority of Sanitation Improvement at the Household Level.

As indicated in Table 3-5, compared to the households currently using individual pour-flush toilets, an overwhelming percentage of respondents who are currently using bucket latrines voted for "renovating toilet facilities" as either first or second priorities (66% from the households with private bucket latrine, and 68% from the households with public bucket latrines). This suggests that improving their sanitation system is clearly an important domestic concern for those households with poor sanitary conditions.

Table 3-5 Priority given to "Renovating toilet facilities" by current sanitation conditions

		At the current sanitation condition.......		
Current sanitation condition	**No. of households** in each sanitation condition	% of respondents which voted the renovation of toilet facilities as their **first priority**	% of respondents which voted the renovation of toilet facilities as their **second priority**	**Total** (vote for either 1st or 2nd priorities)
Individual bucket latrine	53	43%	25%	68%
Individual P/F toilet	312	15%	13%	28%
Public bucket latrine	218	39%	27%	66%
Public P/F latrine	118	25%	23%	48%
Total	*701*	*26%*	*20%*	*46%*

3.5.2 Environmental Attitudes

Figure 3-9 shows the percentage distribution of the first priority votes indicated by respondents from a list of eight environmental problems. Respondents' top environmental concern in all three urban areas was "ground water contamination due to lack of sewer system". The general tendency seems to be that the lower the percentage of respondents relying on a private water connection in an urban area, the greater the number of respondents who voted for the ground water contamination concern as their first priority. Less than 45% of sample households in Haiphong and Thu Duc have a private water connection, while more than 70% of those in HCMC use a private tap.

The next two priorities were "air pollution" and "surface water pollution." Though over one-quarter of the respondents in the Haiphong survey experienced flood damage during the last year, flood control received only 17% of votes for water as the first priority. Also in HCMC and Thu Duc, "flood control" gets less than 5% of first priority concern, though more than 30% of respondents had experienced flooding during the past year. This distribution confirms that people generally prefer a separate sewer system to a combined sewer service.

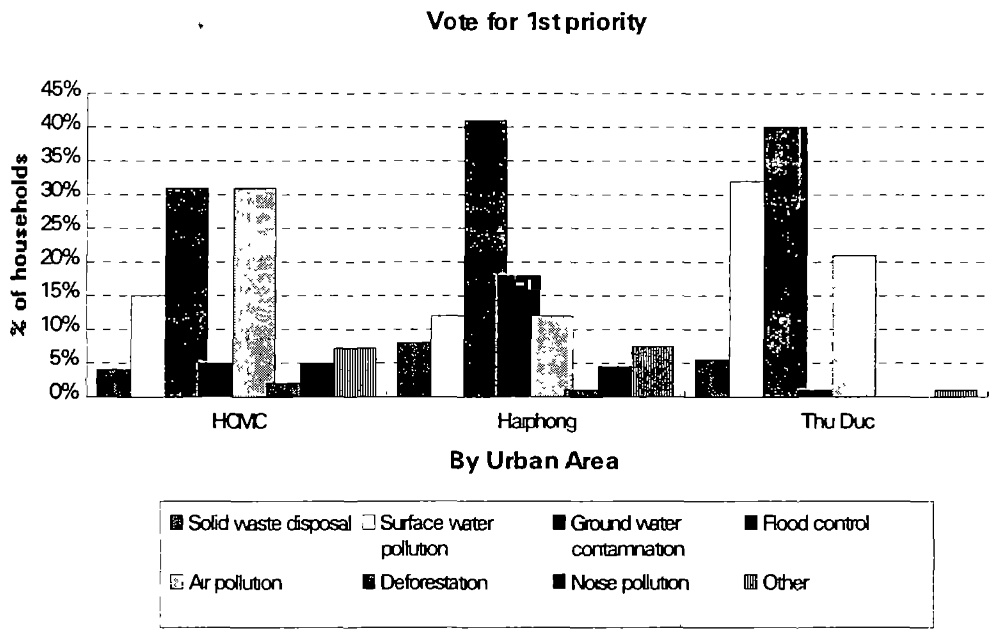


Figure 3-9 Environmental Priorities.

"Air pollution" gets the highest vote (30%) of first priority from respondents in HCMC, but not in other urban areas. The percentage of votes for "deforestation" were minimal in all the urban areas. These facts reflect that the respondents in the surveys carefully considered their environmental problems according to the current environmental conditions of their own residential areas.

Overall, these patterns suggest that respondents carefully considered environmental conditions, given that the "ground water contamination due to lack of a sewer system" was considered as the uppermost environmental problem. These environmental attitudes are consistent with respondents' preference for a separate sewer system.

Awareness of Health Environment

The respondents were aware of the health risks of poor sanitation, but rarely connected improved sanitation with improvement of health conditions in a practical sense. It is also observed during the surveys that individual respondents are aware of "what they should be doing to have a clean health environment"; but, it does not mean that "what they are actually doing in practice to make the environment clean". Therefore, the public communication support component should emphasize the connection between "knowledge and practice".

3.5.3 Quantity Demanded and Willingness to Pay

The effective demand can be defined with two terms; (1) quantity demanded: how many households want to have improved sanitation systems, and (2) economic values-WTP: at what price households would pay for the service. Since the demand estimate is mainly based on three urban areas, effective demand for improved sanitation services would vary depending on the characteristics of individuals and on the conditions of the urban areas. Acknowledging these constraints of the data, the major objective of this discussion is to show the ranges of effective demand and how to incorporate WTP data into a sanitation improvement strategy.

Approximately 70% of urban households in Vietnam valued the benefits of improved sanitation facilities by revealing their positive WTP amount, which was normally greater than their current spending for existing sanitary conditions.

However, the estimated average WTP is only 1% (at most 1.5%) of monthly household income. In the first and second class cities, average WTP as the percentage of income is closer to 0.8% than to 1.0%. In the third and fourth class cities, the average WTP amount seems to be lower (0.6% to 0.8% as revealed in the demand for improved drainage service) than that in the first and second class cities. However, 0.1%~0.2% of income differences across the different level of cities can only be stated as the general tendency of lower WTP amount in the lower class cities, and the percentage differences are not intended to provide the precise estimation here.

The results of household surveys in HCMC, Haiphong, and Thu Duc are summarized in Table 3-6. Though the results only reflect the demand situation in these three urban areas, and not for the whole nation's urban areas, in general, 1% of income seems to reasonably reflect the overall WTP amounts for national urban sanitation improvement. Other existing studies support the view that the average WTP is not more than 1% of household monthly income.

Table 3-6 Summary of Average WTP Bids and Quantity Demanded for Various Types of Improved Sanitation; at the Household Level (VND/month)

	Average WTP bid and % of positive WTP responses for the...				
	on-site improvement of....			**off-site improvement of....**	
Users of	public/commu-nal latrines with a shared septic tank	individual P/F toilets	individual septic tanks	a sewer line connection	a sewer line with a treatment plant
P/F individual toilet	-	-	-	12,000 (60~90%)	16,000 (75~90%)
Dry-type individual toilet	-	8,000 (70~85%)	4,000 ~ 5,000 (70~85%)	10,000 (80~90%)	-
Public/communal latrine	11,000 (90%)	17,000 (60~90%)		9,000 ~ 12,000 (80~100%)	-

At the city level, the demand for improved sanitation services range from 60% to 95% of the sample respondents. These percentage differences could be influenced largely by the existing types of major sanitary facilities in a city, priorities in environmental concerns or domestic concerns, and household income level, among many other factors. A detailed investigation at the city level is thus necessary before implementing a project at each locality.

At the individual household level, the differences in WTP amounts for the various alternative options are rather small in absolute terms.

Based on the surveys the effective demand for **on-site improvements** can be summarized at the household level as follows:

(i) Improving dry-type public/communal latrines to P/F type: 90% of the public/communal latrine users were willing to pay an average of 11,000 VND/month/hh;
(ii) Upgrading a private dry-type latrine into a P/F with a septic tank: 70% to 85% of the individual dry-type toilet users were willing to pay 12,000 to 13,000 VND/month/hh; and
(iii) Installing new individual P/F toilet (either connecting to a shared communal septic tank or a private septic tank): 60% to 90% of the public/communal latrine users were willing to pay 17,000 VND/month/hh

The WTP amount for a separate sewer is greater than that for a combined sewer. Also, survey results show that people prefer a separate sewer system to a combined sewer. Also, survey results show that people prefer a separate sewer system to a combined sewer This preference is consistently represented by their environmental concern about reducing ground water contamination by developing a separate sewer system. Flood control gets very little attention at the household level, though more than 30% of the respondents had experienced flooding during the last year. This distribution confirms that people generally prefer a separate sewer system to a combined sewer service.

In the third and fourth class cities, the demand for improved drainage service was high (over 70% usually), but the percentage of households willing to pay over 10,000 VND per month was very low (less than 20% in general) The NUSS should consider on-site improvements for the lower class cities, since the subsidy for public environmental problems may be less justifiable in the lower class cities than in the first and second class cities.

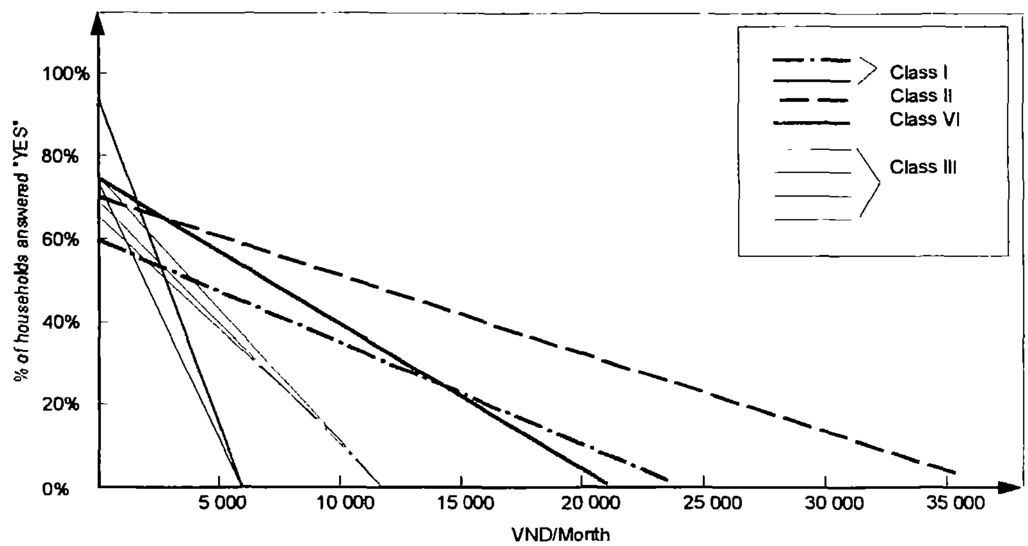


Figure 3-10 Demand for improved drainage service by city classification

Based on the surveys the effective demand for **off-site improvements** can be summarized as follows:

(i) connecting to a sewer line: approximately 60% to 90% of the sample respondents were willing to pay 9,000 to 12,000 VND/month/hh; and
(ii) connecting to a sewer system with a wastewater treatment plant: 75% to 90% of the individual P/F toilet users were willing to pay 16,000 VND/month/hh.

4. SECTOR OBJECTIVES

Based on the developments and experiences of industrialized countries and other countries in the region it can be stated that considerable improvements in sanitation will happen only after the national economy and people's affordability has reached a certain level, and at the same time, when awareness of public health and environmental concern have developed to an extent that there is an effective demand for sanitary improvements. The development of Vietnam's economy, after recent reforms, will create favorable conditions for the change of people's values and desires for a healthy and clean environment.

From the point of view of sanitation, urban areas should be developed with consideration of the environment to protect the environment and to provide good standards of living for the inhabitants of the towns and areas affected by the effluent discharges. The main objective categories of national sanitation are as follows;

(i) Service Coverage;
(ii) Environmental Sustainability; and
(iii) Economic Sustainability.

These objectives are very general and the targets can be set at different levels. The development objectives will determine the ultimate goals of the Sector, therefore, all short and medium term objectives and activities should support the achievement of the long term development objectives.

The set objectives of the Sector are based on the present status assessment of the Sector and development alternatives, which are discussed in more detail in *Volumes 2 and 4*. The objectives are quantified and the achievement of the set targets have been set on an obtainable time frame based on projected development of the national economy. The targets have been set for three periods, namely short term objectives for the period of 1996 to 2000, medium term objectives for the period of 2001 to 2010, and long term development objectives after year 2010.

4.1 DEVELOPMENT OBJECTIVES

Uncertainties in the development of national economy may either speed up or slow down the pace of implementation of the Strategy, but the development objectives should basically remain unchanged. Some minor adjustments may be done in the course of time. The development objectives for the period after 2010 are as follows;

Table 4-1 Development Objectives of the Sanitation Sector

KEY OBJECTIVE	*RESULT OBJECTIVE*
Service Coverage	1. All urban households have appropriate and affordable sanitation facilities 2. Public sewerage coverage is 80-90%. 3. Urban sanitation utilities provide their clients with efficient and cost effective services
Environmental Sustainability	1. Enforcement of laws and regulations, and monitoring of water resources is carried out according to the standards of the other countries in the region 2 Improvement of quality of water resources to an acceptable level 3. All industrial wastewaters meet acceptable effluent quality standards before discharge to a public sewerage systems
Economic Sustainability	1. The "polluter pays" principle is implemented. 2. Full cost recovery with a positive return on net fixed assets from wastewater service charges 3 The sanitation systems are effectively operated and maintained throughout their economic lifetime. 4. Conservation of natural resources through water use minimization and reuse

4.2 MEDIUM TERM OBJECTIVES

The last years of 1990's will pave the way for the medium term objectives. It is estimated that the construction of sewerage systems will speed up significantly during the first years of next century and therefore the objectives are more implementation oriented, and based on the capacities built up. The medium term objectives to be achieved by the year 2010 are:

Table 4-2 Medium Term Objectives of the Sanitation Sector, (2001-2010).

KEY OBJECTIVE	*RESULT OBJECTIVE*
Service Coverage	1. Service types and coverage of sanitation are **in I&II Class towns** * 50-60% of all urban households are connected to sewerage and drainage systems * 10-20% of all urban households are connected to separate sewerage, no drainage * 15-20% of all urban households are using on-site facilities * 10-15% of all urban households are using communal or public sanitation facilities **in III&IV Class towns** * 30-40% of all urban households are connected to sewerage and drainage systems * 10-20% of all urban households are connected to separate sewerage, no drainage * 30-40% of all urban households are using on-site facilities * 10-15% of all urban households are using communal or public sanitation facilities
Environmental Sustainability	1. Stop environmental deterioration outside urban areas caused by wastewater effluents. 2 Septic sludge is treated and disposed of in a way that it guarantees public health, environmental standards, and reuse of nutrients when feasible
Economic Sustainability	1. All utilities have adopted appropriate operating objectives and modern financial management systems. 2. In the beginning of the period, all utilities have taken into use a cost effective and affordable tariff and revenue collection system 3. The financial status of the Sector in capital budgeting has been raised to corresponding investment requirements and respective water supply development in urban areas. 4 Internal financing capacity of sanitation utilities has been raised as follows, a) The revenues of utilities in I&II Class cities cover O&M, the debt service, and a positive return on net fixed assets b) The revenues of utilities in III&IV Class cities cover O&M and the debt service 5. Maximal utilization of private sector in supplying sanitation services under local/provincial government regulations

4.3 SHORT TERM OBJECTIVES

The short term objectives are mainly strengthening the capacity building for the future developments. As estimated in *Section 3 1.2* the funds available for investments are limited, therefore, substantial investments on sewerage systems are not expected before year 2000. Actual improvements in sanitation situation will continue to be at the private household level, and the Government's objective should be to build up the capacity to cope with the urbanization and industrialization process of the country. The short term objectives to be achieved by the year 2000 are:

Table 4-3 Short Term Objectives of the Sanitation Sector, (1996-2000).

KEY OBJECTIVE	***RESULT OBJECTIVE***
Economic Sustainability ◆ **Reorganization** ◆ **Priority of Sector** ◆ **Financial Management** ◆ **Cost Recovery** ◆ **Funding Mechanisms** ◆ **O&M Capacity**	1. Reorganization of the Sector administration is completed 2. The Government has determined the financial objectives and responsibilities of utilities as well as their status among the state owned enterprises 3. The Sector has been explicitly named in the Government budget for capital expenditure, infrastructure development (PIP), and foreign assistance planning. 4 The national policies and guidelines for sanitation tariff setting, incentives, and cost recovery have been prepared and approved by authorities 5. Long term commitments for sanitation sector financing by donors and multilateral agencies have been negotiated with plans for domestic financing mobilization 6 Sector utilities have been adjusted (and computerized) to conform with the new national system of accounts, modern financial, and asset management capabilities 7 New funding mechanisms with operating policies and procedures for private and public sanitation system development have been established 8 O&M capacities of the utilities have been raised to prevent further deterioration of the systems 9 New building permits and connections to public sewerage are subject to a sanitation fee to cover actual costs
Environmental Sustainability ◆ **Enforceability** ◆ **Waste Disposal Management**	1 Enforceable environmental standards have been established 2. MOSTE's capacity to control environmental pollution has been raised to cope with country's industrialization process 3 EIA procedures are implemented in an efficient way, in terms of potential risks as well as available resources /...

Service Coverage ♦ **Rehabilitation** ♦ **Implementation**	1 Rehabilitation needs of existing systems have been estimated and the most urgent rehabilitation has been carried out. 2. Regular septic sludge collection is arranged for every household in urban towns (Class I-IV) 3 Sanitation and Sewerage Master Plans are updated and coordinated with overall city plans in all class I, II and III cities 4 Sewerage collection systems are constructed in new streets and development areas before house construction 5 Technical and institutional alternatives for upgrading sanitation in built-up areas have been tested in pilot scales and replicable approaches developed

5. STRATEGY FORMULATION

The National Urban Wastewater Collection and Sanitation Strategy (NUSS) is one of the macro level strategies to support the Urban Development Strategy for Vietnam. The other macro level strategies, which are related to NUSS, will be prepared or are already done for the following fields; Housing, Water Supply, Environment Protection, and Urban Management and Finance.

One of the objectives of the NUSS-Strategy preparation is to cooperate and support the other mentioned strategies in order to facilitate consistent and balanced national urban development for the forthcoming decades.

During the formulation of the Strategy the Study Team has taken into account the existing low priority of the Sector compared to other sectors and the need of development of other infrastructural sectors as well.

The present systems were to a large extent destroyed by systematic neglect, aggregavated by under-investment, and O&M and construction of new public sewerage systems have got very limited resources. The capacity of the Sector has considerably declined from the past. In late 90's the proposed Strategy aims to rebuild the Sector Capacity and develop public demand towards sanitation improvements, and in later phases. The actual goal is implementation of the sanitation improvements.

The key components of the demand oriented approach based on capacity building are;

(i) Defining roles and responsibilities of the Sector Agencies;
(ii) Policies and legal framework;
(iii) Human Resources Development (HRD);
(iv) Financing of sanitation improvements;
(v) Community participation in already built-up areas;
(vi) Cost sharing and cost recovery; and
(vii) Technology selection.

5.1 APPROACH

5.1.1 Capacity Building

The traditional approach of the water supply and sanitation improvements focuses on the delivery of a mostly technical output through short term implementation projects. They are normally commenced from an **assumed** need. The World Bank's Operations Evaluation Department[14] has concluded that poor institutional performance is the most frequent cause of failure both in water supply and sanitation and irrigation subsectors. A common barrier to good performance in Bank projects during 1980 -88 was institutional weakness and, more particularly, the lack of organizational capacity and staff skills. The proportion of projects which face institutional problems has increased from 30% to 60% during this period.

The **supply orientated** approach, where initiatives and activities are implemented by higher levels not taking into account the local situations and needs, has also been practiced in Vietnam (Figure 5-1). The principle of the Government has been to supply basic commodities, including water supply and sanitation, with a subsidized cost to all citizens. The involvement of beneficiaries has in most cases been limited to self help or periodical collection of fees for repairs and O&M. In this case water supply and sanitation are mainly considered to be the responsibility of the government. Often service levels have been poor and irregular and therefore payments have been neglected, resulting in even poorer financial performance of the utilities. This supply orientated strategy has been common in other countries as well.

Increasingly the restrictions for sector development are no longer lack of availability of appropriate technologies nor lack of financial resources for investments, but in many cases the limited capacity of countries' institutional framework to absorb loan and grant funds and convert them into sustainable projects. Vietnam is presently experiencing a boom of foreign investments in the water supply sector and there are signs of lack of experienced and qualified professionals to cope with the new situation.

Developing enabling environments and individual institutions on the scale of a sector or subsector is called **capacity building**. The approach of the NUSS-Strategy relies on capacity building which involves developing of institutions, their managerial systems and their human resources, which in turn require favorable policy environments. This approach is illustrated in Figure 5-2.

[14] Conference on *"Institutional Development and the World Bank"* in December 1989

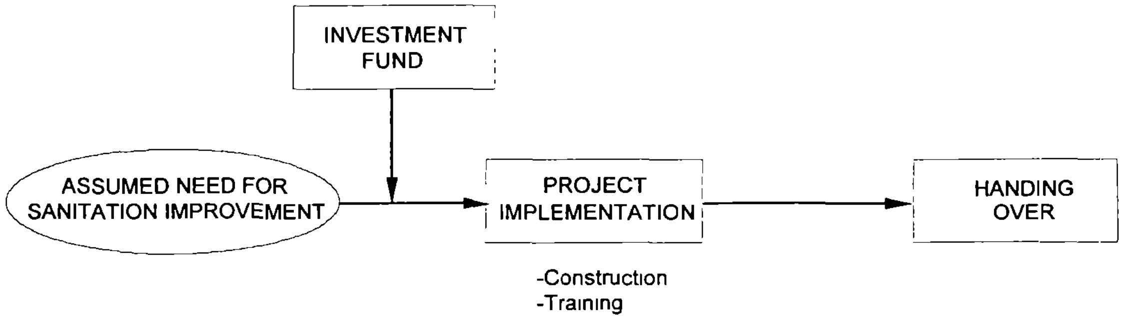


Figure 5-1 Traditional short term project approach.

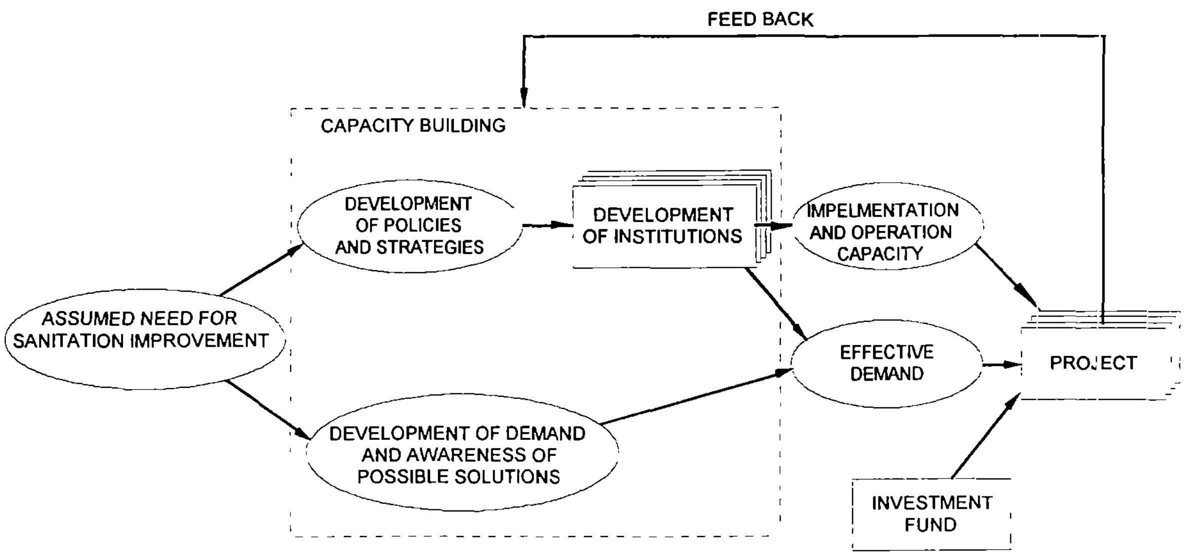


Figure 5-2 Long term capacity building approach for project implementation.

Sustainable improvements can only be achieved if (i) technical solutions are appropriate, (ii) the institutions are capable to meet the present and future needs, and (iii) the beneficiaries understand the benefits and accept their responsibilities for the systems. In this case the sanitation improvements are derived from **effective demand** of the beneficiaries.

When assessing the possibilities for sustainable results of sanitation improvements, the involvement of beneficiaries in the whole project cycle is very important, especially in already constructed housing areas with non-existent or partially developed sewerage systems. In new housing areas the preconditions for building permits and their effective enforcement may lead to a sustainable result. This is based on two assumptions, that (i) the beneficiaries accept the set regulations before making a decision to construct their house in the specific location, and (ii) beneficiaries are satisfied with the provided service.

One of the main principles of the implementation of the proposed Strategy is that general policies and regulations should be set by higher authorities (ministry and provincial levels), and the realization and decision making for suitable technologies and approaches should be decentralized to the level concerned.

5.1.2 Principles

Derived from the objectives defined in *Section 4*, the ten principles elaborated below form the basis of the Strategy recommendations of the Study Team. These fundamental principles are:

(i) sustainability;
(ii) replicability of approaches and affordability of technologies;
(iii) demand-orientation;
(iv) focusing of priority measures on new development areas;
(v) enforcement of legislation and regulations, and improving enforceability of regulations
(vi) involvement of private and community resources in planning, implementation, and operation;
(vii) decentralization;
(viii) maximum reliance on existing institutions;
(ix) clear responsibilities and roles of various parties involved; and
(x) efficient use of human resources.

The first four principles are the Study Team's proposals for general approach, and the remaining six are their direct institutional implications. Each of the above principles is elaborated below.

The requirement of **sustainability** of the achievements is one of the most essential preconditions for any feasible development effort, as learned by experience during the last decades of development cooperation. Achievements are sustainable when they do not need to be (essentially) supported by external inputs once they have been commissioned, and sustainable facilities operate for the benefit of their users throughout their economic and technical life cycle. Sustainability, therefore, calls for adequate operation and maintenance and, consequently, sufficient financial, human and other resources to facilitate this. Typically, sustainable operations are financed by their users. A key element contributing to sustainability is a strong feeling of ownership, involving both utility staff and customers.

Replicability of approaches and affordability of technologies means that projects require only such inputs and resources which are available also for large-scale implementation. Consequently, meaningful pilot and priority projects should not benefit only their immediate target groups and/or privileged priority areas, but they should, particularly, provide experimental knowledge of the applicability of approaches and technologies for large-scale replication. Typical excessive inputs, which limit the replicability of projects, are overly extensive promotion and marketing, technologies based on locally non-available components and spare parts, reliance on continuous external assistance, and excessive subsidies. Replicable technologies need to be affordable. They may not need to be entirely afforded by their users; reasonable subsidies or cross-subsidies could be applied if they were affordable to the respective local or central governments.

Demand-orientation emphasizes initiatives of the users of products or services. Supply is to respond to the demand. Consequently, prioritization of sanitation versus other sectors and services depends on the willingness of users or clients to allocate their resources to this purpose, and on the pressure from the people on the decision-makers. Demand-orientation is a fundamental element of the market economy, and calls for flexibility and responsiveness in planning and provision of services. In essence, demand orientation reduces the power and even importance of planning and government resource allocation, but sets high requirements for policies, regulations, and enforcement. The householders' willingness to pay for sanitation improvements, other than those improving the living standard within the household, is presently low in comparison with the estimated ability to pay, only about one third. However, the Study Team believes that it is possible to increase the demand closer to the ability to pay by promotion, and even by regulations and enforcement.

Focusing of priority measures on new development areas is an implication of the above principles. The Study Team considers that it is much easier and more cost-efficient to tackle the sanitation issues in new areas than in already built-up areas, especially from an institutional point of view. Land developers, investors, and householders who can afford new construction, should afford reasonable investment in appropriate sanitation in their immediate surroundings plus a fair share of larger urban infrastructure. Consequently, sanitation investments could be mobilized and implemented with lower share from the central and local governments' investment. Focusing on new development areas would also have technical and environmental merits. The key instruments of the authorities in new development areas would be building permit regulation and enforcement.

There are already many laws and regulations which could contribute to the improvement of the sanitary conditions, but they are weakly enforced, because of overlapping regulations, weakly defined penalties, inappropriate environmental standards, etc. The focus should be on **enforcement of**

legislation and regulations before developing new laws and regulations. Basically, laws and regulations which are not enforced simply reduce the citizens' confidence in the legal system. On the other hand, laws and regulations need to be enforceable; with adequate details for enforcement and penalties, and clear with well-defined responsibilities for enforcement, monitoring and other measures. It is, therefore, worth paying attention to **improving enforceability of regulations.**

Involvement of private and community resources in planning, implementation, and operation has often proved to be a precondition for sustainable achievements. In fact, private and community involvement should be understood as an integral element of the market economy system. However, planning procedures even in typical market economies have often lacked this element and, consequently, suffered from low commitment. When given a possibility to participate, people and organizations are believed to be better motivated and more deeply committed to the achievement of objectives. This contributes to further mobilization of community and private resources (financial, human, etc.) to implementation and operation.

An institutional implication of the sustainability policy as well as the demand-orientation policy above is the policy of **decentralization**. It is anticipated, and usually proved, that the shorter the link between the users and suppliers of services and goods, the better is the supplier's understanding of the client's needs and expectations, and the better is the communication between the client and the supplier. The operation of utilities, including wastewater and waste utilities, has been decentralized to the provincial/city level in Vietnam. The Study Team considers this an obvious advantage. On the other hand, project preparation and approval procedures have a strong tendency of centralization of the decision-taking to the central level.

The Study Team is very critical about proposing any new institutions to assume key roles in the sub-sector, and recommends **maximum reliance on existing institutions**. There are already more than 20 ministries in Vietnam, and there are also an abundance of provincial and lower level local bodies who have or wish to have a say in sanitation. Whenever possible, tasks are proposed to be incorporated into existing organizations and institutions. New institutions would possibly have a relatively junior status, and it would take some time to develop their power and credibility.

Clear responsibilities and roles of various parties involved are an essential precondition for effective and efficient sub-sector development. The transition from the subsidy economy to the market economy calls for redefinition of responsibilities and tasks, and the public sector should change its role from the supplier of goods and services to the facilitator and supervisor of the development. Organizations as well as individuals have to adapt to this change that brings along requirements for responsiveness and flexibility, and also insecurity.

The Study Team addresses the impacts of the transition on the human resources. It is likely that the breakthrough of the market economy in Vietnam will increasingly affect the availability of human resources. Particularly the public sector organizations in the sanitation sub-sector have to develop very **efficient use of human resources**. The public sector in general is at high risk of being exploited as a source of skilled and semi-skilled labor. The competition is anticipated to be stiff also between sanitation and other sectors (especially because of the low social status of sanitation), and between developed and less developed areas. Higher efficiency of human resources is needed to improve the incentive system in the sub-sector, and to make full use of the limited qualified resources.

5.2 INSTITUTIONAL STRATEGY

5.2.1 Delegation of Responsibilities

Based on the demand-driven policy, provision of services in the sanitation sub-sector, as well as in other sectors, needs to respond to the needs and demand of the users of the services. Experience gained throughout the world, in developed as well as developing countries, clearly suggests that organizations and institutions that are as close to their clients as possible are more responsive to the clients' expectations than more remote organizations. In general, the link between the client and the supplier should be short in order to provide a sound basis for close communication and good understanding of the perceived needs. There are, however, factors limiting the degree of **decentralization**. They include, inter alia. economy of scale, number and capability of human resources, and technical quality of implementation and service.

Similarly, services and goods are usually more efficiently and responsively provided by **private sector** organizations than their counterparts in the public sector. Competition between suppliers is supposed to maintain the quality of goods and services high and the prices low. However, this mechanism does not apply to such situations where the competition is non-existent or restricted, for example in the provision of piped water supply and sewerage services within certain localities.

The administrative system of Vietnam is largely based on the high degree of decentralization of operational responsibility to the 50 provinces and the three cities (Hanoi, Ho Chi Minh City and Haiphong) directly under the central government. This is quite exceptional among developing countries, and a very strong advantage in the development of wastewater collection and sanitation in the urban areas in a demand-oriented way. On the other hand, there are still many opportunities to further decentralize duties and tasks now assumed by central level organizations, thus improving the efficiency of sector development.

As an implication of the demand-driven policy, emphasis in the institutional consideration of the proposed Strategy is in decentralization of activities from the central level to the local level, and from the public sector to the private sector. However, there are many responsibilities that cannot reasonably be decentralized (see a list of functions proposed to be centralized in *Section 5.2.2*). Decentralization also creates new needs for the central level and public sector. They must take measures to regulate and control the local and private sector activities. Furthermore, the human resources requirements in a decentralized model are much higher in terms of number, and also in terms of quality at the local level. Decentralization calls for substantial human resources development in order to guarantee high professional capability at the local level.

The institutional setup in the proposed Strategy is briefly summarized as follows:

(i) sector management and promotion responsibilities will be exercised by the Ministry of Construction through the Management Board for Water Supply and Sanitation Projects, in coordination with other sector agencies;
(ii) project development and implementation functions will, to the extent possible, be done through private sector participation, through contracts with owners/utilities, and under supervision of MOC;
(iii) operations functions (including technical as well as administrative functions) will be the responsibility of local utilities;
(iv) health and hygiene convenience, prestige and other sanitation promotions (social marketing) will be done through the respective Peoples' Committees and relevant local health departments, and the proposed Sanitation Promotion Units;
(v) on-site facilities will be primarily the responsibility of each household, but they also follow clear guidelines, model designs, etc., provided by the local authority;
(vi) communities (primarily Phuong) will coordinate the mobilization of human resources in their respective area to implement sanitation projects and operate sanitation facilities under the supervision of utilities;
(vii) regulatory functions will be exercised at the central level (for general policy framework and standards) and at the provincial/city level (for policy implementation and enforcement).

The Study Team's recommendations on the roles of relevant organizations at the central and local levels are presented below.

5.2.2 Central Level Administration

Water supply and sanitation are closely interrelated, and jointly form water supply and sanitation sector. A national strategy for urban water supply was prepared in 1993-1994 (State Research Program KC-11, Sub-Program KC-11-07). Due to administrative and financial reasons, urban water supply and urban sanitation strategies have been studied separately. However, the organization of water supply and sanitation services must be well coordinated, and any unnecessary separation of the administration of these sub-sectors should be avoided. Therefore, the following paragraphs consider water supply and sanitation as one sector, and institutional recommendations are made for the whole sector, if not otherwise defined.

The Study Team's opinion is that it is more important to define the roles of central and local level administration than the roles of each sector organization. There are various well-functioning ways to organize the sector, and the name of the lead organization is less critical. What is important, is that each organization has a **clearly defined mandate** to operate, and that **each organization only concentrates on the matters under its mandate**. It is also recommended that one sector ministry (MOC) has the undeniable lead role in the overall development of the sector.

The Study Team recommends that the following core functions are centralized to the national level organizations:

(i) policy and strategy formulation, taking into consideration the integration of water supply, wastewater management, and sanitation to overall well-being and development of urban infrastructure;
(ii) sector planning;
(iii) formulation of environmental standards, preparation of environmental guidelines, and overall supervision of environmental monitoring and enforcement;
(iv) regulation on water resources management, water source protection, and allocation of water resources;
(v) legal and regulatory measures to promote, encourage, and enforce development and operation of urban water supply and sanitation (taking into account environmental, economic, public health, and other relevant requirements);
(vi) establishment and maintenance of a sector data base;
(vii) preparation of technical guidelines, standards, codes of practice, forms of contract, etc.;

(viii) definition of professional qualifications, coordination of human resources development, and development of qualification procedures for enterprises on a professional basis (authorization);
(ix) coordination and prioritization of research and development activities;
(x) coordination of central level financial support to investments (to contribute to the materialization of policies), determination of investment priorities and financing criteria, and supervision of sector financing; and
(xi) monitoring and supervision of the sector performance.

The Government of Vietnam has assigned the **Ministry of Construction** to be the lead agency in urban management, including water supply and sanitation. It is anticipated that the National Assembly will consider renaming MOC to the Ministry of Construction and Urban Development. MOC has the main responsibility for policy and strategy formulation; urban master planning including water supply and sanitation; development of technology, technical guidelines, standards, and codes of practice for the sector; approval of unit costs; human resources development; project appraisal and approval; and, not yet materialized, collection of sector information.

Another important sector ministry for wastewater management and sanitation is the **Ministry of Science, Technology and Environment**. It is responsible for formulation of environmental standards, preparation of environmental guidelines and overall supervision of environmental monitoring and enforcement. In order to reduce overlapping of regulating, monitoring and enforcement functions, the Study Team proposes that the mandate for issuing licenses for industrial effluent discharges would be transferred from the former MOWR, now incorporated to Ministry of Agriculture and Rural Development (MOARD), to MOSTE, and the mandate for regulating the monitoring of waste treatment of industries be transferred from MOH to MOSTE.

The Study Team proposes that MOC continues to be in the leading position in the sector development, and that its leading role is made even stronger in relation to other central level organizations.

MOC as the lead agency is proposed to be responsible for:

(i) policy and strategy formulation;
(ii) sector planning;
(iii) establishment and maintenance of a sector data base;
(iv) preparation of technical guidelines, standards, codes of practice, forms of contract, etc. for the sector;

(v) definition of professional qualifications, coordination of human resources development, and development of qualification procedures for enterprises on a professional basis;
(vi) coordination and prioritization of research and development activities;
(vii) coordination of central level financial support to sector investments, determination of investment priorities and financing criteria, and supervision of sector financing; and
(viii) monitoring and supervision of the sector performance.

The National Urban Water Supply Strategy proposed that a unit called Water Supply Management Unit (WSMU) be established within MOC. As the **Management Board of Water Supply and Management and Sanitation Development Projects** has been established within MOC, the Study Team recommends that this Board would be further developed to be the focal point within MOC in the development of water supply and sanitation, coordinating the above functions, and assuming the role of the earlier proposed WSMU. However, the present project-oriented focus of this Board should be extended to a more holistic responsibility for sector development.

In order to coordinate the policies and strategies with the overall well-being and development of urban infrastructure in the country, the Study Team proposed in the Draft Final Report October 1995, that a **National Urban Water Supply and Sanitation Committee** (or Board) to be established. This Committee would be chaired by a senior representative of MOC and meet **at the invitation of the chairperson** only when necessary or when **requested by any of its members**. This Committee was proposed to consist of members from MOC, MOSTE, MOH, SPC, MOFI, and other organizations if found necessary. Although the Study Team is very critical about establishment of new institutions, this Committee is considered important for coordination. The Study Team also wished that by coordinating policy and strategy formulation, actual implementation could be streamlined, and the need for complicated inter-ministerial maneuvers could be substantially reduced.

The Prime Minister has decided (Decision No. 136/TTg) to change the name and supplement the tasks of "Rural Clean Water, Sanitation and Environment Programme" (established by decision 516/TTg 19.9.1994) to "National Steering Committee of Clean Water Supply, Sanitation and Environment" (NSC) which will function under the direct guidance of the Prime Minister. The new NSC will cover the tasks assigned to the **National Urban Water Supply and Sanitation Committee** proposed in the Draft Final Report meaning that the establishment of this committee it is no more necessary. The following ministries or branches will be represented in the NSC: MOC, MOPI, MOF, MOSTE, MOARD, MOH, MOLWISA, MOI, MOD, NCNST and GDMH.

The Steering Committee has functions to combine all the operations of the ministries, branches, unions, social organizations in deployment for carrying out strategies, plans, programs and projects on the clean water, sanitation and environment of the government in the whole country.

The concrete tasks of the Steering Committee consists of:

(i) Combine with ministries and branches to make plans, programs, and projects on clean water supply, sanitation and environment. Acting as a consultant to the Government for approving clean water supply, sanitation and environment projects and conforming that they will be implemented according to Vietnamese laws and regulations;

(ii) Monitoring, controlling ministries, branches, unions, provinces and cities placed directly under the authority of central government in deployment to implement the approved programs, projects and developing plans on clean water, sanitation and environment;

(iii) Directly guide the models in the field of loan, technology, management, exploitation to widely develop in the whole country becoming appropriate models; and

(iv) Organize a combined working between ministries, branches and locals to threat all matters cropping up, and propose an appropriate resolution to the Prime Minister in order to implement the target of the programme.

The Strategy proposal emphasizes the urgent need for a sector data base. Without prompt measures in this respect, there is an increasing risk of losing valuable data and information that was collected and processed at high cost, of wasting time and money in getting data (sometimes of dubious value), and of consequent use of unreliable, outdated and incomplete data. The whole sector would benefit from free access to and free availability of relevant, reliable and updated data. It is therefore proposed that this data base would be established and operated on a non-commercial basis within MOC.

The transition from the subsidized economy to the market economy will have implications on the technical role of MOC. As proposed in the Urban Water Supply Strategy, MOC should divest itself of commercial activities, such as consulting, construction, and manufacturing. MOC's technical role should focus on the preparation of technical guidelines, standards, codes of practice, and other relevant documents. It would be important to incorporate a dynamic approach to these tasks, encouraging technical innovations and efficiency. Consequently, excessively rigid standards and uniform unit costs and fees should be replaced by more flexible guidelines. For instance, the approval procedures of designs based on the guidelines could be simplified. Deviations from guidelines could be made possible, but subject to more detailed review and appraisal.

The Study Team recommends that MOC would define the professional qualifications of the sector personnel, coordinate human resources development, and develop qualification (authorization) procedures for enterprises on a professional basis. Compared with the present situation, MOC could downgrade its role in direct management and operation of training institutions. A similar approach is recommended to be adopted by MOC in the coordination and prioritization of research and development activities.

MOC's role in the coordination of central level financial support to sector investments is proposed to be strengthened. Referring to the National Urban Water Supply Strategy, MOC is proposed to be used as a pilot case to determine the optimum devolution of decision-taking powers from MOPI to line ministries. For example, MOC could have considerable discretion in directing central level financing to investment projects, within the limitations of its budget allocation. MOPI would influence the sector policies and strategies through the Steering Committee of Clean Water Supply, Sanitation and Environment, it would review the sectoral financing plans of the line ministries, and agree upon the overall development allocations to the line ministries.

The Study Team has also a more radical recommendation for the mobilization of financing to sanitation investments: a new financing facility, consisting of a revolving fund for household and community level investments and a credit line for utility level investments. This facility is described in greater detail in *Sections 5.3 5 and 5.2 6.* MOC would have a key role in the proposed Support Unit, jointly with the Vietnam State Bank, supervising the establishment and operation of the facility. The main functions of MOC would include determination of investment priorities and financing criteria, initial training (of trainers), and supervision of operation of the facility. MOC should ensure that the financing facility, in spite of necessary operational autonomy, would, through financing, implement the policies and strategies of the Government.

This proposal is outlined in such a way that the facility would be established entirely for water supply and sanitation sector. Such a facility could also have a wider function, such as urban infrastructure and housing development. In that case the proposed Support Unit should cover expertise of all sectors of the facility's operation.

MOC is also proposed to be in the key position in developing legal and regulatory measures to promote, encourage, and enforce development and operation of urban water supply and sanitation. MOC's predominantly technical personnel needs to be supplemented with expertise in social skills and marketing. The NSC could provide support to MOC in addressing environmental, economic, public health, and other relevant issues.

A logical implication of decentralization of activities is the increased need for monitoring and supervision of the sector performance. MOC is the obvious institution to undertake these tasks.

5.2.3 Local Level Administration

The Study Team recommends that the following core functions are decentralized to the provincial/city level organizations:

(i) integration of development of wastewater management and sanitation to overall infrastructure and social development of the city/town;
(ii) integration of master planning of water supply and sanitation to overall urban planning in the city/town;
(iii) regulation and management of land use and construction;
(iv) monitoring and enforcement of environmental standards;
(v) implementation of legal and regulatory measures to promote, encourage, and enforce development and operation of urban water supply and sanitation, taking into account environmental, economic, public health, and other relevant requirements;
(vi) promotion, supervision and supporting of water and sanitation utilities in development and operation;
(vii) promotion, supervision and supporting of communities and households in water supply and sanitation; and
(viii) coordination of local level financial support to investments.

It is recommended in the proposed Strategy that the operation of the wastewater collection and treatment systems would be the responsibility of the utilities, under the supervision of the provincial/city People's Committees. These operational functions are elaborated in *Section 5.2.4.*

The sanitation companies or services in the sub-sector are currently controlled by **Transportation and Urban Public Works Services (TUPWS)** or **Construction Services (CS)**. There is a tendency in Vietnam to strengthen the utilities and create closer links between utilities and People's Committees (and their Financial Services), actually reducing the importance of TUPWS/CS in the line of command. Another, international, tendency aims at commercializing urban public utilities. Commercialized utilities need autonomy and independence in their day-to-day management and operations but, on the other hand, they are also need quality and efficiency control by the customers and high-powered supervisors. These two tendencies match together well.

The National Urban Water Supply Strategy proposed that each water supply utility would be controlled by a **Board**, established from representatives of the institutions most affected by the service. Similar or preferably the same Board could supervise waste and wastewater utilities. This Board should not interfere in the daily operations. It would set policies and objectives for the utility, and the Managing Director of the utility would regularly report on progress to the Board. Such Boards would allow People's Committees to focus on oversight functions, satisfying themselves that the policies and objectives set by the Board are appropriate, and that they are achieved.

People's Committee is the general executing body at the provincial/city level. It is anticipated in the Strategy proposal that the People's Committees continue to have its present position and, consequently, be the key decision-taking institution, also in the sanitation sub-sector. People's Committees will especially coordinate:

(i) integration of development of wastewater management and sanitation to overall infrastructure and social development of the city/town;
(ii) integration of master planning of water supply and sanitation to overall urban planning in the city/town;
(iii) implementation of legal and regulatory measures to promote, encourage, and enforce development and operation of urban water supply and sanitation, taking into account environmental, economic, public health, and other relevant requirements;
(iv) promotion, supervision, and support of water and sanitation utilities in their development activities and operation; and
(v) local level financial support for investments.

The People's Committees transform national level sanitation and environmental policies to match the local objectives and policies for sanitation. They approve the tariffs and revenues of the public utilities. The People's Committees are in a unique position in mobilizing resources for the sub-sector development, from the provincial/city budget, as well as from the communities and households, by increasing the demand through promotion, incentives, and enforcement.

There are some important multi-sectoral functions, especially those involving communities and households, which may be too much operational to be directly executed by the Committees. On the other hand, there does not seem to be any existing agencies at the local level who would be well suited to carry out these multi-sectoral functions. Therefore, it is recommended in the proposed Strategy that the provincial/city People's Committees who aim at rapid and sustainable development of sanitation would establish **Sanitation Promotion Units** directly under their control. These units are not meant to be a uniform institutional set-up to be implemented throughout the country, and they should not be established without high prioritization of sanitation issues at the local level.

The main duties of these units are proposed to include promotion, supervision and supporting of communities and households in water supply and sanitation.

Consequently, they should focus their efforts on household and neighborhood level activities. The Sanitation Promotion Units should also disseminate relevant information on environmental matters (in association with the local environmental agency), technology alternatives, possible participation approaches and methodologies, contract management, and available financing mechanisms. It is also recommended to develop close cooperation between these units and the financial intermediary operating the proposed revolving fund (see *Sections 5.3.5 and 5.2.6*).

The Sanitation Promotion Units are proposed to merge multi-disciplinary expertise and skills for a comprehensive promotion program. They would bring together expertise, either on a permanent or temporary basis, from existing organizations, e.g., from health departments for health and hygiene promotion (social marketing), from environmental companies for resource recovery, and from environmental companies for monitoring.

It is recommended by the Study Team that the People's Committees pay attention to mobilizing adequate financial resources to its departments (services), releasing them from the somewhat embarrassing job of marketing and charging for their involvement in a variety of activities. Due to serious financial constraints, charging opportunities may direct the attention of authorities to activities outside their original field and less important to the local government. This general recommendation involves all departments, not sanitation alone.

In the integration of the sub-sector planning to the urban planning in practice, the key organization under the People's Committee is the **Chief Architect** or **Construction Service** (and its Planning Institute).

Regulation and management of land use and construction are considered by the Study Team as one of the most efficient tools in the development of wastewater management and sanitation, particularly in the new development areas. The Chief Architect or CS can set conditions and requirements for sanitation in the planning certificate and in the construction permit. Reasonable legislation for effective control of land use and construction is more or less in place. The relevant authorities just need determination (and support from the People's Committee and from MOC) and adequate human resources. (Reportedly, 80 % of new buildings are constructed illegally, i.e., without all necessary permits and licenses.) It is proposed by the Study Team that the People's Committees would make their best efforts to maintain and improve the capability and capacity of authorities responsible for the management of land use and construction. If the Chief Architect or CS are provided with adequate resources, they do not need to authorize their powers to lower level representatives.

The monitoring and enforcement of environmental standards fall under the authority of the **Service for Science, Technology and Environment** or **Environmental Committee**. In general, the local level environmental agencies are anticipated to implement monitoring and enforcement in their jurisdiction, i.e., materialize the national and local environmental policies, guidelines and standards. The Environmental Services are short of financial and highly qualified personnel resources. The Study Team wishes to remark that the environmental agencies do not need to be self-sufficient in monitoring. Sampling and laboratory analyses can be provided by qualified institutions from the private as well as public sector. However, the environmental agency should control the quality of the services provided.

In order to streamline partly overlapping duties, the proposed Strategy recommends that the environmental duties of Water Resources Service (discharge of industrial effluent) and Health Service (monitoring) be transferred to the local environmental department. This proposal is in line with similar streamlining at the central level.

In the process of development of the water resources management in Vietnam a proposal concerning the establishment of committees or boards on a catchment area basis has been proposed in the National Urban Wastewater Collection and Sanitation Conference. These organizations could have members from various levels and sectors of administration as well as from communities and utilities. The Study Team agrees that new institutional arrangements are needed in the water resources management, and that there are many problems which cannot be solved at the local (provincial) level in the case of water abstraction, effluent discharge, etc. Where such committees have been established and proved their efficiency, some functions, especially environmental licensing and monitoring, could be transferred to these bodies.

5.2.4 Utility Responsibilities

The main services potentially to be provided by urban utilities under this Strategy include:

(i) O&M of sewerage (separate wastewater, or combined waste and storm water) collection systems;
(ii) truck, cart or bucket collection of waste and/or sludge; and
(iii) wastewater and/or sludge treatment and disposal.

The sub-sector utilities in Vietnam have the status of a department of the local government, although they are, somewhat misleadingly, called companies. For example, the core financial functions of the utilities, including tariff setting, staff remuneration, asset and depreciation management, capital budgeting, and investment financing, have remained the responsibility of the People's Committees and their financial departments. The waste and wastewater utilities have managed to collect only very low revenues in comparison with the cost of the service. The management of the utilities lacks tools to improve the efficiency of their organizations.

The Study Team considers that the public utilities need to be developed to operate in a much more commercial way. The key to more efficient utility management and performance is that the utilities should have sufficient autonomy both to generate and retain adequate revenues for its needs under the control and supervision of the People's Committees or the Board. **Commercialization** would have a number of implications, such as:

(i) own budgeting and responsibility for financial performance;
(ii) substantially stronger revenue base;
(iii) substantially reduced dependence on subsidies from the local government;
(iv) reconsideration of organizational structures and utility functions;
(v) increased autonomy and flexibility in personnel management; and
(vi) customer orientation.

The increased autonomy and responsibility would have a dramatic impact on utility management. The **financial responsibility** would force the utilities to balance the revenues (even when partly subsidized) and costs. Increased dependence on revenues would direct the utilities to respond to the demand of their customers.

Commercialization and increasing the autonomy, however, do not mean a state of uncontrolled monopolistic business of the utility in its service area. The business has to be transparent and controlled by the People's Committee or, e.g., the Board proposed in *Section 5 2.3*.

The present excessively centralized decision-taking should be needed to be replaced by **delegation of authority and responsibility**, with clear job or task descriptions for each employee or organizational unit. The details of the organizational structure are less important than a fundamental change in the corporate culture. This delegation of authority needs to be enhanced by improved management mechanisms utilizing, e.g., corporate planning and computerized management information systems (MIS), as well as efficient management and development of human resources (see *Section 5.2.8*).

The utilities would also need to reconsider their role by identifying the **key functions** that they can efficiently undertake, the functions that they would preferably contract out, and functions that they would simply let other institutions undertake. The utilities should be active initiators of development projects. They should also assume devoted responsibility for maintaining and increasing the value of the fixed assets, whether being the actual **owner** of the assets or on behalf of the owner in case it is the local government. The Study Team recommends that the ownership of the assets would be transferred to the utility on an experimental basis in, say, 3-5 cities/towns, and the advantages and disadvantages of this set-up would be followed up, compared with the existing set-up on a historical and relative basis (in comparison with other cities and towns), and reported.

There is a tendency in Vietnam to separate the functions of wastewater (and storm water) collection, treatment and disposal from the waste management functions, such as collection, treatment and disposal of solid waste, nightsoil and sludge, and street cleaning. In Hanoi and Ho Chi Minh City, two separate utilities share the responsibility for urban sanitation following the above principle, and similar set-ups are under consideration in some other cities. However, there are some arguments, elaborated below, which do not support such a division of duties.

In Vietnamese cities and towns, garbage is usually disposed of in the streets and sometimes in canals, possibly blocking the drainage/sewerage system. The waste utility collects garbage from the streets as part of its street cleaning function. Unseparated responsibility for proper waste collection, street cleaning, emptying of septic tanks, and drainage/sewerage should automatically motivate the waste utility to make sure that shortcomings in the upstream functions would not negatively affect the downstream functions. This is not self-evident when the responsibilities are divided.

Separate wastewater sewers are rather rare in Vietnam. As long as sewerage is actually part of drainage, it is quite natural to combine the duties related to waste and wastewater (and drainage) management. Separate wastewater collection systems are more clearly customer-oriented, with property connections providing service to a registered clientele. At this stage, sewerage can be seen as a supplementary service to water supply. Those who enjoy water supply services should assume the responsibility for appropriate wastewater collection, treatment and disposal. At this stage, a natural institutional set-up would be merging the wastewater function with water supply functions. This would also facilitate efficient collection of wastewater surcharges together with water revenue collection.

The core functions most naturally provided by waste and wastewater utilities are those which directly make use of the highly **capital-intensive infrastructure system**: wastewater collection networks and wastewater treatment plants, and to some extent also waste treatment and disposal systems. These functions have a monopolistic nature; it can hardly be anticipated that development of two or more competitive reticulation and treatment systems could be feasible. Alternative private sector interventions in water supply and wastewater collection and treatment are discussed in *Section 5.2.6.*

Other service functions, such as collection of waste (including nightsoil and septic sludge), studies, design and construction of facilities, maintenance of equipment, transportation functions, laboratory services, catering, health care, etc., can realistically be undertaken by commercial enterprises or social institutions. Actually, many of these services would obviously be much more economically bought from outside the utility. The role of the private sector in the provision of these services is elaborated in *Section 5 2 6.*

Particularly, utilities should refrain from developing any business (such as manufacturing, accommodation and transportation) non-related to their core functions. Such diversion of business would reduce the utility's dependence on their performance in their main activity, and would most probably result in lower performance in their core functions.

The task of development of wastewater management and sanitation systems is huge. It is proposed by the Study Team that the utilities would focus on the most important duties - their core functions - and would encourage communities, households, and the private sector to undertake all functions that they are willing and capable of doing, subject to supervision of local authorities and/or utilities. Consequently, households and communities would be the key initiators of development at the household level in general and at the neighborhood level in built-up areas. For instance, the Study Team proposes that the responsibility for condominial sewers be delegated to Phuong (see *Section 5 2 5*). However, utilities must have even more strengthened authority on the technical approval of household and neighborhood systems, and authority to control (or provide) the operation and maintenance of the neighborhood level systems.

5.2.5 Community Involvement

When given a possibility to participate, people and organizations are more committed to the achievement of objectives and mobilization of resources (financial, human, etc.) to implementation and operation. Moreover, when people feel ownership for the project, their expectations for personal rewards, such as compensation for obstruction caused by pipe laying, tend to be substantially reduced, such decreasing the total implementation cost.

In the urban areas of Vietnam, **Phuong** (ward) is the key organization from the point of community participation. Its status is, in fact, a mix of an administrative unit and a community organization. It has a chairperson appointed by the local government while the rest of the human resources are

volunteers backed up by the citizens of the Phuong. Phuong seems to function well, for instance in the development of water supply. Presently, Phuong mobilizes finance or labor for some minor sanitation projects, such as drains and sewers, and some O&M functions, such as cleaning.

The development needs in urban sanitation dramatically exceed the development capacity. The proposed Strategy recommends that the authorities focus their efforts on new areas to be developed. The improvement of sanitation in built-up areas, especially at the neighborhood level, calls for initiative and commitment from the beneficiaries: households and communities. The degree of community (or private) commitment and participation is a well justified criterion for the **prioritization** of feasible projects to be supported from the limited sub-sector development funds.

The Study Team recommends that the development of neighborhood level sanitation in existing built-up areas be mainly based on Phuong initiatives and resources. The Study Team recognizes the role of Phuong to be less important in the new areas where wastewater collection and sanitation, as well as the entire infrastructure should be built before the construction of houses and where, consequently, communities do not exist at that stage.

The main responsibilities of Phuong in the proposed Strategy are:

(i) promotion of public health, environmental concern, convenience and improved sanitation within its area;
(ii) disseminate information of technology alternatives, participation approaches and methodologies, and available financing mechanisms;
(iii) assessment of the demand for sanitation improvements in its area;
(iv) liaison with Sanitation Promotion Unit, relevant utilities and local government;
(v) mobilization of financial and human resources for studies, planning, design, and implementation;
(vi) organization of operation and maintenance; and
(vii) management of contracts with consultants, suppliers, and contractors.

It is obvious that Phuong cannot alone undertake all of the above tasks but it is not even recommended. Instead, they should take the **initiative**, and request assistance and support from relevant organizations, particularly from the proposed Sanitation Promotion Units (see *Section 5 2.3*).

There would also be an important role for Phuong in the operation of proposed **revolving fund** (see *Section 5.3.5*). The cost-effectiveness of the financing system could be improved if loans to participating households were packaged and coordinated by Phuong, instead of extending household loans. In such a system, Phuong would recover the debt and operation service costs from households.

The role of Phuong depends also on **technologies** to be applied. Construction of conventional gravity sewers calls for more professional construction supervision than small bore sewers or condominial sewers, and are not recommended to be constructed by self-help labor without close supervision provided by the utility (who has a keen interest in ensuring the quality of construction and pipe installation). Small bore sewers, on the other hand, are sensitive to clogging, caused by uncontrolled discharge to the system (e.g. through unemptied septic tanks). Operation of small bore sewers should be based on compulsory emptying of the septic tanks, and a control system to secure this. Phuong could, for example, charge **compulsory septic sludge collection fees** from the households, and organize emptying of the sludge by assigning a company that operates a vacuum truck to undertake the work.

5.2.6 Private Sector Participation

The Study Team recommends that the private sector resources be fully utilized in the sub-sector development. The first priority should be given to such functions which would be subject to competition, whereas careful consideration is needed in the privatization of services dependent on monopolistic exploitation of infrastructure.

Among the first functions to substantial private sector intervention are engineering services and goods: **consulting**, such as pre-investment studies, design, construction management; **construction**; and **manufacturing and supply of equipment**. In the market economy, there should be no reason for maintaining these functions under the public sector. Utilities, in the first place, are recommended to initiate and manage projects, assign consultants and contractors to carry out the work, and assign an Engineer (specialized construction management consultant, specified, e.g., in the FIDIC[15] documentation) to act on their behalf as the supervisor of the contractor.

An increasing number of international and bilateral financing institutions provide funding for development projects in Vietnam. Typically, these projects generate business opportunities for local consultants and contractors, although they usually involve also foreign enterprises in these fields. The manufacturing of equipment and facilities needed in the sub-sector

[15] *Fédération Internationale des Ingénieurs Conseils* (*FIDIC*), Conditions of Contract for Works of Civil Engineering Construction

development would also be boosted by the increasing financing, provided that the local manufacturing will be competitive.

In other countries which have moved from subsidized systems to the market economy, the consulting business has taken various ways of development. **Formerly state-owned companies** have been transformed to private companies, individual engineers have started to work as **freelance consultants** or established (usually small) **private consulting firms**, and **joint ventures** have been established between foreign consulting firms and local (governmental or private) consulting companies. Smaller private organizations have usually performed more successfully in the new market situation. It is likely, that a similar development will take place also in Vietnam as the market economy develops. This development may, however, be biased by Government interventions and strict control of project preparation and implementation (see *Section 5 2.7*, heading "Project Preparation, Approval and Implementation Procedures").

The construction business could develop largely in a similar way, except that individuals and very small entities could not be credible in the more industrialized construction business.

Commercialization and increasing the autonomy of wastewater utilities would bring the nature of their operation closer to that of the private sector. However, due to their monopolistic business, based on the utilization of highly capital-intensive infrastructure system, the management of utilities is not recommended to be in the first wave of privatization. There are some cases, elaborated below, where private interventions could have a substantial role in utility management.

Collection of solid waste (including nightsoil and septic sludge), possibly also **waste processing and disposal**, could be organized on a private basis, under the supervision of a local body: TUPWS, CS, or waste utility. There is an international tendency that big international waste management companies expand to new potential market areas, such as Vietnam.

Secondary functions, such as maintenance of equipment, laboratory services, transportation functions, catering, cleaning, etc., could probably be more efficiently and economically provided by private sector enterprises. The real benefit from privatization of such functions would come along as the impact of market forces and competition between the suppliers of the services

In principle, the so-called **Build-Operate-Transfer** (BOT) and **Build-Own-Operate** (BOO) concepts, as well as other private (most potentially foreign) direct investment modes, could be applied in the wastewater and sanitation sector. However, the interest of investors has been low, except in water supply in some locations, and the Vietnamese authorities have been concerned by the high projected tariffs. Alternatively, the operation and maintenance of the facilities can be transferred to a private company through various types of contacts, such as management contract, affermage, gerance, and régie intéressée.

The Study Team recommends that local governments proceed with the BOT, BOO, or other private utility interventions carefully, drawing experience from pioneer projects. The most potential cases for private investment in and operation of wastewater and waste management, as well as the entire infrastructure, would be in special industrial areas (for example Export Processing Zones). The requirements for and ability to pay for the investment and service is likely to be substantially higher in such areas in comparison with urban residential areas. Those residential areas that are located adjacent to BOT/BOO operated industrial areas could be served by the same BOT/BOO company as a supplementary requirement of the local government.

The Study Team proposes that a new **financing facility** be established to contribute to the materialization of the Government's objectives, policies and strategies for the development of the sector. This proposal is described in detail in *Section 5.3.5*). It is understood by the Study Team that at this stage of the transition process, the proposed financing utility (bank) could hardly be a private one. In the longer term, however, privatization of such a utility as well as promotion of establishment of competitive financing facilities would most probably increase the efficiency and effectiveness of sector financing. Monopolies tend to lose efficiency, also in the banking sector.

5.2.7 Regulations and Enforcement

Land Use and Building Regulations

The present system of land use and construction regulations provides a good basis to control the aspects related to wastewater collection and sanitation in the development of new areas as well as in rehabilitation, upgrading and supplementary construction in built-up areas. The materialization of the opportunities depends on the determination of the authorities to enforce them.

The Study Team proposes that, in order to further utilize these regulations, the following measures be taken:

(i) the stipulations in the Decree on Management and Utilization of Urban Land (No. 88-CP) and the Decree on Collection of Levy on Land Use Right and Land Administration Fee (No. 89-CP) are strictly enforced before issuing the building permit, in order to **request property connections to sewerage systems** and/or **appropriate sanitation**

facilities and installations on site, and the State to construct the **infrastructure**;

(ii) the land fund to generate capital for construction on infrastructure (as defined in Decree No. 88-CP) will be materialized by allocating a meaningful **seed capital** to the fund and from land tax revenue;

(iii) the cost of development of necessary infrastructure (including sewerage) for the neighborhood level and a fair share of the city/town level infrastructure is included in the **land tax** (Law Governing Taxes on Land-Use Rights), and this proportion of the tax is earmarked and allocated to the land fund for relevant infrastructure investment (most applicable in new areas);

(iv) wastewater utilities are encouraged to implement their right to collect **revenues** for their operations (Decree Promulgating the Statute of the Management of Urban Planning, No. 91-CP); and

(v) the **authority to issue construction permits** for "semi-durable projects" is not delegated from the Chief Architect/Construction Office unless the capabilities of the lower level representatives are ensured.

The effectiveness of land use and building regulations is much higher in **new areas** than in already **built-up areas**. From the environmental and public health point of view, it might be necessary to slow down the rapid progress of installation of **water-borne toilets** without appropriate on-site disposal in non-sewered areas. This would be possible by enforcing the stipulations of Decrees No. 88-CP and 91-CP. This might be difficult to implement, as the demand for upgrading household level sanitation by flush and pour flush toilets is very high.

In built-up areas, the systematic development of a **wastewater conveyance system**, while responding to the needs of households and Phuong, is a difficult task for local governments and utilities. The stipulations in Decree No. 88-CP concerning the responsibility of the State to construct the infrastructure cannot be implemented overnight in built-up areas. The enforcement needs to be flexible, and the prioritizing of implementation is recommended to be based on master planning (involving communities) and commitment of communities and households to mobilize resources.

Environmental Regulations

The newly established environmental regulations, based on the Law on Environmental Protection (1993) authorizes MOSTE to be the lead environmental agency, whose duties include stipulation of a schedule for waste and wastewater issues; management of EIA procedures; preparation of environmental standards; and acting as an appeal agency in case of disagreement on environmental matters.

Other relevant regulation, such as the proposed Law on Water and those based on the Public Health Protection Law, have partly overlapping definitions and authorizations. The Study Team recommends that environmental matters be clearly administered by **one ministry**, i.e. MOSTE and;

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suggests that the following amendments be made in the legal framework:

(i) the mandate of MOH for regulating the monitoring of waste treatment will be transferred to MOSTE;
(ii) the mandate to control the location of industries (safe distances from residential areas) will be transferred from MOH to MOSTE; and
(iii) the mandate of MOWR for issuing licenses for industrial effluent discharges will be transferred to MOSTE.

In spite of the centralization of environmental matters under one ministry, it is recommended to maintain the prime responsibility for the safe-sanitary areas under MOWR, the objective of the establishment of such areas is the protection of water resources for special use, e.g., for water supply.

The present regulations have addressed the pollution issue, and applied the polluter-pays-principle in their stipulations. However, many of the stipulations lack **clarity, realism, and enforceability**. The Study Team recommends that present stipulations, in general, will be clarified and made enforceable. General statements, for instance those requesting all business establishments to organize treatment, should be polished. The regulations should be realistic, and focus on the most urgent **priority measures**, with possible schedule for measures to be taken in various **priority categories**. The regulations should also clearly define sanctions for violation, and the sanctions should be enforced and strong enough in order to encourage pollution control measures, not payment of fines.

The Study Team proposes that the definition of duties between MOSTE and local governments concerning the **appraisal of EIA reports** be reconsidered. The present division of responsibilities has little to do with the potential of environmental risks associated with the projects. MOSTE should focus its limited resources on the most critical projects, and such projects whose impact assessment calls for higher professional competence.

The environmental regulations stipulate that **treatment technologies** have to be approved by the authoritative body. This is not supported by the Study Team. The environmental authorities responsible for enforcement should not bind themselves to any technologies but they should focus on **definition of**

allowable levels of discharge, monitoring, and enforcement. By approving technologies, the enforcement authority commits itself to certain technologies and assumes responsibility for the performance of the treatment facility as well, thus losing a substantial share of its credibility and enforcement power to demand further measures in case of non-compliance with the requirements.

National environmental standards relevant to wastewater discharge and sanitation have not yet been developed. The existing standards, mainly adopted from some local level standards, are outdated: they are partly overly ambitious, partly slack; they set requirements for the water quality in the recipient water body rather than discharges; they do not particularly allow the environmental authorities to focus on most critical discharges or protection of priority areas; and they do not encourage water conservation and clean technologies.

The Study Team recommends that the environmental regulations (which frequently refer to non-existent or outdated standards), will be supplemented with realistic and enforceable environmental standards to control pollution in a **step-by-step** way, aiming at more stringent and comprehensive standards as the financing capability and the enforcement resources grow.

These standards should define the **total allowable load** (for instance per unit of production) for the most polluting activities as a **general standard**, and **special control measures** for areas to be particularly protected. The standards should clearly focus on the **control of discharge**, not on the ambient water quality in the receiving water body. Otherwise the responsibility for pollution is shared between all polluters of this recipient.

While environmental regulations need polishing and updating, the most critical measures to be taken are related to the **enforcement** of these regulations. The gap between the will of the Government expressed in the regulations and the actual measures taken to control pollution is wide, and obviously reduces the **credibility** of the management of the environment and pollution control.

Project Preparation, Approval and Implementation Procedures

The project preparation, approval and implementation **procedures** are mainly regulated by a recent Government Decree on the Promulgation of the Regulation on the Management of Investment and Construction No. 177-CP (issued in October 1994). This Decree defines the main **responsibilities** of various organizations and parties, from the investor and consultant to, and particularly, the central level institutions, such as the Prime Minister, SPC, MOC, MOFI, the Vietnam State Bank, SCCI, and other sector ministries.

The procedures involved are very complicated, and emphasize **strict and comprehensive State control**. The initiators of projects have to intensively follow up the progress of the project proposal and lobby in the involved agencies. This may have been feasible in the subsidized system, where projects were typically financed from the central budget with low responsibility and commitment from the local level, especially operators and users of the facilities.

The Study Team recommends that, as part of the transition to the market oriented and decentralized system, the Government would adopt a substantially **more flexible approach** in project preparation and management, and reduce the number of agencies involved in the process, e.g., by authorizing only one ministry (MOC) to control the technical feasibility of projects. The investors should be encouraged to assume the main responsibility for the project, its feasibility and management. The interests of the Government could be secured by general **policy-making, framework budgeting,** and budget allocations or preferably **lending**, **evaluation** of the project performance (possibly through financing institutions), and **guarantees**, instead of direct involvement in projects.

The strict **control of cost estimates and prices** can also be explained by the low accountability of project initiators or investors. Although the responsibility for the repayment of the loan is assumed by the investor, the Government control reflects suspicion on the ability and willingness of the investor to service the loan. The regulation of unit costs, design and appraisal fees has very little applicability in the market economy. Moreover, the direct dependence of the design fee on the construction cost may provide false incentives, e.g., for over-dimensioning of pipelines. The Study Team proposes that, instead of regulation, the Government would focus on **collecting and disseminating relevant cost data** to investors, in order to assist them to control the investment cost.

The project preparation, approval and implementation procedures are not in accordance with the **procedures of international financing agencies**. This may cause problems and serious delays in the mobilization of projects financed by international agencies. A study on project preparation has been completed in 1995 as part of the cooperation with the World Bank. Its reporting has not been submitted to approval, due to lack of funds for translation. The Study Team proposes that **harmonization** of project preparation, approval and implementation with international procedures would be given a high priority, in order to avoid delays, unnecessary bureaucracy, and excessive costs.

5.2.8 Human Resources Development

Human Resources Demand

The institutional setup in the proposed Strategy is described in *Sections 5.2.2 - 5.2.6*, and is the basis for the human resources projections in this section. The projections are flexible, and only intended to show the scale of magnitude. Conditionally, staffing coefficients have been used for estimating the demand only. They should not be interpreted as recommended staffing levels.

Based on the staffing coefficients derived from the results of the survey of eight cities/towns (see *Section 6 1.8, Volume 2*), an indicative estimate of the number of staff is presented in Table 5-1. A more detailed projection of staffing requirements by major competency area and by geographic locations is presented in Annex I.

Table 5-1 Staff requirement projection for sanitation sub-sector

Area	1995	2000	2010
Red River Delta	2300	2600	3500
Coastal Areas	2100	2400	3000
Highland Areas	650	700	900
Mekong River Delta	4600	5300	7400
TOTAL	9600	11000	15000

Productivity and Availability of Human Resources

Training, by itself, is not a sufficient response in an environment where the major causes of sector deficiencies include basic structural issues and economic inefficiencies. Under such situations, training can only offer partial solutions with little real hope of institutional performance impact or sustainability. For the coming years, two principal HRD strategy recommendations are proposed by the Study Team:

(i) increasing the productivity of existing staff and institutions through:
- management reorientation and training;
- technician skills upgrading;
- improved utility information and control systems;
- improved tools and techniques;
- incentives for outstanding staff/team performance; and
- involvement of user groups in planning, implementation, and monitoring.

(ii) ensuring the sub-sector's access to qualified and trained personnel (professional and technician level) from an open labor market:
- increased private sector participation;
- institutional redesign; and
- strengthening linkages with the formal education sector.

Training Needs and Capacity

Many HRD assessments concentrate on the supply side: identification of training facilities needs, curricula improvement, training material development, and improvements in training methods. The concept of training needs rarely considers resource constraints and priorities and how they can be addressed in a sustainable manner. Formal training is not a sufficient condition for the competent application of skills. Informal training, on-the-job training, and experience are equally important determinants. Innovators, often with little training in core skills, are vital to institutional change.

The priority **management reorientation and training** interventions, to be in conformity with the proposed policies and the proposed Strategy, and to focus on increasing the productivity of the staff and institutions, include:

(i) sector management:
- understanding the impact of the market economy on provision of basic services;
- policy formulation and review processes;
- national sector master planning;
- investment programming;
- legislation (affecting the sub-sector), effective regulations, and enforcement;
- technical standards;
- environmental protection;
- institutional development,
- training and Human Resources Development;
- urban development;
- research and development; and
- sector monitoring.

(ii) project development and management:
- project identification and selection;
- project objectives;
- indicators and measurements for monitoring and evaluation;
- feasibility study (including economic and financial analysis);
- environmental protection and Environmental Impact Assessment;
- financing mechanisms, cost recovery, willingness to pay;
- technology selection;

- strategic sanitation approaches;
- engineering design, construction planning, supervision and inspection; and
- procurement of goods and services.

(iii) utility-based operations, management and maintenance:
- utility management;
- commercial practices;
- tariff setting;
- financial management and controls;
- technical aspects (O&M); and
- customer relations.

(iv) community-based systems:
- community mobilization and organizations;
- social marketing and community-based approaches; and
- management of public sanitation facilities.

Institutions must first recognize that training is a responsibility of every manager towards his staff which cannot be delegated to a "training department". Internal training departments are organized to function as a resource for managers. It is useful to understand how a sector training system starts, survives, adapts and makes a significant impact within institutions. **Internal training capacity** slowly grows in stages.

Technician skills upgrading involves establishment of a training, testing and certification system for wastewater (and water) system operators based on education, training, and actual work experience. The testing and certification system will lay the basis for job qualification in the future as it will require a mix of education and experience requirements.

A commercially-oriented system needs to be put in place to facilitate financial planning and monitoring of utility operations. Such **improved utility information and control systems** would include: billing and collection, customer ledgers, inventories, asset management, cost accounting, etc. Financial and operating indicators should be adopted as operating standards or objectives.

It is important that training will be implemented together with the provision of **improved tools** adopted by the utilities. Impact of training investments will be generated if the right tools and equipment, like computers, for which staff are trained in, are made available, and if the techniques to be taught in management courses (like planning tools, project scheduling techniques) are, in fact, applied.

Based on the budgetary savings or increased productivity, the grant of **incentives for outstanding staff/team performance** should be implemented.

It must be stressed that the rewards should not be given to everyone, but to outstanding employees or teams only. Across-the-board increases do not have incentive value. The expected increase in productivity should more than adequately provide the resources for the incentives. Criteria for performance and incentives have to be put in place first, or else conflicts may arise.

Involvement of user groups in planning, implementation, and monitoring has proved to be an integral element contributing to the sustainability of facilities and services. HRD initiatives should help to improve social and environmental conditions by supporting the establishment of effective mechanisms to sustain delivery of water, sanitation and hygiene education services. If the community is to attain the full economic benefits of improved sanitation and sewerage, household behavior and hygiene practices needs to be addressed. Such component will also contribute immensely to an increased willingness to pay.

Labor Market Approach

The current central policies, in brief, encourage labor intensive industries, self-employment, small enterprises, an open labor market and labor mobility, skills training, social security, gender sensitivity, integration of the disabled in the labor force, occupational safety, and labor-management relations. The reforms in public administration, state enterprise and labor force adjustments should drive future sector HRD strategies.

The restructuring of central planning systems will lead from general rigid norms to more flexible approaches. The shift, in human resources planning, will be from personnel planning to labor market analysis. Understanding of the labor market requires consideration of both the private and public sectors in a more unified manner and includes institutional fundamentals. This approach needs to be undertaken at a sectoral level.

Institutional arrangements, financial sources and packaging, technology, as well as other aspects and policies, will affect the demand for and the sub-sector's ability to tap trained staff. **Increased private sector participation** options bear on all these aspects of "business" and, most importantly, help in bringing about a new and more productive work culture and environment

The proposed Strategy offers a proposal to realign and rationalize sector responsibilities at various levels. Implemented, it would pave the way for challenging opportunities for professionals in the public sector (which may otherwise not be found in the private sector). This **institutional redesign** should be viewed within the wider context of increased participation of the private sector in what have traditionally been government-provided services and goods.

In order to respond to the proposed Strategy, the curricula should expand to include a range of non-conventional sanitation technologies, interrelationship among institutional arrangements, financing mechanisms, appropriate technology selection, and the impact of community management on sustainability. This calls for **strengthening linkages with the formal education sector**.

Financing of HRD Programs and Selected Operating HRD Policies

The Study Team proposes the adoption of the following initial finance and operating policies and guidelines to promote the establishment of and sustain a viable and relevant HRD system:

(i) each agency (ministry, company, enterprise, etc.) will allocate a minimum amount initially, say, equivalent to 3% of annual staff salary budget for training activities; similarly, each agency will formulate an agency training plan to utilize this training budget;
(ii) in order to influence the HRD directions of the various agencies, the Management Board will have at its disposal counterpart funds which may be used to augment agency budgets;
(iii) external loan and grant funds will be utilized for training and social marketing; the use of loans will not be limited to hardware financing;
(iv) all sector investment projects will have a training and technology transfer component and all externally assisted projects will be evaluated, among others, on effective technology transfer;
(v) training abroad will be utilized in familiarizing professionals with developments and new ideas in countries similar to Vietnam;
(vi) all agencies are encouraged to implement local scholarship programs for deserving staff at all levels;
(vii) in-service training, education and experience background shall be the principal basis for job assignment, placement and career advancement; and
(viii) the public sector will actively support the development of a viable local sector consulting industry, as well as suppliers and contractors of major sector services.

Sector Management

The Study Team has proposed (see *Section 5.2 2*) that MOC would continue to be the lead sector agency. Furthermore, the Team has proposed that the Management Board for Water Supply and Sanitation Projects would be developed to assume the coordinating role in the sector management. It is recommended that the staffing of this Board would be strengthened: its present number of (mainly engineering) staff to be multiplied and its coverage of expertise extended by specialists in utility management, environmental aspects, economics, finance, social marketing, legislation, and monitoring and information.

As the focal point for all sector activities, it is envisaged that the Management Board would be the principal coordinator of technical assistance and guidelines to enable sector agencies, the academe, and the private sector to provide effective, coordinated and relevant training services. The mandate for training should remain with each of the sector agencies, specifically, every manager and supervisor. The Board's role is not to conduct training programs but rather to promote and ensure that needed training programs are organized and are effective.

It is assumed that the most active provincial/city People's Committees would take measures to promote and develop sanitation by, e.g., establishing Sanitation Promotion Units directly under their control, as proposed in *Section 5.2.3*. The staffing of these units may consist of: managers/supervisors; institutional development & training specialists; urban planners/engineers; financial analysts/economists; social marketing/community development specialists; environmental (resource recovery) specialists; and monitoring specialists.

5.2.9 Technical Assistance

Grant Technical Assistance (TA) financing has been made and will probably be increasingly made available to the sub-sector development, especially for capacity building. The sources of TA include:

(i) bilateral agencies, either in their own financing programs or as parallel financing to loans and credits from international financing institutions;
(ii) international financing institutions, such as the World Bank and Asian Development Bank;
(iii) United Nations organizations, such as UNDP (especially through the UNDP/World Bank Water and Sanitation Program) and WHO;
(iv) other international organizations, such as the European Union (EU); and
(v) non-governmental organizations (NGOs).

Technical Assistance funds are generally allocated to development activities, excluding investment. There are many possibilities to attract TA financing to support various measures proposed by the Study Team. Possible objects for TA interventions are summarized below:

(i) central level sub-sector development, such as development of regulations, policies, strategies, and financing mechanisms, preparation of studies and plans, and HRD;
(ii) local level sub-sector development, such as preparation of provincial/city level policies, strategies plans, promotion, resource mobilization, and approaches;
(iii) project preparation, including feasibility studies, design, and relevant training;
(iv) utility management, including institutional support, implementation of the accounting reform, studies, planning, and training;
(v) establishment of and assistance to the proposed financing facility, especially the proposed Support Unit;
(vi) establishment of and assistance to the proposed Sanitation Promotion Units;
(vii) community level improvement of sanitation, including motivation, resource mobilization, and technical guidance in selected Phuong.

TA funds from international financing banks are most probably available to the central level sub-sector development and establishment of the proposed Support Unit. ADB has TA funds of its own for project preparation (feasibility studies).

TA funds from bilateral agencies and the EU could be allocated to most of the above objects, except directly to communities because of their small size in comparison with the procedures of these agencies. Bilateral TA funds are often allocated as parallel financing to the preparation of investment projects to be financed by international development banks.

UN organizations would most probably allocate TA to central and local level sub-sector development, utility management, the proposed Support Unit and selected Sanitation Promotion Units.

NGOs could mainly provide support to the Phuong level. NGOs often operate with small budgets and voluntary staff, and they have plenty of experience in working "at the grass root level". Consequently, the small size of these interventions would suit them well.

The TA funds to be allocated to the local level are recommended by the Study Team to be directed mainly for the support of those cities/towns, utilities, etc., who have already presented prospective plans and expressed commitment for the development of sanitation and improvement of the environment.

5.2.10 Program Support Communications

Infrastructure projects have generally avoided longer term efforts to educate users. Institutional performance is, in the longer term, best enhanced and maintained by market demand. HRD, while recognizing the need for sector leadership and skills, can be expanded to a comprehensive approach recognizing the limited role of training in influencing the service demands.

Health and hygiene education programs may include immediate short-run activities, information campaigns, as well as long-term value formation interventions, possibly through the formal school system. Two approaches, school-based approach and media-based approach, are recommended to be used by the Study Team.

Students are the main targets of the **school-based approach**, either directly or through their teachers. Special focus activities, such as Water and Sanitation Week or Environmental Awareness Week can be introduced with programs or convocations to make the student aware of the issues and solutions. Prototype posters, flip charts, and audio-visual materials are already available with MOH/WHO, and can be further tested and disseminated. Such approach can be realized in cooperation with the Ministry of Education.

The **media-based approach** utilizes radio and print media to introduce and reinforce health messages. This approach can be integrated with the Ministry of Health. There is some capacity within the MOH to conceptualize and produce needed audio-visual materials.

Direct house-to-house campaigns will be difficult to implement at this time because of the absence of the institutional structure. Where viable, this approach may also be employed. Such an approach will become practical and economical within the context of a larger primary health care or environmental health service extension program within MOH and WHO support.

5.3 *FINANCIAL STRATEGY*

It is recommended by the Study Team that the allocation of government funds for sanitation investment should be based upon the merits of the project and the suitability for overall development of the country. The proposed Strategy recommends that before such commitments, the government should establish and apply investment criteria, and to take into use an appraisal procedure covering all relevant aspects of viability: technical, commercial, managerial, financial, economic and environmental. The proposed financing Facility could serve as a model on the government financing of sanitation investments. In any case, the following aspects are recommended to be scrutinized when the Sector projects are presented for financing·

(i) Priority in terms of the national development;
(ii) Demand orientation and user satisfaction;
(iii) Appropriate technology selection;
(iv) Sufficient organizational arrangement;
(v) Cost recovery and financial feasibility;
(vi) Economic feasibility; and
(vii) Impact on pollution abatement.

The proposed financing Strategy proposes that the same financing principles be applied to sanitation and sewerage utilities as in water supply, considering the environmental protection nature of the Sector and the limited revenue base of utilities. It is also proposed that different financing terms will be used to match the debt service costs with income levels and payment capacity.

5.3.1 Financing Instruments

Previously sanitation utilities as well as local governments have paid little attention, apart from budget, to other domestic and external financing possibilities. Therefore, their experience and knowledge on those financing means and corresponding outlets are usually low. The most common instruments and their applicability in the financial restructuring of the Sector are presented in the following.

Table 5-2 Selected financing instruments and their potential application

Target of financing/ financing instrument	HH & NB investment	HH & NB recurrent costs	Utility's fixed assets	Utility's working capital	Utility's recurrent costs	Technical assistance support
Commercial loan	x		(x)	x		
Foreign direct investment			x	x		x
Concessional credit	x		x			
Grant financing	x		x			x
Equity financing	x		x	x		
Non-cash contribution	x	x	x			x
Savings/internal financing	x	x	x	x	x	
Direct subsidies					(x)	

HH = household, NB = neighborhood

The financing instruments and their applicability for financing are discussed more detailed in Annex II.

5.3.2 Cost Sharing

In former years, the financing arrangements of the Sector have been rather simple and straightforward. Utility investments have been financed nearly 100

% from municipal, provincial and national budgetary resources. Foreign resources have been channeled only in exceptions for sanitation and sewerage projects. Operation costs of utilities have also been financed to a large extent from budgetary resources and only marginally from revenues.

For on-site facility improvements households have used their own savings. In addition they borrow funds from private lenders and to some extent from the formal financial sector.

The guiding principle of the proposed Strategy is, that those (users, polluters) who benefit from the services at various levels, will also have to pay for them according to the service use. Presently, sanitation systems are largely financed through general taxes.

The principle for cost sharing is, as the government has indicated, that the polluter should pay. Provision of sanitation and particularly drainage are commodities, whose explicit beneficiaries are very difficult to determine, therefore, exact cost sharing between different levels of government organizations and private people is normally done on a political basis. The Study Team proposes the following cost sharing and financing of sanitation systems.

Household/Block Level

Households pay in advance partially or fully the investment costs of providing on-site facilities (toilet, bathroom, piping, septic tank/sewerage connection). The partial payment in kind, labor and/or cash (say 10-50 %) becomes relevant in connection to consumer loan systems. The full upfront payment comes into question, if loans are not available or consumers do not want to use them. A full payment is expected from wealthy families using their savings and own borrowings, whereas the strategy proposes for the support of lower income families, a specific funding arrangement and savings schemes for investment purposes. In addition, households pay the annual O&M (water use, repair, desludging/sewerage fee) of on-site facilities, and a sanitation tariff charged by a utility for a centralized service.

Community/Neighborhood Level

At the neighborhood level, the residents of the area collectively make a full or partial payment for collector pipes and other additional investment costs. A partial payment, say at a minimum of 10% of the cost, should be made as a down payment (to be collected from residents) if there is loan financing available as suggested by the Strategy. The local representative body such as a Phuong, collects information on the desired combination of costs and technology options that local residents are willing to pay for, and identifies investment financing possibilities.

Residents will also pay recurrent costs when collecting and transporting the wastes from houses and blocks to the boundary of the neighborhood including a possible debt service of a loan.

Town/Provincial Level

Because of the high capital cost of centralized collection (and treatment) systems, the Strategy does not presume that users and beneficiaries would normally pay upfront for such an investment to the utility. There are certain exceptions, for example, the connection of new housing areas to the system would precede an instant payment of a relevant incremental cost. A town/provincial level sanitation project calls for financial planning to distribute the capital cost over the years to come. Local government should pay the equity, say 10-30% of the cost, whereas utilities are expected to prepare financial plans and identify sources, which would enter into an agreement with the utility directly or through local government.

The residents, industries and institutions of a city pay collectively the additional recurrent costs of a sanitation utility when collecting the wastes from household and neighborhood levels and transporting them to the boundary of the city (or of treating the city wastes). The same applies to the capital cost payment of a utility. However, the Strategy aims only gradually at a full cost recovery, because the present revenue base is weak and restructuring of utilities is a slow process.

National level

At the national level, the government decides on environmental pollution control policies and measures and the Sector's priority in budgetary allocations, and accordingly on its participation in sanitation cost. Economic benefits like a project's positive impacts on health care, tourism and fishing industry of the country will justify such a participation. The proposed Strategy recognizes decentralization of decision making and, thus assumes that local authorities (provinces, cities, districts) are responsible for the recurrent costs of utilities through revenues and for investment financing of local projects. Central government extends budgetary financing and finds other sources for large scale projects of national interest, particularly when there is a need for setting up of a wastewater treatment plant or other nationally important sanitation projects.

5.3.3 Cost Recovery

Presently, sanitation services if in place, are covered by the most part through general taxation and other government revenues. Because income taxes in Vietnam comprise only a small share of public revenues, it is apparent that enterprises pay in principle most of recurrent costs for the sanitation, which means cross subsidies from enterprises to the household sector. The present institutional, regulatory and financial framework is inadequate for a rapid reduction of subsidies. Utilities themselves are not concerned about the cost recovery either, because revenues are usually submitted to the Finance Service of the city in question, which in turn provides the financing needed for paying the cost of operations.

The proposed financial Strategy recognizes that there is no instant solution to correct the situation, and therefore it recommends a **gradual improvement in cost recovery** and a progressive replacement of subsidies with user charges and revenue financing. For that purpose, not only new sanitation tariff policies are required but also the establishment of billing and collection systems that generate a revenue level as justified by the service quality and affordability considerations.

Other means of cost recovery and additional revenues, also recommended by the proposed Strategy, are to introduce **connection and development charges** for sanitation services. New customers should pay the cost of connection to a sewer, for which purpose tariff policies will have to be made following the principles applied to government regulations on water supply connection costs. Development charges would be applied to new housing construction works and on expansion or renovation of old buildings. When existing buildings are replaced with larger structures having higher rates of occupancy, there is usually a corresponding increase in the consumption of water and discharge of sewage. As a result, the public sewerage utility is faced with providing additional capacity in its collection networks to be able to cope with additional loads. Where the increased loading can be attributed directly to a housing construction, it would be reasonable to levy a charge to the property owner or a developer in proportion to the benefit the service development is expected to bring.

5.3.4 Tariff Setting

In this Section, both sanitation tariff setting policies and the tariff implications of the Strategy implementation are discussed.

Policies

The Strategy proposes that sanitation services should be considered a commercial service with a certain fee rather than a social service financed from the budget. This proposal is in line with "the polluter-pays" principle and as soon as the cost recovery requirement is accepted, the remaining questions are whether the resulting tariffs are acceptable and how to collect revenues effectively without excessive credit losses.

The present tariff setting, where utilities propose and justify sanitation tariffs for the approval of the People's Committee, can be continued. Tariffs should be consistent with both willingness and ability to pay of utility customers. Willingness-to-pay (WTP) alone does not provide enough guidance for practical tariff setting, and therefore it is important that the real income and savings capacity (i.e. affordability) of households is carefully studied in the planning situation. This is supported by the findings of the socio-economic surveys according to which the WTP of households was found to be rather low, only some 10,000-17,000 VND per month, but that real expenditure for sanitation was found to be considerably higher.

As for sanitation billing and collection there are certain alternatives available. First, a separate billing and collection system may be established, for example similar to water supply companies. Second, the service cost is fully or partially charged in connection with property taxes. Third, the tariff is combined with similar systems of other utilities like water supply or power companies.

Of the available options, separate system parallel to those of other utilities would be the most expensive one. The amount of sewage alone would have to be metered which is currently an impossible task. Payment enforcement would also be difficult because the service cannot be easily enforced, like cutting off water and electricity services.

Property taxes could be used to collect either the total service cost or only a part of it, like the capital cost. Experience of other countries (Sri Lanka, for example) does not necessarily endorse the application of property taxes for recovering sewerage costs. The tax revenues collected from properties go into a general fund of the government along with other taxes out of which it is difficult to earmark a part for sewerage purposes, with a result that there is no opportunity for responsible financial planning for cost recovery. There is also a problem to treat all customers on a equitable basis. Many property owners have their private sanitation systems and property tax is determined by the property value rather than the use of sanitation services.

In Vietnam, the property tax base is weak and represents only about one per cent (241 billion VND in 1993) of all the tax revenues of the central government. While property tax rates are known to be low, one can expect that as a practical matter, it would likely require a long time to build the level of property tax revenues necessary to fund sewerage services. Rather than applying a property tax for the revenue collection of sewerage, it could be more suitable for the cost recovery of separate drainage systems, for which purpose the proposed Strategy does not support the use of sanitation tariffs.

The most applicable way of collecting a sewer service charge, when separate sewers are in place, is as a proportion of the water bill, which is also the recommendation of the Strategy. It is not a perfect method, because for example a household abstracting water from his own well and then discharging his wastewater to the sewer would not be paying his fair share. However, it is the most equitable and the use of the service can be metered. As mentioned earlier, in Vietnam only Hanoi applies a sewer surcharge, a flat 10 % of the waterbill, which is collected by the local water company. However, the system is still at an experimental stage and the sewer revenues are unproportional to the operation costs of the sewerage and drainage company.

The pricing of sanitation services with tariff structures and policies need to be created by conducting a national study as a guidance for provincial municipalities while developing the Sector utilities to financial self-reliance. Apart from the basic sanitation tariff itself, other possibilities for revenue raising should also be covered in the study, such as the basis of connection and development charges.

Tariff Implications of the Strategy

The technical part of the Strategy (Section 5.4.2) will introduce a large number of sanitation options with price and cost information available for households who are interested in upgrading their sanitation systems and environment. Of those alternatives, a rather comprehensive package, a separate system without drainage, was selected for a demonstration of the total cost a household has to pay for the service if the proposed Strategy is followed. The sanitation package comprises both a private development on-site and public sector investment components by a local sanitation utility, both of which to be partially financed with a loan. Investment and operating and maintenance (O&M) costs are estimated on a household (HH) basis as follows:

Table 5-3 Investment and O&M costs of a separate sanitation system

Sanitation Component	***Investment*** **VND/HH**	***O&M*** **VND/HH, Month**
On-Site Sanitation (OS 1)	1,060,000	4,583
Neighborhood Sewer (400 prs./ha)	750,000	333
Conveyance System	220,000	833
Primary Treatment	488,000	917
Cost Division		
- Private cost	1,060,000	4,583
- Public Cost	1,458,000	2,083
Total Cost	**2,518,000**	**6,667**

The total O&M cost is about 6,700 VND/HH/month, which is only about 1% of monthly income. Assuming that the household belongs to a low income category[16] i.e. monthly income is 600,000 VND.

The recovery of the capital cost will, however, make the situation more difficult for the example family. The level of the capital cost depends on the structure and conditions of the project financing. In this case, there are actually two projects to be financed, first, on-site sanitation and, second, that of a public utility. It is assumed that the loan share of the on-site project is 50 % and 80% of the utility's investment. It means that a family has to use its savings or borrowings, and that the owners of the utility will have to make an equity investment, both covering the remaining parts of the project cost. It is also assumed that the loan conditions (interest, maturity) reflect better availability of financing than exits today in Vietnam. The financing arrangements are given in Table 5-4.

Table 5-4 Total sanitation cost of the case project

	Real Interest, %/Year	*Maturity, Years*	*Cost/HH/ Month, VND*	*Cost/HH/ Month, %*
Private Loan, 0 5 MVND	6	4	12,700	45
Utility Loan, 1.2 MVND	4	15	8,700	31
Total Capital Cost			21,400	76
+ O & M Cost			6,700	24
Total Sanitation Cost			**28,100**	**100**

It can be seen from the table, that the total sanitation cost of the improved sanitation is 28,100 VND/month, of which 76 % comes from capital and 24 % from O&M costs. The "tariff" charged by the utility is 10,800 VND/month, in addition to which the household pays 17,300 VND/month for on-site costs. The total cost is nearly 5 % of the household's income which one may say to be "too high" in international comparison. In the demand-driven investment approach, recommended by the Strategy, the stated cost would not be a surprise to the households involved, because their willingness would be tested during the preparation phase of the project and the family would agree on the financial implications. Moreover, after having paid back the private loan in 4 years, the sanitation cost will be cut by about 40 %. The household can also count on the increased property value due to the investment.

[16] *Vietnam Living Standard Survey, 1992-1993,* State Planning Committee - General Statistical Office, Hanoi 1994.

5.3.5 New Financing Facility

While promoting domestic and foreign financing resources, the Study Team proposes that a special financing facility would be established to foster the Sector's restructuring and to accelerate its sustainable development. It would operate on a project basis which is expected to facilitate the lending procedures and accelerate the rate of investment for sanitation. The Facility is meant to be a transitional measure to provide financing with favorable conditions and technical assistance on a grant basis until the revenue base of sanitation services is stabilized and the Vietnamese capital market is better equipped for the needs of the Sector. The economic costs incurred as a result of the distortions due to provision of financing at lower than market rates for this specific purpose are considered to be much less than the corresponding costs due to environment degradation if such subsidized financing would not be available creating lower volume of investments.

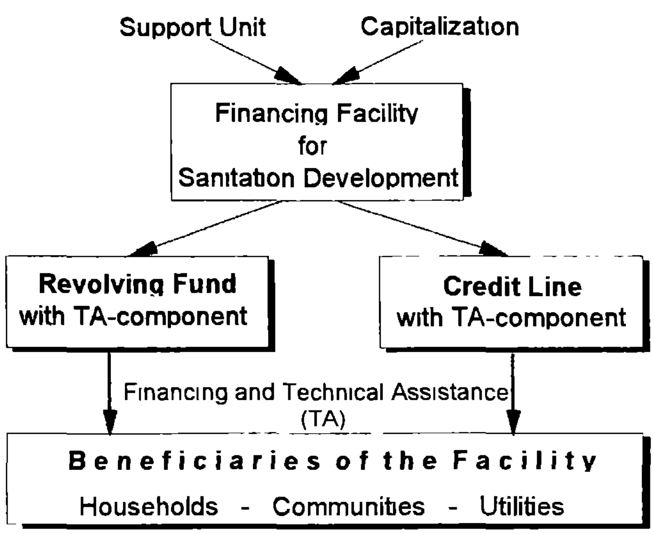


Figure 5-3 Financing facility for sanitation development.

The proposed Facility (Figure 5-3) has two "windows", one **Revolving Fund** for private on-site, community or neighborhood level sanitation investments, sewerage connection cost and technical assistance; and another **Credit Line** for public sewage collection, transportation, treatment, construction of communal facilities, and technical assistance.

The Facility aims at supporting demand oriented sanitation solutions, resource recovery, and pollution abatement There are several reasons why such a facility is required:

(i) Private sanitation and public utilities are now lacking an access to long and medium-term loans and support to prepare and implement service upgrading.

(ii) The cost of informal borrowings is extremely high and households are often unable to offer adequate security as required for a bank loan, if available.
(iii) The Facility will help project-based and sustainable sanitation development and reduce dependency on annually negotiated and uncertain budgetary transfers.
(iv) Vietnamese financial institutions lack management capacities to offer project preparation and appraisal skills of the type required by the Sector.

The recommended size of the Facility is 100 MUSD, which represents about 15% of the total estimated capital investment for sanitation in 2001-2005, when assuming that the Facility will commence operations by end 1990s. The funds would be divided into the Credit Line (75%) and the Revolving Fund (25%) following the ratio of the general investment requirements of the Sector. 10% of the funds are proposed to be used for technical assistance (TA) and demand generation of would-be-borrowers. Later on, both investment and TA-financing mechanisms are expected to offer a working method adoptable to other sectors outside sanitation.

The Strategy anticipates that bi-lateral donors and the Vietnamese government (counterpart financing, say 10 %) provide grant funds for technical assistance and the establishment of the Support Unit, whereas multilateral agencies and donors would finance 100 % of the component for investment. The Strategy recommends that government could use the Credit Line facilities and expertise to lend a part of budgetary funding to utilities instead of channeling it through local governments as a grant.

The Support Unit in Figure 5-3 is required for coordination, implementation and supervision of lending and support activities. Those responsibilities include establishment of standard procedures, for example, for on-lending procedures, project preparation and eligibility criteria of a loan acceptance, guidelines for procurement methods for consulting and contractor services, machinery and equipment, and contractors, and preparation of the Facility accounting, monitoring and reporting systems. The Support Unit would, in the first place, safeguard the interest of the financiers that prudent financing policies would be followed and that funds are spent both efficiently and effectively. International finance institutions are well experienced in the proposed type of funding mechanisms and their help would certainly expedite an early implementation of the Facility.

Prioritization of Financing

It is expected that there will be more demand for the loans than what can be satisfied with the Facility. According to the socio-economic study, more than

90 % of the respondents answered that they prefer a monthly payment to a lump-sum payment for improved sanitation services. The shortage of financing is also apparent to utilities which have been totally dependent on budgetary resources. As a result, utilities, communities and households will have to compete for the limited financing of the Facility. Financing decisions are based either on an application review (small loans) or on an appraisal (big loans) covering all relevant aspects of the project.

The proposed Strategy implies the following general principles to be followed when screening applications for financing:

(i) The project's priority in terms of national importance and development;
(ii) The application should be based on demand-oriented sanitation solutions and choice of technologies consistent with locally determined sanitation plans;
(iii) The application should reflect the willingness and ability of households to pay for sanitation improvement;
(iv) Projected cash flow is based on user charges sufficient to meet upcoming financial obligations for operation and debt service;
(v) The applicant can produce evidence of equity contribution to the project; and
(vi) Proposed project will improve environmental protection and pollution abatement.

The proposed Strategy underlines the requirement for transparency in the Facility's lending and support activities. Decisions and policies should be open for inspection through periodical reporting and auditing.

TA-Component

Major targets of technical assistance funds would be:

(i) for developing local strategies for the economic and safe disposal of wastewater with recommendations on financing sources and structuring,
(ii) for preparation of short- and medium term action plans for upgrading of all sanitation and drainage systems in a town,
(iii) for capacity development of local governments and utilities to support community participation, selection of technologies including low-cost alternatives and construction supervision, and

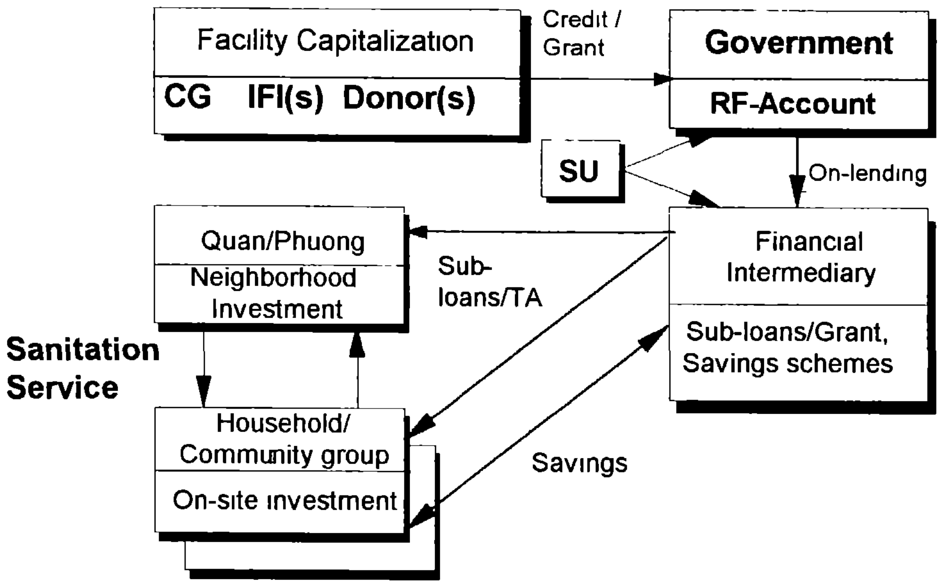
(iv) for promotion of community awareness of the health, economic development and environmental benefits of sewerage and sanitation improvement.

In the first place, the use of TA-funds would focus on households, communities, and utilities which are prospective beneficiaries of investment financing of the Facility.

On-lending terms and conditions to beneficiaries would be an issue to be agreed upon between the intermediating bank and the Government, which borrows from abroad for on-lending. The proposed "financing with favorable conditions" means that (a) the real interest rate of sub-loans would be at least zero percent (= inflation, about 14 % in 1994), that (b) maturity of sub-loans to be longer than currently available in the market, and that (c) available security should not prevent financing for otherwise feasible projects. Loan terms and conditions would be dependent on the applicant's (household/utility) debt service capacity. National financing policies will have to be established for the purpose. As for the risk sharing, the Strategy recommends that government should assume the foreign exchange risk to lower the capital cost to beneficiaries, and that the intermediating bank(s) assumes the project risk.

Revolving Fund

A revolving fund is an arrangement wherein loan funds are relent as soon as loan service payments have been received from the previous borrower. Inflation erodes the purchasing power of the a revolving fund and it must be taken into account in order to make the fund sustainable. A general outlay of the proposed fund arrangement is presented in Figure 5-4:



CG = Central
IFI = International Financing
SU = Support Unit

Figure 5-4 Revolving Fund (RF) Mechanism.

The final beneficiary of a sub-loan can be either one household or several households within a house/block for on-site sanitation or an administrative body of the area (proposed to be Phuong/Quan) for neighborhood level investment like installing feeder piping from individual houses to the neighborhood boundary and a connection of the neighborhood sewer to a trunk sewer. When a sub-loan to a Phuong is extended, the households that benefit could participate in a savings scheme or pay directly the down payment (equity) of the community level project cost.

A revolving loan fund can, in principle, be operated either in cooperation with a national financial institution or by a non-governmental organization (NGO) or by a separate entity. The Study Team recommends that an appropriate financial institution with branch networks in urban areas will be contracted for the purpose. An agreement will have to be reached between the government, external support agencies and the financial institution on how the funds are to be provided to the financial institution, on the structure and the level of interest rates, commissions (spread) and other charges necessary for the financial institution to recover its costs of operation, and what resources it will commit to the fund arrangement. The Support Unit would have to provide appropriate training for the key staff of the bank who would in return organize further training to urban branch managers on lending procedures and assessment of applications.

Financing is closely dependent on the successful decentralization of sanitation responsibilities and institutional innovation to create demand for sanitation, to ensure that enough residents will select and install the system, and that they will be able to pay for and maintain the system once installed. The role of local administration is important and further emphasized when aiming at improved cost effectiveness of the sub-loan system. Instead of extending individual family-based loans, the proposed Strategy calls for active community participation to create larger projects within a street or a block to be packaged and coordinated by the community administration. In such cases a single loan could be made to the Phuong, which would recover the debt and operation service costs from households.

A positive loan decision by the bank should be based on the merits of the project and terms to be tailored (interest rate, repayment period, grace) according to applicants' debt service capacity. In addition, available collateral (employer's guarantee, bank deposit, etc.) should also be requested to avoid debt losses. The proposed financial Strategy relies in some cases also on the social pressure by a community for a loan service.

Usually the most sensitive issue is the level of interest applied in a scheme although its impact on the applicant's cash flow is usually low. The nominal (and also real) interest rates in Vietnam are high, about 2-2.5 %/month in the banking sector for short term purposes (1-6 months) and those of the informal sector, 2 to 3 times higher. When aiming at financial self reliance, the recommended minimum zero real interest rate would be enough only to maintain the purchasing power of the Revolving Fund. Loan proceeds should also cover the bank's administrative expenditure with a profit margin, capital cost, and a reserve for bad debts. A higher average interest level is therefore required for the loan portfolio, but it should remain below the market rate to make the facility attractive to consumers. The Study Team recommends that the terms and conditions of the sub-loans should reflect the household's ability to pay.

Table 5-5 Differentiation of loan terms by income class

Income Class	*High*	*Medium*	*Low*
Real Interest of Sub-loan, % p.a.	6	3	0
Loan Maturity, years	1	2	3
Equity Requirement, %/cost	30	20	10
Loan (100 VND) Cost/year, VND	106	52	33
Grant Element, %	*4*	*9*	*17*

This would also make it possible to allocate a part of the funds at affordable terms to low income and poor households. Table 5-5 provides an example of such differentiation of the loan interest, maturity and the proportion of equity (own financing). According to it, the annual loan service cost of low income families is about one third of that of high income families. The **grant element**[17] shows the degree of concessionality of each loan arrangement.

The following example may clarify the operating principles of the Revolving Fund:

A family of 5 members wants to upgrade its double vault latrine to pour-flush toilet with a septic tank and sludge handling, the total cost of which is 3.6 MVND. The present monthly income of the family is 600,000 VND and hence belonging to the low income category, as explained above. The family is advised by the lending bank that a down-payment of 50 % or 1.8 MVND is required in cash and/or own labor and materials in order to be eligible for a loan covering the other half of the cost. There are no savings left from previous years or possibilities to borrow at a reasonable cost. After having decided to open a savings account at the bank and to deposit 10 % of the income rising 4 % per annum in real terms, the required down payment is available in about 2.7 years. The average annual service cost (annuity) of the loan is 675,000 VND/year or about 9 % of the family's income, which is considered achievable by the bank. The bank found the project financially viable and a loan agreement with a term of 3 years and a 6 % p.a. interest rate plus inflation was signed. The operating costs of the new facilities (mainly water for flushing) is calculated to be reasonably low or about 1 % of the income or 6,100 VND/month.

Figure 5-5 demonstrates the importance of maturity for cash flow when designing the lending terms of sub-loans. The debt service decreases to almost 1/3 if the maturity is extended from one to three years.

[17] *Grant element* is the difference between the nominal value of the loan and the discounted present value of the future debt service payments to be made by the borrower, expressed as a percentage of the nominal value of the loan

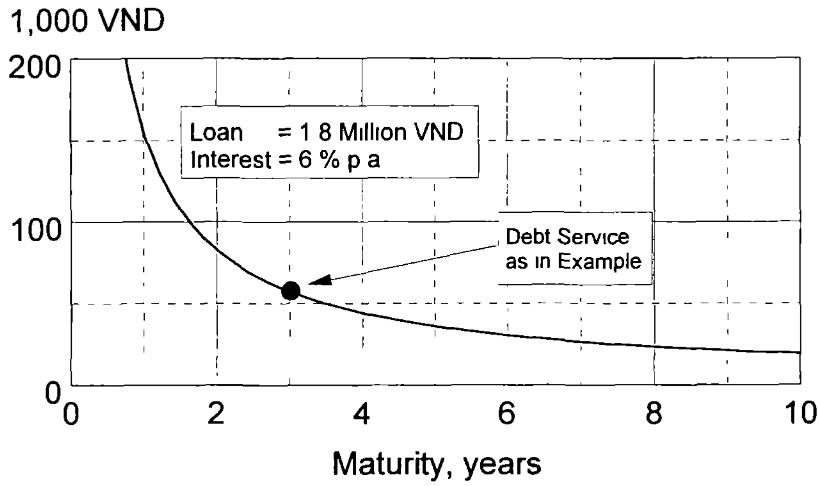


Figure 5-5 Monthly debt service and loan maturity.

Credit Line

The Credit Line provides public utilities a direct access to long-term finance with preferential rates which otherwise is not normally available in Vietnam. The prime targets of the Credit Line loans are for restructuring of existing utilities and for establishment of new collection networks and other sanitation facilities. Particular this type of arrangement is commonly applied to transfer investment funds from international financing institutions to the private sector. Central government is also expected to use the Facility and its expertise as a new transfer channel for a part of budgetary investment funds for sanitation. The funding is expected to be received from international financing institutions and donors as concessional credits for on-lending. Bi-lateral donors have been assumed to provide grant financing for the TA-component of the arrangement. Figure 5-6 clarifies the proposed Credit Line mechanism.

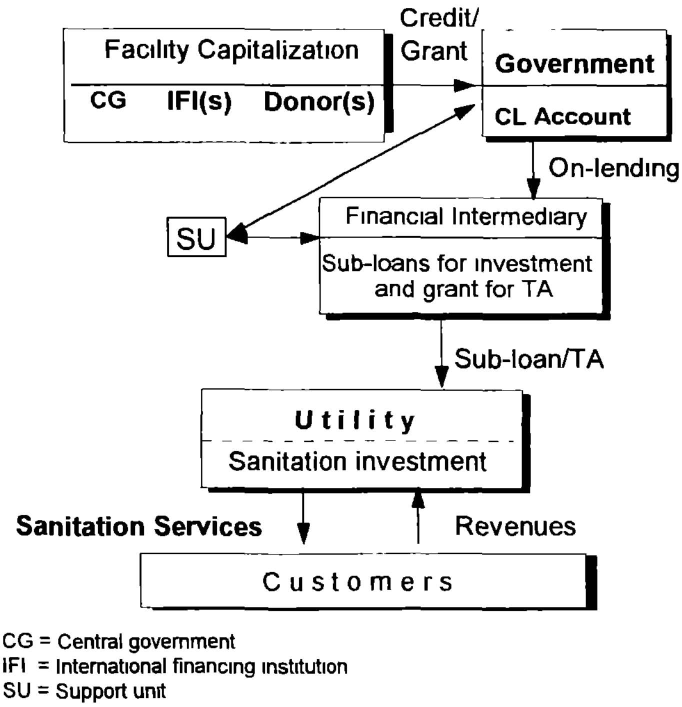


Figure 5-6 Credit Line (CL) Mechanism

After the capitalization of the Facility is solved, a tri-party collaboration is required between the government, foreign financiers, and an intermediating bank which is not necessarily the same as the one selected for the Revolving Fund purposes. The reasoning for separate mechanisms is the differences in sub-loan size and administrative routines. While the sub-loans to households and community administration could range between 200-20,000 USD, the same for public sewer systems could be somewhere between 0.2-1.0 MUSD. Therefore, private loans should be processed and decided upon at the branch level, close to urban communities, but utility loans could be administered in a bank's head office. Utility loans will also require different loan preparation, appraisal and monitoring procedures than those in the Revolving Fund system.

One of the main questions to be solved is the concessionality of sub-loans among towns with different income levels and financing capacity. While there are several alternative methods to carry out regional development policies, the Study Team proposes that loan terms (interest, grace, maturity) could be differentiated to match the debt service cost with income levels and payment capacity in various towns as estimated case by case. An example of such differentiation is shown in Table 5-6 below.

Table 5-6 Differentiation of financing terms by town class

Town Class	*I*	*II*	*III&IV*
Real Interest of Sub-loan, % p.a.	4	2	0
Loan Maturity, years	10	15	20
Equity Requirement, %/cost	20	15	10
Loan (100 VND) Cost/year, VND	9	6	4
Grant Element, %	***23***	***39***	***57***

Class III and IV towns would get the biggest benefits of the financing system measured by the grant element. Detailed lending policies would have to be designed later on. One of the targets of such a policy should be that the Credit Line system will remain financially self-sufficient; i.e. loan revenues will have to cover loan administration expenses, capital cost, and a reservation for bad debts. The application of positive real interest rates would allow government to create a reserve fund against foreign exchange risk.

The use of technical assistance funds would be mainly directed for the support of those towns and utilities which have already presented prospective plans and ideas for their sanitation and environment improvement. The local government is requested to provide equity (cash and/or in kind) in order to secure their commitment to the project whether it be an investment or a feasibility study. Specific guidelines and decision criteria will have to be prepared during the preparatory phase of the Facility.

Possible impacts of the Facility

A rough estimate of the Facility's impact on sanitation development is provided in Table 5-7. In case of the Revolving Fund, only the first round of funds utilization has been considered. Its ultimate impact will depend on the average turnover of loans and on borrowing maturities by the intermediating bank. The use of the Facility does not aim at providing full sanitation systems to households starting from on-site level through collection and treatment to disposal of wastewaters. Rather the proposed financing would support different type of "slices " in the sanitation chain, which are locally considered bottlenecks and problem areas for reaching the overall service quality that the Strategy is aiming at. For example, the reason that justifies the financing of only a conventional separate sewer could be the rapid development of private sanitation in particular townships of the city which increases the demand for a trunk sewer construction to which feeder sewers and households could then be connected.

Table 5-7 Estimated impacts of the Facility

Target Investment	Inv.Cost/ System 1000 USD	Credit/ Inv. Cost %	No. of Systems Financed	Total Finance MUSD	No. of HH Concerned	%
Credit Line						
Conveyance. Primary Treatment	320	0 8	79	20.3	396,000	35
Conveyance System, Drainage	1,450	0 8	35	40 5	175,000	16
Communal Toilet	10	0 8	826	6 7	50,000	4
Revolving Fund						
Neighborhood Sewer	34	0 5	924	15 8	462,000	41
On-Site System, Sludge Handling	0 3	0 5	40,909	6 7	41,000	4
Total				90 0	1,124,000	100

HH = Household

After having invested the resources of the Facility, the total number of households to which may benefit from improved sanitation is estimated to be about 1.1 million. Out of them, only a portion, say 170,000 households, can reach the target sanitation quality level of the proposed Strategy. Table 5-7 demonstrates one possible combination of sanitation improvement supported by the Facility. For example, more than 900 neighborhood level sewer systems with an average of 5,000 people in each of them would benefit from the financing.

5.3.6 Financing Sources

Although the Study Team recommends the establishment of a special facility for acceleration of sanitation development, its share of total financing needs will remain modest. The mainstream of private and public sanitation will still have to rely on other financing and have to compete with other and better established sectors like power supply and transport sectors for budgetary, and other domestic and foreign financing. To survive in this competition, proactive measures by the government are required and proposed by the Study Team, so that all potential funding sources are identified and mobilized (within the national framework) for the support of sanitation schemes and investment projects.

Public sanitation in Vietnam has been fully dependent on budgetary resources for its capital expenditure and on subsidy payments for operating costs. Provinces and cities have their own negligible revenue sources for sanitation investment and they have to share in centrally collected taxes and transfers from central government, subject to negotiations every year. Centralized financial decision-making, together with unreliable availability of funding, makes the application of modern capital budgeting and financial management of a sanitation utility practically an impossible task.

Budget will remain, however, the most important source of public sanitation financing in the foreseeable future. To improve the budget financing sustainability, the Study Team recommends that the funds now allocated by the central government to local governments and to projects on a grant basis, would be divided into two components. The first one would be for the support of the local government's equity investment in the restructured utilities, and the second part of the funds would be channeled as a loan on a project basis through the banking system, including the proposed Facility.

It seems possible that the budgetary financing could be increased because the Government has indicated that it wants to concentrate on infrastructure and in more particular ..."on those socio-economic infrastructure projects where no direct return on capital is possible"[18]. Over the next few years at least, sanitation sector qualifies into that category, although, the proposed Strategy is that the Sector should be placed in the long-run on commercial footing. Because it is a lengthy process, budgetary funds are indispensable to help establish a new foundation for the Sector. The Sector authorities should also do their utmost for increased funding so that further deterioration of the facilities and environment degradation will cease.

The proposed strategy recognizes the low absorption capacity of utilities and difficulties for raising for revenue financing in the short-run, for which reasons local governments may have to continue their recurrent cost subsidies for some time in particular for III & IV class towns. The overall objective of the proposed Strategy is to phase out subsidies during the transition period. Financial plans should be drafted to set targets for termination of subsidies and for availability of budgetary support during the transition period.

Figure 5-7 demonstrates the possible financing sources and mechanisms that are available for sanitation investment purposes. However, the country is still on the way to a market economy and her creditworthiness needs to be improved to tap more comprehensively international financing potential, particularly that of private investors. The limits of the lending country for export credits to Vietnam may still be concerned only for short term financing, or a donor applies only a low concessional credit ceiling under the OECD ruling. Another limitation comes from the practice that financing is tied to the procurement from the lending country, because the foreign component in sanitation is usually low.

[18]The Political Report of the Central Committee in January 1994

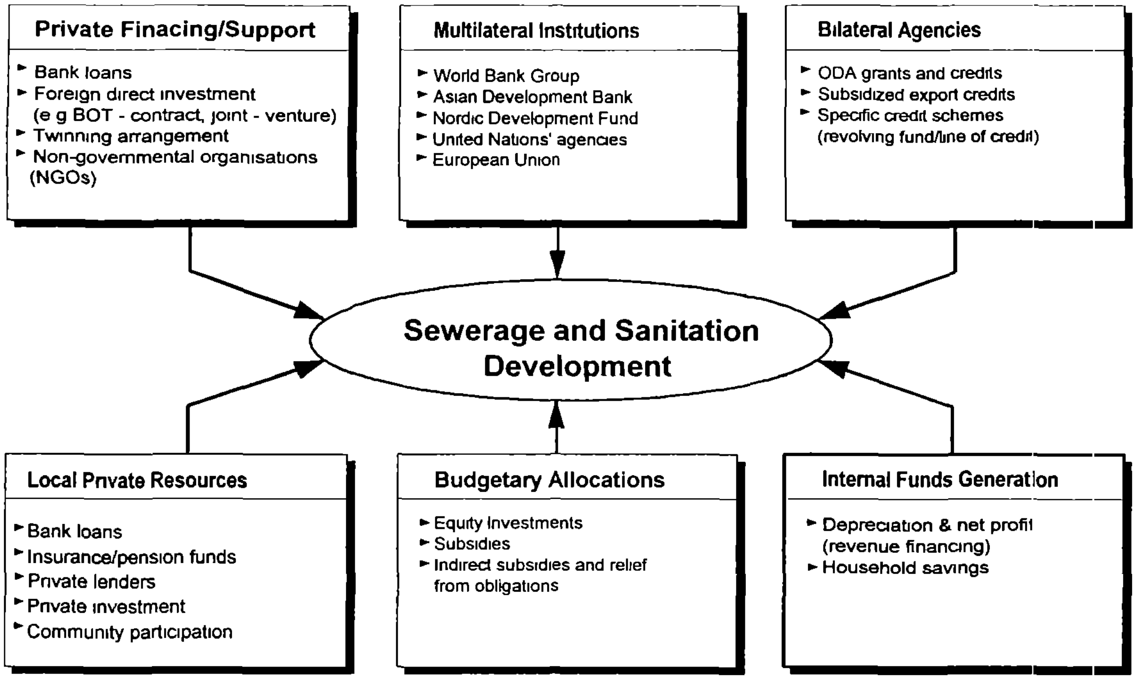


Figure 5-7 Potential financing/support sources for sewerage and sanitation development.

Apart from identifying and mobilizing foreign financing for the Sector's investment, increased collaboration with foreign partners and utilities is also important. According to present regulations, urban municipalities and water supply/sanitation utilities are permitted to have direct co-operation or joint ventures with foreign countries to invest in the development of infrastructure. For example, water supply companies in other countries often enter into twinning arrangements, which could also benefit sanitation utilities in Vietnam.

The Board for Water Supply and Sanitation Projects within MOC is suggested to widen its operations and to launch promotional measures to improve the awareness of donors and other international support agencies on investment needs of urban sanitation in Vietnam. There is a general tendency and willingness within the OECD countries to direct their concessional credit and grant programs for environment protection and pollution abatement projects. Therefore, future sanitation policies and financing strategies should exploit this potential and that policies should be clearly drafted to shift donors' attention to the development needs of the Sector.

Due to the poor functioning of the domestic financial market, the government and the State Bank of Vietnam can provide important indirect support for the Sector's development while taking appropriate measures to enhance the service level and lending capacity of the banking sector. One important measure is to increase savings and long-term deposits to enable the banks to expand the term of their lending. Innovation is required to develop new financing arrangements on the household level. To this end, links could be developed between informal lenders, now actively operating in the market, with formal lending institutions for cost reduction.

Another target for domestic innovative solutions is housing finance, because it serves at the same time as sanitation improvement. The demand for urban housing is likely to accelerate in major towns along with rising incomes of people. Improved financing services for housing developers and buyers would reduce the cost and expand markets for housing of different levels. At present, banks do not provide specific loans to buy a house or a dwelling, and most housing is purchased using personal savings, transfers from family, and loans from friends and private sources. An example of the financial measures already taken to improve small-scale household financing is the recent establishment of the Bank for the Poor which is managed by the Bank of Agriculture with an initial capital of 39 million USD.

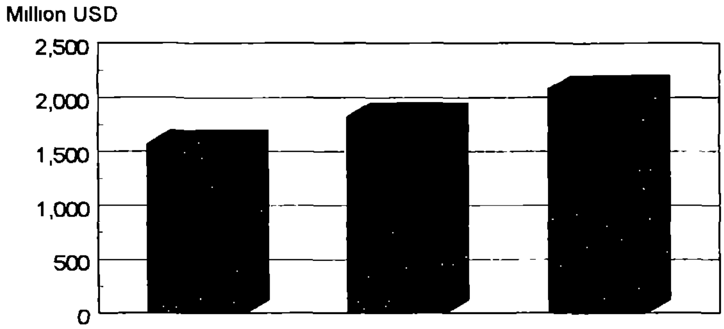
5.3.7 Financial Management

The present situation analysis of utilities reveals that comprehensive upgrading is necessary for both financial management capacity and procedures including reporting and database development. To this end, utility reorganization and corporatization are required which clarify objectives, responsibilities and accountability of company managers. This means that managers should be given full responsibility for decision making under the selected corporative solution and that their performance should be measured by their financial success in terms of cost reduction, revenue collection and management of investments.

The proposed Strategy aims at **increasing managerial and financial autonomy** of the Sector utilities through establishment of reliable revenue sources with an effective user fee system. The idea is that a higher internal cash flow and cost recovery will lead to smaller subsidies and give managers more motivation and incentive to focus on improvement of financial viability of the utility. Motivation improvement also means performance dependent remuneration and salary scales. Finally, the proposed Strategy also underlines the need for training in the areas of business management, accounting, financial control systems, and feasibility studies to ensure that utilities make economically and financially sound decisions.

5.3.8 Investment and Financing

Figure 5-8 combines the earlier findings concerning investment requirements with specific objectives and financing prospects of the sanitation sector.



Year	1996-2000	1996-2005	1996-2010
Softfall	1224	860	114
Financed	340	957	1956

Figure 5-8 Projected investment and financing shortfall for sanitation in 1996-2010

The shortfall-portion of the bars describe the value of investment requirements to meet the estimated need for sanitation improvements. It is projected that accumulated investments would be about 1.6 billion USD by year 2000 to upgrade existing facilities and to provide new sanitation installations for the projected population growth. The financing scenario indicates, however, that only 340 million USD worth of it or 22 % can be implemented and even less if the low growth financing scenario is realized. On this basis, the total financing of about 2 billion USD up to year 2010 would make it possible that the set medium term service coverage objectives would be met (*Section 4.2, Table 4-2)*.

5.4 TECHNICAL STRATEGY

5.4.1 Service Coverage Consideration

Experience from other comparable cities have shown that significant public health impacts will only be achieved if the coverage of potable water supply and proper sanitation services are provided simultaneously with high coverage.

According to the Draft Vietnam Urban Sector Strategy, the main emphasis will be to mobilize the economic strength and growth potential in the major cities, and to place first priority on development in three "development poles" or corridors, namely Hanoi - Haiphong - Halong in the Red River Delta, HCMC - Bien Hoa - Vung Tau in the Mekong Delta, and the coastal area around Hue - Da Nang -Quy Nhon - Nha Trang. These areas cover all Class I and II cities, and some Class III cities. The proposed NUSS-Strategy will follow the National Development Strategy, and therefore, it is suggested that implementation of sewerage systems will be started in these areas.

From a cost efficiency point of view, top priority should be on rehabilitation or partial replacement of existing sewerage and drainage systems, to ensure the longest possible useful life of these systems.

The private sector has demonstrated its willingness to invest in its own sanitation facilities It is expected that this trend will continue. A market oriented approach to the delivery of sanitation services will be pursued in the future. This will require that a number of alternative technologies are available at different affordability levels, and it will only succeed if the government does not fall behind with investments in basic infrastructure facilities, such as macro drainage and sewerage systems, and treatment facilities.

The NUSS willingness to pay survey revealed that most people prefer a separate sewerage system over the present combined system, and are prepared to pay more for it. It is suggested that the government may finance the drainage system in specially flood prone areas, where this is considered necessary from a public health, safety and economic point of view.

Due to public and private sector economic constraints, it will be necessary to prioritize sanitation developments, to invest in those areas where the benefits would be greatest and to the largest possible extent let market mechanisms determine where the investments should go. But the government can and should provide the necessary guidance, regulations, incentives and be instrumental in developing suitable financing mechanisms.

First Priority Areas

Export/Industrial Processing Zones (EPZ, IPZ), commercial centers, tourist resorts, and high income estates in the growth corridors are identified by the government as first priority development areas. Infrastructure in these areas will be developed to recognized international service and environmental standards, i.e., separate sewerage and drainage systems with state of the art treatment plants.

Rehabilitation of the most deteriorated and vital parts of existing combined systems in the old city centers should have a high priority in the development of infrastructure. In many cases only by improving the operation and maintenance capacity of the utilities can considerable improvements be achieved

Second Priority Areas

It is envisaged that developments will spread out from the present city centers into areas that are now partly developed, and then slowly expand into suburban areas, such as new housing estates, industrial developments, and commercial centers, as indicated in Figure 5-9.

Sanitation systems in areas closest to the city center may continue to be combined, expanding upstream, or existing systems may be upgraded to separate small-bore, condominial and simplified sewer systems. This will depend entirely on the local conditions. In new high density residential subdivisions, commercial centers and industrial areas, conventional separate sewerage is likely most economical. Development of neighborhood drainage could in these cases be installed later, as people are less concerned about flooding and less willing to pay for it.

On-site disposal systems should primarily be used in low density, high income residential areas with suitable soil conditions. The local governments should provide macro sanitation and drainage facilities, while the private sector will be responsible for implementation of sewer connections and neighborhood sewerage and drainage facilities, utilizing a range of available technologies according to their demand and willingness to pay.

Third Priority Areas

Upgrading existing of systems in the old city centers should have third priority, because such investments would be less cost effective than in new poorly serviced areas. City centers are already rather well established, and the residents are unlikely willing to pay for the improvements. Infrastructure improvements in existing city centers are relatively much more costly than in new development areas, where roads, pipes, and cables can be installed at the same time.

Public awareness and community involvement campaigns should be launched in areas with existing public collection systems, but with low rate of connections, in order to gain maximal benefits of the existing systems.

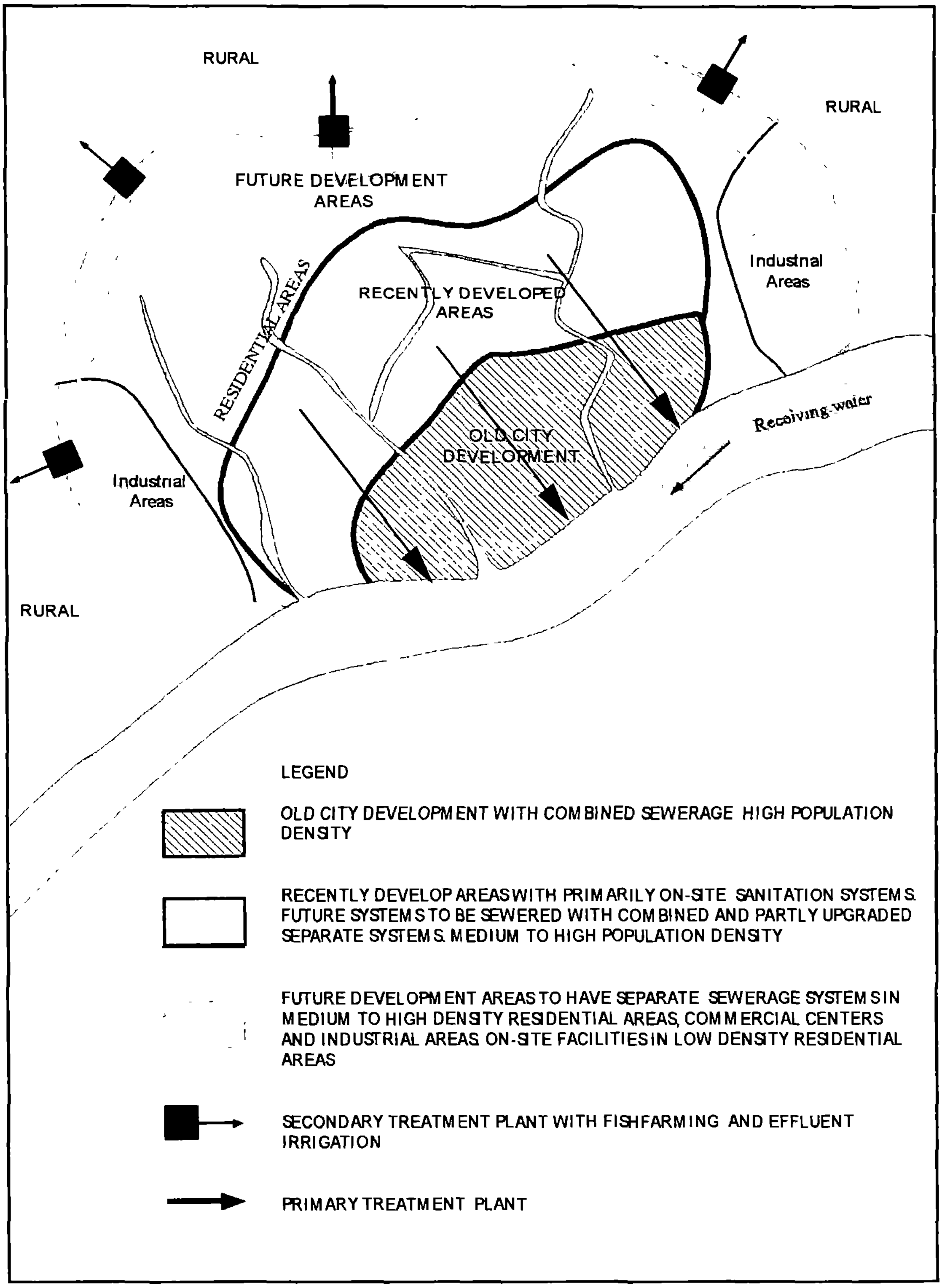


Figure 5-9 Schematic Urban Development Concept.

5.4.2 Appropriate Technology Selection

A wide range of upgradeable technology options are available for each component, from the household level to the final disposal point. Selection of the most appropriate technology must be based on customers' demand, local conditions, rational economic considerations, and service and effluent quality standards set by the government. Some general guidelines will be provided in the following.

ON-SITE	NEIGHBORHOOD	CONVEYANCE	TREATMENT	DISPOSAL
OS 1 Sewered flush or pour-flush toilet	**NB 1** Conventional separate sewer	**CV 1** Separate sewer & drainage	**TM 1** Conventional sewage treatment plant	**DS 1** Inland waters
OS 2 Flush or pour-flush with septic tank and on-site disposal	**NB 2** Small bore sewer	**CV 2** Simplified sewer & drainage	**TM 2** Oxidation ditches	**DS 2** Marine waters
OS 3 Flush or pour-flush with septic tank and sewer connection	**NB 3** Condominial sewer	**CV 3** Combined sewer	**TM 3** Aerated lagoon	**DS 3** On land
OS 4 Flush or pour-flush toilet with pit latrine	**NB 4** Combined sewer	**CV 4** Open Canal and drains	**TM 4** Stabilization ponds	**DS 4** Irrigation
OS 5 Communal or public toilet			**TM 5** Constructed wetland treatment systems	**DS 5** Aquaculture
			TM 6 Primary treatment	
		CV 5 Truck collection of sludge	**TM 7** Digestion by storage	**DS 6** Agriculture
		CV 6 Cart collection of sludge	**TM 8** Composting	**DS 7** Aquacultural use
				DS 8 Landfill disposal

Figure 5-10. Sanitation technology options.

Private Sanitation Facilities

Most dry type toilets have already been replaced with flush or pour flush toilets in the cities in South Vietnam, and the same developments are presently taking place in the North. Clearly people do not want the dry type toilets, and since they are not more economical than wet type toilets, it is recommended that flush or pour flush toilets are built in areas where the conditions are suitable. From the technical point of view the government's role will primarily be to increase the people's awareness for public health concerns and environmental protection, and to provide information and technical advisory services.

Facilities with on-site disposal will meet the demands for convenience and comfort, and provide the necessary health and environmental protection. Several alternatives exist and efforts should be made to inform people about available technologies. It is recommended that building of pour flush pit latrines should be encouraged because it is much cheaper than a septic tank system, and will give the added advantage of producing a safe compost.

In high population densities sewerage is more economical. On-site sanitation should, therefore, primarily be used in residential areas with low population density, less than 200 persons/ha, where the soil permeability is higher than 10^{-7} m/s, where the groundwater table is about 2 m or more below the ground surface, and where shallow wells are not used for extraction of drinking water. Only a macro drainage system is likely to be required in these subdivisions. Another important factor is that as no government expenditures are required for on-site facilities, financing may by easier to arrange, and the developments could be demand driven.

All systems that rely on soil infiltration will sooner or later clog up due to particulate matter that is carried from the pits and septic tank with the effluent. The useful life of septic tank and pour flush latrines are enhanced by using a dual infiltration system, and by regular desludging of the septic tanks and pits. It is recommended that design standards for systems with on-site disposal should specify dual infiltration systems. A regular sludge emptying arrangement must be set up.

For those households that cannot afford an individual facility, or do not have sufficient space on their own property, a sharing of the septic tank and ground infiltration systems, or a communal toilet, could be an economic and satisfactory solution. In many places the infiltration system can be developed within the road right-of-way, or on other public areas. The government should facilitate and encourage such flexible and economic solutions.

Wastewater Collection and Conveyance Systems in New Areas

Cost analyses show, that in new development areas, a separate system would cost about the same as combined system if the population density is low, while for population densities exceeding 200 persons/ha, a separate system would be more economical.

It is recommended that separate sewerage and drainage systems should be required in all new development areas, especially in industrial development zones, commercial centers, tourist resorts, etc.

The collection systems should be designed in a way which accomplishes collection of wastewater for a wastewater treatment plant(s), which may be constructed later on. This in most cities requires pumping of wastewater, but also reduces point pollution and thus decreases public health risk in cities.

It is good economy to complete all roads and other infrastructure, such as water supply and sewerage, prior to issuing building permits, or prior to start of construction of buildings and other work on the individual plots. The planning authorities should also take into account the space and accessibility requirements for maintenance and service equipment, such as sludge emptying vehicles.

Wastewater Collection and Conveyance Systems in Existing Areas.

In areas that already have a combined system it may be necessary to improve the conditions for public health, environmental or aesthetical reasons. Rehabilitation and repair of the existing systems should be given top priority, as well as a program to eliminate direct discharge from septic tanks to street gutters. A pilot project to test out various ways to eliminate or enclose wastewater flows in open gutters is recommended.

The sanitation conditions in some built-up areas may need to be improved. For example in areas where the ground infiltration of septic effluents is not functioning satisfactorily or where proper drainage is lacking and therefore effluent is discharged to the streets or on the ground. The alternatives would be whether to extend the combined system, or upgrade to a separate system. Where economical, a separate upgraded system should be selected because it gives better protection.

Where septic tanks are already installed, several technologies are available that are more economic than conventional separate sewers. These systems take advantage of the nearly solids-free flow after sedimentation in septic tanks or pit latrines, and will allow the system to be designed for smaller diameter pipes, flatter pipe gradients and shallower trenches. Examples of this type of systems are the small-bore, condominial and simplified sewers, described in

Volume 4. These systems should be used where suitable. A participatory approach among the dwellers of the community or neighborhood will normally be required. The government should provide the institutional arrangements to facilitate and enable communities to participate in planning, building and managing their own neighborhood systems.

Wastewater Disposal Management

The present waste management practices, and law enforcement, are not adequate to protect the environment. Pollution of many urban water resources is already critical, to the point where there can be no beneficial uses, and the conditions are detrimental to the general well-being of people. Without reform, i.e. option A, the organic load to natural waters would increase by more than 50% before year 2010, as shown in Figure 5-11. It is recommended that a waste management strategy, i.e. option D, is adopted that will result in no additional pollution. The following steps should be taken to accomplish this:

(i) Collection and treatment of wastewater from areas already built-up with combined and/or septic tanks in 1996 will mainly remain as they are until year 2010;
(ii) Provide a minimum primary treatment level for wastewater discharged from all new sewerage developments, starting 1996;
(iii) Adopt properly designed and operated on-site disposal facilities for approximately 20% of population in Class I and II cities, and for about 40% in Class III and IV cities;
(iv) Establish a regular and compulsory septic sludge emptying system and sludge treatment facilities before year 2000; and
(v) Between year 2000 and 2010 upgrade to secondary treatment all plants installed after 1996, and require secondary treatment for wastewater from all new developments.

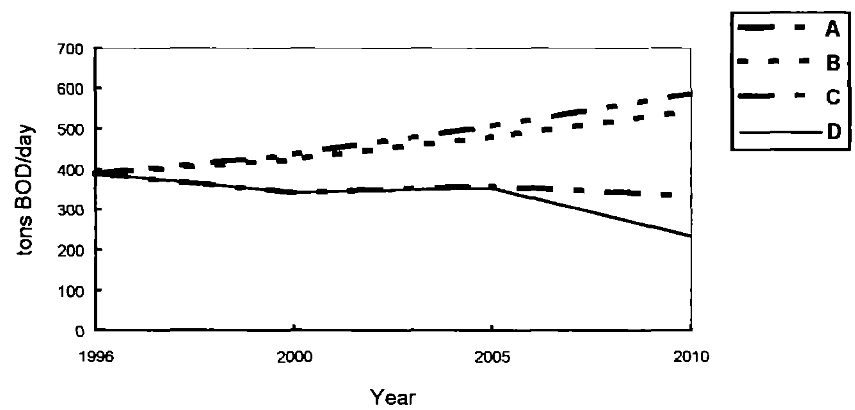


Figure 5-11 Change in organic pollution load.

The above general strategy requires a review and adjustment of the existing environmental regulations and standards. The need for wastewater treatment should be considered case by case taking into account the natural purification capacity of the receiving water and site specific water quality requirements of the downstream or local use.

5.4.3 Water Conservation and Reuse Options

It is recommended that a strategy for water conservation and reuse of wastewater is adopted as a means for reducing the cost of waste management and pollution control. Use of toilets that require low flushing quantities should be actively pursued. There are toilets on the market that operate well with 2-4 liter per use, but not yet used in Vietnam.

Steps should be taken to eliminate groundwater pollution in areas where this is used for drinking water. The implications, in some cases, could be that existing on-site disposal should be stopped or minimized, and a sewerage system installed. In some urban areas, where piped water supply is provided, but where shallow wells are still used by some, it may be more economical to provide piped water supply to all, and sacrifice the upper aquifer of groundwater, if the conditions are otherwise favorable for ground infiltration. This situation must be very carefully examined.

Several wastewater treatment methods are particularly suitable for application in Vietnam, such as stabilization ponds and aerated lagoons, that can utilize the ponds for fish farming, and wetland treatment that may take advantage of the abundance of shallow lakes, marshland and other water areas. These systems are most likely to find application in urban fringe areas, as temporary solutions, and in Class III and smaller cities.

Reuse of wastewater for irrigation and aquaculture should be promoted and explored. It is suggested that the Engelberg Microbiological Quality Guidelines developed by WHO, WB and the International Reference Center for Waste Disposal, see Section 3.3 Table 3-3, are adopted in Vietnam.

5.4.4 Solid Waste Management Issues

Solid waste is normally thrown into the streets and then swept along the gutters to a point where it is heaped and then shoveled on to a push cart. Some of this garbage is swept into storm water gutter inlets, or carried with wastewater in the gutter into storm water drains. It has been estimated that as much as 40 to 50% of the solid waste generated in some areas in HCMC ends up in the drainage system, from where it has to be removed to avoid pipe clogging, flooding, pollution, unsanitary and unsightly conditions. It is recommended that steps are taken to improve the solid waste management system, to introduce containerized collection system that will keep the solid waste away from the streets and from entering the drainage system. Without these steps, separation of sanitary and storm water system will not result in the intended benefits, because the run off water will be heavily polluted from garbage.

5.4.5 Design and Manufacturing Standards

The design standards and guidelines are presently being updated, and they should include detailed information on all the technology options included in this Strategy.

The quality of some locally produced sewer pipes does not always meet acceptable standards. It is recommended that appropriate manufacturing standards and quality control procedures are introduced. Design and product standardization, as well as manufacturing standards for sewers and other sanitation equipment produced in Vietnam, should be commensurable with recognized international product and quality standards for the purpose of compatibility with imported pipes and fittings, and for the possible export of locally produced pipes.

5.4.6 Construction Quality Control

Proper regulations and guidelines for safe construction methods and construction supervision are obviously lacking. Very often pipes are laid without proper attention to vertical and horizontal gradients, and the joints are not constructed water tight. This results in leakage of wastewater, and pollution of the groundwater below the pipe. Where the groundwater stands higher than the pipe invert, there will be an inflow of groundwater, and this puts an extra and unnecessary load on the conveyance, pumping and treatment systems, which, of course, will lead to economic losses. Proper construction guidelines, quality assurance and quality control procedures should be prepared and used in all public works contracts.

6. *IMMEDIATE ACTION PLAN*

The Study team proposes the following actions/measures to be taken in order to reach the set objectives in *Section 4*. The immediate action plan is prepared for the period up to year 2000, but the influence of the actions is reaching much further i.e. meeting the set development objectives.

ECONOMIC SUSTAINABILITY

The proposed actions/measures are summarized in Table 6-1.

Table 6-1 Action plan for short term objectives of Economic Sustainability.

Reorganization and Overlapping Responsibilities

- Clearly define the roles and responsibilities of MOPI and other line Ministries;
    - MOC to be the key agency in urban management, and have main responsibility for policy and strategy formulation; urban master planning; development of technology, technical guidelines, standards, and codes of practice; technical appraisal and approval; and collection of sector information.
    - MOC should divest itself of commercial activities
    - The mandate for issuing licenses for industrial effluent discharges should be transferred from MOARD to MOSTE.
    - The mandate for regulating the monitoring of waste treatment of industries should be transferred from MOH to MOSTE.
    - Management Board of Water Supply and Sanitation Development Projects should re-orient its role from a project oriented focus to more holistic responsibility for the Sector development.
- Decentralize authority from central to local level, from administration to utilities, and from public sector to private sector.
- Simplify project preparation and approval procedures, and increase flexibility in project preparation and implementation
- Centralize environmental management to environmental authorities.

Priority of the Sector

- Determine Sector utilities' status among state owned enterprises and specify the financial objectives and responsibilities of utilities within the framework of increased autonomy
- Open a new sewerage and sanitation sub-sector and incorporate it into the government's budget for capital expenditure and recurrent costs, national infrastructure development (Public Investment Program), and external financing planning
- Generate demand by promotion, public awareness campaigns and education, e.g. through the proposed Sanitation Promotion Units

/...

Financial Management

- Take into use the new national system of accounts, and establish in the Sector, utilities computerized financial and cost-accounting, budgeting and management information (MIS) and reporting systems.
- Prepare instructions to utilities for establishment of an asset register, auditing, and revaluation of balance-sheet values
- Prepare a Sector Investment Profile with potential projects and identify interested donors and other external support agencies for negotiations on finance and other support for the Sector

Cost Recovery

- Prepare national guidelines for setting of sanitation tariffs, and administrative instructions to link the corresponding billing and collection to similar activities of water supply companies;
    - Carry out a financial sector study on sanitation covering the policies for revenue accumulation, loan financing improvement and equity participation possibilities in the Sector utilities.
    - Prepare national guidelines to introduce new sources of sanitation revenues: a connection fee for regular new customers, a development fee for connection of new properties, and a redevelopment fee for expansion or renovation of existing customers.

Funding Mechanisms

- Prepare and implement a pilot project on private sanitation development including financing support for investment and technical assistance.
- Prepare a project plan on the proposed Financing Facility for information of foreign financiers to establish (a) a revolving fund for private sanitation support at household and neighborhood level sanitation, and (b) a credit line for public sanitation systems for centralized sewage collection and treatment

O&M Capacity

- Develop HRD policy frame and HRD programs
- Deal with labor market challenges, e.g., by labor market analysis, Productivity Improvement Programs, and incentives systems
- Establish and operate Sector Data Base within MOC.
- Improve the O&M capacities of the utilities by new equipment.

ENVIRONMENTAL SUSTAINABILITY

The proposed actions/measures are summarized in Table 6-2.

Table 6-2 Action plan for short term objectives of Environmental Sustainability

Enforceability

- Develop realistic and enforceable environmental laws and standards, defining the total allowable loads (instead of concentrations), and limits for discharges (instead of ambient water quality), both as general standards and as special requirements for areas to be particularly protected.
- Redefine the appraisal duties of MOSTE and local governments for EIA to cope with the requirements and capabilities.
- Develop the human and financial resources of MOSTE and local environmental authorities

Waste Disposal Management

- Real enforcement of present enforceable laws and regulations and actions towards violators carried out accordingly
- Provide a minimum of primary treatment level for wastewater discharged from all new sewerage developments
- Regular septic sludge collection, and proper treatment and disposal, is arranged for all urban areas, possibly by privatization
- Design and implement new collection systems in a way which accomplishes collection of wastewaters for future treatment plant(s).
- Reuse of wastewater for irrigation and aquaculture promoted and explored
- Containerizing of solid waste management to keep solid waste away from streets and from entering drainage systems

SERVICE COVERAGE

The proposed actions/measures are summarized in Table 6-3

Table 6-3 Action plan for short term objectives of Service Coverage

Rehabilitation

- In each utility appoint a task force to identify most urgent rehabilitation needs, and carry out rehabilitation accordingly.

Implementation

- Enforce the stipulations concerning the responsibility of the State to construct infrastructure (Decree No 88-CP) and mobilize revenues from the land tax through the land fund for this purpose.
- Enforce the existing laws and regulations, especially for building permit management.
- Sanitation and sewerage master plans are updated and coordinated with overall city plans (Class I-III).
- Test implementation of small bore and condominial sewers by participatory approach in already built up areas without sewerage system.
- Introduce appropriate manufacturing standards and quality control procedures for sanitary equipment
- Improve construction quality and construction supervision, and contracting procedures.

7. FURTHER STUDIES, PILOT AND DEMONSTRATION PROJECTS

There is a need to test out on a pilot project scale certain technologies and approaches before they can be applied, because these are new in Vietnam and, therefore, have to be modified and adopted for the conditions in Vietnam before they can be replicated on a larger scale. The following pilot projects have been identified, and should be further detailed in follow up projects.

TITLE:	***Upgrading of Existing Sanitation Systems with Community Participation***

OBJECTIVES/OUTPUTS:

1. Develop guidelines for upgrading existing areas with septic tanks for separate sewerage using small bore, condominial and simplified sewers.

2. Develop guidelines for community participatory approaches for sanitation upgrading schemes at the neighborhood level.

ACTIVITIES/NOTES:

In many areas of the cities the sanitary conditions are poor, especially within the quarters of old city centers, where the access to main streets with combined sewers is difficult. In these areas the situation can be improved considerably by small bore or condominial sewers, and through community participation and self help of the residents. By providing information on possible low cost technologies and testing the new financing facility, this approach could be developed into a replicable approach.

- Select four suitable residential areas in two different cities, where presently septic tanks are being used, but where the conditions are not suitable, and therefore must be upgraded to a sewered system
- Carry out socio-economic field investigations, design the new sewerage system.
- Organize user groups that are interested in participating in the project
- Design and establish financing mechanisms
- Implementation, field checking, cost control, and monitoring
- Test financing facility and cost recovery system
- Carry out a post-project socio-economic program to discover the participants' experience and satisfaction with the project, implementation approach, and the new sewerage system.
- Reporting and preparation of guidelines and design criteria
- Dissemination of information and approach

TITLE:	*Privatize Septic Tank Emptying Services*

OBJECTIVES/OUTPUTS:

1. Establish a system for regular desludging of septic tanks.

ACTIVITIES/NOTES:

Septic tanks are frequently overflowing due to lack of regular desludging. The role of the local government should be to establish the necessary regulations and control functions, while the actual operation of septic tank services could be left with the private sector. As this would be a new approach in Vietnam, it is suggested to set up and implement privatized sludge collection and treatment services in two areas in two cities.

- Select four suitable residential areas in two different cities, where presently septic tanks are being used, but where the conditions are not suitable, and therefore needs to be upgraded to a sewered system
- Select pilot cities and areas
- Prepare draft regulations pertaining to compulsory desludging, reporting, monitoring and enforcement
- Prepare bid documents for contracting out the services, evaluate bids, prepare model contracts
- Carry out the contract and monitor the performance of the contractors
- Prepare final sludge emptying regulations.
- Prepare model contract documents for contracting out sludge collection and treatment services

TITLE:	*Appropriate Sludge Vehicles*

OBJECTIVES/OUTPUTS:

1. Develop sludge emptying vehicles that are suitable for operation in the old city areas and narrow alleys.

ACTIVITIES/NOTES:

The sludge emptying vehicles used today are too large to negotiate the narrow alleys in many urban areas. The push carts that are used in these areas are unsanitary and cannot be used to transport sludge over large distances, therefore encouraging indiscriminate dumping of sludge.

- Select four suitable residential areas in two different cities, where presently septic tanks are being used, but where the conditions are not suitable, and therefore needs to be upgraded to a sewered system
- Investigate the international market for suitable small vehicles and collect available information

- Procure a limited number of vehicles of different types that appear to be suitable.
- Set up a field program to test the technical and economic performance of the various types of vehicles
- Carry out the program, analyze the experience and compare performance of the various types of vehicles.
- Make recommendations for vehicle types that would be suitable for conditions in urban areas in Vietnam.

TITLE:	***Anaerobic Upflow Sludge Blanket Reactor (AUSBR) for treatment of wastewater from communal or public toilets.***

OBJECTIVES/OUTPUTS:

1. Develop a cost effective treatment method that is suitable for on-site treatment of relatively small, but concentrated wastewater flows, such as from communal or public toilets.

ACTIVITIES/NOTES:

The AUSBR was developed about 10 years ago and has been applied in a few countries in Asia. The treatment process is based on anaerobic decomposition of organic waste, and it is temperature dependent, needing temperatures above 25 degrees celsius to be sufficiently efficient. The solids removal and BOD treatment efficiency fall between that of primary and secondary treatment. The process requires no mechanical equipment and no skilled operators. It is cost efficient, compared with other treatment processes for relatively small flows.

- It is suggested that at least two sites are selected for implementation of prototype plants.
- Carry out a program to determine wastewater flows and characteristics over an extended period of time.
- Design and construct two treatment plants, for respectively about 200 and 1000 persons.
- Carry out a controlled investigation and analysis program for influent and effluent flows and quality, sludge production, operation conditions, and operation manpower needs.
- Based on the experience from these plants, collect design criteria, guidelines, and standard design drawings.
- Prepare estimates of construction cost, operation and maintenance costs.

TITLE:	*Gutter Improvements*

OBJECTIVES/OUTPUTS:

1. Reduce or eliminate wastewater flows in open street gutters.

2. Improve aesthetical appearance of old city centers.

ACTIVITIES/NOTES:

Today wastewater is unsanitarily and unsightly discharged directly into gutters and flows along these for a long distance before entering the manholes. Humans, especially children, are exposed to raw wastewater.

- Make a study of existing conditions and propose simple ways to upgrade the existing conditions. Prepare typical designs and cost estimates
- Test the improvement methods in a few selected areas
- Prepare guidelines and standard design documents,
- Reporting and dissemination of information.

ANNEX I

STAFFING REQUIREMENTS

Staffing projection for sanitation utilities, based on projected urban population growth and present staffing of utilities.

	Year	RRD	CA	HL	MRD	Total
Total projected Staffing Requirement	1995	2270	2110	650	4590	9620
	2000	2600	2370	730	5350	11050
	2010	3510	3070	890	7380	14850
Managers & Supervisors	1995	230	210	60	450	950
	2000	250	240	70	540	1100
	2010	350	310	90	730	1480
Environment and Sanitary Engineers	1995	450	420	130	920	1920
	2000	530	480	150	1070	2230
	2010	700	610	180	1500	2990
Finance	1995	570	530	160	1150	2410
	2000	660	600	180	1340	2780
	2010	880	770	220	1850	3720
Customer Service &/or Community Development Staff	1995	340	320	100	690	1450
	2000	400	360	110	800	1670
	2010	530	460	130	1100	2220
Technicians (Skilled & Unskilled)	1995	680	630	200	1380	2890
	2000	760	720	220	1600	3300
	2010	1050	920	270	2200	4440

Note Central Level Staffing included with Red River Delta Projections

Key:

RRD Red River Delta Areas
CA Coastal Areas
HL Highland Areas
MRD Mekong River Delta Areas

ANNEX II

FINANCING INSTRUMENTS

The most common financing instruments and their applicability in the Sector are described in the following;

Commercial Loan

Commercial loans with market terms and conditions are usually considered not affordable by sanitation utilities with weak revenue base and dependence on government subsidies. Even if utilities were economically stronger, such loans for medium or long-term purposes are not easily available in the Vietnamese financial market. However, commercial loans may be used for short-term working capital purposes as soon as a utility has raised their revenue financing to service a loan. Households rely to some extent on commercial loans, but more on informal lenders and private borrowings.

Foreign Direct Investment

A new mode of operation was introduced in Vietnam for foreign investors in 1992, when amendments were made to the foreign investment law regarding new contract models (BOT, BOO, etc.) for infrastructure projects. In principle, the sewerage and sanitation sector as a part of basic infrastructure is a potential target for foreign direct investment, but due to its low priority status in official policies, unclear revenue base, and institutional weaknesses, foreign investors have not shown much interest in the utilities in question. The proposed Strategy assumes that sanitation utilities will mainly remain in public hands. A BOT-based project financing could come in question in exceptional circumstances, when for example setting up a common wastewater collection system and treatment plant for industrial processing zones which could also serve parts of the residential areas nearby.

Concessional Credit

Concessional credit is a common name for all the means of financing which apply sub-commercial terms such as long repayment periods and interest rates below the market level. The degree of concessionality is usually measured with a grant element (Annex 1) which has to be at least 25 % for ODA financing as defined by the Development Assistance Committee (DAC) of OECD. The proposed Strategy relies on increasing volumes of concessional credits for sanitation investments at all levels. Concessional credit terms mean, for example, a 40 years' term with a grace period of 10 years without interest, using only an annual 0.75 % service charge, as applied by the International Development Association (IDA), a member of the World Bank Group.

Grant

Grants, without a repayment obligation, are normally used for payment of "soft" components in a development project like technical assistance, training and management development. The recommended financing principles of sanitation projects are that the main instruments for fixed asset and working capital investments are equity and loan capital, whereas possible grant financing is reserved for the mentioned soft purposes to avoid financial distortion.

Equity

Equity financing means owners' investment and commitment in a sanitation company (project) representing at the same time counterpart financing in relation to other funding. Local governments are believed to be in the future almost the sole equity investor in sewerage and sanitation because the interest of private investors is expected to remain low during the projection period (1996-2010).

Non-Cash Contribution

A variety of non-cash contributions can be identified, like a household's work involvement and material for on-site and community level sanitation, or a land allocation by government for a sanitation project. Donors may also extend their support for a project as commodity aid. The proposed Strategy emphasizes the importance of community participation and individual work and material inputs as a means of cost reduction when improving sanitation situation at household and neighborhood levels.

Savings/Internal Financing

Household savings in Vietnam are, when compared internationally, low, and partially curtailed by the poorly functioning banking system. Savings are usually needed for the downpayment or for the full price of a durable consumer good like a television set. The proposed Strategy underlines the importance of savings also in connection to on-site (and community) sanitation improvement, and proposes the establishment of savings schemes to enable households to pay their upfront share (="equity") of a sanitation project.

Direct Subsidy

Direct subsidy refers to budget support to meet uncovered operating costs or enterprise losses when providing sanitation services. The purpose of a subsidy is to lower consumer tariffs for political reasons. Such subsidies have, however, negative impacts by encouraging uneconomic use of sanitation services, reducing self financing and creating a shortage of reinvestible funds. The proposed Strategy aims at gradual phasing out of subsidized systems and their replacement with revenue based sanitation services.

Government is also indirectly subsidizing utilities by funding investments by budget allocations and through using distorted unit costs.

ANNEX III

EVALUATION OF TECHNOLOGY OPTIONS

Technology Group	Designation	Existing Ground and Service Conditions						Existing Urban Area			New Urban Area				
		High water table	Low infiltration	Flood Prone	No sewers or drains	No water mains	Ground water used	Old city centers	Developed >1954	City outskirts	EPZ&IPZ, & Tourism	Commercial centers	Residential area by income level High	Medium	Low
On-site Sanitation (flush toilets)															
P/F with Sewer connection	OS 1	H	H	H	L	L	H	H	M	M	H	H	H	H	L
P/F with Individual Septic Tank	OS 2	M	M	M	H	M	L	M	M	M	L	L	L	M	H
P/F with Septic Tank and Connection	OS 3&3b	H	H	H	L	L	H	H	M	M	H	H	H	H	L
P/F with Pit Latrine and Soakaway	OS 4&4b	M	M	M	H	M	L	M	M	M	L	L	L	M	H
Communal toilet with sewer connection	OS 5	H	H	H	L	L	H	H	H	M	L	L	H	M	L
Neighborhood Sanitation															
Conventional Separate Sewer	NB 1&1b	H	H	H		L	H	L	L	L	H	H	H	H	M
Ditto, without drainage pipes	NB1	L	L	L			L								
Small Bore Sewer, Separate System	NB 2&2b	H	H	H		M	H	H	H	M	M	M	M	H	H
Ditto, without drainage pipes	NB2	L	L	L			L								
Condominal Sewer, Separate system	NB 3&3b	H	H	H		M	H	L	M	M	L	L	M	M	M
Ditto, without drainage pipes	NB3	L	L	L			L								
Combined System	NB4	H	H	M		M	H	H	H	H	L	L	L	M	M
Conveyance System															
Separate System	CV 1&1b	H	H	H		L	H	L	L	L	H	H	H	M	L
Ditto, without drainage	CV1	L	L	L		L	L	L	L	L	L	L	L	L	L
Simplified Sewer System	CV 2&2b	H	H	H		L	H	M	M	M	L	L	H	M	M
Ditto, without drainage	CV2	L	L	L		L	L	L	L	M	L	L	L	L	M
Combined System	CV3	H	H	H		H	H	H	H	H	L	L	M	M	H
Open Canals and Ditches	CV4	M	M	M		M	M	L	L	M	L	L	M	M	M

Notes.

1 Suitability/demand
High
Moderate
Low

2 A blank evaluation means that the specific condition does not affect the technology selection
3 Low permeability means <10 liters/m^2/day (1 15*10^{-7}m/sec)
4 High water table mean < 2 m from ground surface
5 IPZ means centralized Industrial Processing Zone
6 EPZ means Export Processing Zone

ANNEX IV

COMMENTS
ON
FINAL DRAFT REPORT

COMMENTS ON THE FINAL DRAFT OF
"THE NATIONAL URBAN WASTE WATER COLLECTION
AND SANITATION STRATEGY"

(Hanoi, 12 April 1996)

By Le Quy An
Chairman
Vietnam Society for Nature
and Environment Protection

Firstly, it takes us real pleasure to greet the issuance of the draft of "the National Urban Waste Water Collection and Sanitation Strategy" (final version) the compilation of which has been done jointly by the Vietnam Consultant on Water Supply, Sanitation and Environment and the Soil and Water Consultants Ltd under the bilateral auspices of the two governments of Vietnam and Finland represented by the Ministry of Construction of Vietnam and FINNIDA.

The issue of urban waste water collection and sanitation has been a serious problem for almost all developing countries where 80% of diseases and one third of death rate are caused by utilization of contaminated water. Annually, all over the world, 5.2 million deaths, of which 4 million of children, are caused by solid and liquid waste related diseases.

A research by the World Health Organization (WHO) points out that if the current water supply situation could be improved, the number of patients of water-borne diseases could be reduced by 37%, and that, if the faeces disposal could be improved, the number of patients could be reduced by 22%.

[That's why] the United Nations World Summit Conference on Environment and Development, Rio de Janeiro, June 1992, launched a plan of action (known as Agenda 21) whereas a separate chapter is made to discuss the issue of "Management of Solid and Liquid Wastes".

The Summit Conference has encouraged developing countries to aim at a objective that by 2005 at least 50% of urban liquid and solid wastes are processed and/or treated in a way that meets suitable standards of environment and human health; and, by 2000, 70% urban population have a satisfactory hygienical facilities.

Vietnam is a developing country with the urban population percentage 20% of the total population. This is a low percentage in comparison to the ones in other developing countries of Asia (33.3%) and of the World (45.6%). Vietnam has not yet suffered from a high level of urbanization, but it has undergone decades of warfare when most infrastructures were either destroyed or un-maintained and degraded becoming weak and unable to meet requirements of development even at the lowest level.

So much effort from the Government and the people as well as so much international aid has been put so far into solution to the problems of housing and water supply and energy supply etc... for the people. However, there no appropriate concerns have been put into the issues of management and treatment of urban wastes.

In the 1991-1995 plan, there was only one of the national scientific research programmes coded as "KC-11" devoting to the urban management problems where a couple of research topics are to highlight the problems of urban wastes. Nowadays, with the support from the Finnish Government a deeper research on the problems of urban water supply, waste water collection and sanitation has been conducted and come to a fruitful result of the issuance of a draft strategy for the whole country. This valuable work has many meanings for the practice. As well as "The Strategy on Urban Water Supply" which has been compiled before, the current "the National Urban Waste Water Collection and Sanitation Strategy" definitely will be an indispensable important component to make up the national strategy on urban development.

The study team has carried out a deep and complete review on the current situation of waste water collection and sanitation services in all the aspects of organization, legislation, investment, finance, human resource and technology etc.., and has come to a conclusion that "currently, the treatment of waste water has not been classified into the high priority group of governmental financing, and has had an inefficient management". This statement is correct and understandable, because during last years Vietnam has been pressurized by more actual needs of food, drinking water, housing and energy supply. In the water supply and sanitation services, only about 15% of capital is invested for sanitation services, and the rest jeopardized part is for water supply. Therefore, the preliminary analysis on econo-social effectiveness of the water supply and sanitation services (presented in Volume 4, Paragraph 1.6), has contributed greatly to the discussions on how it is important to draw more attention to this issue.

In the section on diagnosis of the needs, the research group has presented results of a survey on the public payability for different optional solutions. This is very useful information because it showed us to the fact that most population has a need [to the waste water collection and sanitation services] and is able to pay the service fees even higher than ones they are currently paying in order to get satisfactory improvements in the sanitation services. However, in the current stage of development, the population does not enjoy a high payability which makes about 1% of the household income. Nonetheless, this payability can also be an important basis for the policy-making and formulating of a financing mechanism of the future.

Objectives for the three stages of development: immediate objective (from now to the year 2,000), intermediate objective (from the year 2,001 to 2,010) and long-term objective for development of the urban sanitation services (from the year 2,010 onward) as foreseen by the strategy are realistic and appropriate to the current needs of development. These objectives are realistic, but requiring a lot efforts of the government and the people.

I herewith would like to emphasize on the point of view of the strategy [where it states that] the issue of urban waste water collection and sanitation services is more and more felt actual for the livelihood of urban population. Nowadays, the population has an increasingly high need to these services, and at the same time, their payability for the service expenses is growing with the growth of the national economy. Therefore, whilst playing its important and leading role in the decision making, the government needs to make appropriate policies and measurements to mobilize the people contributions and the participation of different economic components and social organizations. As the first step, it needs to concentrate its material and human resources on solutions of water supply and collection of water and mud wastes. Planning and construction of new areas for human settlement, offices, trading business and services etc... definitely ought to be include the construction of a standardized waste water collection and sanitation system consisted of two separate systems: one for rain water collection and another for waste water collection. The costs of infrastructures must be accounted into the rates for land rent to be paid by the land tenants. It is also possible and advisable to assign specific ventures (either state-run or private-hold) to carry out this business [of planning and construction of waste water collection and sanitation systems].

The current draft strategy has also proposed various options of the technological solution, which I believe will fit in with different conditions of the reality. However, I would like to make a point that it needs to be careful with the application of filtration lavatories/latrines which inevitable leads to contamination of ground-water layers/aquifers. Cemeteries used to be allocated in urban peripheries or suburban areas where the urbanization will take over, will have to have a more suitable allocation in the future. Sanitation facilities requiring 2 to 4 litres of water for each flashing need to be recommended for utilisation in Vietnam. Furthermore, if through tests they are proved to be suitable, we need to seek a capital investment for their production and distribution for users in Vietnam.

Regarding the technology issue, it needs have a further consideration from the point of view of a long-term urban planning in order to select an appropriate technological solution. For instance, for the cosmopolitan planning of Hanoi, according to my opinion, the internal districts of Hanoi have now been over-crowded with too high densities of population where indexes of infrastructure, green cover, and environmental conditions are too far to meet the minimal requirements. However, it is impossible to impose a solution to upgrade the whole Hanoi city to meet the requirements of a modern city, because this solution would be unrealistic and uneconomical. Instead of that, the government should propose multiple policies and measurements aiming at dispersing population from crowded zones to new zones for settlement, step-by-step reallocating industrial enterprises to suburbs and industrial zones, qualitative upgrading of small-scaled waste water collection systems (for example enlargement of sewerage pipelines), and evacuation to increase space for green cover. Establishment of new cosmopolitan districts, new satellite cities, new industrial and business zones must be considered to include the construction of waste water collection and sanitation systems which will be constructed step by step but will have to be large-scaled and modern. Such a solution probably will be efficient and economical.

Regarding the financial needs, the draft strategy reckoned that from now onward to the year 2,000 a budget of US$ 2 billion is needed. This corresponds to a rough calculation of investment of US$ 100 per head in average. This calculation must have been done for a minimal level of investment, however, in the context of the current Vietnamese economy it seems to be a huge investment. Therefore, a policy on extracting a multiple sources funding must be worked out consequently.

With regard to the calculation of an overall econo-social effectiveness, the government has to prioritize its investment for the most important items such as drinking water supply systems, waste water collection systems etc... the construction of which cannot be done by the population themselves and the revenues of which have to be done in a considerable period of time. In regard to the items and services which are of actual needs and which daily affect the livelihood of the population, the population are expected to pay for, for example, construction or upgrading of household latrines/lavatories, reimbursements of fees for sustaining the operations of waste water collection and sanitation systems. However, these fees must be thought of for a one-go collection (by one invoice) at the same time of collection of rates for water supply, and after they have been collected, it is very important to make sure that they are transferred to relevant agencies-dealers of the waste water collection and sanitation services. It is highly appraised the proposal by the draft strategy to form privileged financial funds which are to provide direct credits as well as revolving loans [for the purpose of waste water collection and sanitation improvement] to individualist households and/or groups of households. Certainly, the families of state preferential treatment policies and the poor families must be given more support. It needs also to pay more attention to the public sanitation facilities to be located in streets and places of crowded public gathering, passing-by, or stopping-over such as car/train stations, market places, hospitals etc... the operations of which can be sustained by the sanitation fees collected. It is advisable to let the mentioned sanitation facilities be run by private-hold entrepreneurs under supervision by relevant local authority bodies.

Regarding to the organizational issues, the study team has paid very much attention to the sharp-cut formulation and division of functional responsibilities of and in between the Ministry for Construction, Ministry of Science, Technology and Environment, Ministry for Health Care, Ministry for Planning and Investment, Ministry for Water Resources Reservation (former). There are many research-worthy propositions. The draft strategy has also emphasized on the enhancement of managerial role of the Ministry for Construction, and helping it divest of commercial business activities. This sounds reasonable and also fits in with the government aspirations which were recently pointed out by Premier Minister Vo Van Kiet on 12th March 1996 at the ninth session of the Ninth National Assembly "... the relationship of the state management and the management of production and trading business must be made clear, in esteem of liquidation of the ministerial assignment mechanism".

Regarding the issues of legislation and regulation, the study team has emphasized on the environmental standards, making a good notice on that there have been existing only the standards of watershed basins which are to receive waste solids and liquids, but there have been lacked the standards of waste sources, as well as some other notices. I would like to give herewith a little comment that when the study team was carrying out the study, there existed only a set of temporary standards of 1993 publishing. This set is a collection of environment standards which have been worked out so far until 1992, and thus, naturally there are missing many other standards. On 10th January 1994, the Laws on Environment Protection was launched. Since then, researches aiming at building a systemized standards for environment has been considerably speeded up. In 1995, there have been promulgated 71 [environment] standards of which 34 are related to water quality. There are specific standards to control the waste sources, for example, standard TCVN 5945-1995 for dealing with the industrial waste to control the waste water to be disposed into the waste receiving watershed basin.

Presently the building [of a collection of environment standards] is still ongoing, however, the point made by the study team on setting up a standard on comprehensive quantity of waste, according to my opinion, is very much relevant.

Regarding the environment impact assessment (EIA), the division of responsibilities to endorse EIA reports [as being proposed in the draft strategy] is a reflection of the current situation. Later on, when the [managerial] capacity of local provincial and municipality's authorities is enhanced, the division of responsibilities will be further differentiated. For now, some big municipalities and provinces which enjoy a satisfactory [managerial capacity have been already authorized by the Ministry of Science, Technology and Environment to consider and endorse the EIA reports that accompany a number of investment project proposals. However, when a relevant authority has endorsed an EIA report, it means the authority has endorsed the whole project proposal so that it can be put into the stage of realization, but it does not mean the authority's commitment to support the technology for pollution treatment selected by the project proposal. Besides, that the authority will regularly monitor the process of project realization and will retain for itself the rights to require at any stage [of the project realization] for change/enhancement of the selected technology to meet the latest regulations on environment protection.

The study team has commented on improvement of the procedures of project preparation, endorsement, and realization. This is necessary.

The issue of human resources is an important issue in the draft strategy. Study results and calculations by the study team are useful reference source for administrative bodies in making up concrete plans for action.

Hereby, I would like to emphasize on the educational issues and the community participation which need to be given even more attention. Education and information are not only aimed to raise the awareness of the whole society on the solution of waste water collection and sanitation services, on its relationship to human health to encourage the social and community mobilizations to construct infrastructures, but also, they are aimed to encourage the community to better use and to better maintain these infrastructures making a harmonization of good interior sanitation and public sanitation. It is good if every one and every household can maintain a good sanitation for one's household. However, if the public is still not aware of keeping the public sanitation, and still having no responsibilities while disposing rubbish, sand and other construction materials into sewers etc..., how good the infrastructures for waste water collection and sanitation have been constructed will still not be effective. In Vietnam, in the past, there have been periods when common people, members of the Red Cross Association, youth and teenagers voluntarily participated in weekly activities for sanitation keeping (wiping, collecting and burning out rubbish, unblocking sewers etc...). Recently, the Women's Union of Hanoi city has had an initiative in appealing its members to renew these old-day activities. This is a appraisal-worthy initiative and it is advisable that everybody supports it. Regarding big, modern and strong houses which have been or are to be built with modern interior sanitation facilities, a strict monitoring needs to be done over the design, implementation and functioning of waste water collection and sanitation system in order to make sure that no pollution is caused to their neighbours and their neighbourhood.

The draft strategy has also had a provision for protection of natural resources and reuse of waste water which certainly is worthy consideration.

It is advisable that the draft strategy would be considered in a relationship with the strategy on management of urban solid wastes.

Apart from the above points, it is relevant to raise a point on improvement of the quality of the translated Vietnamese version. It is highly appraised that the painstaking translation of this large document which consisted of 4 volumes and more than 430 pages has been done seriously. However, there are still found many errors in the Vietnamese translation version. There are some errors which the reader can correct him/herself [to get a right understanding], while the other errors can make the reader difficult to understand or lead him/her to a misunderstanding, and/or getting contrary meanings. Here is a example: While the English version says: "MOC should divest itself of commercial activities ...", the translated version says: "Bo Xay dung can chuyen sang nhung hoat dong co tinh thuong mai...", (eg MOC should start shouldering commercial activities)

The English version also contains errors. For example, point 5.4.3, page 120, Volume 1, it should have been: "Water Conservation and Reuse Options", but it has been "Waste Water Conservation ..."

Finally, there are done some comments and notices, I highly appreciate the given draft strategy on Urban Waste Water Collection and Sanitation. I believe that following this workshop the draft strategy will be made completed and submitted for endorsement, and after that it will become a fundamental document to coordinate nationwide the activities that are to solve a routine but very actual problem of the people.

Date: 18 March 1996

(Signed)

Le Quy An

TRUONG THI NGOC LAN
DEPUTY CHIEF - DEPARTMENT OF
INFRASTRUCTURE OF ECONOMY AND INVESTMENT

Hanoi, April 12 - 1996

SOME OPINIONS CONTRIBUTE IN THE FINAL DRAFT ON NATIONAL WASTERWATER COLLECTION AND SANITATION STRATEGY

1. Sewerage and Sanitation, today are vital questions and need to be considered, because it directly effect to people - living health, Environment production and economic development.

The Urban sewerage and sanitation are the questions of infra - structure and also of society. This is an essential domain and also is a weakly domain of our economy. There has not been any priority in being expressed from the planning - link, strategy, investment projects, to the balance of annual budget, they are showing as follow :

+ The organizations and operations of the sector
+ The institutional, policies and law
+ The statistic data, the financial system and the movement of the masses

For contributing to realize the Target how to consolidate and firm our country in the field of society and economy, it means that each branch (sector) should be consolidated and firmly developed, so the strategy and planning needed to be clearly.

2. The final draft of NATIONAL STRATEGY consist of 4 volumes, definited its essential tasks are : proper assessment the existent organizations in the sector, the financial policies and procedures, the current developments of the sector, and the requirements of household in up grading the sanitation system. The final draft predicted the developed tendencies, proposed the technical measures, funds, priority investments and action - plans in the presence and long time. Proposing the concrete targets of short, middle, and long - term periodes. The final draft presented almost sufficient stand points and factors of the questions, especially the questions need to be considered as follow :

+ Organizational strategy
+ Financial strategy
+ Technical strategy

THINH

The draft presented orderly all problems, and on the basis of the Nation's experiences in the region, on the world, the draft analysised and combined with concrete conditions of Vietnamese Cities to propose reasonable and concrete suggestions.

For example : appointe the concrete responsibility to every organization in the field of sewerage and sanitation. Decentralized administration at the central Government and the local authority ; the responsibility of Community and public - service - agencies of private sector in the field of sewerage and sanitation, but simultaneously all regulations of construction, land, environment, technic should be surely realized.

The financial strategy proposed a concrete resolution : state - budget for sewerage and sanitation investment should be considered in domains as follow :

- Priority the development conditions in the whole country
- Direction of requirements and meeting for users
- Choosing in appropriate technology
- Sufficient preparing in the field of organization
- Collected revenues and financial viability
- Feasible economy
- Reducing of environment pollution

The draft definited also the financial resources, the distribution in order from household - level, community area, province, to state - level. Proposed a new financial framework, analysised and confirmed the capability of financial resources to assist for sewerage and sanitation development. The draft was greatly appreciated because of its strategy, guidance and feasibility.

3. However, there are a number of problems in strategy either on this tribune or other time, they should be discussed :

+ On predicted investment, 2 billions USD (≈ 22.000 VND) for 1996 - 2000 phase, it seem to be wrong or unreal. The analysis of capital for sewerage and sanitation is not clear, while the existence of concentrated investment capital for sewerage and sanitation is now very difficult.

+ Sector management : the draft propose to set up a new organizational unit, named the management Board for wastewater and sanitation projects perform as a coordinator in Sector.

At present, the National Committee on clean water, sanitation and Environment has been established by state Government, so how to identify clearly and not be overleaped the functions between Ministry of construction, management Board for wastewater and sanitation and National Committee on Clean water, sanitation and Environment. For raising the role of M.O.C, the draft suggested to transfer investment capital from SPC to MOC, this matter had been requested a long time ago by MOC but it has been disapproved because of financial framework. Sewerage and sanitation utilities are almost managed by local authority and according to the new structure, the local authority is responsible to arrange the investment loan. For receiving reasonable proposals in final draft, discussion and analysis are needed to realize. To day the budget - law was passed, so we need to study continuously for submitting to Government more sufficiency.

+ Propose a new financial institution for urban wastewater and sanitation, this is a good and concrete suggestion. In each category should have its own financial institution and how to reduce cumbersome in the field of finance.

+ We are very interested in arrangement of responsibility according to the level from ministries to local authorities, but in reality, it has not been realized, what is the source of all this, and what are the measures. For example : the mobilization of capital sources but in Vietnam we cannot mobilize more capital from sources. Vietnam has also new structure to allow in using land to feed infrastructures. However the capital is also not so much and requirements of budget in the whole country is more and more increasing.

+ The last proposal of the strategy : the urban sewerage and sanitation sector need to have an invested and developed plan. I'd like to contribute our opinions above to the seminar.

WORKSHOP ON THE NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

Title : "Waster Water Collection in the improvement of the environment of Hanoi"

Engineer Pham Quoc Truong
Director of Hanoi Trans. & Urban Public Work Services

Distinghuishing Mr....
Dear delegates,

For the begining, on behalf of TUPWS, I like to express my thanks to the the organizers of the workshop for granting me this oppotunity to make my contribution to the NUSS and to present the development tendency of the municipal waste water management and treatment in the future.

At present, the economy of Vietnam is undergoing great development withhigh rate of industrialization which results in the extensive urbanization and big requirement for development of infrastructure while in practice in Hanoi as well as in some other cities, the unsatisfactory development of infrastructure in correspondent to the requirement of urbanization leads to environmental pollution, certain areas are freequently innundated...Therefore it is necessary to formulate a national urban waste water collection and sanitation strategy to secure a clean environment. The formulation of NUSS is the right direction to set up policies, mechanism, measures and solutions for the improvement of the existing urban sanitation, reasonably solving matter of sanitation in different environment to overcome present weaknesses of management as well as insufficient attention to investing into waste water treatment. This is clearly reflected in priciples guiding the formulation of NUSS :

- To date, the waste water treatment has not yet been highly priotised in view to financial provision by the government and inefficiently managed.
- If the existing policies and practices are not improved as proposed in the strategy, the situation will continue to be worsen that results in accelerating the environmental pollution.

In order to set out the a.m. principles, the Consultants have analised the results of the collected data on existing situation, sociological investigation, the roles and functions of relevant ministries and authorities to propose action plans for management, policies and regulations of the sector.

In studying 4 volumes of th report : Strategy and Action Plan, Existing Situation Assessment, Household Demand for Sanitation Facility Improvement and Econo-technical Alternatives, Financial Structure and Implementation arrangement, I highly appreciate the scientific value and data analysis of the Report. Evidences shown in the report have justified the existing situation of the Sector as presented in the Volume 2 : Existing Situation Assessment.

* Analysis on institutional structure : this manages to point out advantages and disadvantages of the organization.

+ Advantages : the higher levels all support the Sector development.

+ Disadvantages :
- Laws and regulations affecting the sector.
- Low environmental standards.
- Complexity of the procedures for project preparation.
- Limitation of data and imformations.

* Financial assessment : the report manages to analyse the weaknesses and disadvantages to the sanitation aspect :

- The financial resources for the sector is limited while the investment in the drainage & sewage system is repectively large.
- The rate of cost recovery of drainage, sewage and sanitation is very low
- The possibility of collecting service charge from households is small...

* Assessment on drainage, sewage and sanitation technology : the report has also analysed advantages and disadvantages incured in the field of waste water treatment :

+ Advantages : household demand and investment for improving sanitation facilities is increasing.

+ Disadvantages :
- The development of the public drainage and sewage system does not cater for the development of individual sanitation facilities.
- Waste water treatment plant does not exist in Vietnam yet.
- Dumping of solid waste to the streets and ditches causes block and innundation.
- Badly affect the public health due to pollution and unmanaged waste water ..

Ater analysing possibility and demand for waste water collection and sanitation in view of economy, investment prospect, financial capacity and resources, households' income, population, urbanization, public health...the Draft Report has proposed the development strategy for the sector, middle and short-term development objectives, mechanizm for financial resources mobilization and human resource development of the sector. Those objectives are reasonable and highly feasible to the urban drainage, sewage and sanitation sector.

However, toour opinion, the strategy resented in the report is intensively specialised - as it is not included in the report matters of solid waste management, stormwater drainage and industrial wastewater treatment...

As we all know, to the urban wastewater management, we can apply either on of the two or both types of network .

- The common system : for collecting all sorts of domestic, industrial and stormwater.
- Seperated system : the system for collecting domestic and industrial watewater is seperated from that for stormwater.

The application of each depends on the particular economic condition, population, climate... of certain urban area. The report just concentrates in wastewater treatment but not expand itself to cover matters of developing the public wastewater and stormwater collection system.

On the other hand, solid waste management and wastewater collection system are interrelated. In order to protect the environment from being polluted, attention should be paid to both two sides of the matter : solid and liquid waste; if we just pay our attention to wastewater treatment but neglect management and treatment of the solid waste, then the the utmost efficiency of the project will not be ensure. Therefore in applying this strategy to various urban areas, stormwater drainage and solid waste management matters should be silmuntaneously studied and solved to enhance the feasibility of the strategy.

We have taken into our consideration the a.m. recommendations during the formulation of the Master Plan for wastewater collection and treatment of Hanoi City.

The Wastewater Collection Project of Hanoi was completed in 2.1995 and already approved by the Prime Minister of Vietnam to provide basis for the development of Water Drainage and Sewage Sector.

During the formulation of this project, the practical experiences have been utilised for determining the proper investment to the existing level of economic development as well as that of other infrastructural sectors with the common aim at improving the environment of Hanoi Capital.

In the process of studying the Water Drainage and Sewage Master plan for Hanoi City, we have taken the similar steps as that for NUSS, including :

- Collection of the data on the existing situation, results of the former studies, surveying of sites...
- Collection and studying other data relating to water drainage & sewage : hydro-geological data, water level of Red river, transportation structures over rivers and cannels, water quality and environment, environmental impact of the project, population forecast, general architectural plan and its time acope...
- Other social matters as : questionairs to ordinary people bout the opinions on the investment in water D&S; the importance of the investment in this, influence of innudation and pollution due to wastewater to the living standard, the citizent's willingness to pay the service charge, habid of dumping into the water D&S system...
- Matters of resettlement for the purpose of projects...

After analysing the results of new studies and collected data, we propose a water drainage and sewage plan with 2 following main contents :

- Plan for stormwater drainage : basing on the basic principle . fully utilise the natural flow to Nhue river together with enforced pumping to Red river, dividing into 2 catchments.
- Plan for wastewater treatment : baksing on wastewater standard to prevent pollution for receiving bodies in complient with state regulations and on the suitable technology to the condition of Hanoi.

This presentation will not provide details of quantity, quality and financial requirement, but just point out major technical alternatives, funding requirement and steps to be taken for implementing the project, especislly similar poliocies of NUSS.

* Stormwater drainage · divided into 2 atchments · To Lich discharging to Red river and Nhue discharging to Nhue river

Tech nical solution (for both 2 catchments) :

* Construct stormwater pumping station to Red river, cap. 90m3/s (with protection circle of 10 years) for Tolich catchment.

* Construct stormwater pumping station to Nhue river, cap. 6 - 12 m3/s for Nhue river catchment.
* Construct and rehabilitate completely 4 major rivers and the entire system ofdrainage channels.
* Rehabilitate and reserve lakes in the urban center.
* Construct and rehabilitate all ridges and files on rivers to ensure the cross sections for drainage purpose
* Construct diches for new urbanied areas.

Plan for wastewater treatment : divided into 7 catchments - technical measure id to construct central treatment plants with high anf midium capacity together with local treatment units with small capacity; the total capacity will be : 435 700 m3/day - serving 1,6 million inhabitants

Estimated cost : 1.162 BUSD :
Stormwater drainage · 524 MUSD
Wastewater collection : 638 MUSD

The time scope for the project is 2010, but due to the big volume of work and investment that would be hardly satisfied at the present economic condition, it should require more time for its implementation. It is expected that till 2017 Hanoi could implement the entire plan with the following plrinciples :

- In the coming time concentrating in stormwater drainage for the urban center (at the top priority) to solve innudation and improve environment (this included in FS for the period 1995 - 2000, already approved by Prime Minister with the total expediture of 200 MUSD)>
- Simultaneouslu construct sanitation system with septic tanks and test wastewater treatment in some areas - temporarily pospone the overal wastewater treatment for some years.
- After completing the a.m. steps, continue with the rest of work to complete the wastewater collection system as planned.

To streamline the implementation of the master plan, i also like to empasise on some major investment components ,

* Request the Government to include this project into the list of prior projects within the development program
* The GOV will have proper policies to facilitate the implementation of this project, particularly as follows :

- GOV will invest from the state budgetin the constrruction of staormwater drainage system and big and medium central treatment plants.

- Cost of O&M for the stormwater drainage system will be cover also by the state budget.
- Cost of local treatment of wastewater could be covered by conccessional loans from the government to households in order to enhance the feasibility of the plan or by households' contribution.
- Cost of O&M for the wastewater treatment plants to be covered by benificeries.

As to our projection, the revenue would be as follows :

* Residential areas : 36% of O&M cost.
* Commercial. industrial and public services areas : 64%

With this estimation, each household will have to pay a service charge equal to 0.7% the its income - within their affordability.

Dear delegate,

With the special attention of the Psrty and the Government in investing into the construction of water D&S system - together with taking proper steps in accordance with the development of industry and the modernization of the national economy - the implementation of NUSS ive a significant contribution to the improvement of environment for the city citizents and to securing the ballanced and sustainable development for the national economy in the whole country.

Thanks for your attention!

Best wish for the healthyness and happiness of all delegates!

Wishing the best success for the workshop!

Thanks.

Basic issues on Ho Chi Minh city Urban Waste water collection and sanitation strategy.

Ngo Hoang Van
Vice director of Ho Chi Minh
city TUPWS

Being supported by finish Government and approved by Vietnam Govornment, soil and water consultant Co Ltd and VIWASE Co. Have prepared NUSS, with 4 volumes:

1 - Strategy
2 - Present status assessment
3 - House hold Demand for Improved sanitation systems, and
4 - Technology options.

Ho Chi Minh city (inner), Hai Phong city and Thu Duc province, were selected to survey social economic, they are represented for class I and II cities and small urban areas.

This is a great project with a lot of useful information for the men who involve in this sector.

Vietnam current waste water and sanitation have studied generally, from high complex geography economical structure to varied administrative management.

At present, Vietnam NUSS is a strategy which solute the relative between existing system rehabilitation and renovation in a harmonious way, this problem have soluted in technical and strategy,
Important strategy is priority for application of simple technologies in small urban area, and in large urban area, it is possible to rehebilate and renovate with more advanced technologies. In financial aspect, The study team have estimated average WTP is only 1% of monthly house hold in come (in small cities this index is smaller) for development of sanitation systems, apart from this ability, the development of this sector depend on subsidy of Government. In large cities such as Ho Chi Minh city, the harmony between rehabilitation and renovation, and between Government and community share cost based on general urban planning and carried out depending on each areas or basins

The rehabilitation and renovation of waste water systems would be began from the end of systems, that mean from: conveyer, treatment and disposal.

The programs on water courses rehabilitation in Ho Chi Minh city, can not implement only in waste water and drainage and can't apply simple technologies

Some of projects for rehabilitation of water courses have been implemented in Ho Chi Minh city, now, not any mistake have derived.

the strategy issued two most important elements they are drainage and waste water. but drainage is only considers in item 2 and 3 of system (conveyor and neibough) as a combined part of waste water system. In fact, drainage is a separate system and it must include in urban waste water and sanitation strategy study in Viet nam condition, as issued in volume 1 and 2, the existing sewer is a combined system between storm water and waste water. In advanced condition of scientic and technique at present, water environment is more and more polluted. The new construction of separate system is divided in to two systems, That is transitional period strategy. Study team have posed it, but it is a very difficult problem, in European countries have carried out this process for a very long time. there for, this problem should be guidelines this problem in an annex.

In financial aspect, a lot of capital sources is presented in order to implement of rehabilitation and development of waste water system.

The capital sources from beneficiaries and polluter have been considered to be most important. The strategy also divided beneficiaries in to classes as follow: private household, community, producer, government......

The responsibility of each classies have determined relative exactly for sharing cost of system facilities

However, it is necessary to study more detail of mobilize forms depend on each classes and each urban planning project or investment project.

There are two mobilize form: direct and indirect one.

Direct mobilize often depend on facilities, and indirect one often come to set up credit funds.

In spite of direct or indirect, they have to carry out on the basis of exactly planning projects.

For example: private households are mobilized directly to pay for on - site facilities (or in factories) after that, they have to get permit for connecting to out site facilities and their responsibilities for outside facilities must be determined in planning. Some forms of indirect mobilize have been implemented as waste water fee through water charge (in Hanoi), or through fee of development infrastructure of new housing areas ....and, in fact, national budgets come from taxes which also a form of indirect mobilize.

however, how to establish the credit funds and how to employ them efficiently for development waste water system, that is a strategically issue.

Vietnam society is changing clearly. The capital mobilizes according to percent of income as mention above is reasonable. However it is necessary to mobilize the capital sources suiting with quality of service.

One problem that has tactical property but very important and practical that is to mobilize or concentrate capital investment for big projects. Those sources often come from ADB, WB, other countries, loan of commerce, sale Government bont, BOT, ... there must be guideline for carrying out forms of investment concentrated. At least it must have in annex of the study.

The performance of strategy study is commended as follow the strategy contain a lot of information, that is why the study report has four volumes, that is reasonable.

However, because of large quantity of information such that, a summary volume is needed in order to focus most important subjects. Socio - economic data are also large and they are studied elaborately.

However, those data would contribute for strategy form. When they are analyzed strategically. There are a lot of factors which could make mistakes for strategically data surveyed, in them psychology factor is very important, for example, at present the people prefer to install septic tank, it may become the poor problems between private household and a more civilized communities. The strategy must analyze those problems according to the laws of development.

Strategy issue have supplied concrete guidance wide and deeply, which shall keep valid for a long time. For that reason, the strategy issue should be summered and written by capital letters for easy to read. After that the issue of method or solution for development of strategy, in a sound period and a certain condition, is dealed with correspondlng.

In Ho Chi Minh city, a lot of waste water projects are implementing and are going to implement.

This NUSS study will have leading impact, very important for the city's waste water and sanitation socio-economic efficient of those projects and have been supported diligently of the people. We believe that when the NUSS report completed, it will be a very important guideline for strong development of this field.

SOME OPINIONS ABOUT THE NATIONAL STRATEGY OF URBAN SEWERAGE AND SANITATION.

Prof.Dr.Tran Hieu Nhue
Hanoi University of Civil Engineering.

1. Current Approach of Sewerage and Sanitation problem on over the world.

As there was shown that at the 1992 Intentional conference on water and the Environment in Dublin were established two principles aiming to satisfy users' demands and to guarrantee sustainability of water and sanitation programs.

These two principles are:

+ Water is an economic as well as a social good and should be managed as such.

+ Water should be managed at the lowest appropriate level, with users involved in the planning and implementation of projects.

The World Bank is applying these principles as a means to create incentives that encourage demand - responsive services.

Concerning to spatial level of service, every sewerage and sanitation system includes a number of components as follows:

- Equipments, sanitation installations and pipes in the households.
- Connection pipe for discharging sewage from the household to the neighborhood feeder.
- Pipe line as neighborhood feeder.
- Street collector, trunk sewers and treatment facilities as citywide level or components.

Not all the levels or components are present in every system.

For rationally solving the sewerage and sanitation problems there used unbundling measure. It means breaking down urban sanitation problems into components to reduce scale and complexity and to facilitate assignment of responsibilities for different components to different groups at different levels (e.g the household, neighborhood and citywide).

From this issue there may be selected appropriate technology and low - cost technical option.

- For attaining good sanitation services there should be applied principles cost - sharing arrangement, financial responsibility for investment, operation and maintenance, involving participation of all public communities.
- One of the important methods of approach to solve the sewerage and sanitation problem is a demand orientation. It means responding to users' agenda; satisfying what people feel they need, want and are willing to pay for and involving people in identification, design, implementation, operation and maintenance facilities.

- The facts that contribute to successful achivement of sewerage and sanitation strategy are institutional arrangements that mean assignment of roles and responsibility of actors, assignment of authority for discharge of responsibilities and roles, definition of enforceable rules governing interactions within and between groups of actors.
- The last fact is sustainability. It means long - term proper functioning of installed systems, flow of expected benefits from investments over a long enough period to warrant investments.

2. Achievements of the urban sewerage and sanitation strategy's Draff.

2.1. Sewerage and sanitation strategy's draff is being set up in according to scientific methodological basic as follows:
- Existing situation and social - economical aims of Vietnam in macro scale.
- Actual investment capability of government for the sewerage and sanitation sector.
- Development and management situation of the sector.
- Existing state of urban water supply, sewerage and sanitation in Vietnam.
- Institutional structure, capacity of training and Human Resource Development of the sector.
- Problems of law, regulations and rules.
- Financial sources for sewerage and sanitation.
- Action plan and project of activities.
- Concrete research orientation.

2.2. Strategy is being touched on several factors and over all sides related to urban sewerage and sanitation, such as:
- Social economic.
- Basic master plans and problems related to urban sewerage and sanitation.
- Models and technological schemes of urban sewerage and sanitation.

2.3. Scientific and practical means are very clear in the process of setting up the strategy.
- There were carried out the investigation, social survey concerning to urban sewerage and sanitation in detail such as: actual income, peoples' need and their willing to pay and capability of financial contribution.
- Diversity of technological options of urban sewerage and sanitation: in - household sewerage and sanitation, neighborhood ,street pipe lines, collector of rain water, domestic waste water technological options of urban sewage treatment facilities.
- From these issues there appeared possibilities of large application of these technical options every where, every context of social-economical and natural conditions in different areas or regions.

2.4. Evaluation on the existing situations of sewerage and environmental sanitation in urban areas in Vietnam are truly. We are fully agree with these evaluations.

In conclusion , we would like to emphasis that the urban sewerage and sanitation strategy' Draff is being set up by correct and scientific methodology contents are rich and diversified. It will be able to large and flexible application and it has been followed to the above World Bank's principles.

2.5. The concrete results as issues:

2.5.1. After our understanding, we are fully agree with the evaluations and recommendations proposed in the strategy on macro scale, particularly the problems of institutional arrangements, assignment of roles or functions of ministries related to urban sewerage and environmental sanitation. Among these proposals there are the suggestions to set up the national committee (or commission) of water supply and sanitation, to involve a private sector and public communities in maintenance and operation of water supply, sewerage and solid wastes .These suggestions are very good ones,that we do strongly support.

2.5.2. The aims of long, middle and short terms of sector development are rational and good acceptable.

2.5.3. The basic of capacity improvement and sustainability are listed as above.

- Appropriate technical options.
- Capable institutional arrangements satisfying to present and future requirements.
- The beneficiary people should be informed the benefit and they are willing to pay for service or to accept the responsibilities for the system.

By another words, the improvement of sanitation should be based on demand of people as shown on above principles.

2.5.4. As a men who are working on the training field of specialized water supply, sewerage and environmental sanitation we support two suggesions on Human Resource Development; they are as follows:

- Strengthening capacities of organizations institutions, utilities and employment with different ways.
- Incentive capability development, creating good conditions for individual persons to be trained. The point of view is that the training work should be in priority is quite exact.
- The contents of sector's management and the requirements for training work are rational and good acceptable.

Funding source should be set up on the basic of stable system of Human Resource Development.

2.5.5. Financial policies proposed in the strategy for development of sewerage and sanitation system are good guidance and lessons for Vietnam in the open economical conditions at the present time and in the next future .

- Financial sources and new finacial arrangements of investments and carrying out projects' procedure described in the strategy are good experiences for us in an approach to combine with the management system on the world.

Priorities proposed in the technological strategy are as follows:

- The first priorities consist of EPA, IPZ, commercial and tourism centers, corridors of economic development defined by the Government.
- The second priorities are the areas located between old center zones and new zones to be developed in the future.
- The third priorities include the upgrading present system located in the centers of old cities.

These are general orientations.

Ofcause these orientations should be depended on several facts and actual conditions in every town or city.

2.5.6. The technological options of sewerage and sanitation system in household, connections from the household to neighborhood and then conveyance network to the street pipe line, trunk wide city treatment facilities and final disposal,... are very diversified. The strategy create so many "technical goods "for urban centers or towns and cities for selecting appropriate flexible option depending on concrete conditions in every area, every zone or location. Some case studies and pilot projects proposed in the strategy for inlustrating are necessary and interesting.

2.5.7. The proposed technological options of urban sewerage and sanitation system should be carefully monitored, controlled and considered more deeply and should be passed experimental pilot stage for seeking the improvement and large application.

TRANSPORT AND URBAN PUBLIC WORKS SERVICE
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Haiphong,

Reference speech in seminar on National urban drainage and sanitation strategy

Above all, I extend my appreciation of this seminar and totally agree with your above presented reports and speeches

With my responsibility, a director in charge of Haiphong urban drainage and sanitation for many years, I would like to contribute some experiences and methods to prove the necessity and importance of national urban drainage and sanitation strategy.

The mentioning issues.

- My own thought.
- Hai phong drainage system and prospect.
- Recommendations.

1. Speaking about city, first of all we have to mention the technical infrastructure management and urban sanitation in order to protect urban community ' s health

A national strategy of good technical infrastructure itself is a decisive motivation for socio - economic development, for the whole country as well as communities in each city. The various fields in a city are closely connected to one another during the existence and development process, for instance : urban transportation, landway, railway, port, airport, communicate information, telecommunication, energy supply, public light, water supply and drainage, urban waste treament

- All the basic reports and views on urban drainage and sanitation were presented in this conference. To have it, construction ministry and other relating ones have proposed and provided guidance for implementation in line with special attention of Vietnamese government as well as Finnish government, World bank, Asian development bank, ...

In this speech, I only mention some basic contents of Haiphong urban drainage and sanitation . First , about the awareness that prior synchronous technical infrastructure development is principle and economy to develop the city.With this general principle , in recent years , from 1991 up till now , the authorities of central government , ministries , departments , provinces and cities, especially the ones in Haiphong have paid much attention to Haiphong urban management and investment .

On drainage , major work is dredging channels and branch sewerage construction to deal with partical flooding situation in rainy season . Major urban sanitation work is to strengthen collection capability including manpower and special truck . There have been difficulties in foreign investment for urban road , drainage and waste treatment .

2. Current situation and prospect of Haiphong urban drainage system

According to Haiphong space development plan to 2010 approved by the government

The existing urban area is 1,930 ha

The estimated urban area to 2010 will be about 3,700 ha

The current urban population (including Do Son , Kien An , Minh Duc , Quan Toan) is about 550,000 people of which about 400,000 are inhabiting in Haiphong inner part

The estimated urban population to 2010 will be 8,300,000 people (there are 525 state businesses and joint - ventures , 351 limited businesses and 21,148 individual professional manufacturers

Haiphong slope i = 1/ 1000 (one per thousand)

Average level is from + 2.7 to +3.0 m surrounded by Cam , Lach Tray and Tam Bac rivers , affected directly by the tide

Average annual rain amount is from 1,754 mm to 1,900 mm, the maximum amount of a day is up to 409.5 mm . Rainy season lasts for nearly 6 months , from the middle of May to the beginning of October . It is also affected by heavy and moderate storms

Haiphong existing drainage system is a combine one (i.e rain water , domestic and industrial waste water , waste water from hospitals are collected into the same sewerage) which discharges water directly into rivers or regulating lakes and then into rivers without treatment , that causes serious environmental and ecological pollution .

In Haiphong inner part , there are 62,525 m main pipe (of which 7,895 m cross-pipe) ; 2,347 manholes of various kinds and 12 reservoirs or regulating lakes with total area of 505,000 square meters , the largest lake is An bien belonging to Ngo Quyen district with the area of 80,000 square meters , the smallest one is Van minh belonging to Le Chan district with the area of 6,000 square meters . Generally speaking , all the lakes are polluted , the most polluted one is Thien nga belonging to Ngo Quyen district , next one is Sen belonging to Le Chan district

According to investigation data in recent years:

Tien Nga lake: BOD: 388 mg/l 02.
N - NH4: 20 61 mg/l N.

Sen lake: BOD: 100 mg/l O2.
N - NH4: 142 mg/l N.

Hai phong sewerage system devided into 3 areas:

+ Old urban area: most of pipeline which was built by French with variuos diameter only serves 10,000 residents and discharges into two main pipelines along City centre with diameter: 700 mm X 1,300 mm.

+ North - East area: from railway , Cau Dat - Lach Tray street, collects mainly waste water from Tien Nga, Mam Tom and An Bien lakes and leads through Dong Kho channel to May Den - tide gate and Cam river.

+ South - West area: from Lam Tuong, Sen to Du Hang lake and discharges along South West channel through Vinh Niem - tide gate to Lach Tray river.

Most of sewerage system of Hai phong are old, damaged and not suitable with current conditions, and lack of finance improving regulation lakes and channels based on the approved design.

In sum Hai phong sewerage & drainage system is very backward which can't meet the demands of urban development population at present. especially an open - economy and tourism city with industrial development and well-known port city in the world for many years.

In order to solve and overcome the flooded situation from sewerage system polluting to the ecological environment, we find it necessary to complete the design of detailed plan of sewerage and drainage system in Hai phong based on Master Plan to 2010 approved by Government. Designing the detailed plan of Hai phong sewerage and drainage system is the main title and key leading to prepare the invetment plan in sewerage system at short & long term. From this, we can avoid the current situation with uneffective value and use.

3. The recommendations and main solutions of National strategy on Urban Sewerage and Sanitation in Viet nam.

a. Recommendations on finance and urban sanitation management.

It's known that to invest in costructing infrastructure needs much finance with synchronous model.

At present, some urban areas of our country invest unsynchronously without plan, for example Hai phong has no specific plan of sewerage system, so to use the investment is very wasteful.

- In order to attract of the internal and external investment for development of infrastructure technical system the authorities of the city need to allocate enough budget for the management and maintenance of sewerage system and collection of municipal solid waste.
- Policy and decision on tarrif collection in common services such as waste water tarrif can increase supplement cost for management and maintenance.

- Implementation of mobilazation solutions of social potentiality recovers public movement to participate in management and protection of public projects such as urban sewerage, sanitation system. Combine with public awareness instructs people to follow the Laws on Environmental Protection, Decrees on urban works protection.

b. Main solutions:

- Specific regulation on implementing the construction policy of infrastructure plan since preparation, appraisal and approval of plan, and detailed design of a road, a quarter and an area in old urban area. In new development area needs the planning design and investment in constructing basic infrastruture project as water supply, sewerage... After completion of construction works, it's possible to construct architecture works.

- It's necessary to assess environmental impact of infrastructure projects in accordance with Decree 175 - CP. Hospitals and enterprises, factories producing hazadous matter exeeding provision standard need to have inside waste water treatment and then can discharge into combine sewerage system of city.

- It's also very necessary to have a specialization organization in management of sewerage & drainage system from centre which can permit the locals to set up plan of sewerage system and submit to Government to allocate the budget.

c. The necessity of issue the policy on institution: for the companies which depend on technical infrastructure and public public works can work and develop.

- To concern the training and retraining workers, especially the technicians to have ability of managing and operating modern equipment effectively.

- To have favourable policy for workers cleaning, managing and collecting night soil.

B1/3

NGUYỄN NGỌC QUỲNH
DIRECTOR - HAI PHONG PLANNING INSTITUTE

REPORT : SEMINAR ON NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

Hanoi, April 12 - 1996

The first, I'd like to thank to the organisers let me a chance to express my opinions in the seminar. In my mind, the seminar has a lot of great significance in the process of an important branch, which has closely related to the urban development, industry and public - living.

Our country passed through a long war, the developed process of after - war largely impacted by subsidy; there has been a lot of difficulties in the Urban development, especially infrastructure. After the Party's decision on changing the economic form, the economic and social development has been directed to a new period. Investment activities in the field of construction is more and more animated. Speed of Urban development of many zones in the whole country has been fastly, stand out from the development is beginning to take shape many new industrial areas in large - scale. This process took part to speed up our economy in raising up with high speed, but we have had to face with a number of problems needed to solve as soon as possible. These are : the existent unbalance between urban development and infrastructure, the drastic pollution of environment, especially in big cities to - day is being emergent level. In the background, the Finish Government assisted Ministry of Construction to compile the National Urban water supply strategy for Vietnam. And now is completing the National urban wastewater collection and sanitation strategy.

After researching on the final draft, I suppose that it is a valid research work, foreign and local experts have spent much time to collect many data in the field of natural conditions, economy, society and the existent sewerage and sanitation system in many city. On the basis of analysis the data, research group has promoted directions to develop the sector in which, priority should be : human resources development, institutional framework reform. These are the very important factors to accept effectively the investment capital and modern technology. The proposals of financial policies (procedures) of the sector also are quite real such as : the mobilization of different economic components, contribution of community and revenue fees of sewerage and sanitation services through the water supply services, B2/3

land - tax, holiday services, tourists .. All of them is very fit in Vietnamese conditions.

The all solutions in order to manage refuse, step by step to control pollution of environment in the cities. is presented rather sufficiently; in this matter, maintenance and up - grade the collection system of waste materials and septic - tank are very fit solutions. Rehabilitations of combine sewer systems in urban centers should be priority at present, then expanding sewerage systems at new urbanized areas, then in old center city. sewerage systems should be raised up continuously. We are quite to subscribe to the researcher's opinions in animated solutions, to solve to different areas and conforme . with every developed period of our country. In central areas and out - of - city, a number of solutions for wastewater treatment are very reasonable, in which many modern treatments (solutions) are suggested to use, at the same time the natural conditions, treatment process autonomy, equaculture ... will be also took fully.

Ladies and Gentlemen,

Our suggestions at present are : incomes of concentrated - industrial areas, processing zones, trade centers. tourists are very high but their responsibilities in some place are insufficiently in the field of environmental protection. For example wasterwater of Vinapipe plant in VAT CACH Hai Phong, has not been treated before discharging into communal sewers. This problem has made a great damage to the countrymen around area, the raw water of An Duong plan will be contaminated. We identify very much ourself with author's solutions in the sector, it means that : international level of infrastructures should be constructed (built) combine with private sewerage system and suitable sewerage treatment areas should be built before or simultaneously with other buildings.

Dear Minister, Ladies and Gentlemen,

HaiPhong Planning Institute has been appointed by provincial people's committee in setting up and controlling in urban plan. After the overall planning approved, the people's committee has conducted us to set up special branches planning, in which the special planning on Haiphong water supply and sanitation has been cooperated with WIVASE in studying. Up to now, water supply planning is completing to submit to M.O.C for approval. In the other side. wastewater sanitation and environment in HaiPhong is very complicated. The investment rehabilitation, up - grade in some areas, should be placed in a long - term comprehensive solution. This is quite difficult in HaiPhong because the city located at low - level, a number of locations in the city is lower than the sea level while the old sewerage, within city is very weak, in some new building area have not yet, the control of environmental pollution is almost not effective. Especially the investment capital is very limited.

Ladies and Gentlemen,

Some years ago, the water supply services in HaiPhong had been improving, in the last five - years 200.000 habitants have been supplied the clean water this is a great result to be tied with the closed assistance of Finish government and Finish experts in our city. However in Hai Phong to day, a prevailing problem is more and more clear, that is an unbalance between water supply and wastewater. To reduce the shortcoming, we suggest the government should increase state - budget for watewater, the international assistant organizations, especially Finnida is more and more concerning to the wastewater, sanitation and environment. At first Haiphong should be assisted in the field of Technic, loan for studying to set up the urban wastewater, at the same time invested loan to rehabilitate some special area in the city to infer the best way for rehabilitating and expanding the sewerage system in Hai Phong.

Therefore, we transfer from the National strategy to a phase preparing an overall planning and make up lending - projects from ADB ; WB ; this is a reasonable process. On the basis of fundamental directions of wastewater strategy, I count upon in near future, the urban wastowater and sanitation in our country will have firm steps.

Thanks for all participants.

THINH

Report on national urban waste water collection and sanitation strategy

April 12, 1996 Semina

doc . Phan Vinh Can
vice director of water supply and waste water construction No2.Co.

Good solution of waste water and sanitation of urban areas is actively measure in order to protect water resources supplying for living and producing of people

Dir . ladies and Gentlemen.

As we have known, waste water and solid waste sanitation is a field of economic, technique which have sociological property deeply. We completely agree with all delegates, speeches at this semina about important significances and up date of NUSS and we would like to express my opinion that our country is requesting to solve immediately urban waste water and sanitation in each important area simultaneously with water supply.

In the past, as we know, because of the war, financial capacity is poor,our country only focus to solve main objectives of water supply. But, at present, the situation have changed, economical development have leaded waste water and sanitation up to a new scale, a new strategy, Which require us involve to solve, if not it is certainly we must pay a high price for it more and more.

" Under ground water resources are polluted heavily "

Hanoi has a history of underground water exploiting more than 100 year ago. In the century, the underground water quality doesn't change, and meets the demand for living.

But as studies results last 5 - 7 year, the good quality of underground water resources as before, in Hanoi area, is degenerated. Moreover, they are polluted heavily in alarm level, for example

- PO_4 pollution.

A lot of studies have given 71% deep wells in Hanoi, which have PO_4 increasing following the time, even there is well increasing up to 456% in the time 5 years (1987 - 1992) and lager then standard up to ten times (3,66 mg/l compare with 0,4 mg/l)

- NH_4 pollution.

At present, almost of big water plants in the south and south - east of Hanoi have NH4 pollution larger than standard to 9 - 10 time (30 mg/l compare with 3 mg/l)

NH_4 pollution is expanded to water plants in North and center of Hanoi, such as Luong Yen and Ngo Si Lien water plants.

NO_2 pollution.

The same PO_4 and NH_4 pollution, NO_2 pollution is a evidence of organic pollution and in a higher level will impact to people helth.

In 114 wells studied, then are more thon 70 wells having NO_2 pollution and level from somes to 40 times lager than standard. Even, the sample take from resevoi of Tuong Mai water plan which also have NO_2 , because of traditional Fe treatment process of Hanoi have not eliminated organic materials.

And so, what is the reason of under ground water resources. In Hanoi.

Now, we would like to issue some aspects relative to this semina.

1. Almost industrial and domestic waste water of Hanoi without treatment discharge directly into water course system , more dangerous, almost hospital waste water without treatment also discharge into sewer ,chanels, lakes, rivers,...Hanoi waste water is very poor , for example BOD =120-190 mg/l , COD=100-150 mg/l, NH_4 =20-50mg/l,NO_2 =1-3 mg/l, PO_4 reach 10mg/l , coliform more 100.000 /l

2.Hanoi rivers chanals , lakes , and water courses polluted is "hydrography window" for waster water go in through absorbing soil classes or directly "Windows" at bottom, rivers chanals and lakes . A system of 143 KM long sewers ,30 km long chanals ,900 ha surface of lakes and 40 km long of 4 rivers :Lu , sot, Kim Nguu and To Lich they feeled up with waste water. A part from anaerobic decomposition of organic waste create metal gas declining self cleaning ability of natural water , it threaten water resources supplying for living.

3. Almoust solid waste water of city (appro 2000m3/day). Without treatment by clean technology, dispose in to landfills, lowland, ponds, lakes....

After decomposed, organic and inorganic waste matiarials again absorb deeply in to underground water beneath Hanoi water plants. It must be resources making pollution for underground water in Hanoi city. but now nothing to treat it, if not collecting all urban solid waster and treament it seriously.

Apart from above mentions , flooding, using , raw excreta,... making hingher pollution for underground water resources , are being exploited in Hanoi,

From above examples ,that is subject of this semina , we hope that everybody consider those problems and have action plan seriously in order to stop weaken problems and restrict higher price having to pay for them, a very high price must to pay for delay that we discussing and thinking over.

We hope that this semina will lead to a right strategy and feasibility for waste water and sanitation of urban areas.

UNDP/WORLD BANK WATER AND SANITATION PROGRAM

WATER AND SANITATION REGIONAL GROUP
EAST ASIA AND THE PACIFIC

COMMENTS ON NUSS

Thank you very much for giving us the opportunity to review and comment on the final draft of the National Urban Wastewater Collection and Sanitation Strategy Study(NUSS) which the Ministry of Construction prepared with assistance from FINNIDA.

The document constitutes a major step toward establishing a nationally promulgated urban sanitation strategy for Vietnam It provides a very good assessment of the real conditions of the sanitation situation in Vietnam's cities and towns, with a very detailed analysis of the actual situation In particular, Volume Three containing the results of a household survey carried out in three urban areas, HCMC, Haiphong and ThucDuc, should prove to be very useful in providing a measure of the willingness to pay for sanitation improvements in the communities that comprise these cities

Our detailed comments on the NUSS study are laid out below under the headings Institutional Aspects, Demand Orientation, and Technologies

INSTITUTIONAL ASPECTS

The document proposes seemingly appropriate roles and responsibilities for National and local level Governments (5, volume 1) However, considering further, the experience of other nations in developing institutional arrangements for the water sector may be useful. In several relatively successful cases, **water planning and management agencies were established on a watershed/river basin basis,** called water basin committees This has allowed for relatively cohesive water resources planning and management, for all water used propose This approach has been used in France, Germany, Spain, Brazil and other countries, and it has been found that there is a greater likelihood that truly representative decision-making in planning, management and implementation will occur through more extensive **negotiation and discussion by all the social agents involved** This leads to plans and actions that respond to demand from consumers The actions will be more effective because they will be **carried out at levels closer to the users of the systems rather than at higher, more centralized levels** This will improve technical efficiency by establishing an appropriate cost-benefit ratio, a more efficient allocation of funds, and a well-defined partnership among all levels and the consumer

Responsibilities

Water basin committees should be responsible for policy and strategy formulation in the watershed that they manage The tasks that a water committee might undertake could include

- to combine all water resources' management (for general use),
- unbundling[1] horizontally and vertically the levels of services down to the household level,
- formulation of the rules for regulation and control, including the private sector,
- enforcement of sanctions for violating the rules and rewards for following them,
- determination of the price for bulk water that the utilities will use,
- determination of the price for waste discharges from the utilities,
- Issuance of licenses for industrial effluent discharges,
- monitoring and regulation of treatment of industrial effluent, and,
- arbitration in special cases

A water basin committee should Integrate the interests of as wide a number of stakeholders as possible To achieve this, representation may come from a cross-section of agencies including, but not limited to

- the Ministry of Construction,
- the Ministry of Health,
- the Ministry of Water Resources and Environment
- local government's representatives,
- utilities' representatives, and
- **representatives from the communities** in the basin

[1] Every water and sanitation system consists a number of levels For systems which do not rely on communal latrines, the most local level is that of the household. Beyond the plot boundary, there are various levels of feeder infrastructure, leading eventually to the disposal point There are different ways in which these levels can be defined Traditional approaches to the provision of sanitation have divided responsibility at the plot boundary, the household being responsible for all on-plot facilities and the appropriate government department for everything else In rapidly growing cities, this division of responsibilities places great burdens on government departments with limited technical and financial resources It falls into two broad categories. systems in which responsibilities are devolved to the community and those which encourage private sector involvement in some components of the system However, it is important to note that these two broad categories are not mutually exclusive. Thus, it is possible to have systems in which private companies also encourage community participation since the community are their customers

Among its early objectives, the Committee could negotiate to reduce overlapping of duties and responsibilities of the sector authorities at the national level and at the local level However, the committee should not be responsible for the administration of the utilities or for commercializing the various sewerage and sanitation undertakings The Committee should be **the principal agency responsible for the enforcement of environmental laws, regulations and standards using the power of sanctions and rewards by delegation through the organizations represented on the committee**

Generally, water basin committees need to work to improve the number and the quality of water and sanitation utilities, but some cases they may need to encourage consolidating small and inefficient units. The utilities must become **independent of central and local level administrations**, and it must **be obligatory that they become self-financing, and capable of operating without government subsidies** (5 3 volume 1) The price of water supply and sanitation services will become equivalent to **the market price or the real price**, like other goods in the market. If a government decides to subsidize water or the wastewater services, the subsidy should be made **directly to the household** and not to the utilities Recent water management initiatives in Chile provide a good example Subsidies paid directly to utilities is often fungible, and often used to cover deficits or inefficient O&M practices rather than passed on to consumers

The organizational level at which utilities function most effectively varies according the local situation. A city can have two types of unbundling simultaneously, horizontal and vertical, and **have some utilities operating at the treatment level, at the feeder level, and others at the household level** This flexibility is important to create conditions that are conducive to private sector participation (5 2 volume 1) As is emphasized in the Present Status Assessment (7 2 volume 2), **investment of private capital will be essential to help the government to develop the sector** The document informs us that the government's capital is insufficient to improve sanitation conditions at the level and pace that the Country needs (7 2 volume 2) Also, Vietnam has many other important investment priorities **Conditions must be created in the water and sanitation sector to leverage private capital investment.**

DEMAND ORIENTATION

The Technical Strategy proposed in the document (5 4 volume 1) is very useful and should help the Government of Vietnam to decide on priorities and the menu of alternatives to consider in different urban settings However, the document recommends an approach based **on an economical framework that does not incorporate a demand orientation,** although in other parts of the NUSS the consultant does refer to the need for demand responsiveness Water and sanitation sector development priorities will likely vary if the government, through an entity such as a water basin committee, discusses priorities with stakeholders at the time plans are being prepared The actual conditions in each city in a basin may vary and consumers, government agencies, and other stakeholders might agree on different solutions in each watershed or even in each city

In Section 5 4 of Volume 1 the consultant recommends using on-site disposal systems in low density urban areas However, looking at the experience may again be useful, of cities like Jakarta, Manila, and Bangkok in this regard Where urban communities are encouraged through government policies to address sanitation through individual, on-site solutions (and individual private investment), becomes more difficult to require further private investment in off-site sanitation in the future when the population becomes too dense for on-site options to be feasible Willingness to pay to improve the system after the initial private investment becomes very low

Additionally, encouraging private capital investment in urban wastewater management may be difficult if the consumer has an individual, household level solution and low demand The private sector, in this case, will only invest directly with Government through arrangements like BOT or BOO This arrangement may not be the best for the Government because the private sector **would not share much of the risk; most of the risk will remain with Government.**

Responsibilities

The Immediate Action Plan (6 volume 1) lays out a very comprehensive framework. However, under the topic Economic Sustainability (Table 6-1) the responsibilities for urban master planning and technical appraisals and approvals **could be moved to local level institutions.**

The creation of a National Urban Water Supply and Sanitation Committee is a very good suggestion. **However, this National Committee could become very distant from the consumer, from the community, and from the problem, and may not be demanding responsively.** Creating a Committee for each major river basin may be more effective These Committees could focus on environmental management issues, while central Ministries, through a national committee, could undertake more strategic activities, like coordination of sector agencies and meshing sector policies and standards with the national political strategy

TECHNOLOGIES

Individual Septic Tanks

In the Environmental Sustainability section (Table 6-2) the consultant recommends regulating septic tank sludge collection, and creation of proper treatment and disposal facilities for all urban areas, with possible privatization Once again, looking at similar experiences in the Asian Region, it **needs to be stressed that this kind of service works best if provided by private firms**, with the supervision of local authorities

The Further Studies, Pilot and Demonstration Projects section (Section 7 of volume 1) has a good list of pilot projects through which to learn about and demonstrate technology options However, regarding the proposed Privatized Septic Tank Emptying Services and Appropriate Sludge Vehicles studies, it may be more useful if the Objectives/Outputs could be changed Aiming it toward creating an environment in which private companies can operate may be better. **These firms would make agreements (comprising short term loans or verbal arrangements) directly with individual households to desludge septic tanks, without the involvement of local government (except regulatory matters).** Local public agencies would provide the authorization to companies (with a minimum two firms for each city, without demarcation of areas, to encourage competition) and supervise of the quality of the service delivery Foregoing the bidding process may then be possible because the contracts will be directly between households and the service providers, like purchasing food in the marketplace

To encourage households to contract with private companies for septic tank emptying, a form of "polluter tax" could be applied (perhaps somewhat more than the market cost of sludge emptying), that could be combined with land tax If a household presents receipt for septic tank emptying with the payment of the land tax, the "polluter tax" would be discounted from the total amount to be paid Then, **local governments must only control the quality of the service provided by private companies through monitoring, setting of standards and enforcement.**

These arrangements will also stimulate the private firms to develop sludge emptying vehicles that are suitable for operation in the difficult neighborhoods with narrow alleys, in response to market demands

Small Bore Sewerage

In the Service Coverage Section (Table 6-3) describing situations where small bore sewerage may be applicable, it may be more appropriate **not to recommend using small bore sewers connected to septic tanks to collect effluent. We recommend the use of a condominial sewerage network**, incorporating a participatory approach, in already built up areas without sewerage systems Experience elsewhere has shown that the small bore sewers can be very delicate to operate and maintain (3 2 3 volume 4), and poorly managed septic tanks can lead to frequent clogging of small bore sewers

In the NUSS **the costs of the two solutions are estimated to be similar** (Annex 1 NB2 & NB3), and in some situations the condominial sewer would be cheaper The condominial sewer network is designed to work with prevailing environmental conditions and local preferences and institutional arrangements, making it easier to operate and maintain They also are relatively flexible If a user improves his on-site system and decides not to use the septic tank, this will not have an impact on the overall condominial sewerage system

Anaerobic Upflow Sludge Blanket Reactor

The Anaerobic Upflow Sludge Blanket Reactor **could be an excellent sewage treatment technology for application in Vietnam.** This technology is a very good alternative and it is used in many countries, including the USA, Holland, Brazil, Indonesia, and others in Asia However, to be economical, **the reactor needs to be large**, serving 10,000 to 40,000 inhabitants This technology is easy to adapt to conditions in Vietnam, and it would work well with a condominial sewer system.

Condominial Sewer Network

In the description of the Condominial Sewer System (3 2 4 volume 4), the consultant only mentioned the **backyard type** The condominial system can also be installed **in the front of the house** In this case providing two sewer lines to each block are necessary This option is **still cheaper than conventional sewerage** The local level governments do not need to be involved in the selection process, in both cases. Each block of houses can decide where they want the sewer line to be located and reach an informal agreement. **It is not necessary to develop formal or legal arrangements** for this However, it is absolutely necessary that the consumers **understand the benefit** of the sewer network

The Cost of Development Scenarios (annex II volume 4) offers four different scenarios However, it does not **offer a scenario comprising flush toilets w/sewer connections using the condominial system** In the NUSS **the prices of the small bore and the condominial solutions are similar** (Annex 1 NB2 & NB3), and in some situations the condominial sewer is less expensive In certain cases this scenario would be a good alternative, because the unit cost of the household sewer connections is very low in condominial systems

The Socialist Republic of Vietnam

Ministry of Construction (MOC)

The Republic of Finland

Ministry for Foreign Affairs (FINNIDA)

SOIL AND WATER

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY STUDY

Volume 2

Present Status Assessment

Final Report

August 1996

SOIL AND WATER LTD
Consulting Engineers

VIWASE
Vietnam Consultant on Water Supply, Sanitation and Environment

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

VOLUME 2

PRESENT STATUS ASSESSMENT

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ACRONYMS

ADB	*The Asian Development Bank*
AIDAB	*Australian International Development Bureau*
BOD	*Biological Oxygen Demand*
BOO	*Build - Own - Operate*
BOT	*Build Operate and Transfer*
C : N	*Carbon and Nitrogen ration*
CC	*Central Coast*
CDC	*Consultants, Designers and Constructors*
CH	*Central Highland*
CS	*Construction Services*
CV	*Conveyance*
Doi moi	*Open Door Policy*
DS	*Disposal*
EIA	*Environmental Impact Assessment*
EPZ	*Export Processing Zone*
ESD	*East Southland Delta*
EU	*European Union*
FDI	*Foreign Direct Financing*
GDMH	*General Department of Meteorology and Hydrology*
GDP	*Gross Domestic Product*
HCMC	*Ho Chi Minh City*
HEC	*Hanoi Environmental Committee*
HH	*Household*
HRD	*Human Resources Development*
ICOR	*Incremental Capital Output Ratio*
IDA	*International Development Association*
IPZ	*Industrial Processing Zone*
IRCWD	*International Reference Centre for Waste Disposal*
MIS	*Management Information System*
MOARD	*Ministry of Agriculture and Rural Development*
MOC	*Ministry of Construction*
MOD	*Ministry of Defence*
MOE	*Ministry of Education*
MOFA	*Ministry of Foreign Affairs*
MOFI	*Ministry of Finance*
MOH	*Ministry of Health*
MOHI	*Ministry of Heavy Industry*
MOI	*Ministry of Industry*
MOLWISA	*Ministry of Labour, War Invalids and Social Affairs*
MOPI	*Ministry of Planning and Investment*
MOSTE	*Ministry of Science, Technology and Environment*
MOWR	*Ministry of Water Resources*
MRD	*Mekong River Delta*
MSMU	*Water Supply Management Unit*
MUSD	*Million United State Dollars*
MVND	*Million Vietnamese Dongs*
NB	*Neighborhood*
NC	*North Central*
NCNST	*National Center of Natural Science and Technology*
NGOs	*Non-Government Organizations*
NMM	*Northern Mountain and Midland*

NPK	*Nitrogen - Phosphate - Potassium*
NSC	*National Steering Committee of Clean Water Supply, Sanitation and Environment*
NUSS	*National Urban Wastewater Collection and Sanitation Strategy*
O & M	*Operation and Maintenance*
ODA	*Official Development Assistance*
OOG	*Office of the Government*
OS	*On-site*
P/F toilet	*Pour Flush Toilet*
PACCOM	*People's Aid Coordinating Committee*
Phuong	*Ward*
PPC	*People's Committee*
Quan	*Urban District*
RRD	*Red River Delta*
SCCI	*State Committee for Cooperation and Investment*
SCPA	*State Council for Project Appraisal*
SOE	*State Owned Enterprise*
SPC	*State Planning Committee*
SWOT	*Strength, Weakness, Opportunity and Threat*
TA	*Technical Assistance*
TM	*Treatment*
TOR	*Terms of Reference*
TUPWS	*Transport and Urban Public Works Services*
UN	*United Nations*
UNDP	*United Nations Development Program*
URENCO	*Urban Environmental Company*
USD	*United State Dollar*
VIWASE	*Vietnam Consult on Water Supply, Sanitation and Environment*
VND	*Vietnamese Dong*
VUSS	*Vietnam Urban Sanitation Strategy*
VWSA	*Vietnam Water Supply and Sanitation Association*
WASECO	*Water Supply and Sewerage Construction Company, HCMC*
WASENCO	*Construction Company for Water Supply and Sewerage, Hanoi*
WB	*World Bank*
WHO	*World Health Organization*
WSS	*Water Supply and Sanitation*
WTP	*Willingness-To-Pay*

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

VOLUME 2

PRESENT STATUS ASSESSMENT

1. BASIC DATA ON VIETNAM

1.1 GEOGRAPHY AND TOPOGRAPHY

Located in the center of South East Asia, Vietnam forms an S-shaped strip on the eastern seaboard of the Indochinese Peninsula (see Figure 1-1). The total territory of the State of Vietnam comprises about 330,363 km^2 of land and a vast area of sea, including a large continental shelf with archipelagoes in the Gulf of Bac Bo (Gulf of Tonkin), in the South China Sea and in the Gulf of Thailand.

Vietnam stretches 1,650 km from North and South, between latitudes 24°N and 9°N. The widest breadth from East to West is 600 km between longitudes 102°E and 100°E, and the narrowest only 50 km. Vietnam has 3,730 km of border, 1,150 km adjacent to China in the North, and 1,650 km and 930 km next to Laos and Cambodia respectively in the West. The coastline is 3,260 km long.

Vietnam's topography is mainly composed of old mountains and hills. Northern Vietnam is characterized by a range of mountains running partly parallel to the Chinese and Lao borders. The mountain ranges are divided by deep river valleys, the most notable river being the Song Hong (Red River); the Song Hong delta is one of the most important agricultural areas of the country.

The central part of Vietnam consists of the Truong Son mountain chain and a number of small coastal plains separated by relatively short rivers, the catchment areas of which are within the nearby mountains. On the west side of the ridge is the fertile highland of Daklac-Pleiku.

The main feature of Southern Vietnam is the huge Mekong River delta, the most important rice-producing area in the country. The delta includes an alluvial plain (the Plain of Reeds or Dong Thap Muoi), covering nearly 80 km^2 and seldom rising more than 2 m above sea level. The lower Mekong delta has a total area of about 40,000 km^2.

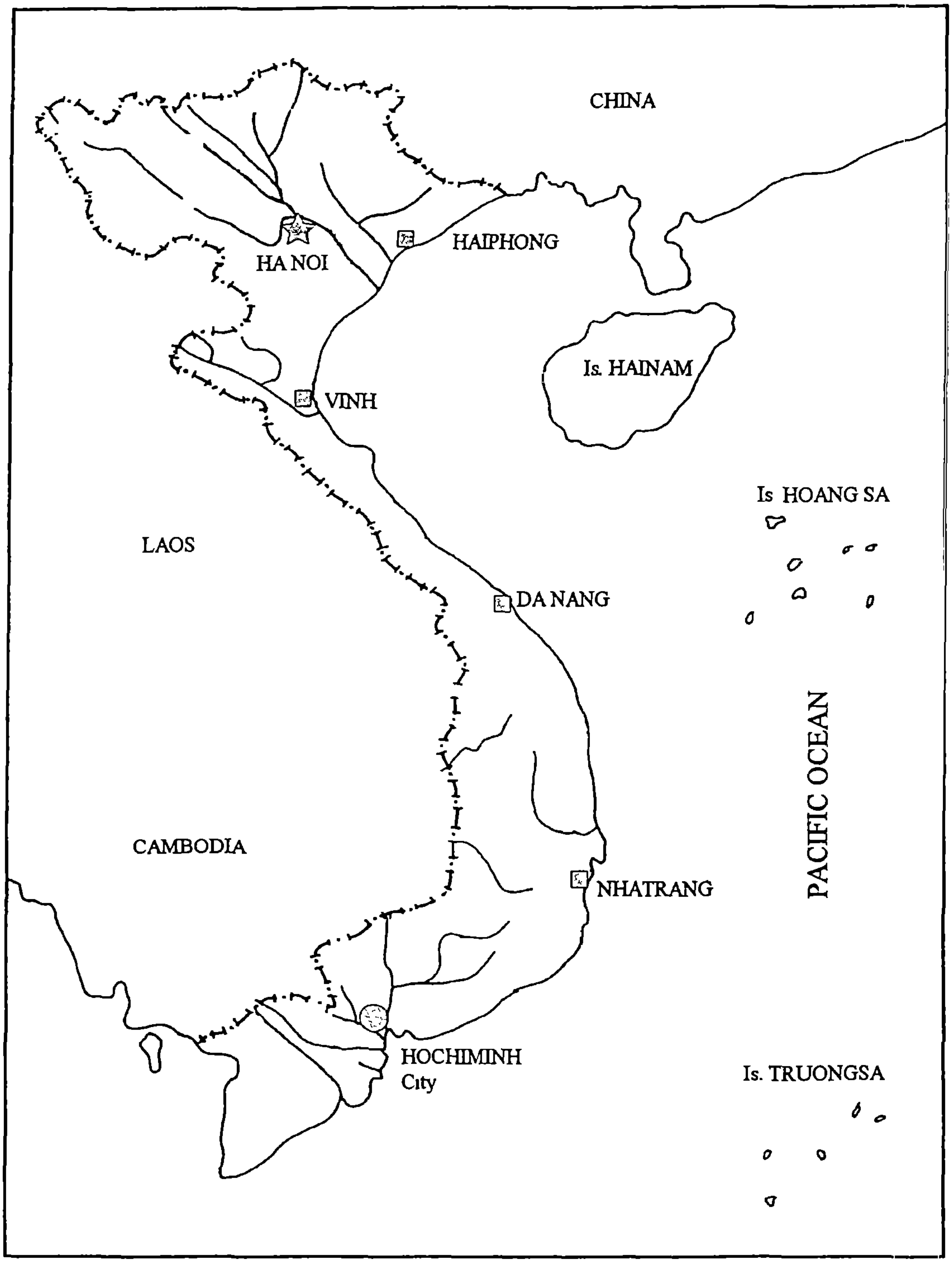

Figure 1-1 Map of Vietnam.

1.2 POPULATION

Vietnam's estimated total population for 1994 was 72.5 million of which 14.1 million and 57.3 were considered to reside in urban and rural areas respectively, reflecting an average annual growth rate of 2.1%. Nearly 40% of the population are under the age of 15, over 30% are between 14 and 28 years of age[1]. Vietnam is the world's 12th largest nation in terms of population size and, after Indonesia, is the largest nation in Southeast Asia. The projected population of Vietnam is 82 million by 2000 and 100 million by 2010. See Table I-1 and Table I-2 in Appendix I.

The regional distribution of population is uneven. The average population density in the country is 195 person per km^2, but this varies, from 50 persons/km^2 in mountainous provinces in the North and the Central Highlands, to 300-500 person/km^2 in the Mekong and the Red River Deltas. As shown in Table I-3 in Appendix I, in a number of localities in the Red River Delta, the density (1,000 persons/km^2) is almost as high as in the urban areas.

The urban areas are divided in five categories based on the classification criteria. The lowest category, class V, is not included in this study. The total urban population of the 64 towns included in this study is 10.8 million, see Table I-4 in Appendix I.

1.3 URBANIZATION

Unlike many other developing countries which have experienced a significant shift from rural to urban population, Vietnam has a low rate of urbanization. For instance, during the 1980s, the rate of population growth in Hanoi was below the national average, and it actually dropped from 2.0% per year in 1981 to 1.6% per year in 1988. However, the current economic reforms will probably change this situation, and so the country may in the near future be faced with high urbanization rates and, with them, overtaxing of infrastructure and exacerbated environmental health problems.

Despite their modest sizes, the urban centers in Vietnam are increasingly experiencing problems, the most prominent of which are:[2]

(i) old and broken (or even, in many places non-existent) infrastructure and services such as sewers, wastewater treatment plants, drainage systems, water supplies, refuse collection, green belts and parks, the infrastructure in most cities and towns, which was built during the end of the

[1] Vu Quy Nhan; *Population policies and development in Vietnam*, unpublished report, National Committee for Population and Family Planning, Hanoi, 1992.

[2] Nguyen Cong Thanh and Diep Minh Tam; *Vietnam Environment Sector Study*, Report presented to ADB at OECD workshop in Hanoi, 1993.

19th and the beginning of the 20th century, has not been rehabilitated or replaced;

(ii) the expansion of populated areas into industrial zones, or *vice versa*, resulting in a number of public health hazards;

(iii) inadequate planning and management of urban development, leading to confusion in zoning and unregulated settlement patterns; and

(iv) lack of regulations, or of their enforcement, governing matter such as building codes, urban traffic, or sanitary compliance.

The overall consequences are that urban dwellers are faced with numerous problems ranging from overpopulation to poor housing; unsanitary conditions (inside and outside the house, on the ground and in the air); unsafe and unreliable drinking water supplies; unreliable power supply; lack of amenities such as playgrounds and green space; lack of public transport for commuting; and crowded, noisy and polluting traffic.

The urban areas are categorized and classified by the following criteria:

1. The Urban Administrative Categories

   (i) Cities under central government's management;
   (ii) Cities and towns managed by the provincial authorities and
   (iii) Small towns managed by district authorities.

2. The Urban Classification

   I Very big cities
   II Big cities
   III Big - medium cities
   IV Small - medium cities and towns
   V Small towns

The principal criteria for urban classifications are:

(i) The size of population
(ii) The non-agricultural labor force in cities
(iii) The population density
(iv) The infrastructure
(v) The role and position of centers in territorial regions.

The classification is used for urban planning and design, administrative purposes and regulating the government's investments on infrastructure. In this strategy the definition of urban areas of the decision of the Council of Ministers No. 132/HDBT on 5 of May 1990 is followed. The Ministry of Finance has stipulated its own classification (50 TC/TCDN on 3 of July, 1993), which will classify the cities in a different way. The classification of MOF is presented in Table I-5 Appendix I.

Therefore, it seems that the classification is not yet settled down properly, and MOC and MOF are using different classification. The classification 132 HDBT of MOC is mainly used for urban planning, and the classification of MOF is mainly used for regulating the government's investments on the infrastructure, thus will play an important role in the future development of the towns.

The three "major cities", Hanoi, Haiphong and Ho Chi Minh City (HCMC), represent about 41% of the total urban population, which in turn is approximately 11% of the total population. The 24 urban centers with populations between 90,000 and 350,000 ("large cities") represent 29% of the urban population, while the 56 centers with populations between 15,000 and 90,000 ("medium-size cities") represent about 16%. The remaining 18% of the urban population live in 353 small urban centers each with less than 15,000 people ("small cities").[3]

The categorization of the cities/towns does not prioritize the budget allocations. The investment priorities occur only for the cities that are located in the development corridors. The major difference between cities of Class I and Haiphong and other Classes is that the earlier mentioned receive their annual budgets directly from the Government, while the latter ones receive their budgets from the next higher authority.

1.4 URBAN HOUSING

In the northern part of Vietnam, Hanoi has a population density of 1,430 persons/km^2. Four other areas have a population density over 1,000 persons/km^2: Haiphong, Hai Hung, Thai Binh and Ha Nam Ninh.

In the southern part, Ho Chi Minh City has a population density of 1,880 persons/km^2, while four other areas have more than 500 persons/km^2: An Giang, Tien Giang, Ben Tre and Vung Tau-Con Dao (Table I-3 in Annex I). This high population density also reflects the serious urban housing problem.

In Hanoi, before 1989 there were only 3,214,000 m^2 of floor space for nearly one million inhabitants, or an average of 3.7 m^2 per head[4] (equivalent to about 11 m^2 for a family of three). All activities in the way of family life have to take place within this space. Meanwhile, investigation results show that the minimum housing requirements for a family are about 18 m^2, with a kitchen, a toilet, a bathroom and a separate balcony for the benefits of airing and drying. On the other hand, southern people have more living area per capita.

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[3] UNDP/World Bank; *Vietnam Water Supply and Sanitation Sector Study*, April, 1990.
[4] *Vietnam: In face of today's socio-economic problems*, Foreign Language Publishing House, Hanoi, 1987.

The housing survey, carried out in 1989[5], illustrates the variances. According to the survey (covering 19 provinces, 10 in the south and 9 in the north), people in the northern urban areas live more often in permanent and semi-permanent houses than people in the southern urban areas (Table I-6 in Appendix I). This reflects not only climate differences but also differences in housing policy; in the north the government has been more involved in housing construction than in the south.

When the urban living area per capita is compared, the picture is totally different (Table I-7 in Appendix I). Southern people have more living space per capita. However, in all areas, and especially in Hanoi and HCMC, a lot of people are living in extremely crowded circumstances (under 2 m^2 per capita).

Urban houses are mainly privately owned, particularly in the south (Table I-8 in Appendix I). Private ownership has an important impact on the improvement of housing, since people have both an incentive to improve and flexibility in deciding the level of housing and water supply.

The coverage of electricity is high throughout the country (Table I-9 in Appendix I), but the service level varies very much from one region to another; the reliability of supply is affected by excessive demand in comparison with the generating and distributing capacity.

1.5 WATER SUPPLY SITUATION[6]

Water supply coverage varies widely in big cities; probably 60-70% of the population receive water from the piped system, while in medium cities the coverage falls to 50% and in small cities to 30%.

Per capita daily water consumption is not equal; in areas close to water plants, pumping stations and water transmission mains the daily consumption can be as high as 600-1000 l/c/d while in areas further away it may fall to 50 l/c/d or less. The main reasons for these large variations are excessive leakage in the old systems and wastage of water due to non-metering and low water tariffs.

Shortage of water and intermittent supply are usual and about 80% of water supply network cannot meet the drinking water quality criteria.

The type of water supply varies in different parts of the country (Table I-10 in Appendix I). There are many more house connections in the south than in the north. Public taps are not commonly used in the south. In the big cities wells

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[5] *Sample results of Housing Survey, Vietnam population census, 1989*, Vietnam Central Census Steering Committee.
[6] This chapter is maily based on the *National Urban Water Supply Strategy for Vietnam*, which was submitted for approval in November 1994, Ministry of Construction/Finnish International Development Agency.

are rare, but some exist. In the smaller urban towns wells are widely used. Supplementary water is taken from rivers, and rainwater harvesting is common.

The criteria applied so far for deciding which centers should be provided with piped water include: 1) population more than 15 000 persons, 2) less than 25% of households involved in agriculture, and 3) population density higher than 100 persons per hectare.

About 30% of the total urban water supply in Vietnam is derived from groundwater sources.

Piped urban water supplies are, in general, limited and in poor condition. The majority of the urban population (80%) is concentrated in 78 cities each with a population over 15,000[7]. Of these, six have no piped system at all, and in those that do, service coverage varies from 15 to 90%. As a whole, about 6 million people, or 47% of the urban population, are covered by a piped water supply. The remainder use water from shallow wells (in most cases unprotected and highly contaminated), rainwater harvesting tanks, rivers and ponds.

Water treatment plants are generally in very poor condition. Many plants, even those recently built, suffer from design and construction faults. Some urban centers have no treatment facilities at all, and even contaminated raw water is distributed directly to the consumers.

Pressure is frequently low and leakages in the range of 40-50 per cent of the water pumped into system are relatively common in the north. Metering of water consumption is at present applied in few cities in the south and middle of Vietnam and has been recently introduced in Hanoi and Haiphong in the on-going rehabilitation projects. Master metering at treatment plants is still very rare.

1.6 SANITATION SITUATION

There are no national statistics about private toilet facilities nor public sewers. According to the 1989 housing survey, only 66.8% of the urban households in main urban centers have a toilet facility (Table I-11 in Annex I). Of those who had some sort of a toilet facility 51.6 % had a flush toilet, 17.1 % had a double vault toilet, and the rest 31.3 % had other types of toilets.

Almost one third of urban households don't have a toilet of their own. They share a toilet with neighbor, use a common toilet or open field. There is a big difference in private toilet facilities between the big cities in the north and the south. In Hanoi 4 out of 10 households had no toilet, in Haiphong 6 households out of 10 had no toilet of their own. The respective figures of Ho Chi Minh and Da Nang are 2 households out of 10. The proportion of flush toilets

[7] UNICEF: *Vietnam - The Situation of Children and Women, 1990*

is considerable higher in the southern parts (over 80 % of toilets) of the country than in the northern parts (40 - 60 % of toilets).

Based on the findings of the study team, private households have improved their sanitation facilities substantially since 1989. Double vault and bucket latrines have almost totally been replaced with flush and pour flush toilets in the South, while the northern cities still have some 19% of households using double vault latrines and as much as 26% use bucket latrines. The number of households that are without toilet facilities or relying on such devices as the overhang toilets remains at 23% in the North, but is only 9% in the South.

The improvement of sanitation situation of the public sector has not followed the development of the private households. Most of the pour or flush toilets discharge wastewater straight into streets, drainage ditches, and natural water bodies, which is an obvious health risk. Management of septic sludge is not done properly in any of the studied cities, and it is expected that serious problems may arise in the near future.

The combined sewer systems are mainly serving the central part of the towns , and built during the French regime. Thus the sewer pipes are aged and in very poor condition. Their transmission capacity has been reduced considerably due to clogging and sedimentation, also several collapses of sewers have been reported. In new development areas, built after 50's, the construction of sewer pipes have either been neglected or has been minimal. Therefore floods are common, resulting serious economical losses and causing health problems. It is estimated that the coverage of households served by public sewers in Class I cities is 48 %, in Class II 44% and in Class III cities only 25%.

In most cases the waste water collection system consists of sewer pipes which discharge the waste water to through open channels and ditches to lakes and ponds. No treatment is done before the discharge to the receiving water bodies. In Hanoi there is one waste water treatment plant serving one small housing area, but it has not been in operation for years. Lack of treatment facilities have polluted or euthrophicated the receiving waters in most towns. Due to the usage of on site infiltration technologies the shallow ground water resources are reported to be polluted in many places.

The industries are mainly outdated and using technology that requires large amounts of water and raw materials. No pretreatment of waste water is used thus polluting environment. Especially in Ho Chi Minh City the water bodies are heavily polluted.

The O&M of sewer systems is suffering of lack of skilled personnel, proper equipment and funds in all the cities. Within a city the responsibilities for the sanitation activities are shared with different authorities. For instance in Hanoi and Ho Chi Minh City Sewerage and Drainage Companies are responsible for sewers with a diameter over 400 mm and district authorities are responsible for smaller pipes. The URENCO, (on request of private households or housing cooperatives), is responsible for emptying of septic tanks. The responsibilities of sanitation are more unclear in smaller cities, and the O&M of the systems in general is neglected.

Recently the Government has promulgated the Environmental Law, but the follow up and monitoring of the enforcement is poor. The local authorities i.e. in most cases Environmental Committees do not have enough trained personnel nor equipment to be able to fulfill their responsibilities.

2. NATIONAL DEVELOPMENT CONTEXT[8]

2.1 DOI MOI POLICY

New developments in political, social and economic spheres have taken place in Vietnam since the latter part of the 1980s. "Doi moi" (renovation) or open door policy to trading and investment with other countries, marks a new stage in the economic development of the country, since its aim is to transform the failed command/control economy to a market-oriented one.

The key elements of the "doi moi" policy include:

(i) decentralization of state economic management, giving greater autonomy to state-owned enterprises in making decisions relating to production, distribution, and financing;
(ii) replacement of administrative measures and controls by economic ones and, in particular, the use of market-oriented monetary policies to control inflation;
(iii) adoption of an outward-oriented policy in external economic relations. Key elements of this policy were the adoption of realistic exchange rates and a liberal foreign investment law;
(iv) adoption of agricultural policies which allow for long-term land use rights and greater freedom in the marketing of products; and
(v) reliance on or acceptance of the private sector as the engine of economic growth.

The first years of "doi moi" have been a success. Inflation has been brought down from more than 700% in 1986 to 18% in 1992, the exchange rate has stabilized, fiscal revenue has improved, etc.

Vietnam is also facing the side-effects of the market economy: gross distortions, corruption, rent-seeking activities, and inadequate "rules of the game". A major challenge for the government will be its ability to introduce the legal and institutional framework necessary to underpin a dynamic economy. The political dimensions of this task include reduced party control, closing of numerous bureaucratic rent-seeking avenues, the establishment of an independent judiciary, and letting the people become rich.

Vietnam's reform program will continue restructuring the state enterprise sector, e.g. by creating a proper environment for all economic sectors to cooper-

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[8]This section is mainly based on two documents : *Vietnam ; A Development Perspective* , Hanoi 1993; Document presented to the international community in the Donor Conference in Paris , 1993, and a book named *"Vietnam's Dilemmas and Options - The Challenge of Economic Transition in the 1990's"*, edited by Mya Than & Joseph L.H. Tan, ASEAN Economic Research Unit, Singapore 1993. The former gives an official insight to the development of the country while the latter presents observations and comments of the foreign "Vietnam -watchers".

ate, compete and develop on an equal footing. Efforts will be also be made to improve market mechanisms, as well as to increase the effectiveness of macro-economics management and to strengthen the planning capability required for a market economy.

Continued attention will be paid to developing an open economy in Vietnam, strengthening and diversifying the country's relations with other countries. Vietnam needs to further develop the legal system, reform the public administration, and train public service personnel at all levels.

3. FOREIGN ASSISTANCE

Vietnam's economic reform since the 1980 has hardly benefited from overseas development assistance (ODA). Indeed, this non-availability of large ODA inflows may turn out to be a blessing in disguise; the Vietnamese have learnt to use their available and scarce resources.

In principle, the fees and charges for infrastructure facilities and services, plus the expanded and deepened revenue base in consequence of higher economic activities induced by ODA expenditure on infrastructure on production projects, should be adequate to cover O&M outlays and the costs of debt service after the grace period. Many projects throughout the developing world have failed in producing the expected benefits because the politically difficult decisions to increase fees and charges have not been made.

The Government of Vietnam has indicated that ODA resources (excluding humanitarian aid) will from now on be utilized primarily for socio-economic infrastructure projects which are unlikely to recover the costs. The Study Team, recognizing the priority of infrastructure projects, anticipates that many such projects, including urban water supply, should be able to generate substantial revenues, in order to maintain the sustainability of the benefits. The government's own self-financing policy emphasizes elimination of subsidies in the water supply sector.

Experience has shown that the benefits of development projects are only sustainable if expertise is transferred to Vietnamese personnel. Training activities for counterpart staff, and the use of local consultants, should be important components of projects.

There are several factors affecting Vietnam's capacity to absorb external assistance effectively:

(i) the availability of counterpart funds from domestic sources is essential;
(ii) the availability of local materials is particularly important for construction and production projects;
(iii) the planning and management capability of Vietnamese organizations needs to be developed; and
(iv) the legal and regulatory framework should enable timely and effective investment decisions.

The Ministry of Planning and Investment (MOPI) plays the lead role in aid coordination but several other agencies have important supporting responsibilities. These agencies include the Ministry of Finance (MOFI); the State Bank; the Ministry of Foreign Affairs (MOFA); the Ministry of Science, Technology and Environment (MOSTE); the Office of the Government (OOG); the People's Aid Coordinating Committee (*PACCOM*); and the State Council for Project Appraisal (SCPA).

4. URBAN DEVELOPMENT STRATEGY

The Vietnam Urban Development Strategy is under preparation at the moment, therefore only some preliminary information is used in formulating this chapter.

The strategy is divided in periods having different priority development objectives.

First Period, 1993 to 2005

Creation of stability in the economy with ' Market economic mechanism', focusing first on industrialization, and concentration of investment in the major regions to reach the objectives of economic and social development. The participation of the labor force in trade and service sectors will increase, also the labor force in industries will increase slowly. Together with the concentration on investment of development in main regions is the pole growth of the metropolitan areas in these regions.

The main emphasis in urban development is put on the improvement of the urban management and development in the following sectors

(i) Administration
(ii) Socio-economics
(iii) Finance
(iv) Construction planning
(v) Land use
(vi) Environment
(vii) Infrastructure

The idea is to have three central development poles using the development potentials of the existing force of big cities and at the same time to coordinate the attracting power of the corridors.

The main development areas are as follows:

(i) The development pole of Ho Chi Minh City in combination of the corridor axe; HCMC - Bien Hoa - Vung Tau along the national road 51;
(ii) The development pole of Hanoi in combination of the two corridor axes; Hanoi - Haiphong - Hon Gai along the national road 5; and
(iii) Development center of Da Nang in combination of small corridors; Hue - Da Nang - Quy Nhon - Nha Trang.

Second Period, 2005 to 2015

Continuation of industrialization with increased speed and the creation of possibilities for development and stability in the economy and society of subregions and other regions of the country. The participation of the labor force in industrial sectors will be subject to major increases. In parallel, there will be the creation and expansion of the development of small and medium cities and towns.

The main objective is to exploit the upgraded corridors and to concentrate all resources to develop 3 big cities into development poles and to accelerate the development of the other cities in the area in subsequent stages. All the potentialities within and outside the area, within the country and abroad, should be mobilized to invest in the renovation of Hanoi Ho Chi Minh City, Hanoi and Da Nang. The other remaining cities shall develop in the harmonious and appropriate into relation in the area.

The weak point of this stage is the gap of the development level and growth rate between the big cities and the medium- and small-size towns.

Third Period, after 2015

Within the third period industrialization, and other production developments are completed. The national economy will be reaching the main objectives on production. Gross national production will be at a high level and the life of the people will be much improved. The labor force in industrial production and trade services will be increased, and the labor force in agricultural production will be reduced but highly productive. The urbanization process, the urban system including the small cities and towns, will be also developing at a high national level. Rural developments will be reaching their objectives, with high productivity and rural settlement systems which will impact on medium and small cities and towns.

The main objective of this stage is to utilize the support of big cities to develop the medium- and small-size towns. All the efforts shall be concentrated on the socio-economic development, renovation, upgrading and building new urban system consisting provincial chief towns or other towns within the provinces.

Policy of Urban Infrastructure Management and Development

The draft strategy states the main objective of urban drainage and sanitation system is to protect the environment from the pollution of urban development. Some general targets are set for the drainage, sanitation and solid waste management;

(i) To construct drainage system for 85 - 90 % of urban areas;
(ii) To minimize the floods and stagnant water during rainy season;

(iii) To rehabilitate, clean and dredge all channels, rivers, and lakes and ponds of big cities;
(iv) 100 % of households have solid waste and waste water disposal system;
(v) To reduce the amount of industrial waste waters and treat them according to set standards before discharging in receiving waters;
(vi) To strictly follow the existing regulations and guidelines with respect to the environmental protection;
(vii) All citizens, especially production and trading organizations should take responsibility in implementation and contribution according to stipulations; and
(viii) The fining policy should be applied to those who break the regulations against the environment.

These target are elaborated and revisions suggested in *Volumes 1 and 4.*

5. SOCIO-ECONOMIC CONTEXT

The economic viability of the urban as well as the nation would affect the feasibility of improving urban sanitation situation and financial sustainability. Also, the social context of the Vietnamese way of living will influence in the future direction of sanitation use behaviors. Since Vietnam has been carrying out its doi-moi policies, its socio-economic context has been benefited from both macro and micro levels.

At the macro level of socio-economic context, the new economic reform has positive effects in opening **new economic opportunities**; hence, non-state sector is expanding its production rapidly. The chosen development policy will direct the nation toward a system of "open-economy", and it is expected that the urban areas of any size will play a major role as the center for economic, cultural and social development within each region. The economic development strategy of Vietnam brings the economic opportunities as well as the constraints and challenges for the people who are facing with the dynamic economic situation.

However, there are a lot of hardships during the transition period. When the economy is restructured, many weak state enterprises halt their operations, resulting in increasing **unemployment**. Also, the rapidly growing work force, the reduction in the size of the armed forces, and the return of a large number of workers from the former socialistic countries increase the unemployment problem still further. The official unemployment rate was about 20% of the total labor force in 1990. The expansion of private sector during the last couple of years compensated for the state sector employment, but has not happened on a sufficient scale to reduce the unemployment rates substantially. Besides, it is estimated that each year, more than one million new workers will enter the job market. The unemployment problem will create a short-term constraint for conducting the economic reform. On the other hand, this labor reservation could provide international companies an opportunity to participate in economic investment in Vietnam.

The **present capacity of social, physical infrastructure services** of Vietnam is not strong enough in terms of quantity and quality to meet the requirements of the fast growing economy. The strategy toward an open market economy requires basic physical infrastructure to facilitate industrial development and trade. At present and in the near future, **massive requirements for capital** improvements exist in the infrastructure for transportation, ports, telecommunications, energy, water supply and sanitation to support the national development policy, because the urban areas of any size will be used as the coordinating center of the administration and the joint venture of the investments in economic activities, although development poles will be have a high priority.

At the micro level of socio-economic context, the **traditional background of agricultural society** and the life style of rural areas are still intermixed with the social texture of urban areas. Considering that fifty percent of GDP is from the agricultural sector, and at the same time, eighty percent of total population lives in rural areas, the sanitation practices of urban areas are still interconnected to the needs of agricultural production in the suburban areas; or people's attitudes and needs for a clean and improved sanitary environment may not have been enhanced as much as overall economic development process.

The problems in social-economic sector that Vietnam confronts, in general, are; a large part of the population remains in poverty, malnutrition exists in some areas and many people lack access to safe drinking water and basic health care services. The **rapid population growth** threatens to undermine the gains that have been made in national economic development.

Especially, the **economic disparities** between the north and the south is widening, which may be seen on the micro level as well. For example, the investment in HCM city produces over 30% of tax revenue[9], which may suggest the basis for possible future dissatisfaction and dispute on both sides. The World Bank, estimates that there is a fivefold difference between the poorest and the wealthiest region in Vietnam.

Vietnam suffers from inadequate and increasingly deteriorating physical infrastructure systems. Although some of them have been rebuilt since the turn of the century, the vast majority have been poorly maintained and are very old. In order to support the fast economic growth, urban infrastructure needs to be provided in time. Due to the facts that 20 % of the Vietnamese national budget still relies on foreign aid, and that local governments do not have enough revenue sources of its own for providing urban infrastructure. Therefore it is difficult for the governments to secure appropriate **financial sources** to provide the improved infrastructure. Besides, state-owned-property rights, land-ownership, together with state-owned banking system make private investors' access (or who wants to improve their sanitation conditions of their own housing) to capital or lending very limited.

On top of the State controlled banking systems, the real interest rate fell back in 1990, and consequently the informal credit market collapsed[10]. The collapse of informal credit market posed a hardship for ordinary people, who need to borrow money for their economic activities. The improvement of housing will be difficult for those ordinary regular income class households, if **credit market** is inaccessible. Therefore, from both governmental and private users sides, the access to financial sources are limited and thus discouraging any further improvement on urban infrastructure.

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[9] *Vietnam: Transition to Market Economy, page 202*

[10] *The Double Transition From Underdevelopment and From Socialism in Vietnam*, Andreff, W., Journal of Contemporary Asia, Vol. 23, No. 4, 1993

The new economic policy has allowed individual private household units to explore **opportunities of private business ventures**. This household-economy will play an important role in developing socio-economic textures of the society and this fundamental economic unit would utilize its household assets, capital and manpower. Support of these economic activities through providing appropriate social and physical infrastructure will greatly enhance the overall economic performances of the nation.

6. SECTOR STATUS ASSESSMENT

The sector status assessment has primarily been based on a review of the 1989 Household Survey, the 1992-93 Living Standard Survey[11], the 1990 Water Supply and Sanitation Sector Study[12], as well as other reports and documents compiled and made available by the DCWSS, and the NUSS Information Collection Survey carried out by the DCWSS staff. The survey started with questionnaires sent to 49 utilities in 33 cities, but only two were completed and returned. Therefore, field visits were made to the following cities to compile more detailed information:

Class I:	Hanoi, Ho Chi Minh City (HCMC)
Class II:	Haiphong, Da Nang, Hue, Can Tho
Class III:	Nha Trang, Thai Nguyen, Phan Thiet Bac Giang, Hai Duong

The above classification is used for data processing and analyses in this chapter.

A specially designed socio-economic study of randomly selected households in Haiphong and HCMC, as well as institutions and commercial enterprises in HCMC was carried out as a part of this study. The institutional and financial sector assessment is based on the literature available and on the NUSS Information Collection Survey.

An impressive data base has been established for the 11 cities visited. Reference is made to Appendix II, which contains the detailed results of the NUSS Survey, while extracts only have been used in this chapter. It is unavoidable in a survey like this, which is carried out in a very short period of time by a number of different people, that the reporting and understanding of the information not are subjective, that cross references and validation of information have not always been possible, and that the reliability and accuracy of some the information may be questionable. However, the NUSS Information Collection Survey data have proved to be reasonably consistent and comparable to data from previous surveys listed above, as well as the NUSS Household Survey. It is, therefore, believed that the compiled data are sufficient and adequate for a sector status assessment.

The terminology used in the above mentioned reference surveys is not identical and not well defined. For example, the surveys list households "with" or "with access to" toilets, or households that "use other or no toilet". This definition fails to distinguish clearly enough between households that have own toilet facilities in their apartments, families that share a toilet facility in the same build-

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11 *Vietnam Living Standards Survey 1992-1993*, State Planning Committee - General Statistics Offices, Hanoi 9-1994

12 *Viet Nam, Water Supply and Sanitation Sector Study, Volume 1: Main Report*, UNDP/World Bank, Asia Water Supply and Sanitation Sector Development Project With Assistance from the Government of Finland and France, RAS/86/160 Bangkok Unit, March 15, 1990.

ing, or households that have access to a separate toilet facility shared by a larger number of households (communal toilets). In this study we have assumed that households with own toilets and shared in-house toilets are classified as "with" and "with access" to toilets, while households that use communal or public toilets have been classified as households that "use other or no toilet".

While the definition of the wet type flush and pour-flush toilets is quite clear, there is considerable confusion as to the definition and understanding of the various types of dry toilets. It is felt that some cities report the number of vault or bucket latrines without making a distinction between them. The 1989 Housing Survey seems to use the term "simple" toilets for bucket latrines.

The detailed results of the NUSS Household Survey in Haiphong will be presented in a separate report.

There are, unfortunately, still areas where vital information is either insufficient or lacking, such as age and physical condition of existing drainage systems, quantities and quality of groundwater extracted from private wells, soil conditions and permeability, industrial and hospital waste handling, and waste reuse.

6.1 INSTITUTIONAL FRAMEWORK

6.1.1 Present Policies

Official Sector Development Objectives

The Seventh National Congress of the Communist Party, which met in June 1991, adopted the Socio-Economic Stabilization and Development Strategy to the Year 2000. This strategy[13] is reviewed in this section. This general strategy includes also some objectives related to the sanitation sector, such as to:

(i) focus the limited investment resources available to develop the infrastructure needed to promote investment in services and industries in the three priority areas: (i) Hanoi-Haiphong-Quang Ninh; (ii) Ho Chi Minh City-Bien Hoa-Vung Tau; and (iii) the Danang area;

(ii) encourage the growth of medium and small centers, avoiding too great a concentration of the population in major cities;

(iii) improve the management mechanism of state enterprises, experiment and gradually expand the transformation of state enterprises into private companies, including enabling employees and workers in these enter-

[13] *Vietnam; A Development Perspective*, Hanoi 1993; Document presented to the international community in the Donor Conference in Paris, November 1993.

prises to become shareholders, and phase out or privatize ineffective and non-strategic enterprises;

(iv) establish a well-functioning executive and administrative system, streamline the number of line ministries, and focus policy-making powers within the central government and increase the role of local governments in supervising law enforcement in their territorial boundaries; and

(v) protect and properly utilize natural resources, improve the environment, fight the degradation of the environment and ecology and ecology and fight the tendency to care only about economic growth and its immediate benefits while overlooking damage to the environment.

The above objectives do not suggest concrete targets (e.g., for specific service levels at a given time in the future). Taking all prevailing constraints and uncertainties into consideration, it has been reasonable to set directions rather than targets that might well have been proven unrealistic. The above statements provide support to the development of the waste water collection and sanitation sub-sector to sustainability.

Sector Development Strategies

The basic framework for the development of Vietnam is also outlined in the Socio-Economic Stabilization and Development Strategy to the Year 2000.

Safe drinking water and proper sanitation, besides being important elements contributing to the quality of life, are basic to preventive health care. The supply and proper use of safe water and sanitation are among the most cost-effective ways of reducing the risk of infection and communicable diseases. Vietnam's "investment in people" through proper health care will, therefore, include priority attention to the provision of safe drinking water and proper sanitation. Accordingly, the State plans to:

(i) designate a national agency with coordinating responsibility for all matters relating to improving quality and availability of water and sanitation services;

(ii) increase the funding and support for simple water and sanitation technologies in rural areas, using the UNICEF Rural Water Supply Project and the UNICEF Sanitation Project as models;

(iii) provide incentives to families to invest in appropriate sanitation technologies;

(iv) prepare master plans, feasibility studies, detailed design specifications, and other documents for rehabilitation and expansion of the water supply and sewage systems in urban centers;

(v) continue rehabilitation and expansion of water supply and sewage systems in cities and towns; and

(vi) apply measures for strengthening management and effective use of potable water.

Priority actions for Vietnam's environment include:

(i) technical support in helping draft environmental legislation, to translate it into a consistent set of sub-laws and detailed regulations, and to train staff in this process;
(ii) utilization of the best experience of Asian and other countries in developing a workable approach to control industrial pollution, supplementing traditional engineering approach to environmental norms by economic and ecological considerations;
(iii) effective measures to protect and improve urban environment by investment, improved management and better training; and
(iv) environmental impact assessment procedures.

As part of the overall strategy, the State also intends to:

(i) gradually raise rents and wages for public employees to reflect market values;
(ii) continue with the sale of public housing, while retaining some for social welfare beneficiaries;
(iii) provide housing allowances for low income families, and undertake public infrastructure improvements where poor people are concentrated;
(iv) determine counterpart funds and recurrent costs associated with projects financed by external sources, and ensure the availability of sources of financing to meet those costs;
(v) improve data collection, follow-up and evaluation of projects financed by external sources, with particular attention to the rate of return on the investment;
(vi) apply user fees for selective infrastructure;
(vii) resolve a number of land use and land management issues, and include ownership of property provisions in the Civil Code;
(viii) separate management roles of the state from business operations;
(ix) subject all state enterprises to a relicensing and independent auditing process;
(x) establish guidelines for disposing and divestiture of enterprises which will not necessarily be kept as state enterprises;
(xi) focus on improving the management efficiency and financial control of state enterprises, to ensure that the rights of the state as owner are protected;
(xii) continue to reformulate public administration at all levels, focusing on the requirements of a market-oriented economy;
(xiii) further downsize public administration at all levels, improve rules and procedures, and improve the quality of public administration through staff training and other measures;
(xiv) help coordinate the exchange of information among technology users, in particular to improve efficiency by standardizing materials and equipment;

(xv) formulate a strategy for ensuring maximum scientific and technology from donor participation in Vietnam's development; and
(xvi) encourage efficient information sharing, by organizing seminars and by other means.

Virtually all of the above items are very positive for the development of the sanitation sub-sector. In many aspects, Vietnam has already made impressive progress since the adoption of the strategy in 1991. For instance, the Management Board under MOC has been designated a national agency with coordinating responsibility for all matters relating to improving quality and availability of water and sanitation services; environmental legislation and environmental impact assessment procedures have been developed, and included ownership of property provisions in the Civil Code (its twelfth draft was publicized for reactions and comments in March 1995).

Protection of the Environment

Vietnam's report on social development [14] recognizes protection of the environment as one out of ten main sectors of social development. Unlike for seven other sectors, this report does not define objectives or targets to the year 2000 for environmental protection. The policies and measures in the report suggest to:

(i) establish and upgrade a national system responsible for monitoring, managing and coordinating environmental protection from the central to the local level throughout the country;
(ii) strengthen planning for the environment along with the socio-economic development plans for the short, medium and long term; the Government has made a budgetary appropriation for environmental protection and this source of funding will be increased every year in proportion to the rate of economic development;
(iii) organize information and education campaigns, train servants in charge of environmental protection, and introduce environmental education from elementary schools to tertiary and professional colleges in order to raise environmental protection awareness; and
(iv) continue issuing, amending and perfecting policies on natural resources and the environment.

The above measures are essential for the improvement of the environment. Without increasing the funding of environmental protection, little can be expected. So far, steps have been taken in building up legislation and regulations, but enforcement lacks resources.

[14] *Viet Nam's Country Report on Social Development*, prepared for the World Summit for Social Development, Copenhagen, 6-12 March 1995

The proposed measures do not clearly address urban environmental problems. Instead, the focus seems to be on nature conservation which, undoubtedly, deserves special attention, but has relatively little in common with urban sanitation.

Resource Mobilization

The Government is preparing a number of urban infrastructure projects in order to borrow funds from the World Bank and the Asian Development Bank, and to apply Overseas Development Assistance (ODA) from bilateral development agencies. The Government also encourages the private risk capital to invest in the development of urban infrastructure in various forms.

One of those forms is Build-Operate-Transfer (BOT) The Government encourages foreign BOT companies (organizations and individuals) to invest capital and technology in Vietnam.

The Government guarantees that the revenue received by a BOT company during its period of operation can be converted from Vietnamese currency into foreign currencies. The tolls, fees or other revenue of a BOT project are defined in the BOT contract, and controlled by the State Committee for Cooperation and Investment , nowadays by MOPI (SCCI). According to the BOT regulations, the BOT company shall transfer the whole project to the Government without compensation upon the expiry of the period of operation.

The BOT concept has been considered to be applied, e.g., in water supply in Da Nang, Vung Tau and in the industrial and residential area along Highway 51, and waste treatment and fertilizer production in Hanoi, Haiphong, Hue, Da Nang and Ho Chi Minh City. So far these ventures have not been launched, mainly due to fees or tariffs unacceptably high to the Vietnamese side.

Vietnam will certainly attract the international community to provide financing for the development of the country, including urban sanitation.

6.1.2 Legislation and Enforcement

Legal instruments are being developed in Vietnam at an impressive pace with the aim to replace the former system that was based on political decisions and case-by-case management. Laws and regulations, i.e., for environmental protection and water resources management and protection have been issued or are under preparation. Laws are generally so-called skeleton laws which need to be strengthened by supporting regulations and bye-laws. More detailed regulations are provided in the form of Government decrees, ministerial guidelines and provincial bye-laws. Some of these regulations also have references to environmental standards. It may be indicative, however, that the contents and even existence of these laws and regulations are not widely known, and it is often difficult to obtain copies of them even in Vietnamese, not to speak of English translations.

Public Health Protection Law

Regulations on sanitation, among other health-related issues, are provided in a Decision of Council of Ministers No: 23/HDBT, passed in January 1991 on the basis of the Public Health Protection Law, which dates back to July 1989.

The decision recommends that factories and enterprises shall be (gradually) concentrated in separated industrial zones, and that industries must avoid polluting the environment. More specifically, "the waste water containing toxic chemicals from factories and enterprises, and disease causing bacteria from hospitals, must be treated before being discharged into common sewerage in the city or town". The Ministry of Health is authorized to regulate the monitoring of waste treatment.

The decision contains some provisions on sanitation, e.g., prohibition of construction of latrines near water sources and prohibition of going "to stool freely". It also states that when constructing or rehabilitating offices, schools, hospitals, restaurants, etc., they must be equipped with "efficient toilet facilities" and they must discharge waste water to urban sewerage. Construction of "nice and clean toilet houses" for public in crowded areas and streets is considered necessary, and money is allowed to be collected for their maintenance and service (without specifying who is entitled to do so).

According to the decision, nightsoil has to be stabilized before it is used, and manure can only be collected and transported outside rush hours, and it shall be transported in tight closed tanks to avoid dropping onto the streets.

According to the decision, it is mandatory to obtain a permission from the local public health organ and competent authorities before new construction as well as rehabilitation of existing buildings. The health authorities have to confirm that the design documents include design of appropriate toilet facilities, and their representative has to be a member in the project inspecting organ to examine the building before it is taken into use.

Waste is requested to be "swept, collected and carried away every day". It is not allowed to throw rubbish and waste or defecate on streets, pavements, lawns, trees, lakes, ponds and other public places. Streets are not allowed to be swept at rush hours.

The decision states that "waste water disposal must ensure hygienic standards, and waste water is discharged into rivers, lakes or other places only when the regulation allows". Sewers must be regularly improved, repaired and dredged, and it is forbidden to block sewers by building or by waste disposal.

Concentration of industries in particular areas is quite reasonable, and would facilitate more efficient environmental protection investments, monitoring and enforcement. The statement in the Decision is, however, a weak policy expression without reference to any possible measures. There are few wastewater treatment plants in the whole country and hardly a single one in operation. The role of MOH in monitoring is overlapping with MOSTE's responsibilities.

The stipulations on the stabilization of nightsoil are not enforced, and vast majority of the rural population in the North of the country is affected by parasitism, mainly resulting from the use of fresh excreta in the fields.

The enforcement of the clause on the role of health authorities in building permission and inspection is not enforced as the construction sector is seriously out of control. Construction business in Vietnam has experienced a drastic growth. The price of land prices in Ho Chi Minh City is in 1995 five times as much as it was three years earlier, and in Hanoi, in spite of later start of price hike, the average price of land is higher than anywhere else in the country. In these circumstances illegal housing expands to surrounding areas. Extremely strong measures have, however, been taken in Hanoi against illegal structures on the dike protecting the city. Prime Minister Vo Van Kiet has strongly implored that all government officials involved in the construction of these buildings be punished and these structures be torn down[15]. Destruction of the illegal houses was commenced in April 1995.

In spite of the clause forbidding disposal of rubbish and waste in the streets, this is actually the normal practice in waste management in Vietnam. Households throw garbage in the streets, to be swept, collected and transported for final disposal. It is also common to throw garbage into open sewerage and drainage systems.

Government Decree on Management and Utilization of Urban Land

The Government Decree No. 88-CP on Management and Utilization of Urban Land stipulates that "Organizations and individuals that have need to use urban land, must file and application for land assignment", and that "after receiving the assigned land, the assignee must immediately carry out preparations for the construction and start filling procedure to apply for the construction license."

The Decree states that urban land must be built with infrastructure when it is put in use, and addresses the responsibility for the infrastructure to the State: "The State shall invest in transforming and building for common use by the entire urban area infrastructure projects which are not able to generate direct return on capital, or it shall assign to businesses, in the form of bidding or contractor selection, the construction of infrastructure works which are able to generate direct returns on capital." By the Decree it is also possible to enforce

[15] The Saigon Times, March 23-29, 1995

connections to sewerage systems: "Organizations and individuals shall build infrastructure works on the land plots assigned by the State in strict compliance with the plans and investment projects already approved by the competent State authority".

Article 27 introduces a very interesting concept of an infrastructure fund:" The use of the land fund to generate capital for construction of infrastructure works and the assignment of land for businesses to invest in projects for infrastructure development in urban areas shall be determined by the Prime Minister."

Land use and building regulations are effective tools in the management of sanitation development in new construction. Decree No. 88-CP includes important elements whose enforcement largely depends on mobilization of resources.

Government Decree on Collection of Levy on Land use Right and Land Administration Fee

The Government Decree No. 89-CP on Collection of Levy on Land use Right and Land Administration Fee defines provisions for charging for land allocation: "Organizations, households or individuals (commonly referred to as land users), except cases defined at article 2 of this decree, have the duty to pay land use right levy when allocated land by the state." "An organization, household or individual has to pay land administration fee in the following cases: issuing a certificate of land use right; certifying the registration of change in land use right; and excerpting items from the administration dossier."

Law Concerning Taxes on Land-Use Right Assignment

This law was passed in June 1994. Its Chapter I (General Provisions) states that "organizations, family households or individuals that have the right to use land shall pay a tax on the assignment of land-use rights when they assign such rights in accordance with law, except for cases provided for in article 2 of this Law."

The law authorizes the People's Committees of provinces or cities to set the value of the land for calculating the tax. Generally, the tax for land for residence is 20% of the land value.

Levies and taxes on land use rights could substantially contribute to the mobilization of resources for infrastructure development if a fair share of the collected levies and taxes were allocated to these investments.

Government Decree Promulgating the Statute of the Management of Urban Planning

The Government Decree No. 91-CP promulgates the Statute of the Management of Urban Planning. The latter states that "Urban transformation and construction must be based on the urban construction plan already ratified by the authorized State agency" and that "the urban construction planning project must be drawn up by the professional organizations recognized by the State, and must comply with the technical standards, norms and processes allowed by the State."

A key tool in land development control is a planning certificate: "Before making a feasibility study or designing the construction of a project, the investor must apply for a construction site from the urban development planning agency. When the construction site has been determined, the Chief Architect or the Construction Office (where there is no Chief Architect) shall grant planning certificate at the investor's request."

According to the statute, the planning certificate should clearly specify the main conditions, including;

(i) conditions for sanitation, fire prevention and fighting, and environmental protection; and
(ii) requirements for construction and use of urban technical infrastructure facilities, such as transport, ground filling, drainage of rain and waste water, supply of water, electricity and communication.

Furthermore, "the granting of a permit to renovate or build a project must be based on the valid papers on the right to use land and own the project, the minimum conditions for construction sanitation, the requirements for urban architecture planning, for aesthetics, urban landscape...".

The dossier applying for the construction permit of a new project includes:

(i) an application for construction permit;
(ii) papers certifying the right to use land (decision to allot land, lease land or a certificate of the right to use land); and
(iii) dossier of the project's technical design made by a licensed organization or an individual.

The Chief Architect or the Construction Office (where there is no Chief Architect) grants permits for repair and permits for construction in urban centers. However, permits for construction of separate, semi-durable projects along roads within street quarters and alleys with roads not larger than 12 m, and in quarters specifically planned and ratified by the authorized State agency, are granted by the representative of the Chief Architect in cities or of the construction office in towns, precincts and districts.

In case the investor wants to change the design, he/she must make a dossier for readjusting the design, and re-apply for a construction permit. If the construction does not conform to the construction permit, the investor or the constructor must bear full responsibility and must strictly comply with the requirements of the Chief Architect or the Construction Office.

The statute calls for coordination of the development of urban infrastructure: "The construction of underground projects on the main roads must be carried out simultaneously and in a uniform way."

Article 35 stipulates pretreatment of toxic pollutants and registration of polluters: "Those organizations and individuals, that are managing and using projects which release toxic pollutants ... to the urban environment, must take measures to treat them into public sewer systems, and at the same time, must register with the authorized State environmental management agency..."

The People's Committees of cities, towns and townships can delegate the responsibility for collection and treatment of industrial and human waste to "specialized organizations".

Article 40 forbids damaging of urban technical infrastructure, and states that "the authors of these acts must pay compensations for the real losses".

Connections from local drainage facilities, such as sluices, ditches, conduits, main sewers to the common drainage system in urban areas "must have the permission of the authorized specialized management agency". If waste water contains noxious or polluting substances, it must be treated before being discharged into the common drainage system in urban areas.

Article 50 authorizes "the agency managing the exploitation and use of the urban technical infrastructure works" to collect and use the charge for the use of the technical infrastructure, fees and other auxiliary charges "as prescribed by the Ministry of Finance for the purpose of managing, maintaining and upgrading the urban technical infrastructure works."

On the basis of Decree No. 91-CP, the Chief Architect (or the Construction Office) has a couple of important instruments to control new construction and renovation and ensure, inter alia, that sanitation issues have been addressed before and during construction. These instruments are planning certificate, and construction permit. How efficiently these stipulations are put into force, depends on the determination of the authorities. An issue of concern is that construction permits for "semi-durable projects" in the quarters have been delegated to lower level representatives whose professional capabilities do not necessarily facilitate them to consider all aspects, such as environmental issues.

Government Decree on the Promulgation of the Regulation of the Management of Investment and Construction

Government Decree No. 177-CP promulgates the Regulation of the Management of Investment and Construction which includes stipulations on construction permits. "The presidents of the districts and provincial towns shall issue construction permits for single dwelling houses and new constructions capitalized at less than 500 million Dong."

The dossier to apply for construction or repair permit consists of an application, the dossier on the project design, and the certificate of lawful right to land use.

The quality of the construction is controlled by tests on completion which, on the basis of Article 33, "shall have to be conducted phase by phase right after completion of the volumes of work concerning hidden installations,... parts or the whole installation or the whole project.

This decree classifies the investment projects in three categories: A, B and C. Urban water supply and wastewater projects fall under category A if the total investment exceeds 200 billion Dong or MUSD 20, category B when the total investment is 25 billion to 200 billion Dong (MUSD 2.5-20), and category C below 25 billion Dong (MUSD 2.5). The for A projects are taken by the Prime Minister, and for B and C projects by relevant ministers and chairmen of the People's Committees of Provinces/Cities.

The main responsibilities of various organizations and parties, as defined in the Decree, are briefed as follows:

(i) the State Planning Committee defines investment policies, prepares strategic and development plans for each "region and territory", determines investment structures, and prepares a to be examined, approved and promulgated by the Prime Minister, or can be delegated by the Prime Minister to approve;
(ii) the Ministry of Construction "exercises" of consultancy, construction and assembly, and management and guidance on bidding and selection of consultants and contractors. MOC also reviews the of A projects;
(iii) the Ministry of Finance allocates funds to the projects defined by the Government;
(iv) the Vietnam State Bank coordinates with MOFI in to finance the projects with capital borrowed from international credit organizations;
(v) the State Committee for Cooperation and Investment manages direct foreign investment, issuing investment licenses and monitoring the licensed operations;

(vi) other sector ministries direct investors in their relevant fields by reviewing investment proposals and, in extreme cases, proposing "suspension of unlawful investments and construction activities";
(vii) the investor has, inter alia, the responsibility for repayment of loans; and
(viii) consultancy organizations on construction and procurement are responsible to the investor for the implementation of the contract, and "shall be accountable before law on the result of the implementation of the contract".

The Decree defines the work involved in project preparation. Projects in category A and the projects financed by ODA capital must involve pre-feasibility and feasibility studies while only feasibility studies are requested for the other projects. Feasibility study reports shall be made with the guidance of SPC i.e. presently MOPI and MOC.

The feasibility studies for projects in category A have to be submitted to the State Expertise Council, headed by the chairman of SPC i.e. presently MOPI, before approval. Other standing members in this council represent MOC, MOFI, MOSTE, and the Office of the Government. Expertise Councils can also be established for project appraisal at ministry and provincial/city levels for B and C projects.

The maximum allowable period of appraisal is 45 days in category A, 30 days in category B, and 20 days in category C. The approved project has to be commenced within 12 months after the decision to invest, and the maximum allowable delay during implementation is six months; otherwise the project may be suspended.

Once the project has been approved, the contents of the project cannot be changed without written consent of the authority that has approved it.

The Decree defines the project implementation to include the following tasks:

(i) application of the certificate for land use right;
(ii) ground leveling;
(iii) bidding for consultancy (for survey, design, and "expertise of technique and project quality");
(iv) "expertise of project design";
(v) bidding for purchase of equipment, installation and construction;
(vi) application of the construction permit;
(vii) contracts with concerned organizations and individuals to implement the project;
(viii) construction; and
(ix) supervision of construction.

The Decree states that bidding for construction consultancy shall be carried out according to the regulation of the State and, in case of bidding for international consultancy, according to international practice "with consideration for the concrete conditions of Vietnam". If foreign modalities and construction norms are applied, they must be approved by MOC.

Projects involving high technical requirements have to apply two-step design approach. The steps include technical design and construction blueprint design (understood as conceptual design and detailed design). Other projects can proceed directly to the detailed design phase. MOC defines the contents of design for each step.

The technical designs of A projects are appraised and approved by the relevant minister, of B projects initiated by government agencies by MOC, and of other projects by authority deciding about the project.

Bidding for construction is made compulsory for all projects relevant to this Study, except small projects valued less than 500 million Dong. The international bidding for projects has to be held in Vietnam.

The technical designs and cost estimates have to be approved before starting the construction. However, in large-scale projects with long construction time and difficulty in making a total cost estimate, technical designs and cost estimates can be approved for each period or each phase in the course of construction.

The Decree states that the investor shall have to carry out by himself or to hire "a consultancy organization to expertize the construction quality during the process of construction". The role of this consultant is understood to be similar to that of the "Engineer" in international construction management terminology.

The Decree also stipulates the procedures related to the handing over and conclusion of the project. The project can be handed over to the user only after it has been completely built according to the approved design and the quality of construction certified as up to standard including, inter alia, "the clearance of waste matters".

The Decree defines various modes of project implementation, also including turnkey projects. It considers turnkey approach to apply to the construction of dwelling houses and other projects which have a small scale and require simple technical solutions.

The construction costs are managed by the State by pricing policies, standardizing the methods of cost estimation, and providing basic cost data. With regard to already signed contracts, the paid price even in cases of absolute necessity shall not exceed 5 % of the approved total cost estimate without reapproval of the authorized institution.

A set of standards issued by MOC define standard fees for investigations, feasibility studies, design, and costs of construction and installation. For instance, the design fee is defined as a percentage (2.3 %) of the cost of construction and installation, and the appraisal fees for design and for cost estimate as a percentage of the design fee (6 % for design and 3.4 % for cost estimate).

Decree 177-CP particularly defines the ways of State management of project preparation, approval and implementation. The procedures involved are very complicated, and emphasize strict and comprehensive State control. The initiators of projects have to intensively follow up the progress of the project proposal and lobby in the involved agencies. This may have been feasible in the subsidized system where projects were typically financed from the central budget with low responsibility and commitment from the local level, especially operators and users of the facilities.

The strict control of cost estimates and prices can also be explained by the low accountability of project initiators (called investors in Decree 177-CP). Although this Decree addresses the responsibility for the repayment of the loan to the investor, the approach of the Decree reflects suspicion on the ability and willingness of the investor to service the loan. The regulation of unit costs, design and appraisal fees has very little applicability in the market economy. Moreover, the direct dependence of the design fee on the construction cost may provide false incentives, e.g., for over-dimensioning of pipelines.

On the other hand, the Decree pays attention on delays in project preparation, defining maximum periods to certain review and appraisal functions. This is a positive sign in the protection of the investors' interests.

Law on Environmental Protection

The Law on Environmental Protection was passed in December 1993 by the National Assembly, and went into effect in January 1994. The law provides for the protection of the environment with a view to protecting the health of the people, serving the cause of sustainable development of the country and contributing to the protection of regional and global environment. This law covers a wide scope of environmental issues but is relatively general, leaving more specific provisions to be regulated later.

The law defines the scope of State management of environmental protection, and delegates the responsibility for this function to the Ministry of Science, Technology and Environment (MOSTE). The duties and responsibilities of MOSTE are described in Section 6.1.4, and the environmental administration at the local level is described in Section 6.1.5.

In relation to sanitation, this law generally states that "organizations and individuals must protect water sources, water supply and drainage systems, vegetation, sanitation facilities, and observe the regulations on public hygiene in cities, urban areas, countryside, population centers, tourism centers and production areas", and that "in carrying out production, business and other activities, all organizations and individuals must implement measures for environmental sanitation and have appropriate waste treatment equipment to ensure compliance with environmental standards (see Section 6.1.3) and to prevent and combat environmental degradation, environmental pollution and environmental incidents".

Slightly more concretely, the law states that, e.g., "waste water must be properly treated before discharge", and that "the State management for environmental protection agency (i.e. MOSTE) shall stipulate a schedule for waste water and refuse" and "supervise their treatment process before discharge".

According to this law, the Government shall stipulate the nomenclature of environmental standards and delegate the authority at different levels of promulgating and supervising the implementation of such standards. In case of failure to meet environmental standards, even within a given period of time given to the polluter for taking remedial measures, the responsible environmental agency has to report to higher State authority at the next level to consider and decide on the suspension of operation or other penalizing measures.

The law contains general stipulations on EIA. Generally, EIA reports have to be submitted to "the State management agency for environmental protection" for appraisal before implementation of development projects and also for operations commenced prior to the promulgation of the law. The National Assembly will consider and make decision on projects with major environmental impacts. A schedule of such projects shall be determined by the Standing Committee of the National Assembly.

For environmental pollution, incidents, and degradation occurring within one province or in a city directly under the Central Government, the responsible parties are either determined by a specialized environmental protection inspector, or reported by him/her to the Chairman of the People's Committee for consideration and decision. In case of disagreement, appeal can be addressed to the Minister of Science, Technology and Environment whose decision shall prevail.

For environmental pollution, incidents, and degradation occurring in two or more provinces/cities, the responsible parties are determined by an environmental protection inspector of MOSTE, or reported by the him/her to the Minister of Science, Technology and Environment for consideration and decision. In case of disagreement, appeal can be addressed to the Prime Minister.

According to the law, those who have "good records in environmental protection activities, in the early detection and timely report of signs of environmental incidents, in the remedy of environmental pollution, environmental degradation, in the prevention of acts which damage the environment, shall be rewarded", and possible damages while carrying out of these activities shall be compensated.

Those who violate the law "shall be dealt with administratively or be criminally prosecuted, depending on the nature and extent of the infringement and the consequences". Moreover they have to "compensate for the damages and costs of remedying the consequences".

The Law on Environmental Protection is a skeleton law which needs supporting regulations to materialize. The law addresses the key issues and introduces, i.e., the EIA procedures but the enforcement will depend on other, more detailed regulations.

MOSTE has some overlapping functions with MOH, whose duties have been determined in the Public Health Protection Law in 1989. The Law on Environmental Protection refers to the role of MOH only in association with corpses and remains of the dead.

It is noteworthy that environmental authorities act simultaneously as issuers of licenses, enforcing authorities, and arbitrators in environmental disputes.

Government Decree on Providing Guidance for the Implementation of the Law on Environmental Protection

The Government Decree on Providing Guidance for the Implementation of the Law on Environmental Protection (No. 175/CP, October 1994) regulates environmental protection in greater detail than the law. This decree defines the responsibilities of the Ministry of Science, Technology and Environment (see Section 6.1.4) and local authorities (see Section 6.1.5), and stipulates environmental impact assessment and prevention of environmental deterioration, pollution and incidents.

Environmental Impact Assessment has to be carried out for:

(i) overall strategies for regional development, strategies and plans for development of provinces and strategies for urban development;
(ii) economic, scientific, health, cultural, social and defense projects; and
(iii) projects financed with funds invested, assisted, granted or contributed by foreign or international organizations and individuals

According to the decree, The scope of EIA includes:

(i) assessment of the current situation of the environment in the operating area of the project or unit;
(ii) assessment of impact occurring to the environment as a result of the activities of the project or unit; and
(iii) presentation of measures for environmental protection.

The EIA assessment has to be in accordance with the Vietnamese environmental standards. If such standards do not exist for a specific field, an agreement has to be obtained from the relevant environmental authority (see Sections 6.1.4 and 6.1.5). The EIA reports have to be appraised within two months from the date all related documents were made available. Foreign-financed projects have to be appraised in the period prescribed for issuing investment licenses. Complaints have to be resolved within three months.

The organizations and individuals conducting operations relating to the environment, have to comply with environmental standards. The most relevant of the 20 environmental standards listed in the decree are those for (i) land protection; (ii) water protection; (iii) environmental protection in residential areas; (iv) environmental protection in production areas; (v) protection of the sea and oceans; (vi) environmental protection of tourist areas, and hospitals and special illness-treatment areas. MOSTE shall coordinate with the related ministries and branches in preparing and issuing standards on the above list.

All production and business establishments, hospitals, hotels, restaurants, etc., which have substances to be discharged, have to organize the treatment so as to comply with the environmental standards. The treatment technologies have to be approved by the authoritative body before discharging.

Environmental protection is financed from:

(i) State budget allocations;
(ii) appraisal fees of EIA reports; and
(iii) other sources, such as fines charged on administrative violations, and funds from voluntary contributions.

These sources, with possible but unlikely exception of budget allocations, will obviously remain extremely low in the foreseeable future.

Organizations and individuals conducting operations that cause environmental pollution have to pay "environmental protection fees", i.e., fines. The fee level depends on the harmful level possibly caused to the environment.

The decree, as well as the Law on Environmental Protection refers to environmental standards. A list of such standards is included in the decree, but the standards have not yet developed. Some (earlier) standards have been published by MOSTE (see Section 6.1.3), but their applicability is very limited.

According to the law, all polluters should have operational treatment facilities which meet the standards. Actually, there are few treatment plants and virtually none operational.

The decree stipulates that treatment technologies have to be approved by "the authoritative body", without any definition. Most probably, this refers to provincial/city services responsible for the environment. Anyhow, it is not advisable that the enforcement authority commits to certain technologies. Instead, it should only define the acceptable level of discharge, monitor and enforce.

By approving technologies its enforcement power and credibility is substantially reduced if the approved technologies do not comply with the requirements.

The level of fines is not defined in the decree, but obviously they are not regarded as compensation for the damage. There are local level bye-laws which define sanctions in greater detail. The fines in Hanoi vary from 50,000 VND to 500,000 VND.

It is not known how many polluters have been fined on the basis of this legislation, and how many of them have complied with. In Hanoi, Hanoi Environmental Committee (HEC) reported of measures against 124 cases of violation in 1993. Twelve enterprises were ordered to close, 29 had to invest in treatment, eight had to replace raw materials or production by less harmful materials or processes, and others had to submit a plan to reduce emission.

Temporary Guidance for Environmental Impact Assessment

MOSTE has issued "Temporary Guidance for Environmental Impact Assessment of Technical - Economic Project" No: 1485/Mtg, in September 1993. Assessment of environmental impacts is also regulated in the above Decree 175/CP.

The temporary guidance document of MOSTE provides instructions for two types of EIA reports: preliminary reports and detailed reports. A preliminary report has to be attached to feasibility study reports of domestic projects and to investment license applications for projects involving foreign investment. These guidelines do not specify when the detailed report (apparently in association with the design documents). The contents of preliminary and detailed reports are annexed to the guidelines.

The approval procedure and levels of authorities follow the project approval procedures, described in Section 6.2.3 and 6.4.6. The EIA reports are reviewed and approved by MOSTE for projects which involve foreign investment in:

(i) exploitation and processing of rare and valuable minerals;
(ii) telecommunication, radio, television and publishing;
(iii) overseas transportation, airline, and construction of sea ports, air ports, railways and roads;
(iv) production and circulation of medicine, hazardous and explosive substances;
(v) business on real estates, financing and banking;
(vi) defense and security;
(vii) international tourism,
(viii) heavy industry, if the size of investment exceeds US $30 million;
(ix) other sectors, if the size of investment exceeds US $20 million; and

(x) other projects which need large areas or have serious impact on the environment.

MOSTE will also review and appraise locally financed projects, such as:

(i) large construction projects, e.g., sugar factories with a capacity over 500 tones/day, road sections longer than 10 km, hospitals with at least 100 beds, generally projects involving area of 3,000 m^2.
(ii) construction projects, if the size of investment exceeds six billion VND, in the fields of generation of electricity, oil, metal, textile, heavy engineering, pulp and paper, cement industries and railways and railway bridges;
(iii) construction projects, if the size of investment exceeds three billion VND, in the fields of engineering, power transmission, electronics, chemical, rubber, construction material and construction, and wood industries, food processing, forestation, irrigation and transportation;
(iv) construction projects, if the project cost exceeds 1.5 billion VND, e.g. in farming, accommodation, education and health care; and
(v) projects with foreign currency demand exceeding 200,000 VND.

Other projects are reviewed and appraised at the local level.

The EIA reports have generally to be appraised within two months from the submission of all related documentation; projects involving foreign financing follow the licensing procedures.

The list of projects to be appraised by MOSTE is based on the general centralization/decentralization procedure of investment projects, and has little to do with the severity of the expected environmental impacts. For instance, local authorities are responsible for industrial projects (heavy industry) up to US $ 30 million, whereas MOSTE appraises even minor road projects and all projects involving financing and banking. As a result, MOSTE's limited resources may be occupied, if MOSTE cannot rely on local level appraisals), by environmentally less important work load, while industrial projects possibly causing substantial environmental impacts are beyond its normal authority. As a consequence, local authorities assume responsibilities which call for high professional competence and enforcement power.

Apart from the appraising authority the guidelines do not make any distinction between various types of projects. This will probably be included in further development of the temporary guidelines.

Law on Water (draft)

Until now, water resources have been managed on the basis of political and administrative decisions, case by case. Water legislation has been under preparation for some years, and the following review is based on the fourteenth draft.

The ownership of all water resources belongs to "all people", and these resources are managed by the State.

The Law on Water prohibits pollution of water environment, damaging of water resources, and changing of flows resulting in damages of banks, dikes, revetments, sluices and other negative consequences. Water authorities are responsible for collecting opinions and recommendations of people on relevant projects. The law also prohibits pollution of ground water.

The draft law refers to regulations of the public health sector for discharging domestic waste water, except in the case of so-called "safe-sanitary areas". For discharging industrial effluent, a license has to be applied from MOWR, and fees paid for discharge.

Existing productive enterprises which do not have treatment plants for waste water, have to draw up a plan for treatment, and submit the plan to the relevant water management and environmental authorities of the province or the central government. New establishments have to obtain a license before starting operation. The duties of the Ministry (Minister) of Water Resources include issuing and revoking licenses on selection of intake and outlet location for new factories and industrial centers. Productive enterprises have to contribute to funds for prevention of pollution.

The Law on Water aims at particular protection of "safe-sanitary" areas of water resources, to be defined by respective People's Committees or, in case of larger areas, by the Ministry of Agriculture and Rural Development. Even domestic waste water is not allowed to be discharged into "safe-sanitary areas". Licenses are issued and revoked by provincial People's Committees. Typically, safe-sanitary areas protect water resources to be used in domestic water supply, recreation, tourism, etc.

A substantial change in the administration is included in the proposed Law, while it addresses the responsibility for the administration of both surface and ground water (as assisting the Government) to the Minister of Water Resources. Presently, the Ministry of Heavy Industries is responsible for ground water issues. The Minister of Fishery has the main responsibility for sea water resources.

Disputes are settled by the same organizations which issue and revoke licenses. A basic principle is that the settling authority represents a higher level than the organizations in dispute, and complaints on the decisions are resolved by authorities on the next level higher. Disputes on the right to concession, heritage and compensation of damages are resolved by Court as provided for in law.

The establishment of river basin committees to assume the responsibilities of the local authorities in the riparian provinces is provided by the draft law..

The draft law does not make difference between various industries, their size, production or polluting load, or the requirements of the recipient, when requesting "all enterprises" to submit a plan for treatment. This is serious wastage of limited resources and far beyond any reasonable resources in the foreseeable future. The reality is that industrial effluent is not treated. Something could be achieved by concentration on main polluters in the beginning, and enforcing regulations step by step.

MOWR and local water authorities have no authority to regulate domestic waste water, except when discharged to "safe-sanitary areas". Establishment of such areas facilitates concentration of control measures on priority targets. This is reasonable when resources are limited.

It is highly recommended that the management and protection of surface water and ground water resources belong to the same ministry. The law suggests a major improvement in this respect.

As in the environmental sector, also water authorities act simultaneously as issuers of licenses, enforcing authorities, and arbitrators in environmental disputes

River basin committees are proposed in the draft to assume the responsibilities of the local authorities. This is a kind of participatory approach in water resources management and may have plenty of advantages. It may, however, result in lengthy negotiation and bargaining processes between the representatives of the riparian provinces. Another alternative for river basin management could be involvement of MOWR.

Local Bye-Laws

Provincial/City People's Committees issue local bye-laws and administrative decisions which supplement to the central level regulations. Typically these bye-laws define the responsibilities of the sectoral services, as well as tariffs, fees, fines, etc., and stipulate the monitoring procedures and authorities. Some People's Committees have also issued environmental criteria. PPC of Hau Giang has been particularly active. The collection of 20 environmental criteria published by MOSTE in 1993, contains six standards issued by Hau Giang PPC (see Section 6.1.3).

Provincial sectoral services issue supplementary guidelines and regulations. Usually they are largely based on central level regulations with some additional local features.

Hanoi, for instance, has issued a set of regulations on the protection of urban environment as early as 1991, prior to the establishment of the environmental legislation at the national level.

6.1.3 Environmental Standards

MOSTE has published in 1993 a collection called "Provisional Environmental Criteria". It consists of 20 standards, mainly issued by the Ministry of Health and Hau Giang People's Committee. The most relevant subjects to urban sanitation are:

(i) Maximum permissible concentration for toxic chemicals in surface water;
(ii) Coastal sea water quality;
(iii) Maximum permissible concentration of wastewater's constituent discharging into water sources; and
(iv) Classification of minimum sanitary protective distance for enterprises and plants.

The standard for toxic chemicals, issued by MOH in April 1992, gives maximum allowable concentrations for 159 chemicals, including heavy metals, hydrocarbons, chlorine compounds, etc., without specifying where and when these standards will be applied.

The standard for coastal sea water quality, issued by Hau Giang People's Committee in November 1991, defines the maximum allowable concentrations or limits for 21 parameters, including suspended solids (25/200 mg/l), biochemical oxygen demand (15/20 mg/l), total coliforms (1000/5000) mg/l), pH (6.5-8.5),and a number of chemicals. The maximum values and concentrations are separately defined for beach zones (the first values in parentheses above), and for other zones (the latter values in parentheses above).

The standard for wastewater constituents, issued by Hau Giang People's Committee in November 1991, defines the maximum allowable concentrations or limits for 21 parameters, including suspended solids (50/100 mg/l), chemical (160/200 mg/l) and biochemical oxygen demand ,(80/100), total coliforms (5,000/10,000 per 100 ml), pH (5-8/4-9), and a number of chemicals including heavy metals. The maximum values and concentrations are separately defined for receiving waters used or to be used for water supply, tourism and fishing (the first values in parentheses above), and for other recipients (the latter values in parentheses above).

The classification of minimum distance for enterprises and plants, issued by MOH in 1992, sets five different grades (minimum distances) of 1,000 m (Grade I), 500 m (II), 300 m (III), 100 m (IV), and 50 m (V) for various industries and activities. One category, equivalent to industrial sectors, is titled "Sanitary Engineering and Public Utilities". The following classification is given under the above title:

(i) Grade I: solid and liquid waste disposal and recycling sites and heaps for deodorizing and decomposing of untreated waste;
(ii) Grade II: centers for solid waste recycling and incineration, and disposal of treated solid waste;
(iii) Grade III: heaps and grounds of solid waste, grounds for composting toxic solid waste for fertilizer production, parking areas for waste collection vehicles, collection tanks for desludged material from the drainage system, cemeteries, waste storage, and incineration of hospital waste; and
(iv) Grade IV: temporary storage for untreated garbage.

The document does not explain where and when these distances are applied, and what this distance means. Based on certain stipulations in the regulations on public health, these distances are understood to mean distances between industrial sites and residences.

The standard for toxic chemicals in surface water contains an impressive list of various chemicals but which are likely to be difficult and expensive to detect and analyze with the present resources. Monitoring of such constituents in water courses seems to have a very low benefit/cost ratio.

The standard for coastal water allows concentrations of typical effluent from well performing waste water treatment plants.

These waste water standards define only concentrations, not allowable total load for polluting activities. Consequently, polluters may comply with the standards by dilution. In any case, these kind of standards do not provide any incentive for water conservation and clean technologies. Predominantly domestic municipal waste water could normally meet these requirements (except ambitious coliform limits) virtually without treatment in wet periods, and by mechanical or "natural" biological treatment, or by dilution, in dry periods. On the other hand, the standard is quite strict for the concentrations of heavy metals, and would require firm control measures at the source of pollution rather than treatment of large quantities of municipal waste water.

Local authorities have issued environmental standards which may be quite different from each other. Hanoi, for instance, has its own criteria for permitted concentrations of toxic substances in surface waters.

6.1.4 Central Level Organizations

The names, functions and tasks of some ministries were changed at the end of 1995. The major changes related to the water and sanitation sector are described in the following chapters.

Ministry of Planning and Investment

The Ministry of Planning and Investment (MOPI) was formed from the former **State Planning Committee** and **State Committee for Cooperation and Investment**.

The Ministry for Planning and Investment is responsible for national development planning and, particularly, for projects to be financed from central and external sources, and direct foreign investments. The most important task of MOPI is to propose to the Government (formerly called the Prime Minister's Office) the overall national allocation of state finance. This makes MOPI the most influential policy maker at the ministry level in the sanitation sector as well as in other sectors. MOPI has to approve any investment project exceeding a limit set by the Government (currently six billion VND). All major projects involving foreign investment (Group A projects) must be appraised by MOPI who then submits them to the Government for approval. Group A projects include:

(i) projects for infrastructure construction of industrial zones and export processing zones, and BOT projects;
(ii) projects capitalized with US $40 million upwards belonging to electricity, mineral exploitation, oil and gas, metallurgy, cement, chemicals, engineering, electronics, sea ports, airports, telecommunications, trade centers, cultural and tourist areas, and estate business industries;
(iii) projects on culture, press and publications;
(iv) projects on national defense and security; and
(v) projects occupying 5 hectares upwards of urban areas or 50 hectares of other areas.

MOPI is also responsible for development of policies and mechanisms to promote external investments in Vietnam, for studying the feasibility of direct foreign investment projects, granting licenses for enterprises involving foreign capital, dissemination of relevant information, issuinginvestment licences and supervision of implementation of the projects according to the laws on foreign investment.

MOPI announces the list of projects calling for foreign investment and promulgates dossiers for investment projects. MOPI has also the mandate to ratify Group B projects (those which do not belong to Group A). Relevant ministries have to send officials to MOPI to appraise projects.

MOPI is in the focal point in all major investments calling for finance from the central level and external sources. The budgetary allocations between sectors are made by MOPI, whereas the line ministries have comparatively little control over either the level or direction of sector investment. As the pace of national development has increased, i.e., as a result of dramatic growth of overseas development assistance (ODA) and high economic growth and international investments to Vietnam's industry, the burden on MOPI has correspondingly increased. The risk that the MOPI decision process will become a bottleneck has already been addressed. It was proposed in the National Urban Water Supply Strategy[16] *that limited devolution of some decision-taking powers to line ministries should be considered.*

The recent incorporation of SPC and SCCI has made the project appraisal and government's financial policy making clearer and improved the financial management. Although the screening, appraisal and approval procedures have been streamlined from the past, they still involve several authorities, each of them having a say on the final approval. This system requires still intensive lobbying and follow-up from the project initiators or developers and results in delays in project mobilization.

Ministry of Finance

The Ministry of Finance (MOFI) works closely with MOPI and distributes the state budget finance to the sectors and projects (including sanitation projects), according to the actual liquidity of the state treasury. MOFI also sets annual sectoral goals, and regulates management accounting; any exceptions from the uniform system must be reported to MOFI.

MOFI bears responsibility for accounting the investment capital of the State budget, and for maintaining the liquidity. MOFI extends loans to enterprises through banks.

State Bank of the Socialist Republic of Vietnam

The duties of the State Bank include mobilization of local and foreign funds, management of the exchange rates for the investment projects according to the interest of the market. The bank works closely with MOFI in assigning eligible banks to extend loans from international credit organizations to feasible projects.

[16] *National Urban Water Supply Strategy, Final Report*, November 1994, Ministry of Construction/Finnish International Development Agency

Ministry of Construction

The Ministry of Construction (MOC) is an extremely large and complex organization, employing over 20,000 people. MOC has long been the lead agency in urban water supply, drainage and sanitation. In 1994, the Ministry's mandate was extended to rural water supply and sanitation. Hence, it has become the overall lead agency in the sector.

MOC has also wide responsibilities for physical planning, housing, etc.. MOC is outlining a new urban management strategy which will propose organizational changes in the urban infrastructure sector. Establishment of a new ministry to be responsible for urban infrastructure is under consideration.

MOC sets regulations, issues guidelines, ratifies technical and economic quotas and unit costs to be applied, plans, designs and constructs water supply and sanitation facilities, and supervises project implementation through its design and construction companies. The organization chart of the Ministry is shown in Figure 6-1.

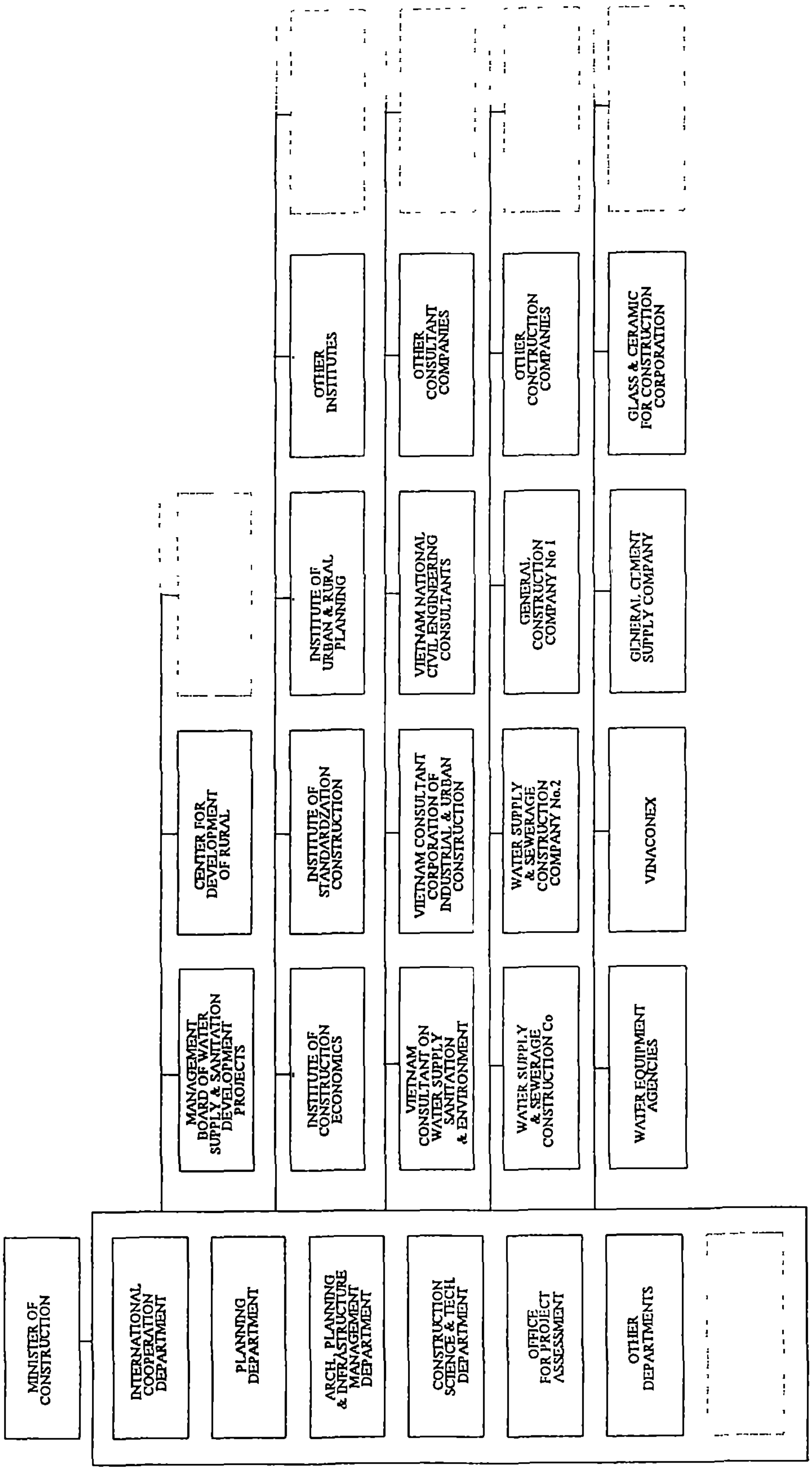

Figure 6-1 Organization chart of the Ministry of Construction.

MOC established in September 1994 a Standing Board for Water Supply and Sanitation Development. This Board was renamed in April 1995 to **Management Board of Water Supply and Sanitation Development Projects.** The status of this board was also upgraded: the former board was under the Department of Architecture, Planning and Infrastructure (of MOC), whereas the new board is directly under the Ministry of Construction. The board is a permanent body with about ten permanent employees. The board has since April 1995 a legal status and its own seal, and the right to open bank accounts at the State Bank and the State Monetary Storage. The main responsibilities of this committee, as redefined in April 1995, are to:

(i) manage, implement and make full use of water supply and sanitation projects so that the Ministry can provide guidelines and plans for periodic development strategies and objectives for the sector;
(ii) liaise and coordinate with individuals and organizations, inside and outside the country, in relation to investment projects for water supply and sanitation;
(iii) monitor, guide, supervise and develop work in the provinces to accelerate the implementation of water supply and sanitation projects;
(iv) develop human resources for water supply and sanitation projects including the formulation and implementation of training plans to foster the professional capability of the personnel, and organize the activities in scientific information, technology, economic and water sector management; and
(v) directly manage water supply and sanitation projects under authorization from the Ministry, and manage the project budgets that are contributed by the Vietnamese Government pursuant to relevant state regulations.

The main role of MOC's **Design Company for Water Supply and Sanitation Systems (DCWSS)** is to design and supervise water supply and sanitation investments. Until recently, DCWSS has also been the technical arm of MOC in the sector; DCWSS being involved in sector studies, research, formulation of water supply and sanitation policies and strategies, and development of national standards and guidelines. After the establishment of the Standing Committee for Water Supply and Sanitation Development, the role of DCWSS is resembling that of a consulting company. DCWSS has 260 employees, including 150 engineers.

The task of the **Union of Survey Companies** is to make geotechnical, topographic, soil and groundwater investigations. The union has 1,200 employees.

The Construction Company for Water Supply and Sewerage (WASENCO) is MOC's main contractor in the North. Its activities include technical design and construction of water supply and sanitation projects, well drilling, electro-mechanical works and production of construction materials. The number of employees is 1,500, including over 100 engineers.

Water Supply and Sewerage Construction Company (WASECO) operates in the South, with its headquarters in Ho Chi Minh City. Its functions are similar to those of WASENCO, with the addition of production of cast iron pipes. Its design department is a competitor of DCWSS in the South. The total number of WASECO's personnel is 800.

Also other MOC's companies have departments or units working on water supply and sewerage. Their (mainly technical) staff are involved in the preparation, detailed design and even implementation of water and sanitation projects. Examples of these include Consultants, Designers and Constructors (CDC) and Urban and Industrial Construction Consultant Company.

MOC's present responsibilities are very wide. Its role has been strengthened by recent decisions but its resources have not been developed in pace with the scope of responsibilities. The newly established Management Board is a reasonable step towards reorganizing the sector administration at the central level. Its duties are well focused on the most critical issues, and it will be a powerful organ especially in the execution of projects financed by development banks. Until now its financial and human resources have been much below its requirements, but it is likely that it will benefit from technical assistance to be provided in association with sector loans and credits under its supervision.

The executing agencies within MOC are for the most part traditional engineering bodies. This calls for extensive need to consult agencies within ministries representing the social sector, such as the Ministry of Labor, War Invalids and Social Welfare, the Ministry of Education and Training, and the Ministry of Public Health (or develop their own capacity) to carry out new policies for decentralized planning and management of projects.

A major constraint for efficient sector development is the lack of centralized sector statistics library and data base where data and information would be freely available to all parties involved in the sector development. It is often very difficult to obtain adequate and consistent data, especially when data is required from agencies not directly controlled by the executing agency.

There are some remains from the centralized economy that do not match well with the market economy; e.g., the use of officially ratified (by MOC) unit costs to be used in the cost calculations of feasibility studies and detailed design. There is an on-going technical assistance project under the World Bank umbrella preparing water supply and sanitation design guidelines. It is likely that the project preparation procedures will be revised in near future to cope with those of international financing institutions.

MOC is simultaneously the sector policy maker, planning agency, a consulting organization for system design, a contractor in the construction sector, a pipe manufacturer, etc.. The National Urban Water Supply Strategy addressed this *issue, and recommended that MOC should progressively divest itself of any potentially commercial activities or, at least as the first step, convert them into parastatal operations. Maintaining the present arrangements would perpetuate a situation in which insufficient attention is paid to planning and sector development strategy, in favor of undertaking revenue-earning activities. It would also, once the private sector is more developed and the country continues to move towards a market economy, give rise to various types of conflict-of-interest situations when the MOC is both submitting tenders and awarding contracts for the same work. The recent measures taken within MOC indicate that the divesting process has been initiated.*

Establishment of a new ministry to be responsible for urban infrastructure would be in line with the recent tendency at the city/provincial level to transform the responsibility for urban infrastructure from construction departments to public works departments. On the other hand, coordination between urban planning and public works would become more complicated.

Ministry of Science, Technology and Environment

The Ministry of Science, Technology and Environment (MOSTE) was founded on the basis of the former State Committee of Science and Technology, and has the function of governmental administration over the scientific and technological activities, industrial patents, standards, measurement and quality of the products, as well as environmental matters. As the lead environmental agency, MOSTE undertakes the integrated State management on environmental protection of nation-wide scale and bears responsibility to organize and direct activities of environmental protection within its functions and duties, as described in the Law on Environmental Protection (see Section 6.1.2):

(i) promulgation and organization of the implementation of statutory instruments on environmental protection, and promulgation of systems of environmental standards;
(ii) development and supervision of the implementation of strategies and policies of environmental protection, and plans to prevent, control and remedy environmental degradation, pollution and incidents;
(iii) establishment and management of environmental protection facilities as well as facilities relating to environmental protection;
(iv) organization, establishment and management of monitoring systems, periodical assessment of the current state of the environment, and forecasting of environmental changes;
(v) appraisal of Environmental Impact Assessment (EIA) reports on projects and production or business establishments;
(vi) issuing and revoking of certificates of compliance with environmental standards;
(vii) supervision and inspection of the observance of environmental protection legislation, settling of disputes, appeals or complaints concerning

environmental protection, dealing with branches of environmental protection legislation;

(viii) training of personnel in environmental science and management, education and dissemination of knowledge and legislation in environmental protection;

(ix) organization of research and development activities, and application of scientific and technological advances in the field of environmental protection; and

(x) development of international relations in the field of environmental protection.

The duties of MOSTE as the lead environmental agency are reasonably well defined and supported by newly developed regulations (see Section 6.1.2). It will, however, take time until the results of enforcement can be seen. In regard to waste water and sanitation, the main responsibility for environmental issues is, quite reasonably, delegated to the local level.

Ministry of Agriculture and Rural Development

The Ministry of Agriculture and Rural Development (MOARD) was incorporated from former Ministry of Agriculture (MOA), Ministry of Food (MOF) and Ministry of Water Resources (MOWR) during the reorganization of the goverment administration at the end of 1995. Basicly the duties of the former ministries where maintained, but the administration streamlined under one ministry in order to improve cooperation and decrease overlapping of responsibilities.

MOARD is currently concerned with surface water resources management, hydrology and hydropower development, coordination and management of food and agricultural production. In terms of water supply and sanitation MOARD is responsible for allocation of surface water to different purposes, with a priority given to irrigation. The use of surface water for water supply is also under the control of MOARD, which allocates a specific quantity to each town or city.

The proposed Law on Water (fourteenth draft, see Section 6.1.2) extends the responsibility of former MOWR and in present situation MOARD to cover also ground water (as assisting the Government). Thus, MOARD has an important role in controlling industrial surface and ground water pollution. The draft suggests that the duties of the Ministry (Minister) of Water Resources include issuing and revoking licenses on selection of intake and outlet location for new factories and industrial centers and, in certain cases, on discharging waste water into "safe-sanitary" areas of water resources.

The Ministry of Marine Products has the main responsibility for sea water resources.

The rearragement of the Ministries and combining of three ministries operating in relatively close operational areas will improve the cooperation and reduce overlapping of responsibilities in the sector. Traditionally the transfers of information between different ministries has been slow and sometimes even lacking, hopefully this can be avoided in MOARD and thus improve the efficiency. Naturally these changes will take some time until all the changes can be finalised and the new ministry will be fine tuned.

Centralization of management of surface and ground water to one ministry is a substantial change, and facilitates integrated water resources management, including pollution control. The proposed Law on Water extends the mandate for issuing licenses for industrial water abstraction and discharge to MOARD, without any reference to MOSTE.

Ministry of Industry

The Ministry of Industry (MOI) was formed from three ministries i.e. Ministry of Light Industry, Ministry of Heavy Industry and Ministry of Mine and Coal.

The Ministry of Industry (MOHI) takes care of overall development of industry, including mines. Groundwater management, including hydrogeological research and studies, and groundwater allocation and protection, is also the duty of MOI. In the provisional Law on Water (the fourteenth draft) this duty is transferred to the Ministry of Water Resources, which is now incorporated to MOARD.

MOI has issued regulations on groundwater abstraction and groundwater protection in 1992. Surveys and groundwater monitoring is carried out by the Geological Survey of Vietnam.

Ministry of Health

The Ministry of Health (MOH) takes care of the preventive and curative health services. In the water and sanitation sector MOH is the lead agency for on-site sanitation, it monitors potable water quality, and shares some responsibilities for health education with the Ministry of Education and Training. MOH has also implemented sanitation projects in the rural areas as the counterpart organization in the UNICEF-assisted rural water supply and sanitation program.

On the basis of the Public Health Protection Law, MOH is authorized to regulate the monitoring of waste treatment of industries.

There is no reasonable justification to involve also MOH in the industrial effluent control. The responsibility for monitoring should be clearly concentrated to MOSTE.

Vietnam Water Supply and Sanitation Association

Vietnam Water Supply and Sanitation Association (VWSA) can be considered a non-governmental association of water supply and sanitation utilities, although the utilities are government-owned and VWSA's leaders are high-ranking officials from MOC and its daughter organizations. VWSA has actively organized seminars and workshops, and it has assumed some of the training and dissemination functions of MOC.

6.1.5 Sector Administration at Local Level

General Administration

The country is divided into provinces and three cities: Hanoi, Ho Chi Minh City (HCMC) and Haiphong. These three cities are directly under the central government, and have a status equivalent to that of a province. Other urban centers are under provincial governments. During the collection of the data for the present status assessment the number of provinces was 50, but after recent reforms the total amount is nowadays 59. Due to time allocations and lack of data according to the present province distribution, the final report is based on the previous provincial distribution.

At the local level the general administration is under the People's Councils which are elected every fourth year. People's Councils are elected for provinces, districts, towns and even for smaller administrative units. The Councils nominate People's Committees for each administrative level. The Communist Party is also involved in the decision-making at all levels of administration. However, since the adoption of the new Constitution in April 1992, its role in decision-making on technical matters has been significantly reduced. Others than Party members have been allowed to participate in elections as candidates since 1989.

The highest day-to-day executive authority is the Provincial People's Committee (PPC). Legally, the People's Committees are responsible for the enforcement and implementation of laws and regulations in their administrative area. The status of the People's Committees and other authorities in the three cities under central government is similar to that of their provincial counterparts. Each PPC is headed by a chairman and deputies. The PPC members are directors of provincial (sectoral) Services.

PPC directly controls the administrative departments (also called services). These services have roles similar to their counterparts at the central level. The most relevant local level organizations and their central counterparts are presented in a matrix format in Table 6-1.

Table 6-1 Administrative counterparts at central and local level

Area of Responsibility	Central	Provincial/City
Executive authority	Government	People's Committee
Allocation of resources	MOPI	Planning Committee
Financial management	MOFI	Financial Service
Land use planning, construction	MOC	Construction Service
Public utilities, including sanitation	MOC	Construction Service/ Transportation and Urban Public Works Service
Environment	MOSTE	Service for Science, Technology and Environment/ Environmental Committee
Water Resources	MOWR	Water Resources Service
Public Health	MOH	Health Service

The high number of provinces and decentralization of operations to the provincial/city level is a strength in Vietnamese administration. As long as financing is not needed from the central level, provinces and the three cities can prioritize and operate their activities quite independently. The link between the users and suppliers of services is short, providing a basis for close communication and understanding of perceived needs.

On the other hand, the administrative system involves a high number of agencies also at the local level. Cooperation between these agencies is often slow and difficult. Agencies generally suffer from shortage of funds, and they tend to be involved in as many activities as possible hoping to be able to enhance their financial position by charging each other for their services.

Drainage, Sewerage and Waste Management Authorities

PPC is the highest local authority in sanitation. It determines sanitation policies, approves budgets and possible tariffs, sets targets, and decides upon subsidies and local investments. Sanitation is heavily subsidized by the government: major investment from the central budget, and minor investment plus operation and maintenance from the provincial/city budget. Dependence on subsidies limits the autonomy of the lower level sector authorities in sanitation.

The line departments responsible for water supply and sanitation are Transportation and Urban Public Works Services (Departments) in Hanoi, Ho Chi Minh City and Haiphong, or Construction Services (Departments) in other urban areas. These services act as controlling links between PPC and the actual operational units (companies) in the drainage/sewerage and sanitation/waste management sub-sector. Transportation and Urban Public Works Services as well as Construction Services, although accountable to the People's Committee, are also dependent (for instance in the case of appointment of the top management and financing of major investments) on MOC which supervises the whole sector.

The responsibility for management of urban public utilities is with one service. This set-up is clear and provides a good basis for supervision and coordination of the activities of the utilities. However, these services depend on the complicated decision-making mechanism of the province and, in case of major investments, of the central level.

Sanitation Utilities

In Hanoi and HCMC, there are separate companies responsible for drainage and sewerage on one hand, and for sanitation and waste management on the other. As drainage is largely based on open canal and pond systems, drainage utilities have authority to regulate some urban ponds and lakes. The drainage/sewerage utility is responsible for the centralized waste and storm water reticulation and discharge, whereas the waste utility bears the public responsibility for on-site facilities, i.e., emptying, collection and disposal of nightsoil and septic tank sludge. In most other cities and towns covered by this strategy study, one company is responsible for the entire drainage/sewerage and sanitation/waste management sub-sector.

The companies in Hanoi are called Sewerage and Drainage Company and Urban Environmental Company (URENCO), and in HCMC Urban Drainage Company and Urban Public Service Company, respectively. The companies in the overall operational responsibility for the sub-sector are called Urban Environmental Companies (e.g., in Haiphong, Hai Duong and Da Nang), Urban Public Works Companies (e.g., in Can Tho, Hue and Phan Thiet), and Urban Management Companies (e.g., in Thai Nguyen).

In Nha Trang, Water Supply and Drainage Company is responsible for water supply, drainage and sewerage services, including cleaning and emptying of manholes in sewers and drains. Nha Trang Urban Public Service Company is responsible for solid waste management and emptying of septic tanks, and would be responsible for operation of waste water treatment plants if such existed.

These utilities are closely controlled by their parent organizations and PPC. The level of control varies case by case, but usually the autonomy of these companies remains very limited. The organizational structures of the utilities are usually complicated and unclear with parallel reporting lines. Operational decision-making inside the companies is centralized to the director who is kept busy by daily routine management. The decree of delegation of responsibilities and authority to deputies or middle management is very low.

Private sector involvement in the urban sanitation is briefed in Section 6.1.7.

Where one utility is responsible for the whole sanitation sub-sector, the responsibilities are reasonably clear. The authority of the utilities in sewerage and drainage is, however, geographically limited somewhat strangely. There are compounds of usually four-story buildings in major cities and towns constructed by various government organizations for the residence of their employees. The internal drainage and sewerage systems of these compounds are managed by separate "management boards" of housing cooperatives, and are beyond control of the municipal utilities. This is a serious restriction of authority which tends to lead to lack of concern for and maintenance of these internal systems, resulting in problems in municipal systems. Some responsibility for the utilities (sewers with a diameter less than 250 mm) is also decentralized to "Quan" (urban district) and "Phuong" (ward) levels (see Section 6.1.6)

Where two utilities share the responsibility for urban sanitation, there are some problems regarding the impact of waste management on drainage and sewerage. Households generally dispose of garbage in the streets, and the waste utility collects the garbage as part of street cleaning. A separate waste utility, not responsible for drainage, may not be seriously concerned for the waste disposed of in drainage canals, etc., and the resulting problems. If waste utility is responsible for emptying septic tanks, similar problems may arise with sewer blockage.

While it is becoming accepted in Vietnam that water supply services should cover at least operation and maintenance costs and, in longer term, also capital costs from revenues, the sanitation services are far from self-sufficiency (see Section 6.2.2). Similarly, some water supply companies have been recipients of external support for some years, while sanitation utilities have mainly survived with domestic subsidies. It is not surprising, therefore, that sanitation utilities are even more unfamiliar with customer-oriented corporate-type management than their counterparts in the water supply sub-sector.

Environmental Authorities

Environmental matters at the local level are in most towns administered by provincial Committees for Science and Technology, recently renamed as Committees for Science, Technology and Environment. These services report to the People's Committee but are also supervised by MOSTE. In some cities, for instance in Ho Chi Minh City and Hanoi, a special Environmental Committee has been established. The exact duties of these organizations depend on the authorization from PPC, but the case of HCMC represents reasonably well the scope of their responsibilities.

The Environmental Committee of HCMC has the authority to:

(i) critically review the environmental aspects of new construction projects;
(ii) grant permits to commercial production enterprises, design and construction projects, investment projects, and exploitation projects with a commercial character;
(iii) inspect, control and monitor administrative units, agencies and factories in order to assess their compliance with the relevant regulations and standards;
(iv) punish and temporarily or definitely suspend activities of enterprises polluting the environment, proposing to jurisdiction to prosecute them;
(v) collect fees for controlling, inspecting and monitoring services from units and enterprises which do not comply with laws and regulations; and
(vi) study complaints and petitions from the public on environmental pollution.

Health Authorities

Health Services and institutions under their control implement the duties of MOC at the local level. Local health authorities participate in the licensing procedure for new construction as well as rehabilitation of existing buildings. The health authorities have to confirm that the design documents include design of appropriate toilet facilities, and their representative has to be a member in the project inspecting organ to examine the building before it is taken into use.

Water Authorities

Matters related to surface water resources management (also ground water in future) are under Water Resources Service. The main scope of this authority is drainage and irrigation. Within urban centers, water bodies whose primary function is urban drainage serving are regulated by drainage utilities under the supervision of their parent organizations. They have to consult local water authority when affecting receiving water bodies and, thereby, drainage or irrigation of the surrounding (agricultural) areas.

Until now, little attention has been paid on water quality aspects, rather on safeguarding water availability for agricultural use, prevention of flooding on cultivated land, and the needs of aquaculture. Sometimes these interests conflict with drainage, and may result in problems in regulation of the urban water system which serves drainage.

6.1.6 Community Organization

Community participation in the urban areas of Vietnam is organized in a way that makes it part of the administrative system. Under the city level there are two major administrative levels: (I) Quan (urban district); and (ii) Phuong (ward).

Quan is administratively an extension of local government, with a chairman and personnel appointed by higher-level authorities. There are also departments responsible for various sectors at the Quan level, for example construction department. The finances from PPC in the sanitation sub-sector may be allocated down to the Quan level for minor investments (not exceeding 300-500 million VND) in, e.g., small sewers, waste containers, or handcarts. This is specific for sanitation and different from, for instance, water supply.

From the point of community participation, Phuong is the key organization. Only the chairman of the Phuong is appointed, while other staff are volunteers backed up by the citizens of the Phuong.

Phuong carries out sanitation activities by mobilizing financial resources from citizens living in its area. Phuong is responsible for mobilizing contribution fund for Quan-level projects and for some operation and maintenance functions. If monetary contributions cannot be raised, Phuong can mobilize labor.

In solid waste management, Phuong organizes labor for solid waste collection from households to the points ordered by the waste utility. Phuong has the authority to collect fees from each household for this purpose and personnel for collection. This model is reported to be successful.

In drainage and sewerage Phuong organizes citizens to participate in construction of new facilities (drains and sewers) and in maintenance (e.g. , cleaning) of existing systems. Phuong mobilizes local contribution to supplement the city budget.

Phuong is further organized through "Groups of Representatives" of streets and blocks of flats. These representatives are elected by people in their respective area, and the groups form a voluntary organization which assists in revenue collection and labor mobilization.

Phuong seems to be a reasonably well functioning organ between the administrative apparatus and people. The level of activity and commitment at the Phuong level may be used as a criterion for allocation of limited funds and for prioritization of certain development projects (such which are not affected by the implementation of major infrastructure projects). For instance, the "Phuong Model" has been successfully applied in improvement of water supply in Haiphong.

6.1.7 Private Sector Involvement

Engineering

In spite of the determined move towards market-oriented economy, the private sector has had few opportunities to be involved in urban sanitation "business". Engineering and design services and contracting are predominantly provided by public sector companies, such as DCWSS and WASECO under MOC, and local design institutes in provinces and cities, and by the utilities. In the Vietnamese system, the utilities cannot directly carry out these tasks for themselves. They need a client which, in such cases, usually is their parent organization.

The involvement of international development banks has contributed to minor steps in private consulting business. Some individuals have retired from government service and started to work as freelance consultants, mainly in association with foreign consultants. Private consulting companies and contractors are still virtually non-existent.

Supply of Sanitation Facilities

Sanitation facilities, such as pour-flush toilets and toilet seats, are sold in private shops; there is an abundant supply of this equipment, and the business is obviously high-geared.

Nightsoil Collection

Private waste collection and reuse, including nightsoil collection, has recently been studied in Hanoi.[17] The following description of these activities is extracted from this study.

Private nightsoil and septic sludge collectors provide some services to households outside the (Hanoi) URENCO collection system. These are primarily households that use double vault latrines. The nightsoil staff would like to pre-

[17] DiGregorio, M. (1994). *Urban harvest: Recycling as a peasant industry in northern Vietnam.* Honolulu: East-West Center.

vent this since, they say, these collectors disrupt the system of composting and collection, and in the case of a spill, create public health hazards. Nevertheless, private nightsoil collectors continue to maintain familial contracts with households in Hanoi. These contracts are intergenerational, allowing for steady collection of nightsoil at contracted locations over the course of time, given no change in either the village household's occupation or the urban household's sanitation system. No money is exchanged in these contracts; rather, toilets are cleaned as a service in exchange for a marketable resource.

Co Nhue village, to the West of Hanoi, was formerly the center for the trade in nightsoil. At the beginning of this century, about one-sixth of the village's residents collected nightsoil in Hanoi. The peak of the market occurred between 1940 and 1954. Since then, the number of Co Nhue households collecting nightsoil has reduced to between 20 and 30.

Urbanization seems to be a threat to the end of this trade in Hanoi's immediate area. As farmland has been converted to other uses, the need for nightsoil has decreased. This transition has been extremely rapid. There are no private septic tank cleaning services in Hanoi. Nightsoil collectors, who empty latrines manually and cart wastes away in baskets and on bicycles, are not currently equipped to handle large volumes of wastes from septic tanks.

Solid Waste Management

Hanoi's recycling system is loosely organized around a three-tiered network of collectors, small traders and dealers. Collectors (itinerant junk buyers and scavengers) gather materials from three groups of sources, two predominantly public and one predominantly private, and sell their materials to buyers at dumpsites, along sidewalks or at recycled materials shops. Due to the volume of materials they handle, dealers are able to grade and process materials, and sell specific materials of consistent grade to local industrial users and export to foreign traders or industries.

Nearly every conceivable item of value is recycled. Scavengers and junk buyers alone collect between 22 and 32 percent of the waste materials generated in Hanoi. All totaled, the recycling rate, which would also include materials recycled within shops, traded between them, and the organic materials collected from restaurants by pig farmers, is probably greater than 40 percent.

The private sector is taking its first steps in urban sanitation. Government organizations dominate the sub-sector, except unofficial and partly illegal private waste collection and recycling. The private sector is strong where the demand for facilities, services or (by-)products is high. Typically, the clients of private sector are households (or buyers of recycled material), not the public sector.

6.1.8 Human Resources

Impact of Market Economy

The pace at which the economy is opening up and growing is not only straining the adequacy of infrastructure to support the growth, but also the capacity of sector institutions to keep in step of the developments. The availability of trained human resources affects and is affected by these economic developments.

The sector has been characterized by plans which have generally included ambitious projections of sector targets and resource requirements. These plans pay casual regard to the effectiveness of institutions, and commonly assume that the institutions are, and should be, the exclusive recruiter, trainer and employer of skilled manpower. Training has been regarded as one of the primary interventions to follow on from human resources planning. The human resources projections have quickly fallen out of date because of administrative and budgetary constraints, and ignored substitution possibilities stimulated by technical and institutional innovations (e.g., telemetry, computerization, private sector participation, new technologies and approaches, etc.). Human resource planning has paid little regard to the emerging situation in the labor market brought on by the new economic order. One of the shortcomings of current human resources approaches has been inadequate economic analysis of human resources.

Implicit in the inadequacy of sector institutions is the non-recognition of the incentives structure for professional and skilled workers. Water and sanitation provision has historically been regarded as a public sector activity and the incentives for skilled manpower to stay within the sector have largely been assumed and not considered in a consistent manner. This is now evident from the considerable disparity between public and private sector remuneration in the engineering profession and the prevalent practice of sector staff taking on a second job. The likely future scenario will feature stiff competition for available skilled staff among the sectors, between the public and the private sector, and among the developed (Class I/II) and less developed areas (Class III to V). Labor export and foreign migration may also come into play. The sector institutions stand to lose skilled personnel ("brain drain") if this issue is not addressed in a holistic manner. The public sector, particularly state enterprises, are viewed as the source of skilled and semi-skilled labor, by domestic and foreign investors.

Human Resources within Utilities

For this study, data was collected from a representative group of nine companies with sewerage and sanitation responsibilities. The information and analyses are presented in Tables II-1,2 and 3, in Annex II and in Table 6-2. Table II-1 gives an analysis on decision making powers of the sanitation undertakings, Table II-2 educational attainment and Table II-3 salary levels of employees. Where identified, figures were adjusted to discount staff working on the solid waste management functions of the companies. Drainage functions were not discounted as facilities in the towns/cities studied were combined systems. Current staffing coefficients are presented in Table 6-2 below. This is sufficient for establishing an initial projection for future manpower need, but a more comprehensive study is recommended.

Table 6-2 Current Manpower Coefficients for Sewerage/Sanitation Utilities.

City	No of Staff per 1,000 HHs	Ratio to Total Staff Size				
		Management	Engineering	Finance	Customer Svc	Technician
Hai Duong	2.18	0.33	0.29	0.08	0.17	0.13
Phan Thiet	6.51	0.05		0.61	0.17	0.17
Thai Nguyen	4.06	0.03	0.58	0.09	0.15	0.15
Nha Trang				0.07	0.05	0.88
Can Tho	3.74	0.01	0.33	0.12		0.54
Hue	11.00	0.06	0.53	0 30	0.01	0.09
Da Nang	1.67	0.22	0.42		0.28	0 08
HCMC	2.70	0.02	0.16	0.60		0.23
Average	4.55	0.10	0.33	0.27	0.14	0.28

Analysis shows a staffing level of 4.55 employees per 1000 sewerage connections. In addition, management and supervisory staff constitute about 10% of the staff, engineering and finance staff constitute another 60%, customer service, including billing and collection comprise 14% of the staff. Technician level accounts for 28%. The distribution profile indicates strong and weak points: there is a high number of office staff and low number of technician or field staff. Most of the unskilled field staff are engaged in nightsoil removal and not maintenance of sewer lines. Customer service also needs to go higher. Management and supervision, at 10%, seems reasonable. However, the range is too wide to make conclusive statements about current conditions; for example, the actual data for management staffing ranges from 1% (Can Tho) to 33% (Hai Duong).

Salaries and Incentives

The survey indicated that salary ranges, as in other sectors, are perceived by employees as low. The key flash points here, however, are: whether or not the remuneration is sufficient to allow for a reasonable cost of living; and, whether or not the salaries are increasing at pace with the removal of market prices distortions (or subsidies). Salary-related issues are national in scope and cannot be sufficiently addressed in this sector study. It should be sufficient to point out that the two flash points should be adequately and creatively addressed, or else, the sector will experience a serious drain of human resources. Fostering the proper incentives environment will require creative approaches to increase revenues by, among others, cost recovery policies, tariff enforcement, cross-subsidies from industrial (commercial) to domestic/residential users, to reduce operating costs or generate budget savings, and to reform the institutional arrangements under which the service is provided through merging of related services, increased private sector and user participation, or clear job performance standards. Increased staff salaries and benefits will have to be earned through productivity increases. Promotions (with salary raises) must be commensurate with performance and productivity. Across-the-board (for everybody) salary increases do not have any performance incentive value.

Formal Engineering Education Institutions

There are more than one hundred state colleges and universities in Vietnam. Not all are supervised by the Ministry of Education and Training (MOET); some are under ministries or provincial administrations. The National Institute of Public Administration even enjoys the status of a State Committee under the Prime Minister.

The higher education system closely resembles models found in the former Soviet Union in form and curricula. Only few institutions are multi-disciplinary (Hanoi, HCMC and Hue). Most are focused on one discipline, such as universities specializing in law, economics, civil engineering, etc. High priority has been placed on the reorganization and consolidation of universities to achieve more economically efficient and higher quality of education. Such mergers are, in fact, gradually being implemented among the universities affiliated with MOET. It is not clear, however, how, and if, the universities and institutes not affiliated with MOET, are included. The UNDP VIE/94/006 Project - Urban Sector Strategy Study (Strengthening Capacity for Urban Planning and Management) has prepared a detailed description of many of the institutions involved in urban planning which serves as a useful reference.

The Hanoi University of Civil Engineering graduates about 35 students per annum in its program for water supply and sanitation; CEFINEA in HCMC has produced about 50 graduates since 1985. Other universities include water supply and sanitation subjects as part of their civil engineering curriculum. Almost all of the engineering graduates have been absorbed into the public sector, although this trend is changing. In Hanoi, it is estimated that about 30% of civil engineering graduates now enter the private sector; 5% go for post graduate studies. It was also reported that about 10-15% of the engineering graduates are not engaged in the engineering profession (either by choice or circumstance). Day classes and night classes have been organized to serve working students. At HUCE, all the students graduate within the prescribed 5-year engineering program "because of the high admission standards"; only 10% of applicants are accepted into the program.

There is increasing anecdotal information about, for example, the masters graduate who immediately leaves the institution for which his training was provided: the doctoral student who never comes back, the engineer trained in techniques which have little application in his work, etc.

Local Training Resources

It is difficult to comment on the sufficiency of resources allocated for HRD. Compared with capacity to use HRD funds, the resources are probably more than sufficient. However, when compared with needs, it is probably not enough.

The economic return from basic education and in-service training investments generally outweigh higher education investments. There seems to be a sufficient number of related multi-disciplinary training institutes and centers already established or planned. The problem is in increasing the training demand and utilization of these centers.

There are some training materials and facilities now available with various agencies. The materials are of varying degrees of quality and applicability. Some have been developed locally, others for global use. Translation and adaptation of these materials is extremely important to make them accessible. Operation and maintenance training materials are needed. The Vietnam Urban Development Strategy Study reports a wide need for more relevant and updated materials. The sector has not kept pace with current ideas about approaches and technology options. The absence of major infrastructure development investments in recent years has no doubt contributed to the decline in interest.

There is difficulty in attracting and transforming operating staff into trainers with good teaching and technical skills. Technical staff generally view a training responsibility as a career deviation with an unclear path. There is need to enrich and promote careers in training and organization development within the sector. Current trainers (lecturers) come part-time from within MOC or other institutions, including universities. Training methodology generally consists of lectures. There is a need for more trainers who are skilled at using innovative methods. While the approach of recruiting outside subject-competent lecturers is useful; it is equally important that sector agencies: i) build their in-house core staff of trainers; and ii) improve the skills of current trainers on better methodologies.

Strategies and leadership for developing the internal HRD delivery system is generally weak. Beyond the training of trainers and the development of materials and facilities (which are the perceived "standard" ways of strengthening capacity), there is need to promote a process stressing development of a responsive leadership for the HRD system and establishment of relevant development indicators of HRD capacity.

There is need for more efficient and effective use of HRD resources and for increased investment of local funds for HRD. Addressing this issue will alleviate materials and facilities inadequacies.

Statement of sectoral and institutional priorities, performance indicators and human resources assessments have generally lacked clarity. This has made the planning and evaluation of the HRD contribution to the attainment of sector goals difficult. In addition to projecting staff requirements to plan and execute the plans, a definition of priority skill and knowledge gaps would be more useful for HRD practitioners. This sets the stage for the HRD specialists in the planning process and creates the demand for qualified HRD specialists and systems.

Locally, hard evidence on the effectiveness of training as a developmental response in the sector is still scant. Inappropriate measurement indicators, limited follow-up of training, lack of investigation of outcomes and poorly-understood interrelationships between skill development and institutional strengthening all limit our understanding in this area. The expectations, thus, of sector, project and utility managers and policy makers on the impact of effective training is low. It is seldom a controversial topic and is generally viewed favorably by many officials. The HRD promise that impact will happen but may not be visible has tended to reduce real expectations.

External Technical Assistance for Sector Training

The **United Nations Development Programme** in Vietnam puts a premium on ensuring that growth and economic development are attained in an environmentally sustainable manner. This is achieved, among other means, through a portfolio of pivotal technical assistance projects, including human resources development.

The **World Bank** and the **Asian Development Bank** have major water supply and sanitation lending projects in various stages of preparation. The investment projects include provisions for training targeted at project implementation.

The **UNDP/World Bank Water and Sanitation Program** manages the International Training Network for Water and Waste Management (ITN). The Program seeks to increase the capacity of developing countries to deliver water supply and sanitation services to low-income groups, using primarily appropriate technologies and community-based approaches. The ITN assists in strengthening education and training institutions, conducting skills training of national staff, supporting expanded programs for multi-disciplinary training in the sector, and promoting the training of community members in the management and maintenance of water supply and sanitation. It promotes integration of women, children, and disadvantaged groups into the development process for water supply and sanitation by training sector professionals and field staff in the use of appropriate methods (e.g., community education and participation) for the involvement of these groups throughout project planning and implementation. A Country Program Office for Vietnam has been established in Vietnam located at the World Bank mission office in Hanoi.

The **Economic Development Institute (World Bank)** has launched a global Water Management Program to assist governments in strengthening sector policies principally through promotion of in-country dialogue and workshops.

The **UN Economic and Social Commission for Asia and the Pacific**, based in Bangkok, organizes policy-level, regional meetings. While principally concerned with general water resources technology and policy issues, its assistance activities in Vietnam have been in the area of wastewater management as they affect the overall water resources situation.

The **Environmental Health Center** (formerly PEPAS), based in Malaysia, is the technical assistance unit **of the World Health Organization (Western Pacific Region)**. The WHO/EHC conducts regional and country workshops and meetings on environmental health matters.

Bilateral assistance from Finland, Australia, Denmark, Switzerland, Japan and Sweden and others have provided steady support to the water, sanitation and environment programs.

The **Asian Institute of Technology** (AIT) has established a center in Hanoi. AIT Center envisages itself to be an international gateway for technology transfer through postgraduate education, training and outreach services. In Vietnam, it has conducted various management and technical short courses and has expressed a keen interest in pursuing further HRD activities in wastewater management following this Strategy.

Dependence on external funds to finance training activities is a growing cause for concern. While external agencies have been increasing their support to training and development activities, internally-initiated and internally-funded HRD activities have unfortunately declined further or become non-existent.

The approaches and methods of delivering and utilizing external technical assistance have been closely monitored. Technology transfer is a prominent feature of most externally supported projects. There is an urgent need to review and coordinate strategies, priorities and methods to ensure that technology transfer is vigorously and effectively pursued during project implementation. Many learning opportunities are missed when external experts replace or are unable to tap services of local local staff for either sector or project work. On-the-job training is not done effectively when external consultants are under severe time pressure to deliver outputs within schedules and budgets.

Similarly, common practices like payment of monetary incentives for trainees to attend training activities need to be reviewed by donors and the government. Their long-term impact on institutional values and attitudes towards training should be ranged against the short-term result of motivating increased participation in training activities. Policies seem to have implementation loopholes or are being ignored.

There is a need to improve coordination at central and provincial levels on utilization of the local training institutes and resources. There is a lack of clear central and provincial policies and guidelines on HRD, including manpower planning, needs assessments, preparation of curriculum, organizing training activities, monitoring and evaluation, etc. Linkages with other important local HRD-related systems, like the universities and colleges, vocational training institutes, and continuing education programs of professional organizations have been inadequate. There is need to develop wider and stronger partnerships among existing local and international institutions to widen base of expertise, experience and coordination.

In the context of appropriate technologies and multi-disciplinary, community-based approaches, HRD delivery systems are seldom organized to reach field staff and communities efficiently and effectively. Some NGOs have successfully ventured into community-level training. Their approaches need to be studied with the end view of long-term, country-wide replication by enabling the government to undertake similar methods.

6.2 FINANCIAL ASSESSMENT

6.2.1 Economic Setting

Vietnam's Doi Moi or "renovation" programme was formally confirmed in 1986 and changes became increasingly pronounced in 1989 when Gross Domestic Product (GDP) growth reached 8 % - the best performance in years. During the next two years the country's economy suffered from the collapse of aid by the former Soviet Union while new sources of financing did not materialize, as yet. Also the trade between the two economies halted almost totally and annual growth declined during 1990-91 to the range of 5-6 %. However, the Vietnamese economy recovered rapidly and in 1992 the GDP growth was 8.7 % and 8.1 % in 1993 when major aid flows resumed to Vietnam. According to the latest report of the General Department of Statistics, the GDP growth in 1994 was estimated to be 8.5 %. By sector, the highest growth (17.5 %) was recorded in construction and lowest (4.5 %) in agriculture. The target set for the GDP growth in 1995 is 9-10 %.

Despite the strong growth, Vietnam still belongs to the poorest countries in the world relying on agriculture. On average, the GDP per capita in the country was estimated to be 240 USD in 1994. Economic disparities between low and high income people are wide and they are growing. In the most backward regions of the country the per capita figures are considerably below the average, whereas the income level in HCMC was 810 USD and 616 USD in Hanoi.

Over the last few years Vietnam has been moving away rapidly from a centrally planned economic system towards a market economy. Although there are concerns about macro-economic stability, it is generally accepted that the followed strategy and policies for reducing imbalances and removing constraints have succeeded in many regards like reduced inflation in the 1990s, the reduction of the fiscal deficit and stable Vietnamese currency. On the other hand, an example of sustained instability is inflation, the control of which appears to be difficult. Although low compared to late 1980s (390-770 %), inflation in 1994 still reached 14.4 % in 1994 in spite of much lower projections for that year.

The country's major problem - at least in a short run - is rising unemployment being now accelerated by reduction in employment in state owned enterprises (SOEs) and returning guest workers from Eastern Europe and Gulf states. An economic constraint having impact also on sewerage and sanitation (the Sector) development, is the relatively low domestic savings rate in Vietnam.

Financial Policies

The public utilities sector and most notably the Sector companies are among the last SOEs to have been affected by economic reforms, enterprise restructuring and introduction of financial self-supportance. The initiative for reforms is now mainly the responsibility of local authorities, because in the 1990s, the central government has decentralized its decision making and given those authorities more independence how to run service enterprises within their juridiscation.

Provincial and district administrations have not been very enthusiastic about their new financial responsibilities and old systems, management practices and administrative regulations are still largely in place. Consequently, only a little financial improvement towards self-sufficiency can be seen within sewerage and sanitation companies. According to the Survey, they are to the most part or totally dependent on budgetary financing as for their recurrent cost recovery, let alone the capital costs. As public expenditure and subsidies have remained limited, many utilities have severely deteriorated and are in need of major repair or reconstruction.

The dialogue opened up with donors in 1993 and the resumed collaboration with international financing institutions have somewhat clarified the government's position not particularly regarding sewerage and sanitation but social and economic infrastructure in general. Consequently, allocations of state budget investment resources are being focused on developing social and economic infrastructure to create favorable conditions for investment in the directly productive sectors. Thus, the central government is supposed to concentrate on financing basic services like power, transport, water resources, water supply, communications, and social infrastructure.

Operation Objectives and Tariff Setting

One of the basic tasks in the ongoing restructuring of the state economic sector has been to distinguish public service organizations from business enterprises which are to operate under the market mechanism. The former organizations would continue to be based fully or partially on budgetary financing, whereas the latter would have to reorganize themselves for a revenue based cost recovery in order to avoid liquidation. So far, the status of sewerage and sanitation companies has remained unclear. On one hand, officially accepted Polluter Pays Principle applies to the Sector implicating that more revenues should be collected from those responsible for pollution. On the other hand, the government has shown only a little interest and taken only a few measures for overall improvement of the Sector operations and cost recovery with revenues. As a result, the funding priority of the Sector has remained low, physical resources (networks, vehicles, equipment) have continued to deteriorate and the utility organizations have continued to be weak.

Some of the reasons for the unsettled situation of the Sector are the decentralization policy of the government without clear definition and establishment of development responsibilities, and that water supply is usually considered more important and urgent target for development than sanitation. Other reasons for the backward situation of the Sector are the following:

(i) Sector's low priority as for investment financing;
(ii) Lack of guidance of the government to introduce reform and new policies;
(iii) Lack of supporting measures like technical assistance and advice for development of services;
(iv) Due to Vietnam's isolation, international financing flows - either official or private - have remained at a low level and
(v) Lack of awareness of positive health impacts when sanitation services are improved.

Tariff setting for sewerage and sanitation services is the responsibility of provincial and local authorities. In the 1990s, utilities have introduced new tariffs to cover at least a part of operation costs and usually those tariffs have also been accepted by the People's Committee in question. Tariff adjustment takes place so that first the utility will prepare a proposal concerning rate setting with justifications. The proposal is reviewed by local Construction Services (TUPWS), the Financial Service, the Material and Price Committee and the Planning Committee before the final decision of the People's Committee.

Traditionally, sanitation services like solid waste and night soil collection has been to domestic customers free of charge. The same applies to centralized sewerage and drainage services, if available. Only in Hanoi the provincial government has applied in recent years a 10 % surcharge on water billings and other provincial cities like Haiphong are now considering the same. Therefore, charging domestic customers is still new concept to utilities and in those cases when a fee has been levied on the service, it is still at an experimental stage without a serious attempt to match operating costs with respective revenues. A sanitation tariff structure of a utility in Binh Thuan province is in Table 6-3 below.

Table 6-3 Tariffs Applied in Sewerage and Sanitation Sector

Tariff Category	VND
1) Solid Waste Collection	
- Households	3,000/month
- Shops	10,000/month
- Small scale industries	15,000/month
- Restaurants	50,000/month
- Street restaurants and cafes	30,000/month
- Offices	10,000/month
- Market Solid Waste	10,000/m3
2) Other Operations	
- Sludge Collection	30,000/m3
- Public Toilet	300/visit
- Wastewater	NIL

These tariffs can be taken as typical to the Sector, because utilities often follow each others in tariff setting. A common basis appears to be the standard waste production particularly among domestic customers. For commercial and industrial customers, utilities also apply the actual collected volume (cum, ton, truckload) as a basis of a tariff.

Asset Management

The realistic valuation of fixed assets on the balance sheet and properly designed depreciation policy are indispensable preconditions for sustainable and self-supporting operations. Basic problems in Vietnam are that all assets of the Sector companies are considered state property and that some of those assets may not be found in the books of the utilities concerned. Also, the present Vietnamese accounting system does not function according to internationally accepted accounting conventions and therefore the mentioned preconditions are only poorly fulfilled in the Sector utilities.

As for asset valuation, the utilities' fixed assets were found still to be undervalued despite a revaluation done in 1992 to reflect high inflation in previous years. The Ministry of Finance has given instructions on how to keep fixed asset (networks, buildings, vehicles) values updated with price development, but it seems like those instructions have not always been followed by utilities. Other problems are that despite a balance sheet is available, it does not necessarily include all the assets participating in the revenue generation, and that transfer pricing of new assets does not necessarily represent the real value due to insufficient cost accounting systems.

Depreciation is an important part of asset management as it recognizes the annual contribution of fixed assets to operations. If operating costs do not recognize the contribution of capital assets, the costs are understated leading to an overstated financial result for that year. In Vietnam, the government regulates depreciation rates but it does not guarantee that depreciation is made, because policies of local authorities differ. Moreover, the Sector utilities have to surrender the depreciation funds to local government fully or partially and anyway to the extent that specific assets have been financed by the government.

If the existing system functioned properly, it could still serve asset replacement in time and there would be a chance for sustained operations. In practice, however, depreciation funds have been and still are an important source of budgetary financing for local and provincial governments. The funds are utilized - not necessarily for asset replacement and new investment of the utility in question - but for other recurrent and capital investment purposes of the community. When adding to this frequently changing rules by the Finance Department of the People's Committee on depreciation charges and their surrender requirements, the present system contributes effectively to deteriorating assets, increasing malfunctioning of operations and decreasing quality of sewerage and sanitation services of the Sector utilities.

Financial Management

The general reform of the Vietnamese accounts (United Accounts System), applied in the Sector utilities, was commenced in 1988 and taken into use in 1990. The main objectives of the new system were

(i) to create a system appropriate to a market economy;
(ii) to develop the system for meeting international standards and
(iii) to facilitate the utilization of computers.

Despite the stated objectives, the reform appeared to be quite superficial. It is still difficult after five years to assess, how the new system would fit to the requirements of a market economy and meet generally accepted international accounting conventions. The accounting system seems to be nearly the same as used in the former Soviet Union.

The Sector enterprises produce a large amount of financial information which is summarized in quarterly, semi-annual and annual financial statements. However, those statements are not prepared in the first place for the use of the management, but rather to authorities for centralized planning, administrative and statistical purposes.

Furthermore, utilities are legally tied to the public accounting system and they are applying the cash accounting principle which is the most common within the public sector organizations. The cash principle in accounting can effectively distort the financial assessment of a company because, for example, collections of deferred accounts billed in prior years will increase the revenues of this year. Instead, sewerage and sanitation utilities should use the accrual accounting which shows revenues as they are earned and expenses as they are incurred.

The above problems are expected to be solved in the near future because the Ministry of Finance has introduced in 1995 an accountancy reform to be applied first to 300 SOEs. The base of the reform is the American Accounting System, which will be modified according to the Vietnamese requirements before putting it into use nation-wide. No plans have been available of its implementation in the Sector utilities.

Administrative rulings alone can hardly be enough for improved financial management, because utilities' own initiative is at least as important. It is well recognized at the national level that, for example, accurate cost accounting tailored to each sector's requirements is needed to commercialize operations and therefore central government has encouraged state owned enterprises to develop their own systems. However, according to the field survey, a little evidence could be found about establishment of such systems in the Sector enterprises.

Financial independence of the Sector companies is usually extremely low and financial management activities are often limited to basic book-keeping, preparation of periodical reports, standard budgets and carrying out of cash transactions. Companies are closely tied to local administrative complex including such organizations like Urban Transport and Public Works Services, City Financial Services, Planning Committee and People's Committee, which organizations carry out functions that normally fall within companies' responsibilities. Those responsibilities include fixed asset management, investment financing, debt service and capital budgeting. They are also dependent on the government regarding cash payments as the normal banking services are not available and to surrender excess funds including recurrent revenues to local Financial Services.

The survey could only confirm the low (financial) management profile of the Sector companies as described above. Managers appeared to be poorly informed about their financial responsibilities and plans in the future despite ongoing countrywide restructuring of the SOEs. The response was expected because in the centralized planning system utilities themselves have usually a relatively small role to play.

In regard to financial constraints, the utilities were more concerned about insufficient subsidies and budget allocations than the low billing coverage which together with low or non-existing tariffs effectively hamper revenue generation and the achievement of financial independence. Some of the reasons hampering effective revenue generation are that official policies still regard sanitation as part of public services to be financed through taxation, and that sufficient revenue collection and enforcement systems have not been developed.

6.2.2 Financial Performance

Revenues, Recurrent Costs and Cost Recovery

Except in Hanoi and HCMC, wherein specific companies have been established for sewerage and drainage, local environment (or public services) companies for solid waste management are usually in charge of centralized sewer (and drainage) system operation and maintenance - if in place. Up to now, the use of those systems in most towns has been free of charge; i.e. fully subsidized by provincial and local governments. Most of the revenues of the Sector companies comes from solid waste management. Other activities with less financial importance include collection, disposal and possible selling of sludge and night soil from on-site sanitation facilities, operating public toilets, street cleaning and cemetery services.

The Sector includes both labor intensive activities like solid waste and nightsoil collection from bucket latrines, and capital intensive sewerage and drainage network systems.

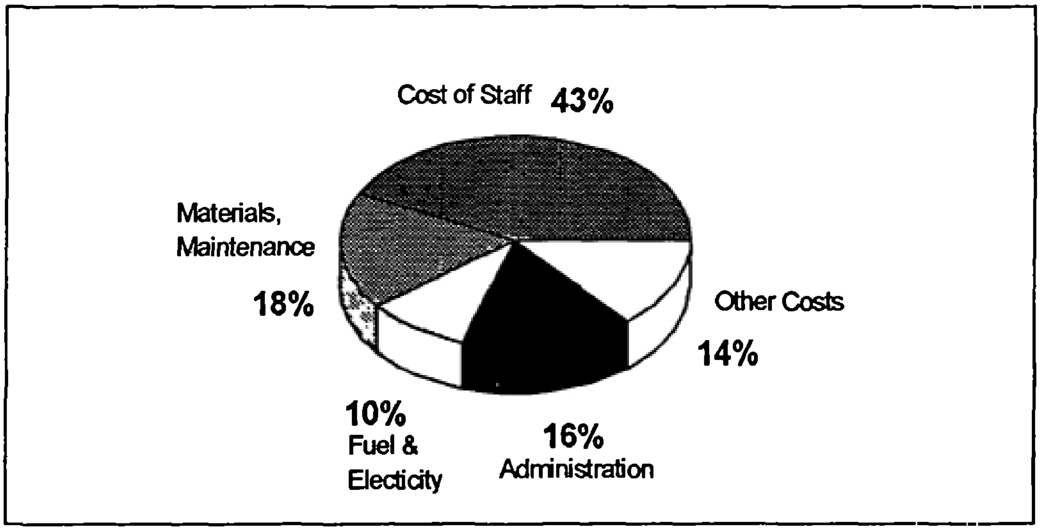

Figure 6-2 Operating and Maintenance Costs of Sewerage and Sanitation.

The shown cost structure based on the Survey is typical for a Sector utility with responsibilities to collect human excreta and solid waste, and to maintain centralized sewerage and drainage networks. The share of the main cost category, "Cost of Staff" is not high only because of a large number of people employed but due to a high cost per employee. Total income of night shift workers in street cleaning compares favorably with salaries of the management and in addition, social expenditure like medical expenditure is higher than in other sectors. Another typical feature in the cost structure is that the categories for "Administration" and "Other Costs" cover a rather large share (30%) of total expenditures. It is an indication of low discipline in cost management which is supposed to accept, in principle, only those costs to the accounts of the company which contribute to revenue generation. The Survey did not reveal the real contents of those categories.

Present accounting system applied by environment companies does not allow extraction of expenditures of individual activities in a reliable manner to draw conclusions on the Sector cost recovery. However, scattered information indicates that environment companies are carrying out various services to the people who are usually paying only a nominal fee of the real service cost. For example, in Haiphong, the local utility is running 6 public latrines in the city with a revenue of 30 million VND in 1993, but the corresponding operating costs were calculated to be 210 million VND. According to another example, a rather general charge for collecting sludge from septic tanks is 30,000 VND/m3. One of the utilities has estimated that the total expenditure including capital cost for the same service is more than 300,000 VND/m3.

On the utility level (including all operations) the combined revenues of six environment companies in the survey were about VND 2.6 billion and corresponding operating and maintenance (O&M) costs nearly VND 11 billion. This means that O&M cost recovery from revenues was about 24 % and the share of subsidies 76 %. The overall (O&M plus capital) cost recovery can be assumed to be only about 14 %, in case the average capital cost is 40 % of total operating expenditure. Utilities themselves are not very concerned about the cost recovery, because revenues are usually submitted directly to the Finance Service of the town in question, which in turn will provide the financing needed for paying the cost of operations.

Billing, Collection and Enforcement

Solid waste and sludge collection from commercial, industrial and institutional customers is based on a contract and usually paid on the spot. Revenue collection rate is therefore high and no particular enforcement measures are required. However, collection volumes and resulting revenues often remain low because utilities are not in a monopoly situation and customers are free to use other services. Industries may take care of refuse disposal by themselves and domestic septic tanks are often emptied by farmers free of charge or emptied by a public utility only at a request of the owner. To save in the cost, collection frequency may remain low due to insufficient control of septic tank discharge to ditches and rivers, and illegal connections to open drains. Domestic solid waste and sewerage are potentially the largest revenue sources but for the time being, either the services are not billed at all (centralized sewage service) or billing is still on an experimental stage resulting in low collections (solid waste/sludge collection).

Experience is being gained about a method, according to which sanitation billing is decentralized to the administration of sub-districts (phuongs) which are in charge of fee collection and measures in case of non-payment. The system is already being used in some water supply companies. Part of collections is paid to the administration as an incentive to reach a higher coverage and collection efficiency. The system is being tested, for example, in selected housing areas of Hanoi with encouraging results. Billing is based on "social responsibility" and willingness to pay. The idea of social responsibility is that in case of default, the family's name is made public and it is assumed that social pressure from neighbors would make the family to pay its waste collection bill. The main problems of the system seem to be high collection cost and payment enforcement. An option considered for enforcement is to cut off the waste collection service from the area lagging behind of payment. In practice, however, official policies have not usually favored any stiff actions against people and households.

Arguments of the above system's viability in a long-run may still be raised. First, current typical charges (200-400 VND/person/month) are relatively low even for a low income household and therefore easy to accept as a payment. New and considerably higher tariffs are already being applied in many urban areas. The same trend is expected to continue in the future due to restructuring, capital investment and debt service needs. Second, introduction of (fixed) capital cost recovery calls for a considerable expansion of billing coverage to strengthen the revenue base and operating margin after O&M cost reduction. Third, internal movement of people will increase in urban areas in course of economic development resulting in weak and short term contacts with local community and administration, and in lower social responsibility. A conclusion of the present collection situation is that if the utility fails in the beginning to collect the waste management fee imposed, there is very little to be done later on and most probably, the fee remains unpaid.

6.2.3 Public Utility Financing

Major issues in capital financing of sewerage and sanitation sector are, first, how to recover the capital cost or to what extent it should be recovered. Second, the extent to which public/external funds should be used to improve sewerage and sanitation considering, for example, economic benefits of better health conditions. As already discussed, official financing policies have not been explicitly established and general policies regard the Sector's priority low in budgetary allocations. Government policies on capital cost recovery should be based on such considerations as grant (budgetary) proportion in project financing, degree of cross subsidies in tariff setting in favor of domestic sector and the terms and conditions of external funds to be onlent to the utilities by the government. In the following discussion, certain external financing types (commercial bank lending, export credits) have been bypassed deliberately because their lending terms fall easily beyond the present debt service capacity of most utilities in the Sector.

Financing of the State

An analysis on the central government real expenditure on sewerage and sanitation in the past is hindered by lack of detail and by inadequate classification of expenditure; i.e. the Sector is often included in water supply or social infrastructure. Therefore, the picture on Sector investment and financing development remains unclear and what has been analyzed is mainly based on scattered information of former studies and informal interview results.

A general understanding about the sector's development is that many of the urban sewerage and drainage networks were constructed during the French colonial period and that during the past 10-15 years, the sector has suffered seriously due to lack of finance, physical deterioration and decrease in service quality. In the 1983-86 period, urban water supply expenditures (including sewerage and sanitation) were less than 1.5 % of the government's total capital expenditure, while provincial contributions accounted for 5-7 % of total provincial budgets. It was estimated in monetary terms that in 1989 both central and provincial governments' investment volume was only USD 0.56 million in urban water supply. In 1991-1992, the overall capital spending by the government was at a low level but then recovered so that the GDP share of capital expenditure in 1993 was 7 % compared with 2.8 % in 1991. The share of sewerage and sanitation in these figures remains hidden.

In 1994, the capital investment budget of the government was VND 9,300 billion (USD 845 million) representing 7 % of the GDP and a quarter of the government total budget. These investment funds were divided by sector as shown below.

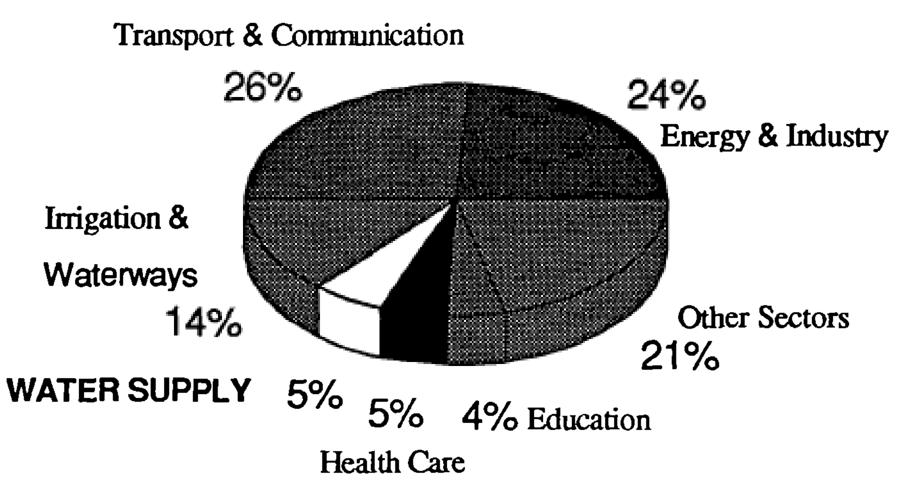

Figure 6-3 Government Capital Budget for 1994.

Investment mainstream comprise funds allocation for large projects in infrastructure such as road building, telecommunication, hydro power stations and irrigation. Investment funds for water supply projects (5%) including sewerage and sanitation, are budgeted to be about VND 490 billion (USD 44 million) and comparable with those of education and health care. Detailed information about the Sector's share in water supply has not been available to the Consultant, but if the ratio is the same as found in a sample of on-going investments (1:9), then it would remain low compared to the apparent needs.

In order to improve the management of investment preparation for budgetary and external financing, the former State Planning Committee (SPC) has commenced preparation with help of UNDP of a three-year rolling Public Investment Programme (PIP) which should take place in 1995. PIP will provide the strategic framework for the use of government capital expenditure, as well as a bulk of future foreign development assistance. PIP would set out medium-term financing requirements for priority investment projects and it will focus on projects that cannot efficiently be undertaken by the private sector and those which are complementary to private sector development. This means that PIP will concentrate on infrastructure projects in the transport and power sectors, as well as on irrigation, water supply and sanitation.

Financing Potential of Local Governments

The present policy of the central government is that provinces and districts will account for an increasing share of investment budgets as towards rehabilitation of infrastructure. The central government may still assume responsibility for infrastructure investment financing in provinces where local authorities do not have resources for it. In those cases local authorities would still have to take care of operation and maintenance financing, and to look for larger revenues from the utility's cash flow.

In spite of the stated policies that underline decentralization of investment administration, it appears to be, on the contrary, highly centralized in Vietnam. Local authorities (provinces/districts) have very limited revenue powers, and therefore low financing potential. They share in centrally collected and administered taxes, but can also benefit from central government transfers. Moreover, the state controls local investment by requiring all major projects to receive central government approval.

An example about provincial level financing is the City of Hanoi. In 1994, the investment budget for infrastructure projects of Hanoi was VND 149 billion, of which transportation covered the most, VND 100 billion. The financing share earmarked in the budget for sewerage and drainage was VND 10 billion (USD 0.9 million) or 6.7 % of total infrastructure investments. To place this allocation into a proper perspective, an investment programme of USD 1,162 million (about USD 77 million per year) has been recently proposed to rehabilitation and expansion of Hanoi sewerage and drainage systems in 1995-2010.

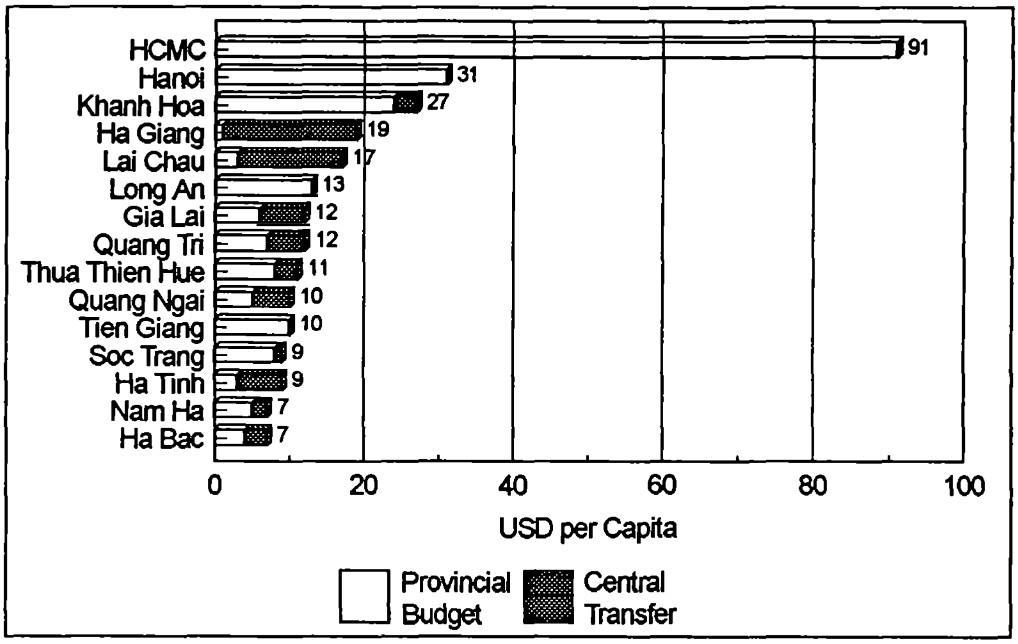

Figure 6-4 Financing of utilities, USD per capita.

The above comparison demonstrates the limited provincial resource base compared to the needs. The comparison becomes even more striking because the financial potential of Hanoi is among the highest when compared with other provinces in Vietnam (Figure 6-4).

Per capita financing have been calculated by dividing 1993 provincial budget revenues and central government transfers with respective population. The Figure demonstrates the high discrepancy between financial resources of various provinces. The poorest areas are the Central Highlands (Gia Lai) and the Northern Mountains (Ha Giang, Lai Chau) where provincial revenues per capita vary only between 1-8 USD (except Quang Ninh). A conclusion is that those regions are almost totally dependent on the central government transfers and donor funding when developing their utilities in sewerage and sanitation.

Financial Sector

The Vietnamese financial sector is rather underdeveloped and consists essentially only of the banking system. This system is dominated by the four state-owned commercial banks. In addition, there were (end-1993) 35 shareholding banks, 63 credit cooperatives, 3 joint-venture banks, 8 foreign banks and about 10 popular credit funds. The State Bank of Vietnam is the central bank controlling among other things money circulation and interest rates of the banks. The four commercial banks account for most of deposits and 90 % of total credit outstanding as end-1993, of which some two-thirds is to poorly functioning state-owned enterprises with high overdue service payments.

The banking sector is in transition and the dominating banks have not developed their operations quickly enough to keep pace with new service requirements of emerging market economy. Many banking improvements have already taken place with help of foreign technical assistance, but still banks are operating mainly on cash basis. There are also several practical obstacles to be solved like long payment time between cities and delays in making cash withdrawals from bank accounts. Apart from operation inefficiencies, one of the basic problems is a lack of confidence in the financial system. It is estimated that the banking system serves only some 7 % of population. Low confidence has contributed to a low savings mobilization and non or low availability of medium- and long-term credits to enterprises for working capital and investment purposes, in particular.

The utilities operating in sewerage and sanitation are so closely tied to local government financial administration, that their dependency on banking system and its performance has been low unlike other state-owned enterprises in commerce and industry. In principle, the Sector utilities may enter into a (short-term) bank loan agreement, but due to the high cost of financing (1.8-2.5 % per month) this possibility has been reserved to extreme situations. In a normal situation, local Financial Services pay most of the operating costs and take care of financing of asset procurement. If/when more financial responsibilities are transferred to the utilities, and in particular in case expansion of operations, the utilization of banking services at least for working capital purposes will become a necessity. However, that transfer can hardly take place before the service level and lending capacity of the banking will improve.

Foreign Financing

Although there are no statistics available to the Consultant, it can be safely estimated that very limited amounts of foreign financing has been channeled in previous years to the development of sewerage and sanitation systems in Vietnamese urban areas. Finland has been since 1985 the biggest foreign financier of water sector, but up to now those programs in Hanoi and Haiphong have been limited to financing of investment and technical assistance for water supply companies only. After having normalized relations in 1993 with the International Monetary Fund, the World Bank and the Asian Development Bank (ADB), and after trade embargo lifting in 1994, international and bilateral donors have re-entered the country rapidly. First financing commitments have been made, but corresponding disbursements have realized slowly.

International Financing Institutions

Because Vietnam belongs to the lowest income country group, it is eligible for credits with concessional terms available from the special funds of ADB and the International Development Association (IDA), a member of the World Bank Group. "Concessional" terms mean for example a 40 years' term with a grace period of 10 years without interest charge, only a 0.75 % service charge.

Official Development Assistance

To utilize ODA in the most effective manner, Vietnamese government has issued in March 1994 General Provisions for regulation the management and utilization of ODA. According to those Provisions, foreign grant financing will be used for studies on development projects, sector reviews and various research activities in socio-economic infrastructure including water supply and sanitation. Concessional loans respectively are for construction and rehabilitation projects and programs on a priority basis. At the 1993 Donor Conference a total ODA commitments of USD 1.8 billion were made, of which 78 % have reached in 1994 a formal aid agreement. It is estimated that the level of disbursements in 1994 were about USD 400 million.

As for mobilization of ODA resources, the triggering phase is when ministries, provinces and local governments submit their ODA requirements to MOPI. MOPI is the lead agency and responsible for coordination with other ministries and agencies in preparing ODA mobilizing activities. Those activities include the review of ODA proposals, preparation of list of projects and programs for submission to donors for consideration, negotiations with donors and preparation of financing proposals to the government for approval. In case of a loan, ODA funds are relent through the banking system to beneficiaries with projects and programs. Those recipients will then be responsible for the interest and repayment of the loan as specified by the State Bank of Vietnam. The coverage of ODA-financing is in a region of 80-85 % of the project needs and the government is responsible for arranging the remaining funding.

ODA-funding is a prospective financing opportunity to the Sector utilities. Because of socio-economic objectives, donors have spelled out their preparedness to provide aid to upgrade water supply and sanitation systems in the large cities, towns, districts and villages. In particular, ODA-grants are suitable in the beginning for improvement of the Sector's absorption capacity in order to make effective use of external assistance for investments. At present, absorption capacity of most companies is extremely low, and the companies require financial strengthening and operative restructuring. In most cases, the starting point should be the creation of a conducive legal and institutional framework for newly designed utilities with clearly defined objectives, financial targets and operating responsibilities.

Foreign Direct Financing

In recent years, Vietnam has been successful in attracting the interest of foreign private investors. At the beginning of 1995, the accumulative FDI commitments in 1988-1994 were USD 11.1 billion including 1,117 projects from 45 countries. A typical setup is a joint venture with a SOE, which offers land to the venture as an equity contribution. Most of those commitments have been made since 1991. However, actual implementation of foreign investments is lagging behind and they are about one third of the commitments. The lag indicates both a need to improve investment climate through the enforcement of laws, and "wait and see" attitude of investors before the disbursement of funds and project implementation.

In principle, sewerage and sanitation sector as part of basic infrastructure is a potential target for foreign direct investment, but due its low priority status in official policies, unclear revenue base and institutional weaknesses, foreign investors have shown only a little known interest in the utilities in question. Only one project related to the Sector was found in a recent list of 150 projects by the Investment Transaction Center calling for foreign direct investment.

A new mode of operation was introduced to foreign investors in 1992, when amendments were made to the foreign investment law regarding Build-Operate-Transfer (BOT) contracts for infrastructure projects. The most recent circular on BOT contracts was issued by SCCI in 1994. According to those documents, a BOT arrangement is for the purpose of constructing and carrying on a business operating infrastructure project. Under BOT regulations, the project will be transferred back to the government without compensation at the end of a specified period. The decree includes generous tax, customs duty and other benefits to BOT companies. BOT contracts on a project can be signed with various authorities including ministries or provincial and city level people's committees.

Although no BOT projects have been identified in sewerage and sanitation sector, the first BOT company (Binh An Water Supply BOT Company) has recently been established in Ho Chi Minh City for water supply purposes. The project time is 20 years and the water to be produced (100,000 m3/day) will be sold to HCM City Water Supply Co.

Financing of On-site Sanitation

Development of on-site sanitation technologies and their financing is an important alternative for capital intensive centralized sanitation solutions. Those solutions may remain outside the reach given the fiscal constraints of urban municipalities, limited subsidy possibilities from donors and central government, and undeveloped capital market for large-scale financing. Unfortunately, statistics on private expenditure in on-site-facilities and their financing have not been available.

In some poor housing areas in Vietnam, municipalities are supporting low income families to acquire better sanitation facilities. For example in a Southern district of HCMC, the People's Committee of a low income sub-district (commune) subsidizes households with some 35 % of the cost to build a pour-flush toilet with a septic tank. Still, there are no countrywide financing mechanisms developed for purchasing of new sanitation equipment, upgrading of old systems or for technical assistance of domestic sector. In other countries, those mechanisms are usually based on a (revolving) fund sponsored by a donor or an international financing institution through the government. Such an arrangement is presently proposed in Da Nang.

The present situation in Vietnam is that households have to cover the cost of a facility with savings and/or through a loan. As the financing market in Vietnam is poorly developed, the main lenders are individuals (relatives, friends) and private money lenders. According to a survey in 1993, their share of the total household credit was nearly two thirds. State-owned banks were the third common lenders. The borrowing cost is usually high and even a bank interest for a short -term loan can easily be 3.5 % per month. The charges of private money lenders are even higher.

6.2.4 On-going Projects

A list of the known water supply and sanitation projects is presented in Table II-4, Appendix II. It is not complete because Vietnam is carrying continuous negotiations with donors on new projects and their financing. In any case, the estimated total investment cost of the listed projects is USD 1, 632 million. If excluding the Sewerage and Drainage Project in Hanoi (USD 1,162 million) which is exclusively for sewerage and sanitation, most of the remaining investments (USD 470 million) are for water supply purposes only. For example, sewerage, drainage, sanitation and solid waste comprise about 23 % of the World Bank financed project in four cities and only about 5 % of the ADB-financed project in HCMC.

As for the similar plans of SPC, confirmed public investments according to early-1994 figures in the water supply and sanitation sector were USD 582 million, of which USD 265 million for water supply, USD 315 million for waste water disposal and the rest for other purposes. SPC had in 1994 already received donor commitments for almost 75 % of the total, but mainly for water supply projects.

Comparing the present situation and apparent needs with the planned investments and external financing, it seems with the exception of Hanoi that the poor centralized services in sewerage and sanitation will continue in most cities, and will even deteriorate. On the other hand, the sector's absorptive capacity for managing large-scale investments and resulting debt service is low. Before any major investment programs are developed like those in the water supply sector, not only is the upcoming national long-term sanitation strategy required, but also considerable support for immediate and pre-project strengthening and restructuring of sector utilities, planning capacity, management skills and systems, and financial policies and practices.

6.3 ENVIRONMENTAL SETTING

6.3.1 Climate

The climate of Vietnam is humid tropical, strongly influenced by Asian seasonal wind patterns. Over the whole Vietnamese territory there are three typical climatological areas. The rainfall and temperatures within a year vary very much in these regions.

In the north, the climate is affected by winds from Central Asia, and the temperature varies greatly from season to season. Generally, there are two seasons: the winter from November to April, which is cool with temperatures as low as 4°C and humidity as high as 80-90%, and the summer from May to October, which is hot with a maximum temperature of 40-42°C interrupted by heavy rains and occasional typhoons.

In the central part of the country, the climate varies progressively from north to south, the north having a rather cool rainy season from November to March. The temperature in southern Vietnam is relatively constant. Temperature can vary from 12°C to 40°C.

The climate is predominantly influenced by monsoons, and the average annual rainfall ranges between 1,500 and 2,500 mm. Some areas in the northeast and central Vietnam have rainfall over 3,000 mm per year. The Southern end of the central part (around Phan Rang and Phan Thiet) has the lowest rainfall: 80-800 mm per year. The average monthly hydrological information in each climate region are presented in from Figure II-1 to Figure II-8, Appendix II.

The local rainfall in Vietnam produces an average annual runoff of about 366,000 million m^3. A large volume of runoff is also contributed from catchment areas located outside Vietnam, including the Mekong and the Red River which contribute about 500,000 million cubic meters.

Flood season coincides with rainy season and the flow of rivers vary very much. For instance in Red - Thai Binh river basin, August water volume is the largest making 15 to 35 % of total annual volume. After floodseason the water level in rivers declines strongly, some small creeks even dry up. Lowflow period lasts in 7 - 8 months. Lowflow runoff makes 10 to 30 % of total annual runoff. This long dry season has a considerable effect on the surface water quality, especially in cities next to small rivers and systems consisting of lakes and ponds (like in Hanoi). Water quality deteriorates substantially, and in many cases resembles wastewater.

Typical monthly flows of rivers with different size of catchment area are shown in Figure II-9, Appendix II.

In delta plains, river slope is very small, river channels are widened, many estuaries are communicating with the sea and create favorable conditions for tide intrusion far into the delta. In Red river plain tide penetrates as far as 180 km, in Mekong delta it may invade up to 400 km.

Vietnam is surrounded by sea on both sides and has many rivers and lakes, and therefore the proportion of water in the atmosphere is high. The area with the lowest humidity is Ho Chi Minh City: 80%. The highest is in Quang Ngai Province: 87%.

In general the climate of Vietnam has favored crop development, but has a negative influence on construction and economic development. Vietnam suffers from 7-10 tropical storms each year, causing a loss of 2-3% of national income. Along with loss of life and materials and the destruction of irrigation systems such as dikes, dams and aqueducts, Vietnam loses about 300,000 tons of crops each year. Apart from storms and floods, pests and crop diseases have also spread and caused serious harm; every year, about 10% of the area under cultivation is damaged by pests to various degrees.

6.3.2 Topography and Soil Conditions

The topography of Vietnam is characterized by large low-laying plains of the Red River delta in the North and the Mekong delta in the South. Mountainous highland surrounds the deltaic plain of Red River in the West and in the North. In the Central Vietnam, topography raises from the narrow coastal plain towards Cambodian and Laos borders, forming the central highland.

Surface layer soils consist mainly of alluvial and marine formations from the quarternary era. These soils are typically sandy along the coastline, clays and silts in the Mekong and Red River delta areas, but more diverse in the highland and mountain areas.

The permeability of surface soils are generally more than 1 m/d in the sandy coastal areas, and around 0.5-1 m/d in the river delta areas (see Table II-5 in Appendix II). According to literature, if pour-flush toilets are used and sullage is disposed of separately, a permeability of 10^{-3} m/d should be sufficient for septic tanks to operate The permeability ranges of all Vietnamese cities fall to this category. The few cities with marginal permeability values (10^{-3} to 10^{-2} m/d) are all situated in the Red River delta area in the North.

Groundwater is found in soil formations, but also major amounts in the rock consisting of limestone or basalt. Often there are separate aquifers one on top of the other.

Upper aquifer groundwater levels are generally high in the low-laying parts of the country. The values in the Table II-5 represent the situation in dry season, yet in many places groundwater table is quite near to the ground surface. During wet season, water logging is common in the cities of north-eastern Southland, Mekong River delta, large parts of the Red River delta, and coastal towns of Northland.

6.3.3 Land Use

Information on land use and housing was collected from the City Master Plans prepared by the Urban and Rural Planning Institute of the MOC. This data is presented in the Table II-6, Appendix II. However, the data should be interpreted broad-mindedly, due to differences in categorization in the different city plans.

Generally, residential use takes about 40-60% of the urban area, industries about 5-15%, transport and public uses about 15-25%, and parks about 3%. The rest 15-30% includes other uses like military, history, agriculture, and water bodies.

There is a policy to separate industrial areas from residential areas. However, since in practice land use is not controlled, there is a considerable amount of industrial activity scattered in the city center areas. Residential land use seems also to be wild. Houses are built very densely on narrow lots, or enlarged by supplementary stories or rooms stretching out to pavements.

Except for class I cities and a few coastal resorts, urban population densities are generally less than 200 persons/ha. Housing area is only 4-6 m^2/person, and average storage about 1.5. There is a clear tendency to increase the number of stories of in all City Master Plans.

The new residential areas throughout the country seem to develop rather uncontrolled. The plot sizes are small and very narrow. The landuse pattern of small alleys and big blocks has not changed, which will considerably effect on the suitable SWM, water supply and sanitation technologies. There will be serious limitations for private transportation and parking in the near future, if the number of private cars is increasing as rapidly as in the neighboring countries.

6.4 WASTEWATER AND SANITATION SERVICES

6.4.1 Historic Perspective on Sanitation Developments in Vietnam

Public Drainage and Sewerage

The earliest records of drainage and sewerage developments in Vietnam traces back to the 1870's in HCMC and 1905 in Hanoi, when French engineers planned and constructed the first combined sewers. By 1938 about 11 km of pipe had been installed[18] in Hanoi, which at that time had only 150,000 people on an area of about 1000 ha, i.e. 11 m/ha (0.07 m/person). The same level of drainage development as in Class II and III cities in Vietnam today. The drainage system was extended in steps with the urban growth during the French period up to 1954, when France gave up its colonial powers in Vietnam.

The sewerage system was constructed in the old city from 1905 to 1945, and in the new residential areas after that period[19]. According to the Sector Study the total length of drainage pipe had increased more than ten-fold to 120 km in 1989, or about at the same level of development as today 29 m/ha (0.13 m/person). The population increased only six-fold to about 900,000 over the same period.

According to anecdotal evidence very little new developments took place after 1954 in the northern cities. This means that most of the existing drainage must have been built from 1938 to 1954.

According to a sewerage feasibility study[20] carried out in 1971, Saigon's drainage system consisted of 112 km of pipes in 1970. The population was then 2.6 million on an area of about 17,100 ha, which means that there were only 6.5 m/ha (0.04 m/person), again the same level as for Class II and III cities today, yet at that time Saigon was already a metropolitan area. In 1989 total length of drainage pipes in the city had increased to 450 km, covering an area of some 14,000 ha and serving a population of 2.8 million, i.e. 32 m/ha (0.16 m/person). The HCMC Urban Drainage Company reports to operate and maintain about 500 km of pipes with diameter larger than 400 mm, and that an additional 400 km smaller diameter pipes are taken care of by district authorities. The system consists of 100 km (20%) that are older than 100 years, 250 km (50%) that are 100 to 30 years old, and only 150 km (30%) that are less than 20 years old.

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[18] *Les Egouts de Hanoi*, 1938, Paris.
[19] *Hanoi Water Supply Programme Phase III, Environmental Enhancement and Impacts*, YME Group, Hanoi, August 1992.
[20] *Saigon Sewerage Feasibility Study*, Hennigson, Durham & Richardson and Lyon Associated Inc., 1971

The same rapid expansion of the drainage systems has apparently not taken place in other urban areas in Vietnam. In 1975[21], the cities of Hue, Da Nang, Nha Trang, Phan Thiet, and Can Tho had a combined drainage pipe length of about 39 km serving a population of about 625,000 people, or 0.06 m/person, which is at about the same level of development as today. This trend was confirmed in the Sector Study. In 1989 these cities had a combined population of 1,117,000 and 77 km of drainage pipes, i.e. 0.07 m/person.

Private Sanitation

Available information suggests that there were about 5,500 bucket latrines in Hanoi in 1955 and only a very few households had flush toilets. The so called "overhang" toilets were used more frequently in the South in connection with fish ponds, while bucket latrines were more common in the North where nightsoil was used in the agriculture.

A demographic study carried out by the National Institute of Statistics in 1967 showed that 75% of the houses in Hanoi were equipped with toilet facilities, but only 40% had flush toilets. The distribution of wet and dry toilets has changed surprisingly little since then.

The official policy in North Vietnam from the 1960's until 1985 was to build double vault latrines, as nightsoil was commonly used as fertilizer and soil conditioner. However, it was recognized that compost would be a more hygienic and safer material than fresh nightsoil. The same approach was not applied in South Vietnam, where nightsoil was rarely used in the agriculture. This difference in sanitation policies has led to very different developments in private toilet facilities in the North and the South of Vietnam.

In 1989, the government started a campaign to replace the double vault latrines with water based toilets and septic tanks. This policy is still being pursued, and some cities have programs to assist people in replacing their bucket and vault latrines. Da Nang for example is experimenting with a revolving type fund to provide financing for needed households, and self-help programs have been used to assist communities in upgrading their drainage and sanitation conditions.

6.4.2 Service Coverage and Technologies

Public Service Level

The public combined sewerage systems consist of trunk pipes, drainage ditches and canals discharging into ponds, lakes, rivers and the sea in some cases. The various district administrations manage secondary and tertiary collection pipes

[21] *National Water Supply Development Program*, 15-16 October 1973, Saigon, Vietnam.

within their respective areas. No information has been made available about the extent of district sewerage or drainage systems.

Separate sewerage systems have been installed in the Kim Lien district in Hanoi, but this failed after some time, due to lack of proper operation and maintenance, and because there were so many illegal connections to the storm water drainage system. This system has now been turned into a combined system. Haiphong has a small separate system in a residential area, which in fact operates as a combined system like in Hanoi.

Information about connection to public water supply and sewerage or drainage systems is important for the assessment of the current sanitation level. Table 6-4 contains data compiled as part of the NUSS Survey in 1995, more detailed data is presented in tables starting from Table II-7 up to II-11. About 60% of all households have access to public water supply, either through house connections or through outside taps - private or public. Water supply coverage is highest in the larger cities - HCMC, Hanoi and Haiphong, and decreasing to about 40% in the smaller cities. The cities in the North have a slightly higher connection rate than cities in the South. In Hanoi the percentage of households with access only to outside taps was 46% and in HCMC 7%. The standard of service is found to be considerably higher in the South, although the service coverage is about the same in the North and the South.

Connection rates to public sewerage follow the same pattern as for water supply, only more pronounced, as seen from Table 6-4 and Figure 6-5. The proportion of households with connection to public sewerage or drainage is much lower in the North, and the smaller cities have proportionally fewer connections.

Table 6-4 Households connected to public water supply and sanitation

	Water supply % of households	Sewer connections % of households
City Class I	63	48
City Class II	54	44
City Class III	39	25
Average North	62	27
Average South	57	52
Average all	59	44

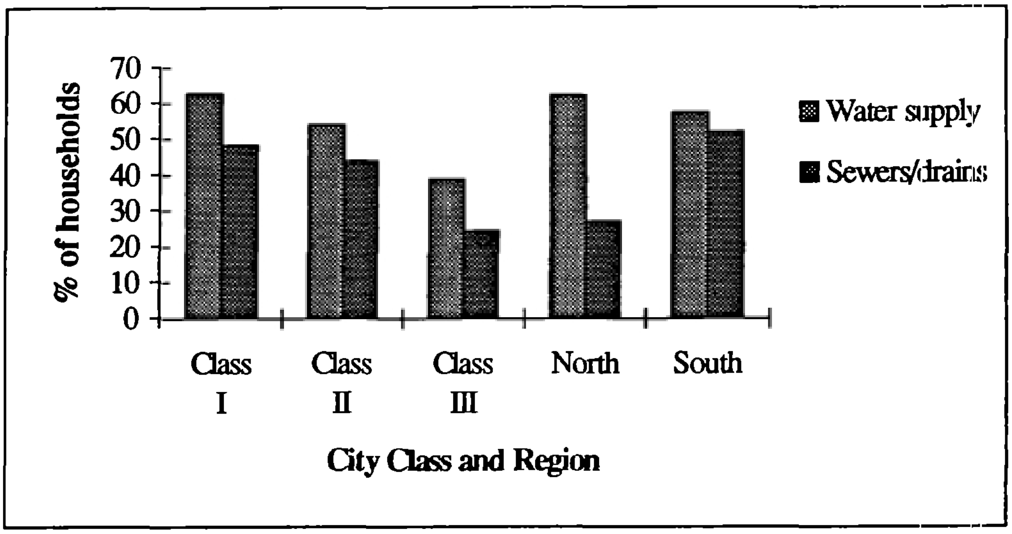

Figure 6-5 Household connections to public water supply and sanitation.

Table 6-5 shows that the solid waste and nightsoil management services in the northern cities lag considerably behind that in the South. The extent of solid waste services provided seems to be at about the same level regardless of the city size, while the level of nightsoil services seems to be better in the large cities.

Slightly less than 70% of all households have regular waste collection services. This means that 30% of the households dispose of their wastes uncontrolled. The actual amount of waste that is not collected is considerably higher than the mentioned 30%, as much of the garbage that is thrown in the streets ends up in the drainage pipes and ditches. A similar situation exists for the nightsoil collection, although a larger proportion of the households with dry latrines receive collection service.

Table 6-5 Solid waste and nightsoil management coverage levels

City	Solid waste households served %	Nightsoil households served %
Class I	66	92
Class II	72	63
Class III	67	58
Average North	51	66
Average South	74	90
Average All	67	83

Table 6-6 Service coverage in the cities surveyed, % of households

City	Class	Region	Public water supply	Public sewer service	Solid waste service
Hanoi	I	North	68	25	42
Haiphong	II	North	67	27	78
Thai Nguyen	III	North	40	33	30
Hai Duong	III	North	55	55	75
Bac Giang	III	North	14	0	50
HCMC	I	South	61	54	73
Da Nang	II	South	39	53	74
Hue	II	South	34	20	57
Can Tho	II	South	68	91	68
Phan Thiet	III	South	31	30	100
Nha Trang	III	South	41	3	99

Large variations in the service coverage must be expected from one city to another within the various city classes as well as the North and South regions, as demonstrated by the numbers in Table 6-6. There are a few dubious figures, such as the 100% and 99% solid waste service coverage in Phan Thiet and Nha Trang. Since the solid waste is collected from the streets, and not from each individual building, every household within the area covered by the street sweeping crew has the opportunity to use the public cleansing service. It is believed that all households within the service area have been included in these two cities.

One would expect to find, that the share of connections to public sewers would increase with the population density, however, the available data do not support this assumption. This may be explained by the fact that it is quite common that buildings in the older sections of the large cities discharge wastewater directly to the streets, drains or where convenient, particularly in areas with low ground permeability.

It is concluded that the coverage of sanitation services is better in the South than in the North, and that the larger cities generally have better public services than the smaller ones, but that considerable variations exist between cities within each city class and within each region. The need for improvements is particularly high in cities such as Hanoi, Haiphong, Bac Giang, and Hue.

Private Water Supply and Sanitation Services

Figure 6-6 shows that urban households have improved their sanitation facilities on a very substantial and impressive scale since 1989. The number of households that have substituted bucket or double vault latrines with flush and pour flush toilets has been quite dramatic, and a large number of households previously without toilets must also have installed flush toilets.

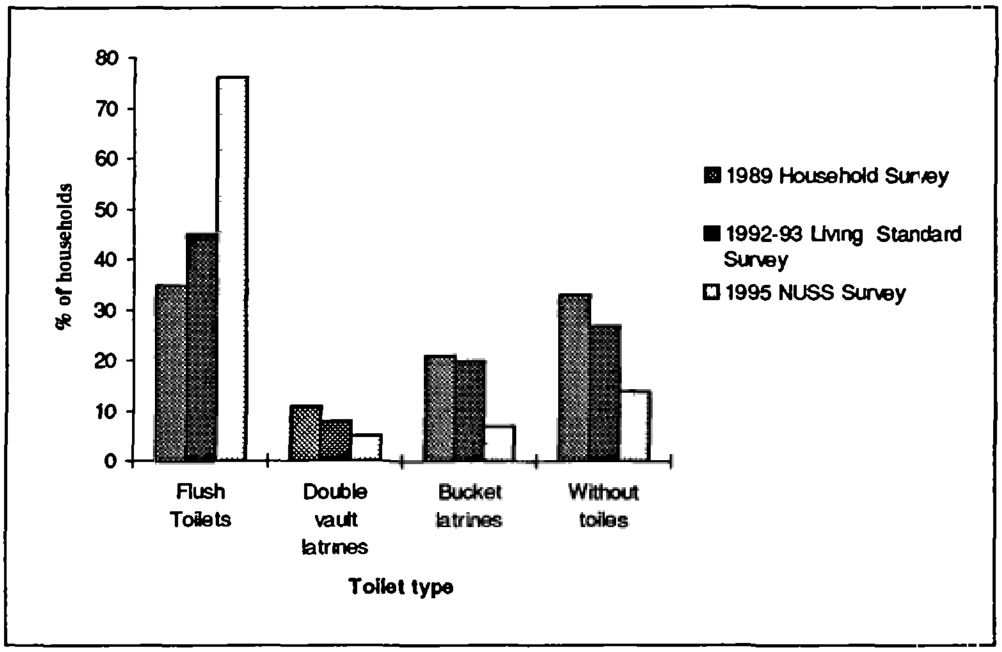

Figure 6-6 Household sanitation developments in urban areas in Vietnam.

Figure 6-7 gives an impression of the disparity of household sanitation development in the North and the South. Double vault and bucket latrines have almost totally been replaced with flush and pour flush toilets in the South, while the northern cities still have some 12% of households using double vault latrines and as much as 21% use bucket latrines. The number of households that are without toilet facilities or relying on such devices as the overhang toilets remains at 23% in the North but is only 9% in the South. The need for improvement of private sanitation facilities is, therefore, much higher in the cities in the North, while the sanitation situation in the cities in the South seems to be satisfactory.

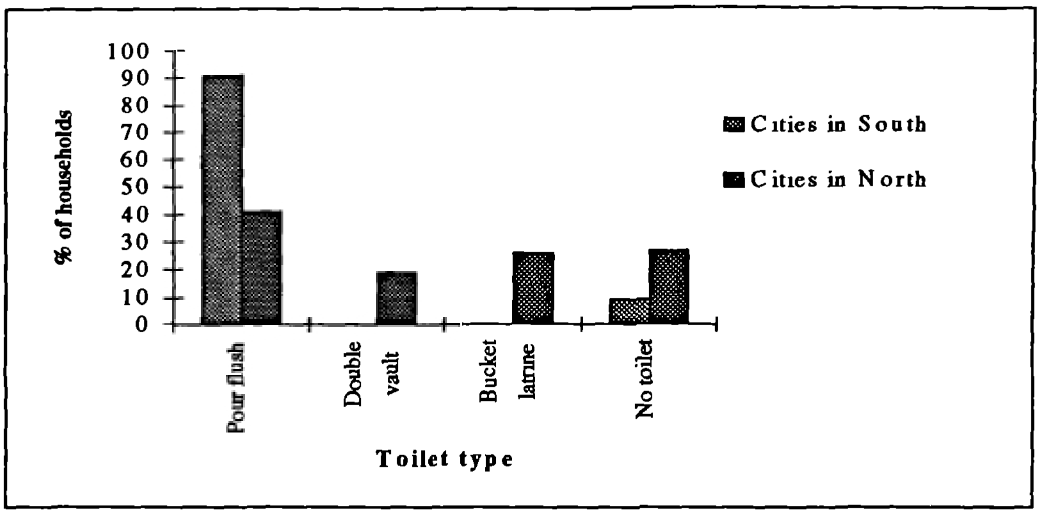

Figure 6-7 North-South differences in household sanitation.

The overall average number of urban households that are without own sanitation facilities is now about 14%. This corresponds roughly to the percentage of temporary houses - about 19% in 1992-93[22]. Some improvements have probably taken place since then, so that the share of temporary housing should be lower now, if there is a correlation between households living in temporary houses and households without toilet facilities. It may, therefore, be reasoned that households living in temporary housing are likely to neither afford nor be willing to invest in improved sanitation facilities. The population living in this type of housing may be served by communal or public facilities.

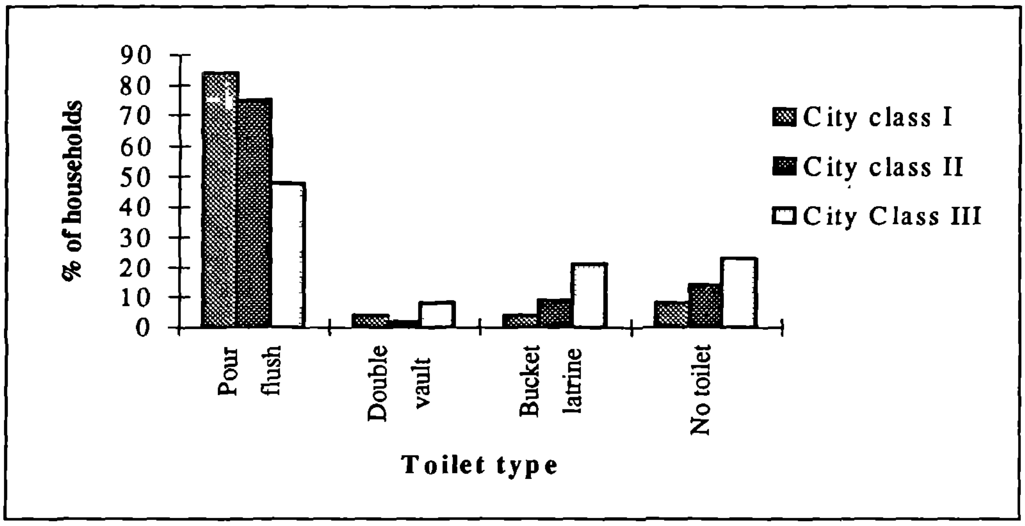

Figure 6-8 Toilet types used in households surveyed.

[22] *Vietnam Living Standards Survey 1992-1993, Table 9.2.2* ("Temporary houses or other" consists of types of dwellings constructed from primitive and simple materials, such as tents, shacks, sheds, places under bridges, containers used for living. Houses that are going to move , demolish or dismantle, but at the moment of the survey are being used for living, also belong to this type.)

Figure 6-8 shows that the share of households using flush or pour flush toilets is decreasing with the population of the city. Households in the larger cities generally enjoy a higher sanitation standard than households in the smaller cities, and not only that but the share of households that rely on bucket latrines and other simple or no toilet facilities is much higher in Class II and III cities.

Table 6-7 Toilet types in the NUSS surveyed cities, % of households

City	Class	Region	Flush or pour flush latrines	Double vault latrines	Bucket latrines	No individual toilets
Hanoi	I	North	48	18	16	18
Haiphong	II	North	27	0	23	50
Thai Nguyen	III	North	45	0	24	31
Hai Duong	III	North	55	33	0	12
Bac Giang	III	North	0	0	100	0
HCMC	I	South	95	0	0	5
Da Nang	II	South	83	4	0	13
Hue	II	South	63	1	0	36
Can Tho	II	South	91	0	0	9
Phan Thiet	III	South	36	0	0	64
Nha Trang	III	South	82	0	0	18

There are very large variations in the use of private toilet types in the various cities, even within the same city class or geographical regions, as shown in Table 6-7. The table confirms the fact that the non-water based toilets seem to be almost totally phased out in the southern cities. Nevertheless, the demand for improved sanitation is high in some cities, such as Phan Thiet and Hue. The conclusion is that one can not generalize the sanitation condition according to city class or region, but that the demand for sanitation must be assessed individually for each city.

6.4.3 Operation and Maintenance

The existing drainage systems are generally quite old, 20 years or more, except for some recent developments in the cities in the South. The physical condition of existing drainage systems is deteriorating due to wear and tear and neglect of maintenance. The rate of replacement of old pipes is generally much lower than the rate of deterioration of existing pipes, which means that not only will it be necessary to invest in public sewerage to meet future demands, but also to step up investments for rehabilitation of existing system to prevent further deterioration of sewerage and drainage services.

Serious constraints are caused by a general lack of equipment, spare parts, chemicals, and funds for operation of pumping stations and other facilities. All maintenance is carried out manually, and there is no motorized equipment available for cleaning or flushing out sand, grit and debris accumulating in the pipes. There is also a shortage of financial resources, trained personnel, as well as of qualified staff for maintenance management. As-built drawings, repair and maintenance reports are generally incomplete, inadequate or missing all together.

Pipes have been laid at too flat a slope, and the curb inlets lack adequate sand-traps. These deficiencies together with lack of means or equipment for hydraulic flushing contribute greatly to the difficulties of operating and maintaining the drainage system.

The existing combined sewers are likely to have serious groundwater infiltration and sewage leakage problems, which will further complicate proper waste water management in the future, whether combined or separate sewers are used.

The particular solid waste collection system used in most cities in Vietnam add to the drainage operation and maintenance problems. Solid waste that is thrown in the street is swept along the curb and often into the drainage inlets, or flushed down the curb with wastewater and runoff water during rain storms. If there were collection bins or containers for the households to dump their garbage, the clogging and drainage maintenance problem would be reduced. The collection system would be less labor intensive, but probably more economic, as the number of street sweepers could be reduced, and the collection vehicles could be used more efficiently. HCMC Urban Drainage Company reports that they removed 235,000 m^3 of sludge and debris from the drainage system in 1994, 450 km of drainage pipe, i.e. 0.5 m^3 /m/year, plus 440,000 m^3 from the rivers and canals. This amounts to 0.5 kg/day/inhabitant in HCMC, or nearly as much as the municipal solid waste (0.65 kg/day/person). There can be no doubt, that it would be far cheaper to collect the waste before it entered the drains.

Sewage from houses with flush toilets are flowing into the drainage pipes. Due to the flat gradient and low flows the water in the drains quickly turns anaerobic and the gaseous sulfuric acid corrodes the crown of concrete pipes.

Additional maintenance problems are caused by septic tanks that are not emptied frequently enough resulting in overflow of solids to the streets and drains. A septic tank should normally be emptied every second year, but it was found out by the NUSS Survey, that they are emptied only every 6 to 9 years. The NUSS Household Survey in Haiphong confirmed, that the emptying frequency of the oldest tanks was on the average 9 years. The impression is that some of the public service companies have more than sufficient equipment capacity, but the equipment may not be appropriate to reach septic tanks along narrow alleys or too far from major roads, and therefore not accessible for the large sludge suction vehicles used today. The larger cities, where the change to flush toilets have been particularly rapid, have insufficient equipment as well as inappropriate equipment. As more than 50% of the tanks have been installed during the last 5 to 6 years problems caused by loss of infiltration capacity due to clogging of the ground, and solids build up in existing septic tanks, may not have become apparent or serious enough yet to raise the concern of the households and public entities.

On the other hand sludge from septic tanks are generally collected only on request from the households by the urban public service or environment companies. Due to economic reasons households will not request tank emptying services unless there are obvious problems or concerns to the owner or user. Regulations regarding enforcement of regular and compulsory emptying of septic tanks are not in place. This particular problem may therefore continue unaddressed for a long period of time.

In Class I or II cities sludge is normally disposed of at the municipal solid waste landfills without any treatment or special arrangements, whereas in Class III cities farmland application is prevailing. However, in the biggest cities, sludge from collection trucks is also known to be dumped into the nearest and most convenient sewer or water body. Private contractors may to a lesser degree be involved in septic sludge collection.

Nightsoil from bucket and vault latrines is generally collected by private contractors and sold to farmers, or collected directly by the farmers. The farmers use the nightsoil as fertilizer and soil conditioner and apply it to agricultural areas without pre-treatment. The urban public service and environmental companies frequently collect nightsoil from public toilets with bucket latrines. Also this part of the nightsoil is sold to farmers.

Solid waste is disposed of in open dumps. There is no control with leachate or greenhouse gases generated by the decomposing material. The waste is not properly compacted and soil covering is not used. Spontaneous and man made fires at the landfills are common. Uncontrolled scavenging for glass, metal, hard plastics is common on all landfills. Hanoi is operating a small composting plant, but the market and selling price for this type of compost are too low to even recover the operation cost. HCMC also has a mechanical composting plant, but is has been put out of operation for economic reasons. A private company in HCMC is manually producing small quantities of high grade compost.

Hospital waste is regularly being placed unprotected on the sidewalks for collection together with other municipal solid wastes, where it is exposed to humans, animals and insects that may become carriers of infectious diseases. A separate collection system and safe disposal of hospital waste are urgently needed.

6.4.4 Waste Disposal and Discharge

Municipal Wastewater Quantities

Table 6-8 shows the estimated domestic public water supply and wastewater flows for the various city classes based on information from the study survey. Wastewater flows are very uncertain as the flows are not measured in any of the cities. It is seen that the wastewater flow for the Class I is higher than the domestic water supply. This may be explained by the fact that many households are using private water wells and some of these households might also be connected to public sewers. This is particularly common in the South, for example in HCMC. The data reveal that water supply is increasing with the city size and that this trend is even stronger with regards to wastewater. Specific wastewater flow is only 39 l/day/person in the Class III, increasing to 125 l/day/person in Class I cities. This reflects the fact that a smaller proportion of the households with flush or pour flush toilets are connected to public sewers or drains in the smaller cities.

Table 6-8 Public water supply and wastewater flows

	Public water supply l/day/hh	Wastewater/ water supply %	Domestic wastewater l/day/hh	Specific wastewater l/day/per.
City Class I	472	119	562	125
City Class II	352	87	306	68
City Class III	281	62	174	39

Table 6-9 shows that the percentage of households with flush toilets who dispose of their wastewater on-site appears to increase with the size of the city. It would be expected that the effluent from septic tanks would be infiltrated into the ground, but it has been observed that in many urban areas wastewater is discharged directly into the streets, drainage ditches or natural water areas. Information about soil permeability and groundwater level suggests that the Red River and the Mekong River deltas may not be suitable for ground infiltration, while cities along the coast from HCMC to Danang have more favorable ground conditions for on-site disposal.

Table 6-9 Disposal of domestic wastewater, % of households

	Flush toilets	Disposal to public sewers/drain	On-site disposal from septic tanks
City Class I	84	48	37
City Class II	75	44	31
City Class III	48	25	24
Average North	41	27	14
Average South	91	52	39
Average All	76	44	32

Most households use so called "sealed" septic tanks. This is a two chambered tank with a volume of 2-4 m^3 with open bottom and without overflow pipe. In areas where the ground is too impermeable to allow infiltration, or the groundwater level is too close to the ground surface, there is an overflow pipe that allows the wastewater to flow into the street, drains, or elsewhere.

The share of households that use on-site disposal in the South is two to three times as high as in the North., which underscores the fact that the sanitary conditions are better in the urban areas in the South than in the North.

Industrial Wastewater

There is only one known operational industrial wastewater treatment plant in Vietnam, namely in Hanoi for tannery waste water. The plant was financed by UNDP for training purposes, but it is reported by the managers of the factory, that due to lack of raw materials, the factory is not in operation at the moment.

Most of the industries are generally located within the residential and commercial areas. These discharge their wastewater into the public drainage system without any pretreatment or control. This is unacceptable from both an environmental and public health point of view, as hazardous and toxic substances may cause a much more serious and longer lasting damage to the environment than domestic wastewater.

Insufficient information is available to make a meaningful assessment of industrial wastewater flows, treatment or disposal methods, however, Table 6-10 contains data from the study survey. The industrial wastewater flow as a percentage of the industrial water consumption varies from 14 to 100% with an average of 39%. Reportedly the industrial wastewater in Haiphong equals the consumption, which seems unlikely, and probably there is reporting error. It seems equally improbable that industries in Hanoi should discharge only 14% of the consumed water. If both these cities had been excluded, the wastewater ratio would have been 52%. Based on the available information it is assumed that the industrial wastewater flow is in the range of 35 to 55% of the consumption.

Table 6-10 Industrial water consumption and wastewater flow

City	Class	Consumption m^3/d	Wastewater m^3/d	Wastewater %
Ho Chi Minh City	I	100000	44869	45
Hanoi	I	80000	11340	14
Haiphong	II	9000	9000	100
Da Nang	II	10600	10000	94
Hue	II	5850	5000	85
Hai Duong	III	1100	1000	91
Total		206550	81209	39

Wastewater Treatment

Only in Hue is there a primary treatment plant with a capacity of 300 m^3/day, which is 6% of the total municipal wastewater flow. A primary treatment plant for domestic wastewater has been installed in Kim Lien district in Hanoi. The operation of this plant was stopped, presumably due to lack of necessary funds for operation and maintenance.

Most of the 76% of the households that have flush toilets also have septic tanks as a pretreatment before disposal. A fairly large number of households do not have septic tanks, probably in the range of 20% based on observations in Haiphong. This means that the equivalent of primary treatment is provided to only 50-60% of the domestic wastewater flow.

Ponds, lakes, canals and rivers are used as receiving waters. They provide natural purification of wastewater, but water quality analyses from the lakes in Hanoi indicate that the purification capacity has been exceeded. All the surface water bodies are considered euthrophicated or polluted by wastewaters. During dry season the bottom layers and sediments are anaerobic. A danger prevails, that many of these natural water bodies will turn anaerobic unless the pollution load is reduced. The canals in HCMC are already overloaded and septic.

There are no known operational industrial wastewater treatment plants, except for the tannery treatment plant mentioned earlier.

It is concluded that the public and industrial sectors lag far behind the households with respect to wastewater treatment and pollution control.

Sludge and Nightsoil

Exact information about the quantities of sludge and nightsoil collected and disposed of by the public and private companies are not known. However, Table 6-11 gives information about the average quantities collected from each household according to the city classification. There is insignificant regional differences in sludge and nightsoil collection rates. The relatively large difference in sludge collection rate per household for the various city classes may be the result of several households sharing toilet facilities, and that the survey has not been able to differentiate between house with own and households sharing in-house toilets. This situation is believed to be more prevalent in the larger cities with blocks of flats. Nightsoil collection rates are, on the other hand, considerably higher per household in the smaller cities, but city sample size may be too low to give an accurate estimate.

The amount of sludge and nightsoil collected per person seems surprisingly low. The nightsoil and septic sludge collection in Shanghai amounts to about 1.0 kg/day/person[23]. Septic tank sludge production is roughly 10-20 g/day/person of dry solid, and with a water content of about 97%, the volume would be 0.3-0.6 l/day. This shows that uncontrolled discharge of wastewater (liquid and solids) from septic tanks must indeed be widespread.

An adult discharges[24] per day 130-140 g of faces and 1.5 l of urine, or a total of 1.6 kg, but the Survey shows that only 0.11-0.19 l/d/person is collected (based on households using bucket latrines). The explanation for the very low generation of nightsoil could be that not as many households as reported are using bucket latrines, particularly communal facilities, or that the quantity of sludge collected is grossly under-reported.

Table 6-11 Quantities of septic sludge and nightsoil collection

City	Septic tank sludge[1)]		Nightsoil[2)]	
	l/day/hh	l/d/person	l/day/hh	l/d/person
Class I	1.27	0.28	0.48	0.11
Class II	0.87	0.16	0.61	0.11
Class III	0.35	0.08	0.85	0.19

Notes:
1. Based on households connected to public sewers/drains
2. Based on households with septic tanks with on-site disposal, vault and bucket latrines

[23] *Shanghai Environmental Project,Staff Appraisal Report*, World Bank, 1993.
[24] *Human Faeces, Urine and Their Utilization*, by ENSIC Translation Committe, May 1981.

Solid Waste

Municipal solid waste is collected daily from all urban areas and disposed of in nearby uncontrolled landfills. Reportedly about two-thirds of the population have access to regular waste collection, regardless of city class and region. The average amount collected per person per day is about 0.70, which appears quite reasonable when compared to the specific collection rate in other Asian cities. The actual generation is somewhat higher, probably in the range of 0.8 to 1.0 kg/day/person after recovery of recyclable materials at source of waste generation. It can be estimated that 40 to 50% of the waste generated remains uncollected. Some of this will be burned by the households, some will be left to decompose on the ground, but a substantial part ends up in sewers, drains, canals, and other water bodies.

A very small part of the solid waste is composted in Hanoi and HCMC. Most of the valuable recyclable materials, such as metal, glass, hard plastics, cardboard and clean paper have been recovered before the waste is thrown away. The remaining recyclable materials have a very low potential value, and further source separation as an impediment to waste minimization and resource recovery is not considered viable.

Industries are responsible for collection and disposal of their own solid waste, but there is no control with or monitoring of how industrial waste is managed. Hazardous waste handling and disposal, and in especially hospital waste, is a particular environmental and public health concern.

6.4.5 Environmental and Health Impacts

The Sector Study comments, that the health status compares favorably with that of other lower middle-income countries in Asia. Vietnam has generally a higher life expectancy and a lower infant mortality rate than some of the neighboring countries. The nutritional level was low in the late 1980's but has since then improved considerably. Vietnam, which at that time had to import rice, has managed to improve its agricultural outputs and is now one of the major rice exporters in the region. The relatively good health condition may partly be attributed to the fact that personal hygiene is good, and that there is a general understanding of the relationship between water, excreta and health.

UNDP gives an estimate of population per doctor around 1,000 in Vietnam, or about the same as in China, but significantly higher than in Indonesia, Thailand or LDCs (less developed countries) as a whole. Population per nurse also compares well with other LDCs.[25] However, the professional competence of Vietnamese doctors varies, depending on the extent of their training.

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[25] *Vietnam's Dilemmas and Options* - ASEAN Economic Research Unit, Institute of Southeast Asian Studies, 1993.

Vietnam ranks below the average among LDCs in terms of public access to safe water supply, and is at the same level as Indonesia. Lack of safe water and of adequate sanitation practices and facilities are major causes of Vietnam's above-average incidence of water-borne and hygiene-related diseases such as gastro-enteritis, diarrhea, typhoid, cholera and hepatitis. Excreta from compost latrines is traditionally used as fertilizer in paddy fields in the North. This has resulted in intestinal parasites affect more than 95 % of the population (includes rural population) in the North and 40 % in the South.

The vector-borne diseases, malaria and dengue fever, are major health problems, as are water-borne diseases and acute respiratory infections. The ten leading causes of morbidity and mortality are practically all due to communicable diseases, most of them preventable. Based on the Vietnam Living Standards Survey 1992 - 1993, only 51 % of urban people, who said they were sick in the past 4 weeks, visited a public health center. The average annual private per capita health expenditure is Dong 82 560, and it takes 6.1 % of consumption expenditure. The total annual health expenditure per capita from the government budget was in 1992 Dong 17 206, and in 1993 Dong 23 160. See Tables from Table II-12 to Table II-14 in Appendix II.

UNDP cites an overall figure for life expectancy in Vietnam of 62.7 years for 1990[26], slightly above that of Indonesia, and slightly below those of Thailand and China (See Table II-15 and Table II-16 in Appendix II).

Urban Environment

Municipal wastewater is discharged without treatment to rivers and lakes. The NUSS Survey revealed that the majority of households have flush toilets, indicating a high environmental standard. Unfortunately this may be deceiving, because most households discharge their septic tank effluent directly into the streets, drainage ditches or natural water bodies. The minority infiltrate the effluent into the ground, although this may vary from place to place according to the soil condition. There is a flagrant lack of environmental management and control with the disposal of wastewater from public as well as private sanitation facilities.

For example, the situation in Haiphong may only be representative for the Red River Delta, where the soil is clayey and not very suitable for ground infiltration, but according to the Household Survey, 81% of sullage from households is discharged to the streets. Among households with flush toilets and septic tanks only 9% infiltrate the effluent the into the ground, 67% discharge directly to the streets, while the remaining 24% to natural waters or wetland. It is not difficult to observe in Haiphong, that sewage and sullage are flowing long distances along the gutters where it mixes with the street garbage.

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[26] UNDP: *Human Development Report, 1991*, New York, Oxford University Press.

The management of industrial wastes, both liquid and solid, is generally the responsibility of the respective industries, but government monitoring, control and enforcement of environmental regulations are lacking or absent. The environmental and health impact of uncontrolled disposal of toxic industrial waste is likely to be more serious and longer lasting than for domestic wastes.

Hospital wastes of all kinds are also disposed of without adequate treatment and control, even though some hospitals have treatment facilities, they are not put into operation. This poses a most dangerous public health risk.

Poor management of nightsoil and septic tank sludge is another major environmental concern. Nightsoil is regularly sold to farmers for application on their fields as a fertilizer or soil conditioner without treatment. This use of untreated nightsoil is illegal according to the current environmental legislation, but the enforcement is overlooked. The Sector Study reports, that infestation rates of intestinal parasites are more than 95% in areas that use nightsoil in the agriculture. This compares well with findings from studies in China and elsewhere.

It was found in the NUSS Survey that about 14% of the urban population have no proper toilet facilities. Some of the people in temporary dwellings use overhang toilets and defecate directly into rivers, lakes and ponds. This, of course, adds to the pollution of these waters and is not exactly a sanitary practice. Also, it can be observed that there is a fair amount of indiscriminate defecation and urination in urban areas, even directly into the street gutters. This is a particularly unsanitary practice and a considerable public health concern. However, it can be understood that people resort such measures, as the public and communal toilets are far apart and often in appalling conditions. There is a dire need for improving the public and communal toilet situation in most cities.

It is perhaps part of the unique Vietnamese culture, that so much of the daily activities and trade are conducted from the sidewalks and in the streets. This pulsating life may seem fascinating to a casual visitor, but it is a very important contributing factor to the urban pollution problem. For example, animals are slaughtered, food prepared, utensils and clothes washed on sidewalks and in streets, and solid and liquid wastes flow along gutters and into drains. It is against the current environmental laws to leave solid waste in heaps in the streets. Nevertheless, waste is left in heaps on the ground to be collected by the street sweepers or swept into the drains. It has been estimated that as much as 40-50% of the solid waste remains uncollected. This enhances the clogging, pollution and foul odor problems in an otherwise so pleasant and interesting urban environment.

Table 6-12 Extent of flooding and drainage systems in urban areas

City	Class	Frequency of flooding times/year	Area inundated %	Urban density pers/ha	Trunk sewers m/ha	Trunk sewer m/person
HCMC	I	5-6		238	30	0.13
Hanoi	I	5-10	60%	231	29	0.13
Haiphong	II	often		203	85	0.42
Da Nang	II	2-3	10%	155	25	0.16
Hue	II	1	20%	38	4.9	0.13
Can Tho	II	0		45	7.4	0.16
Phan Thiet	III	5	10%	90	6.3	0.07
Nha Trang	III	1	10%	346	45	0.13
Thai Nguyen	III	not usual	5%	51	1.3	0.03
Hai Duong	III	3-5	50%	16	6.3	0.38
Bac Giang	III	not usual	20%	46	5.8	0.13

Most of the urban population live in flood prone areas in the major river deltas. As a matter of fact large urban areas are located in low laying areas below the maximum river elevations. Flooding of large parts of the cities several times per year is not uncommon, as shown in Table 6-12. It has not been possible to quantify the damages, economic losses, public health impact and hardship caused by these frequent flooding, but it must indeed be considerable. The situation is somewhat better in cities outside the big river deltas, such as Da Nang, Hue and Nha Trang, mainly due to the topography and the sandy soils.

The drainage systems, which almost entirely consist of combined sewers without pumping stations, drains and canals, are generally in poor condition due to lack of maintenance, poorly designed and constructed, and without sufficient hydraulic capacity. Drainage coverage is unevenly developed in the various cities, as demonstrated by data in Table 6-12. The length of trunk sewers per ha and per person are useful indicators, which show that the extent of trunk sewers in most cities in Vietnam is about one-fifth to one-tenth of what would be required for a well sewered city.

Water Quality Considerations

There are numerous lakes, rivers and ponds within the urban areas. These are used for drainage, flood control, recreational purposes, irrigation, aquaculture and as receiving waters for wastewater. Table 6-13 lists the area of natural water bodies in some of the cities studied. Hanoi has the largest proportion with 15% of city area as natural waters, but HCMC and Haiphong also have large water areas.

These resources are generally heavily polluted with a water quality more typical for wastewater, see Table 6-14. Discoloration, foul odor, and floating garbage make many of these water bodies repulsive instead of the attraction they could have, and they have become a liability instead of an asset. Water quality samples from the lake inlets and outlets show high nutrient concentration and eutrophication of the lakes. The natural purification capacity of some of these lakes have already been exceeded during the dry seasons. The high biological oxygen demand and correspondingly low dissolved oxygen concentrations indicate that these waters cannot sustain aquatic life. Gas bubbling from the bottom shows that the bottom sediments are anaerobic.

Table 6-13 Water areas in urban areas

City	Lake area ha	Water course area ha	City area ha	Portion of water area %
HCMC		1,045	14,036	7.4
Hanoi	551	79	4300	15.0
Haiphong	62	57	2000	6.0
Da Nang	22	8	2830	1.1
Hue	20	87	6770	1.6
Can Tho	13	47	5540	1.1

Table 6-14 The quality of natural water bodies in urban areas

Parameter	HCMC	Hanoi	Haiphong
pH	6-7.4	7-7.5	7-8
Oxygen, mg O_2/l	0-4	0-6	
Turbidity, FTU	25-300	20-300	10-160
Conductivity, µS/cm		300-750	200-600
Phosphorus, mgP/l		0.2-8	0.5-2.5
Total Nitrogen, mgN/l			50-90
Ammonia, mgNH_3-N/l	0.7-30	0.6-35	2-20
Suspended Solids, mg/l	25-300	5-50	200-1700
COD, mg/l	15-400	25-300	90-400
BOD_5, mg/l	15-200	8-40	40-400
Coliform count, nos./l	10^3-10^6	10^4-10^5	10^3-10^8

The groundwater is also reported to be polluted in many cities, although detailed information has not been made available.

Health Impacts

The health impacts have been assessed by correlating health statistics with service coverage and physical and environmental factors such as flooding, groundwater level, and soil permeability. The health statistics[27] are provided on the provincial level only, and will therefore include a larger than the urban population in the cities studied. The combined incident rates of diarrhea, shigellosis and amoebiasis have been used as health indicator. These excreta related diseases are transferred from man to man. Reference is made to Table II-12 and II-13 for detailed information about the incident rates and to cross reference Figure 6-9 for the service coverage and correlation parameters for each city. Individual graphs and regression lines have been plotted as shown in Figure 6-9. The graphs show that the disease incident rate is declining rapidly with the extent of water supply coverage, with increased coverage of public sewerage or drains connections, and with the percentage of households using wet type. The incident rate is also dropping with increasing urbanization. The reason for this is probably that the water supply and sanitation services are not as well developed in the rural areas, and the fact that the rural population is much more exposed to contaminated water, soil and food from the use of nightsoil on cultivated areas.

The curve representing disease occurrence against solid waste collection services shows a very slight upward trend. This could, possibly, be explained by the fact that the collection workers and scavengers at the landfill are at risk of direct exposure to the solid waste, which frequently contains excreta or is contaminated by sewage.

The occurrence of flooding and groundwater level show no correlation with the occurrence of diseases. An increase in soil permeability indicates a significant decrease in the disease incident rate, and could possibly be the result of more wastewater being infiltrated into the ground in these areas, and thereby reducing the amount of wastewater that otherwise would be discharged directly to the streets and surface waters, where people are more prone to be exposed to contaminated water and soil.

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[27] *The 1994 Health Statistical Yearbok for Vietnam,* Ministry of Health, People's Republic of Vietnam

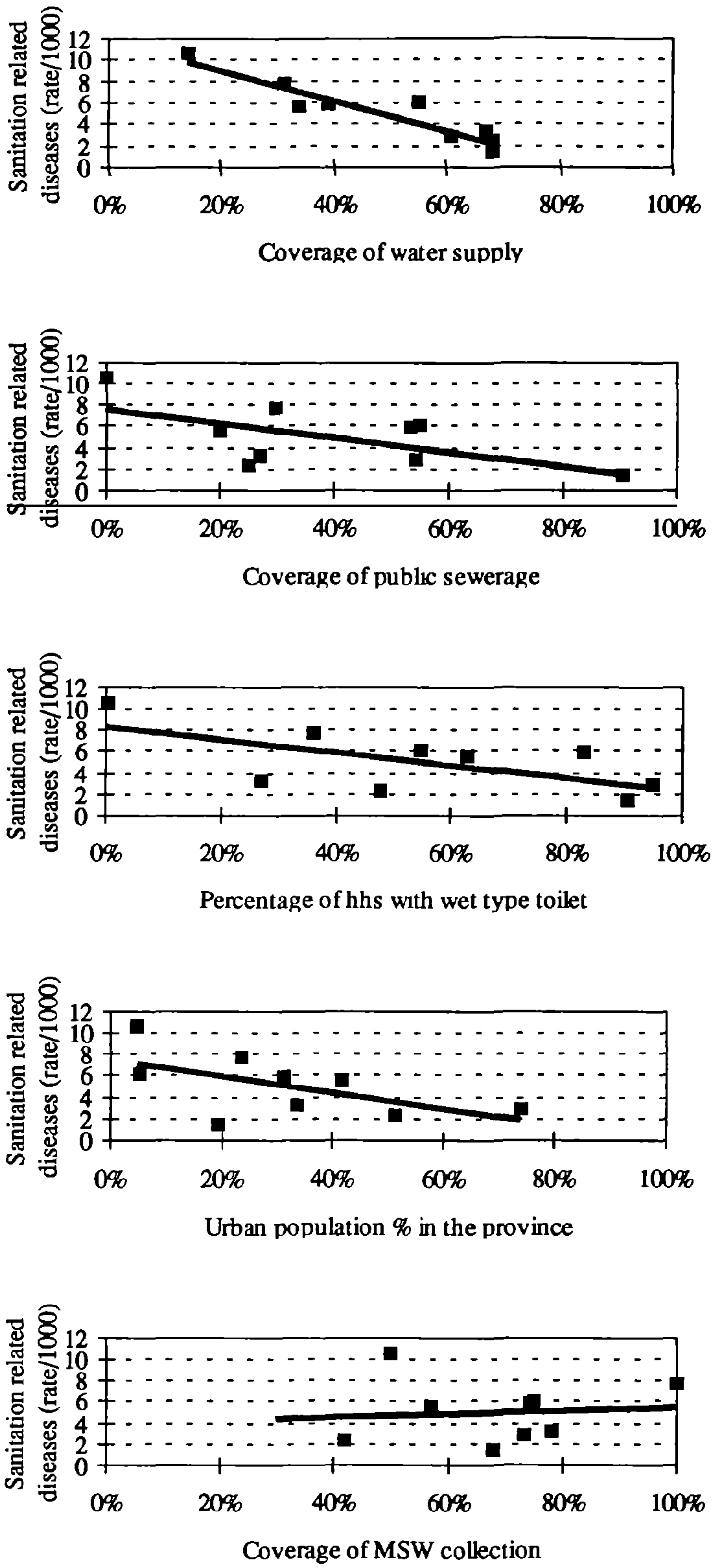


Figure 6-9 Health impact analyses.

6.4.6 Design Codes and Standards

General

The design codes and standards used in Vietnam are generally based on norms used in the former Soviet Union, the so called "SNIP Norms". These norms have to some degree been modified to reflect the Vietnamese conditions, but are generally considered unsuitable for today's requirements. The norms are used as guidelines only, and various design institutes or consultants propose their own design criteria and standards for the individual projects.

Every project, whether it is prepared by a government agency or a private entity has to go through an approval procedure that may possibly enable coordination. A project proposal is first submitted to the Provincial People's Committee for approval, and from here it may be passed on to the standing Evaluation Committee under MOPI. This committee is an advisory board to the Prime Minister, who has the final mandate and power to approve or reject a project proposal.

The main drawbacks of the current system are that codes and standards are not known to the designers and builders. Time and resources are lost in preparing individual design criteria and standards, and the approval is, at least theoretically, open to influence, manipulation and abuse. Finally, the most appropriate and cost effective designs for the conditions found in Vietnam may not be applied.

Presently AIDAB is financing a study to prepare new design guidelines and standards for water supply and sanitation works. The draft report is expected to be ready in May 1995.

Table 6-15 Water supply, sewerage and drainage systems standards in Vietnam.

Code	Title
TCXD 70-77	Taking over and operation rules for sanitation facilities of industry and civil construction works
TCVN 5576-91	Water supply and sewerage systems, technical management rules
TCVN 3988-85	Design documents and working drawing standards for construction of water supply and sewer networks
TCVN 4038-85	Terminology and definitions for water, sewerage and drainage systems
TCVN 2622-78	Fire fighting water
20TCN 51-84	Standard branch sewerage and drainage system and works. Standard design
20TCN 66-91	Operation of water supply and sewerage systems safety
Sector Standard	Design criteria for water distribution systems and structures
Sector Standard	Drinking water quality standards

It is noted that there are no specific standards for the production of pipes, equipment or materials. Likewise there appear not to be standards applicable to construction and testing of pipes and works prior to handing over or completion of a project. It is emphasized that there seems to be no standards for testing of the water tightness of either water supply pipes or sewers.

Only the draft "Sector Standard. Design Criteria for Water Distribution System and Structure", and 20 TCN 51-84 which apply to the design of sewerage and drainage system have been reviewed. The following specific comments are made:

<u>Water Supply:</u>

(i) Overall domestic water consumption:

- Major cities, tourist cities 200-300 l/c/d
- Medium and small cities, towns 150-200 l/c/d
- District towns 80-120 l/c/d

(ii) Residential water consumption:

- Houses with private taps, without wet toilets 60-100 l/c/d
- Houses with wet toilet, shower, internal drainage 100-150 l/c/d
- Houses with wet toilet, bath tub, internal drainage 150-250 l/c/d

The per capita domestic water consumption in major cities is considered excessive. Very few cities in Asia have domestic water consumption higher than 100-150 l/c/d. This is also considered a normal water supply in urban residential areas in Europe. The specific domestic water consumption was found to be 166 l/c/d in Class I, 122 l/c/d in Class II and 160 l/c/d in Class III cities according to the NUSS Survey.

Sewers and Drains:

(i) Runoff water is calculated according to the Rational Method, i.e. based on rainfall intensity, runoff coefficient and catchment area. The rainfall intensity is based on estimates of time of concentration for overland plus pipeline flows. This is a conventional design approach, used worldwide, where data are not developed that allow application of the more accurate and sophisticated Unit Hydrograph Method;
(ii) DCWSS has now adopted the Manning's Formula for canal and partially full flowing pies. This is also a conventional standard and acceptable design procedure. Minimum pipe velocities are given as a function of the depth of dry weather flow, ranging from 0.75 to 1.00 m/s. If the households are using septic tanks the minimum velocity is allowed to be reduced by 30%. While this may be an acceptable approach in a country where there is control with the septic tank discharge or sludge emptying, and where there is not so much garbage entering the drains, it is considered inappropriate for the typical conditions in urban areas in Vietnam. It would result in excessive settling of solids in the pipes;
(iii) the minimum pipe diameter for domestic wastewater is 300 mm if installed in streets and elsewhere 200 mm;
(iv) the standard specifies a minimum pipe wall thickness, but fails to give standards for pipe strength, and is therefore considered to be of little practical value. The standard also fails to specify requirements as to pipe joints and water or air tightness tests, vertical and horizontal laying tolerances, etc.;
(v) there seems to be no standards or requirements for installation of sand and grit traps on combined sewers or storm drains; and
(vi) finally, there are no standards for leakage testing of water supply or sewage pipes.

Septic Tanks:

(i) Paragraph 7.3 states that septic tanks should be used for primary treatment of wastewater before discharge to lagoons, infiltration beds, or infiltration wells. It states specifically that **septic tanks with filtration compartment should not be used**. If this standard is understood correctly it means that the so called "sealed" septic tank with an open bottom, that is so widely use in Vietnam, is contrary to this standard. The standard fails to give any requirements regarding infiltration rates for the various types of soil or how to design the infiltration beds or wells. However, the typical tank design used today is a 2.3 m^3 tank with open bottom. This has sufficient retention time to serve one or a few households, particularly if the sullage water is by-passed, but the infiltration area is only one-tenth of the internationally recommended criteria. It must therefore be expected that the soil under the tank will clog in depth, but this may take several years depending on the soil characteristics and distance to the water table.

(ii) The standard specifies that septic tanks shall be designed for one or two days hydraulic retention time, as this will ensure that the sediments can be taken out once a year. Obviously the installed septic tanks are not operated according to this criteria, as the emptying frequency is found to be between 6 and 9 years

(iii) Three types of septic tanks are specified:
- One compartment tanks for flows of 1 m^3 /day
- Two compartment tanks for flows of 10 m^3 /day
- Three compartment tanks for flows between 10 and 25 m^3 /day.

  The capacity of the first compartment shall be 50% and 75% respectively for the two and three compartment tanks.

The design guidelines for sewers and septic tanks are not considered appropriate for the conditions found in Vietnam.

6.4.7 Local Production

Locally manufactured products and factories are listed in the Table II-17, Appendix II. The data is based on the information gained through DCWSS in April -95, the latest investments and the projects under preparation are not included.

On-site Sanitation Equipment

Main products are ceramic pour flush bowls and hand washbasins. Toilet seats with cisterns are not locally produced, most of them are imported. They are mainly manufactured according to the American and Italian standards, and the volume of cistern is unreasonably (10 - 15 liters) large.

Slabs of toilets are normally cast at the site from local materials. The septic tanks and vaults are normally constructed of locally manufactured clay bricks. The total production capacity is not known, but the it seems to meet the demand. The quality of bricks varies a lot and do not follow any international standard. Most of the brick factories are of small scale and are owned by individuals or co-operatives.

Burned clay pipes, which are produced by small scale industries, are commonly use in as drains of individual houses and industries having corrosive effluents. The quality and tightness of these pipes is questionable. The resistance to traffic loads and wear is weak. Recently locally manufactured PVC pipes are substituting clay pipes.

The usage of cast iron pipes has reduced due to the high costs.

Waste Water Collection

Concrete Pipes

Most of the industrially manufactured pipes do not fulfill any international standard, and even the Vietnamese manufacturing standards are missing. The products are manufactured according to different dimensions and the reinforcement varies depending the manufacturer. Rubber seals were introduced recently by Thinh Liet Concrete factory and VIBEX Union of Concrete Construction Enterprise, but their products are not yet widely used. The joints are normally done by concrete filling or by brick sleeve, which means that in the Vietnamese soil conditions watertight joints can not be done. The quality control of production of some factories is weak and the production technology is out-dated.

There are hundreds of local small scale concrete pipe production, which use manual technology for mixing of aggregates and cement, bending and cutting of steel bars, and molding the pipes. This production is completely uncontrolled, and the quality of pipes is more than questionable. During field visits to manufacturing sites it could be seen that part of the pipes were already cracked and joints damaged. The usage of these pipes, combined with rough handling during transportation and poor workmanship of pipe laying, has created problems (leaking, collapses, etc.) which are expected to increase in the future.

PVC Pipes and Fittings

The total capacity of plastic products is approximately 2,300 t/a. This figure includes a wide variety of plastic products comprising consumer items, domestic and medical appliances, and PVC pipes. The range diameter of PVC pipes varies from 1/2" to 8", some of the factories use British units and some ISO-standard units. The biggest manufacturer of PVC pipes is Tifoplast in Haiphong. The production of 1992 was 1,100 t of uPVC pipes with diameters 21..160 mm.

The first imported PVC pipes in water supply network were introduced in Hanoi Water Supply Programme as late as in 1985 by the FINNIDA financed water supply project. The usage of locally manufactured PVC pipes is limited and mainly limited to water supply distribution networks and internal plumbing works. The small diameter of PVC pipes is reducing their applicability for sewer and drain pipes.

The socket pipes are normally jointed by glue, only one factory uses rubber seals in the joints.

Manholes

The manholes whether having a sand trap or not are constructed of locally produced bricks. The reinforcement and watertightness of these structures is poor. Industrially manufactured concrete rings are not used in Vietnam.

During the French regime the covers were made of cast iron, but since then until early 1990's only insitu concrete slabs have been used. In most cases the quality and workmanship has been poor, and the covers are in poor condition or totally damaged. Tan Long Moulding Enterprise has started the production of cast iron covers for manholes.

The gullies to the sand traps are wide open, and don't have any grid or screen to prevent large objects to enter into the drain, which in turn results blockages in sewer pipes and local flooding. Based on the information from DCWSS, the steel grids are being introduced in new construction projects.

Waste Water Pumps

The pump factory in Hai Duong manufacturers clean water pumps and valves, but they don't have any sewerage pump in their production.

Most of the irrigation pumps are imported from the former USSR or other east European countries.

O&M Equipment

There is no industrialized local manufacturing of O&M equipment. The most commonly used equipment for removing sediment and sand from sand traps are spades, buckets and hand pulled charts. Some utilities have done themselves some special sewer cleaning equipment, manually pulled plugs etc.

All the vacuum tankers and pumps are imported.

Waste Water Treatment

There is no local manufacturing of waste water or sludge treatment equipment, except nightsoil and sludge application to agricultural use.

Aluminum sulfate, ironsulphate, lime and other chemicals that could be used in waste water treatment are produced locally.

Construction Enterprises

Construction enterprises are under several ministries. Major share of construction (80%) is under Ministry of Construction, but roads and railroad construction is under Ministry of Transportation, water ways and water resources development under Ministry of Agriculture and Rural Development. There are plenty of local constructors under provincial people's committees and more and more small private construction companies.

Usually the companies are poorly equipped and using labor intense technologies. In Vietnam the soil conditions are extremely difficult, therefore bedding of pipes and jointing should be done carefully. In none of the sewer line construction sites visited by the Study Team these phases were done properly. Leveling of pipelines is usually neglected due to lack of construction supervision. This and poor bedding result sagging of pipes and decreased hydraulic transmission capacity.

In 1990 there were 6557 registered units producing building materials. Most of these units are very small and poorly equipped. The capacity of cement production is increased in a few years.

7. MAIN ISSUES

7.1 INSTITUTIONAL FRAMEWORK

7.1.1 Low Priority of the Sector

There are positive statements concerning sanitation, public health and environmental protection in long term development strategies of the Government. However, these issues do not seem to enjoy a very high priority. Sustainable sanitary improvements are not possible without clearly indicated demand for these improvements. Sanitation is a commodity much more difficult to sell to customers than, e.g., drinking water. Therefore, the demand needs to be generated by social marketing, social pressure (solidarity), legislation, regulations and enforcement, and government incentives or budget allocations. This structure for demand generation is still very weak.

7.1.2 Overlapping Responsibilities and Duties

The roles of various organizations have, to some extent, been clarified and streamlined in the past few years. There is still overlapping in the duties and responsibilities of, e.g. health, environmental, and water resources authorities at the ministry level as well as at the provincial/city level. Project preparation, appraisal, and approval procedures are particularly complicated, involving many organizations and maneuvers. Project initiators need to intensively follow up the progress and lobby in the involved agencies.

Operational power, for instance operation of utilities, as well as implementation minor investments which do not need central level allocations, is decentralized to the provincial/city level. This is a major strength and a good basis for client-oriented management. However, this approach calls for skilled and motivated staff in every province, and local financing through revenue collection.

At the utility level, a special problem is the limited authority of drainage and sewerage authorities. For instance, small sewers are under the control of Quans and housing cooperatives, and emptying of septic tanks is sometimes under a separate waste utility (if such exists). Such division of duties may hamper efficient management of the system.

7.1.3 Poor Enforcement of Laws and Regulations

The legal system already provides reasonable means for relevant authorities to take measures against pollution and potential risks to public health. In fact, laws, regulations, and standards are partly too strict, in comparison with the existing situation in the country. It is impossible and unreasonable to enforce and apply all stipulations. This may, and most probably will, reduce the credibility of these and other regulations. The enforcement in general is still weak, probably due to the transition from one system to another, the relatively weak position of the enforcing ministries and agencies, and the low priority given to environmental and sanitation issues when aiming at rapid economic growth.

7.1.4 Lack of Sector Data Base

A major constraint for efficient sector development is the lack of a centralized sector statistics library and data base, where data and information would be freely available to all parties involved in the sector development. It is often very difficult to obtain adequate and consistent data, especially when data is required from agencies not directly controlled by the executing agency.

7.1.5 Human Resources

Human resource planning has paid littleattention to the emerging situation in the labor market brought on by the new economic order. One of the shortcomings of current human resources approaches has been inadequate economic analysis of human resources.

Implicit in the inadequacy of sector institutions is the non-recognition of an incentives structure for professional and skilled workers. The likely future scenario will feature stiff competition for available skilled staff among the sectors; between the public and the private sector; and among the developed and less developed areas. Labor export and foreign migration may also come into play. The sector institutions stand to lose skilled personnel ("brain drain") if this issue is not addressed in a holistic manner. The public sector, particularly state enterprises, are viewed as the source of skilled and semi-skilled labor by domestic and foreign investors.

There is difficulty in attracting and transforming operating staff into trainers with good teaching and technical skills. There is a need for more trainers who are skilled at using innovative methods..

In the context of appropriate technologies and multi-disciplinary, community-based approaches, HRD delivery systems are seldom organized to reach field staff and communities efficiently and effectively. Some NGOs have successfully ventured into community-level training. Their approaches need to be studied with the end view of long-term, country-wide replication by enabling the government to undertake similar methods.

Statements of sectoral and institutional priorities, performance indicators, and human resources assessments have generally lacked clarity. This has made the planning and evaluation of the HRD contribution to the attainment of sector goals difficult.

Locally, reliable evidence on the effectiveness of training as a developmental response in the sector is still scant. Inappropriate measurement indicators, limited follow-up of training, lack of investigation of outcomes and poorly-understood interrelationships between skill development and institutional strengthening all limit our understanding in this area. Thus, the expectations of sector, project and utility managers and policy makers on the impact of effective training is low.

Dependence on external funds to finance training activities is a growing cause for concern. While external agencies have been increasing its support for training and development activities, internally-initiated and internally-funded HRD activities have unfortunately declined further or become non-existent.

7.2 FINANCIAL PERFORMANCE

7.2.1 Lack of Financial Objectives and Revenues

The ongoing restructuring of the state economic sector has started slowly in sewerage and sanitation, and the target degree of self-financing of utilities is still unclear. The officially accepted policy, that the polluter pays, has not materialized, as yet. The government has shown little interest and attention to the Sector requirements, and has taken only a few measures for overall improvement of the Sector operations and cost recovery. Therefore, clear and urgent decisionmaking is required for financial objectives, strategies and policies, together with establishment of a sustainable revenue base for the Sector.

Tariffs for waste management and sewerage are too low or either totally missing in all the utilities in Vietnam. Only in Hanoi there is a surcharge levied in water billings for drainage and sewerage cost coverage. The connections to public sewers are not charged at all, which has led to an increase in government subsidies for operation and investment purposes. In those cases when a fee has been levied on a particular service like sludge collection, resulting revenues are usually disproportionally low in relation to the real cost of the service.

7.2.2 Low Priority in Budgetary Allocations

In 1994, the share of water supply projects, including sewerage and sanitation was about 5 % of the government's capital budget or 490 billion VND, out of which the assumed portion of sewerage and sanitation is only 10 - 20 %. The central government has strong control on local investments, regardless the stated policies that underline devolution of decisionmaking and administration. Even if case decisionmaking was decentralized, local authorities have very limited financial potential for investments and knowledge to identify and negotiate external finances.

Due to the substantial and lengthy underinvestment, the physical facilities of utilities are often in poor condition and wearing out without replacement, let alone new investment. Utilities have also remained behind in managerial development and skills, contributing to the high cost but low revenue operations.

7.2.3 Constraints in Funding Availability

Apart from insufficient budgetary financing, the Sector utilities have been unable to raise funding from other sources. Reasons are both structural and managerial. The financial market consists essentially of only 4 commercial banks which are now in transition, operating inefficiently, and unable to extend long term loans for investment purposes. New and usually foreign supported banks and their branches are being established at increasing numbers (currently about 60), but they are mainly for short term financing needs of high growth sectors like industry, commerce, tourism, and foreign trade. Another structural constraint is that savings mobilization in Vietnam is low, and other specialized financing institutions like insurance companies and pension funds are either non-existent or unable to fulfil expanding needs for long-term finance.

As for managerial limitations, utilities themselves are not responsible or experienced in raising foreign or local capital for investment. Instead, they have been waiting for help from local government which are also inexperienced and dependent on central government, when mobilizing finance from various sources. As a result, the Sector has not succeeded in competing for foreign development assistance.

7.2.4 Poor Financial Management and Low Autonomy

Utilities' financial responsibilities are often limited to basic book-keeping and periodical reporting for government and statistical purposes, whereas the core financial functions (such as tariff setting, staff remuneration, asset and depreciation management, capital budgeting, investment financing) have remained in the hands of urban and provincial authorities. Under these conditions, managers consider themselves as civil servants without initiative and motivation to improve the revenue base or cost efficiency of operations.

The present accountancy system does not fulfil modern management requirements, and internal cost accounting and capital budgeting are insufficient or non-existent. The large number of financial reports currently prepared are mainly for centralized planning, various authorities, and statistical purposes. Inadequate and unreliable accounting practices, together with lack of audit requirements, mean also a serious obstacle for obtaining financing from international financing institutions and many other sources as well. To correct the situation, the Ministry of Finance introduced in 1995 an accountancy reform to be adopted by state owned enterprises. Its application also to the Sector utilities is urgently required and a precondition for improved financial management procedures and practices.

7.2.5 Undervalued Assets

In spite of the asset revaluation done in 1992 and the Ministry of Finance's instructions to keep the fixed asset values updated, the Sector's assets seem to be highly undervalued. This is partially due to the insufficient transfer pricing of new assets and partially due to inadequate cost accounting and auditing systems.

The government regulates depreciation rates, but local authorities have different policies to implement them in practice. In some cases depreciation is not made in full, because in any case utilities have instructed to surrender the depreciation funds fully or partially to the government. These depreciation funds are not necessarily used for replacing a utility's fixed assets, but converted into a source of general budgetary financing. This policy has led to insufficient O&M and sustained deterioration of operating facilities.

7.2.6 Financing of Private Sanitation

Traditionally, investment plans of government utilities have not included on-site needs, nor have the financiers (i.e. government) of the utilities included provisions or financing means for on-site purposes. In spite of it, households have upgraded their sanitation systems by relying on savings and borrowings from the informal financial sector and private people. Borrowing costs from private lenders is high (3-4 %/month) and its availability is occasional.

Due to financial constraints, many of the households who prefer better sanitation conditions may not be able to improve the situation as needed. Almost all the respondents in socio-economic study answered that they prefer a monthly payment method to a lump-sum payment in order to install the improved sanitation systems. At the same time, respondents wanted to get financial support from the government for improvements of their sanitation facilities.

7.3 WASTEWATER AND SANITATION SERVICES

7.3.1 Disparity in Public and Private Service Levels

The development of wastewater and sanitation services has followed different paths in North and South Vietnam. This has lead to a significant disparity in the standard and coverage of services provided. The South has a better developed public wastewater system, and the dry type toilets have almost entirely been replaced with private, flush or pour flush toilets.

The smaller cities in the North and the South have not so well developed water supply and wastewater systems as the larger cities. Households have consequently invested less in wet type toilets, because these are not appropriate without a readily available water supply. The sanitation standards therefore are generally lower in the smaller cities, although there are significant differences from one city to another.

There is still a fairly large portion of households that have no toilet facilities or are using primitive facilities such as overhang toilets. These may possibly be households living in temporary housing, and the poorest that cannot afford the needed investments to improve their housing and sanitation facilities. Therefore there is a need:

(i) to develop financing mechanisms - subsidies and credits - that will enable also the poorest families to improve their sanitation conditions, and
(ii) for the local governments to upgrade existing facilities and to build new communal and public toilets.

Improvements in private sanitation facilities have taken place at a very rapid pace in the largest cities particularly during the latter part of the last decade. This process is expected to continue and to accelerate in the smaller cities, provided adequate water supply is provided. The preference is obviously for flush or pour flush toilets. Investments in public infrastructure has not followed at the same pace as in the private sector. Consequently there is now a large demand for infrastructure improvement, including construction of water supply and wastewater collection systems.

7.3.2 Lack of Waste Disposal Management

There appears to be a serious lack of management, control, and enforcement for disposal of wastewater from public and private facilities, industries, and hospitals. Wastewater that is discharged from public sewerage systems to rivers, lakes and other wetlands without treatment causes serious pollution. A large part of households with flush toilets discharge sullage and sewage directly to streets, open drainage systems, natural water bodies, or on the ground. Only a small part dispose wastewater on-site by ground infiltration, and those systems that do use "sealed" septic tanks with open bottoms are bound to fail over time. There is an urgent need to take steps to improve the management, control, and enforcement of discharge from septic tanks.

A satisfactory functioning system for collection and disposal of sludge and nightsoil from septic tanks and latrines is not in place. Sludge is dumped into drains, water courses or on the ground in a haphazard manner. Untreated nightsoil is spread on farm land without control. A system for collection and safe disposal of septic tanks sludge and nightsoil needs to be put in place.

Solid waste from households is dumped in the street where it mixes with wastewater and storm water before it is manually swept up, collected and disposed of in open, burning dumps. As much as 40 to 50% of the waste is not collected, and much of it finds its way into the combined sewers and drains, where it causes clogging and adds to the already very serious flooding problems. A better solid waste collection system that reduces the amounts of waste thrown on to the streets, and eliminates direct exposure to waste collectors, needs to be introduced.

The public health is seriously affected by exposure to liquid and solid wastes. Natural water bodies have become so polluted that they are unsuitable for all other beneficial uses than as recipients for wastewater. The urban environment has many places become most unpleasant due to littering of public areas, polluted and foul smelling lakes, rivers, and canals. This is not only a loss of valuable resources, but detrimental to tourism and international industrial commercial developments. A system for better protection of natural water areas needs to be developed, possibly by controlled use of existing wetlands for waste treatment and/or introduction of more conventional treatment methods.

There is a serious lack of properly prepared land for new industries. The city authorities are under pressure to give permission for new establishments, and industrial expansion is taking place within the already developed areas without the necessary infrastructure to handle industrial wastes, and without adequate enforcement of environmental legislation. This contributes to the already uncontrolled and serious water, soil and air pollution problems from the existing industries. Therefore, mitigating measures have to be taken to reduce and prevent industrial pollution, and measures to establish new industrial parks with properly designed and constructed infrastructure, and then possibly to relocate existing polluting industries to these areas.

7.3.3 Lack of Operation and Maintenance

Many of the present shortcomings and deficiencies in provision of public water supply and environmental services can be reduced or eliminated if better and more appropriate operation and maintenance systems had been in place, such as enforced, regular emptying of septic tanks, appropriate systems and equipment for flushing and cleaning of combined sewers, including installation of pumping stations and sandtraps.

7.3.4 Inadequate Design Standards, Production and Construction Methods

There is an obvious and urgent need to develop new and more appropriate design criteria and guidelines, as well as production and construction standards, materials and finished systems testing, and quality control procedures and standards.

Concrete pipes presently used for sewers and drains are not of a sufficiently high quality. Better production methods and quality control should be encouraged.

Construction methods are sometimes dangerous. Construction quality is substandard, for example, pipes are laid without the necessary attention to vertical and horizontal tolerances. Measures need to be taken to introduce the necessary construction safety codes, quality control and assurance procedures, improve construction management and workmanship, and enhanced government supervision.

ANNEX I

GENERAL BACKGROUND

LIST OF TABLE

LIST OF FIGURE

Table I-1 Mid-Year population 1993, per 1000 people

No	*PROVINCE*	*Total population 1993*	*Urban*	*Rural*	*Urban population (%)*
	Northland	**33204.2**	**4496.2**	**28708.0**	**13.5**
1	Hanoi	2154 9	1106 0	1048 9	51.3
2	Hai Phong	1583.9	532 0	1051 9	33 6
3	Ha Giang	520 4	46 3	474.1	8.9
4	Tuyen Quang	628 5	63 4	565 1	10.1
5	Cao Bang	624 7	61.3	563.4	9.8
6	Lang Son	671 9	85.6	586 3	12.7
7	Lai Chau	501.2	61.9	439 3	12 4
8	Lao Cai	535.4	65.9	469.5	12 3
9	Yen Bai	638.2	113 2	525.0	17 7
10	Bac Thai	1144 5	214 9	929 6	18 8
11	Son La	776 0	103 3	672 7	13 3
12	Vinh Phu	2203 2	161.2	2042 0	7.3
13	Ha Bac	2262 8	114 2	2148 6	5.0
14	Quang Ninh	889.6	377 1	512 5	42.4
15	Ha Tay	2217.8	139 4	2078 4	6 3
16	Hoa Binh	712 9	108.2	604 7	15 2
17	Hai Hung	2658.0	137.0	2521 0	5.2
18	Thai Binh	1768 4	102 0	1666 4	5.8
19	Nam Ha	2585 9	298.8	2287.1	11.6
20	Ninh Binh	839 9	70 4	769 5	8.4
21	Thanh Hoa	3311 9	240 6	3071 3	7 3
22	Nge An	2680 6	219.9	2460.7	8 2
23	Ha Tinh	1293.6	73 6	1220 0	5.7
	Central Coast	**9875.5**	**2377.0**	**7498.5**	**24.1**
24	Quang Binh	736 7	65 1	671.6	8 8
25	Quang Tri	520.9	86 8	434.1	16 7
26	TT-Hue	1243.2	520.2	723 0	41.8
27	QN-Da Nang	1911.7	596 9	1314.8	31.2
28	Quang Ngai	1149 5	99 9	1049 6	8.7
29	Binh Dinh	1373 1	243 1	1130 0	17.7
30	Phu Yen	708 9	132 3	576 6	18 7
31	Khanh Hoa	923 7	352.4	571 3	38 2
32	Binh Thuan	858 7	202 4	656.3	23 6
33	Ninh Thuan	449.1	77 9	371.2	17 3
	Central Highland	**2160.6**	**418.7**	**1741.9**	**19.4**
34	Gia Lai	737.7	166 0	571.7	22 5
35	Kon Tum	249.6	54 5	195.1	21.8
36	Dac Lac	1173.3	198 2	975.1	16 9
	Southland	**24967.4**	**6625.4**	**18342.0**	**26.5**
37	TP H-C Minh	4322 3	3198 5	1123 8	74.0
38	Tien Giang	1622.0	197.4	1424 6	12.2
39	BR Vung Tau	657.1	220.3	436.8	33 5
40	Long An	1224.8	154 8	1070 0	12.6
41	Dong Nai	1762.9	440 5	1322 4	25 0
42	Minh Hai	1719 1	317.7	1401 4	18 5
43	Vinh Long	1041.3	132 2	909 1	12 7
44	Tra Vinh	938 5	57 5	881 0	6 1
45	Song Be	1081.7	50 6	1031.1	4 7
46	Dong Thap	1462 9	231 9	1231 0	15 9
47	Lam Dong	742 9	252 8	490 1	34.0
48	Tay Ninh	868.9	98.2	770 7	11 3
49	An Giang	1933 8	358 6	1575 2	18 5
50	Ben Tre	1309.4	95 7	1213 7	7 3
51	Can Tho	1780 6	346 6	1434 0	19 5
52	Soc Trang	1172.6	193 7	978 9	16 5
53	Kien Giang	1326.6	278 4	1048 2	21.0
	TOTAL	70207.7	13917.3	56290.4	19.8

Source. Health Statistics Year Book, 1993

Table I- 2 Forecast of different urban population scenerios within the planning period.

City/or town	Classification	ADM	Urban Pop -89	93	95 Low	95 High	2000 Low	2000 High	2010 Low	2010 High
Hanoi	I	CA	906	1132 7	1202	1285	1393	1760	1773	2440
Ho Chi Minh City	I	CA	2800	3184	3378	3611	3916	4948	4993	6859
	I TOTAL			4317	4580	4896	5309	6708	6775	9299
Hai Phong	II	CA	352	511.5	543	580	629	795	803	1102
Bien Hoa	II	PCC	274	301.9	317	336	359	439	442	588
Can Tho	II	PCC	208	231.4	243	258	275	337	339	450
Da Nang	II	PCC	370	423	444	471	503	615	619	823
Hue	II	PCC	211	220	231	245	262	320	322	428
Vinh	II	PCC	111	120 6	127	134	143	175	177	235
	II TOTAL			1808	1905	2024	2171	2681	2701	3627
Buon Me Thuat	III	PCC	97	116.8	123	130	139	170	171	227
Da Lat	III	PCC	103	116.1	122	129	138	169	170	226
Ha Long	III	PCC	123	132 3	139	147	157	192	194	258
My Tho	III	PCC	105	113.1	119	126	134	165	166	220
Nam Dinh	III	PCC	166	194	204	216	231	282	284	378
Nha Trang	III	PCC	214	238	250	265	283	346	348	463
Quy Nhon	III	PCC	160	172.8	182	192	205	251	253	336
Thai Nguyen	III	PCC	126	133.7	140	149	159	194	196	260
Thanh Hoa	III	PCC	85	92.5	97	103	110	135	135	180
Viet Tri	III	PCC	73	79.2	83	88	94	115	116	154
Vung Tau	III	PCC	122	139.9	147	156	166	204	205	272
Ca Mau	III	PCT	83	90	94	95	103	111	117	131
Cao Lanh	III	PCT	54	59.9	62	64	69	74	78	87
Hoa Binh	III	PCT	69	70	73	74	80	86	91	102
Long Xuyen	III	PCT	132	137 7	143	146	158	169	179	201
Phan Rang-Thap Cham	III	PCT	71	79.7	83	85	92	98	104	116
Phan Thiet	III	PCT	114	120.4	125	128	138	148	156	176
Pleiku	III	PCT	76	82.8	86	88	95	102	108	121
Rach Gia	III	PCT	138	150	156	159	172	184	195	219
Soc Trang	III	PCT	88	94 8	99	101	109	117	123	138
Tan An	III	PCT	50	55	57	58	63	68	71	80
Thai Binh	III	PCT	58	61.8	64	66	71	76	80	90
Tra Vinh	III	PCT	48	42	44	45	48	52	55	61
Tuy Hoa	III	PCT	54	60 1	63	64	69	74	78	88
Vinh Long	III	PCT		89.5	93	95	103	110	116	131
Yen Bai	III	PCT	59	59.1	61	63	68	73	77	86
Bac Lieu	III	PT	83	88.8	93	94	103	109	116	127
Cam Pha	III	PT	105	110.2	115	117	127	136	144	157
Chau Doc	III	PT	51	54.7	57	58	63	67	71	78
Sa Dec	III	PT	51	51.9	54	55	60	64	68	74
Tam Ky	III	PT	46	49.6	52	53	57	61	65	71
Uong Bi	III	PT	50	53.7	56	57	62	66	70	77
	III TOTAL			3190	3337	3464	3728	4267	4399	5388

Bac Giang	IV	PCT	51	54	58	60	69	79	86	104
Ben Tre	IV	PCT	45	47	51	52	60	68	75	90
Cao Bang	IV	PCT	28	31.1	34	35	40	45	50	60
Dien Bien Phu	IV	PCT		12.4	13	14	16	18	20	24
Dong Ha	IV	PCT	35	58.2	63	65	75	85	93	112
Dong Hoi	IV	PCT	22	55.2	60	61	71	80	88	106
Ha Dong	IV	PCT	39	54 9	59	61	71	80	88	106
Ha Giang	IV	PCT	15	16.7	18	19	21	24	27	32
Ha Tinh	IV	PCT	15	18.9	20	21	24	27	30	36
Hai Duong	IV	PCT	53	59.2	64	66	76	86	95	114
Kon Tum	IV	PCT	34	49.1	53	55	63	71	79	94
Lang Son	IV	PCT	24	41.6	45	46	53	61	67	80
Lao Cai	IV	PCT	15	16	17	18	21	23	26	31
Ninh Binh	IV	PCT	26	34.4	37	38	44	50	55	66
Quang Ngai	IV	PCT	34	40 7	44	45	52	59	65	78
Son La	IV	PCT	22	26	28	29	33	38	42	50
Tay Ninh	IV	PCT	37	34.9	38	39	45	51	56	67
Thu Dau Mot	IV	PCT	44	46.3	50	52	59	67	74	89
Tuyen Quang	IV	PCT	24	27.6	30	31	35	40	44	53
Bac Ninh	IV	PT	34	36.4	38	38	41	43	45	49
Bim Con	IV	PT	42	38.4	40	40	43	46	48	52
Hoi An	IV	PT	25	26.9	28	28	30	32	34	36
Son Tay	IV	PT	32	33.4	35	35	38	40	42	45
Vinh Yen	IV	PT	22	24.1	25	25	27	29	30	32
	IV TOTAL			**883**	**948**	**973**	**1110**	**1243**	**1358**	**1607**
GRAND TOTAL:				**10199**	**10770**	**11357**	**12318**	**14899**	**15234**	**19921**

Basic for projection

ADMINISTRATIVE UNIT CLASSIFICATION	GROWTH RATE (%)					
	1993 - 1995		*1995 - 2000*		*2000 - 2010*	
	Low	*High*	*Low*	*High*	*Low*	*High*
Centrally Administered						
Class I	3.0	6 5	3.0	6.5	5 0	6.75
Class II	3.0	6 5	3.0	6 5	5.0	6.75
Provincial Capital-City						
Class II	2 5	5.5	2 5	5.5	4.25	6.0
Class III	2.5	5.5	2.5	5.5	4.25	6.0
Provincial Capital-Town						
Class III	2 0	3 0	2.0	3 0	2.5	3.5
Class IV	4 0	5 5	3 5	5 5	4.5	5.75
Provincial Town						
Class III	2.25	3.0	2.0	3.0	2.5	3.0
Class IV	1.75	2.5	1 75	2.5	2 0	2.5

Based on Draft Vietnam Urban Strategy Study Report

Table I - 3 Area and population density, 1985 - 1989[1]

N.o	Province	Area	Population (1000)		Density (persons/km²)	
		km²	1985	1989	1985	1989
	Whole country	330,363	59.821	64,412	181	195
01	Hanoi	2,141	2,938	3,057	1,372	1,428
02	Ho Chi Minh City	2,089	3,668	3,934	1,756	1,883
03	Haiphong	1,503	1,421	1,448	945	963
04	Ha Tuyen	13,632	905	1,026	66	75
05	Cao Bang	8,445	546	566	65	67
06	Lang Son	8,187	540	611	66	75
07	Lai Chau	17,142	387	438	23	26
08	Hoang Lien Son	14,852	879	1,032	59	69
09	Bac Thai	6,503	926	1,033	142	159
10	Son La	14,210	582	682	41	48
11	Vinh Phu	4,569	1,703	1,806	373	395
12	Ha Bac	4,616	1,929	2,061	418	446
13	Quang Ninh	5,938	820	814	138	137
14	Ha Son Binh	5,796	1,730	1,840	289	317
15	Hai Hung	2,553	2,408	2,440	943	956
16	Thai Binh	1,532	1,642	1,632	1,072	1065
17	Ha Nam Ninh	3,796	3,080	3,157	811	832
18	Thanh Hoa	11,168	2,793	2,991	250	268
19	Nghe Tinh	22,500	3,458	3,582	154	159
20	Quang Binh[1]	8,245		646		78
21	Quang Tri[1]	4,592	2,002	458	114	100
22	Thua Thien - Hue[1]	4,723		891		188
23	Quang Nam-	11,989	1,687	1,739	141	145
24	DaNang	5,833		1,040		178
25	Quang Ngai[2]	6,075	2,367	1,248	199	205
26	Binh Dinh[2]	5,170		626		121
27	Phu Yen[2]	4,634	1,350	837	138	181
28	Khanh Hoa[3]	11,422	1,096	1,170	96	102
29	Thuan Hai	25,596	746	873	29	34
30	Gia Lai-Kontum	19,800	661	974	33	49
31	Dak Lac	10,173	511	639	50	63
32	Lam Dong	9,546	791	939	83	98
33	Song Be	4,017	772	791	192	197
34	Tay Ninh	7,585	1,741	2,007	229	265
35	Dong Nai	4,338	1,105	1,121	255	258
36	Long An	3,276	1,336	1,337	408	408
37	Dong Thap	3,423	1,812	1,793	529	524
38	An Giang	2,339	1,399	1,484	598	634
39	Tien Giang	2,247	1,184	1,214	527	540
40	Ben Tre	3,857	1,724	1,812	447	470
41	Cuu Long	6,161	2,559	2,682	415	435
42	Hau Giang	6,243	1,150	1,198	184	192
43	Kien Giang	7,670	1,371	1,562	179	204
44	Minh Hai	237	102	136	430	574
	Vung Tau-Con Dao					

Source. 1989 population census

1. Formerly Binh Tri Thien province with 2,002 thousand population and 114 density in 1985
2. Formerly Nghia Binh province with 2,367 thousand population and 199 density in 1985
3. Formerly Phu Khanh province with 1,350 thousand population and 138 density in 1985.

[1] Vietnam, *The Situation of Children and Women*, UNICEF, 1990

Table I—4 List of towns included in the scope of the Study with classification and urban population of 1989 and 1993.

N:o	*Name of Town*	*Class*	*Urban Pop-89 (1000per)*	*ADM*	*Urban Pop-93 (1000 persons)*
1	Hanoi	I	1,027.3	CA	1,132.7
2	Ho Chi Minh	I	2,899.7	CA	3,184.0
	TOTAL		**3927.0**		**4,316.7**
3	Haiphong	II	448.7	CA	511.5
4	Da Nang	II	369.7	PCC	423.0
5	Bien Hoa	II	279.5	PCC	301.9
6	Hue	II	211.7	PCC	220.0
7	Can Tho	II	208.1	PCC	231.4
8	Vinh	II	110.8	PCC	120.6
	TOTAL		**1628.5**		**1808.4**
9	Nha Trang	III	213.5	PCC	238.0
10	Nam Dinh	III	165.6	PCC	194.0
11	Quy Nhon	III	159.9	PCC	172.8
12	Vung Tau	III	123.5	PCC	139.9
13	Da Lat	III	102.6	PCC	116.1
14	My Tho	III	104.7	PCC	113.1
15	Thai Nguyen	III	124.9	PCC	133.7
16	Ha Long	III	123.1	PCC	132 3
17	Viet Tri	III	73.3	PCC	79.2
18	Thanh Hoa	III	85.0	PCC	92.5
19	Ban Me Thuot	III	97.0	PCC	116.8
20	Long Xuyen	III	128.8	PCT	137.7
21	Phan Thiet	III	114.2	PCT	120.4
22	Rach Gia	III	137.8	PCT	150.0
23	Ca Mau	III	81.9	PCT	90.0
24	Cao Lanh	III	54.3	PCT	59.9
25	Hoa Binh	III	69.3	PCT	70.0
26	Phan Rang-Thap Cham	III	71.1	PCT	79.7
27	Pleiku	III	77.0	PCT	82.8
28	Soc Trang	III	87.9	PCT	94.8
29	Tan An	III	50.3	PCT	55.0
30	Thai Binh	III	57.6	PCT	61.8
31	Tra Vinh	III	38.8	PCT	42.0
32	Hai Duong	III	53.4	PCT	59.2
33	Tuy Hoa	III	54.1	PCT	60.1
34	Vinh Long	III	81.6	PCT	89.5

35	Yen Bai	III	58.6	PCT	59.1
36	Bac Lieu	III	83.5	PT	88.8
37	Chau Doc	III	50.9	PT	54.7
38	Cam Pha	III	105.3	PT	110.2
39	Sa Dec	III	50.7	PT	51.9
40	Tam Ky	III	45.8	PT	49.6
41	Uong Bi	III	49.6	PT	53.7
	TOTAL		**2975.62**		**3249.3**
51	Bac Giang	IV	50.9	PCT	54.0
52	Ben Tre	IV	44.8	PCT	47.0
53	Thu Dau Mot	IV	43.8	PCT	46.3
54	Ha Dong	IV	38.9	PCT	54.9
55	Dong Ha	IV	47.1	PCT	58.2
56	Quang Ngai	IV	34.4	PCT	40.7
57	Tay Ninh	IV	32.9	PCT	34.9
58	Kontum	IV	34.1	PCT	49.1
59	Son La	IV	22.0	PCT	26.0
60	Lang Son	IV	24.4	PCT	41.6
61	Ninh Binh	IV	26.5	PCT	34.4
62	Cao Bang	IV	27.8	PCT	31.1
63	Tuyen Quang	IV	24.3	PCT	27.6
64	Dien Bien Phu	IV	10.7	PCT	12.4
42	Dong Hoi	IV	37.0	PCT	55.2
43	Ha Tinh	IV	15.3	PCT	18.9
44	Ha Giang	IV	14.5	PCT	16.7
45	Lao Cai	IV	5.4	PCT	16.0
46	Son Tay	IV	31.6	PT	33.4
47	Bac Ninh	IV	33.8	PT	36.4
48	Vinh Yen	IV	22.2	PT	24.1
49	Bim Son	IV	36.6	PT	38.4
50	Hoi An	IV	25.5	PT	26.9
	TOTAL		**684.5**		**824.2**

Source: General Statistical Office

Key:

CA Centrally - Administered
PCC Provincial Capital City
PCT Provincial Capital Town
PT Provincial Town

Table I - 5 Urban classification of Ministry of Finance, 3.7.1993

CLASS I		
Ho Chi Minh City		
CLASS II		
Hanoi		
CLASS III		
1. Haiphong	2. Hue	3. Da Nang
4. Vung Tau	5. Bien Hoa	6. Nha Trang
7. Can Tho	8. Da Lat	
CLASS IV		
1. Nam Dinh	2. Cam Pha	3. Hon Gai
4. Lang Son	5. Cao Bang	6. Bac Ninh
7. Ha Dong	8. Hai Duong	9. Thanh Hoa
10. Do Son	11. Sam Son	12. Quy Nhon
13. Long Xuyen	14. Buon Me Thuot	15. Phan Thiet
16. Thu Dau Mot	17. Tay Ninh	18. Vinh Long
19. Soc Trang	20. Ca Mau	21. My Tho
22. Bac Lieu	23. Thi tran Thu Duc	24. Thi Tran Hoc Moc
25. Thi Tran Nha Be	26. Thi Tran An Lac	27. Thi Tran Dong Anh
28. Thi Tran Soc Son	29. Thi Tran Gau Giay	30. Thi Tran Gia Lam
31. Thi Tran Van Dien		
CLASS V		
1. Thai Nguyen	2. Viet Tri	3. Vinh
4. Hoa Binh	5. Son La	6. Yen Bai
7. Vinh Yen	8. Tuyen Quang	9. Ninh Binh
10. Lai Cau	11. Lao Cai	12. Ha Giang
13. Ha Tinh	14. Phu Tho	15. Son Tay
16. Thai Binh	17. Bac Giang	18. Kien An
19. Uong Bi	20. Bim Son	21. Tam Diep
22. Ha Nam	23. Hung Yen	24. Phan Rang
25. Playcu	26. Rach Gia	27. Tuy Hoa
28. Cao Lanh	29. Chau Doc	30. Sa Dec
31. Dong Ha	32. Quang Tri	33. Kon Tum
34. Hoi An	35. Dong Hoi	36. Tan An
37. Tra Vinh	38. Tam Ky	39. Ben Tre
40. Vinh An	41. Vi Thanh	42. Song Cong
43. Go Cong	44. Quang Tri	

Table I - 6 Percentages of urban housing type in 1989

Area	*Permanent*	*Semi-permanent*	*Other*
North (total for 9 provinces)	32.8	57.9	9.3
South (total for 10 provinces)	9.5	64.1	26.4
Hanoi	43.1	50.0	6.9
HCMC	19.6	71.2	13.2
Haiphong	31.6	61.3	7.1
Danang	12.1	68.6	19.3
ALL	20.1	61.3	18.6

Source: Sample Results of Housing Survey, Vietnam population cencus, 1989

Notes:

- Permanent housing: villas, multistory houses, reinforced-concrete houses
- Semi-permanent housing: houses lasting under 20 years, with brick materials or tile roofs
- Others: houses made from simple materials, such as; wood, bamboo and thatch, or makeshift shelters.

Table I - 7 Distribution (%) of per capita urban living space, 1989

Area	*< 2 m^2*	*2.1–4 m^2*	*4.1-6 m^2*	*> 6 m^2*
North (9 provinces)	4.4	24.4	27.9	43.3
South (10 provinces)	6 2	18 6	20.7	54.5
Hanoi	7 1	28.9	27.6	36 4
HCMC	7.9	18.4	19.2	54.5
Haiphong	5.9	29.3	31.7	33 1
Danang	5.9	22.1	33.1	48.0
ALL	**5.4**	**21.3**	**24.0**	**49.3**

Source: Sample Results of Housing Survey, Vietnam population cencus, 1989

Table I - 8 Percentages of private urban housing type in 1989

Area	*Permanent*	*Semi-permanent*
North (9 provinces)	66.5	58.3
South (10 provinces)	64.0	84.0
Hanoi	37 2	54.9
HCMC	50.3	75.9
Haiphong	56.5	56.9
Danang	69.8	90.4
ALL	**65.8**	**72.9**

Source: Sample Results of Housing Survey, Vietnam population cencus, 1989

Note:

- Private houses are built by individual persons, or they are bought or rented by private persons

Table I—9 Percentages of urban households with electricity in 1989

Area	*%*
North (9 provinces)	94.8
South (10 provinces)	83.4
Hanoi	94.2
HCMC	92.8
Haiphong	98.7
Danang	90 4
ALL	**88.4**

Source: Sample Results of Housing Survey, Vietnam population cencus, 1989

Table I—10 Percentages of urban households by water supply type in 1989

Area	*House connections*	*Outside connections*	*Wells*	*Others*
North (9 provinces)	29.4	36.7	24.3	9 6
South(10 provinces)	40.2	8 4	26 3	25.1
Hanoi	46.5	45.8	6 0	1.7
HCMC	73.1	7.0	13.1	6.8
Haiphong	29.0	58.3	5.3	7 4
Danang	36.6	4.6	34.3	24.5
ALL	**35.3**	**21.3**	**25.4**	**18.0**

Source. Sample Results of Housing Survey, Vietnam population cencus, 1989

Table I—11 Percentages of urban households by toilet facility type in 1989

Area	With Toilets				Without Toilet
	Flush toilets	Double vault	Other toilets	Total	
North (9 prov.)	17.6	18 0	24.4	59.9	40 1
South (10 prov)	48.6	5.9	18.1	72.6	27 4
Hanoi	35.9	13.1	8.2	57 2	42 8
HCMC	70.3	6.1	5.7	82 1	19.9
Haiphong	19.1	7.3	16.4	42.8	57.2
Danang	66.3	3.9	11.2	81.5	18.5
ALL	**34.5**	**11.4**	**20.9**	**66.8**	**33.2**

Source. Sample Results of Housing Survey, Vietnam population cencus, 1989

ANNEX II

PRESENT STATUS ASSESSMENT

Table II - 1 Decision Making Powers of Utilities on Selected issues

City	*Can Tho*	*Hue*	*Hai Duong*	*Thai Nguyen*	*Da nang*	*Nha Trang*	*Phan Thiet*	*Ho Chi Minh*	
Name of the Utility	Urban Public Works Co	Urban Public Works Co	UREN Co.	Urban Management Co	URE NCo.	Urban Public Service Co.	Urban Public Works Co.	Urban Drainage Co	Urban Public Service Co.
Year Established	Mar-90	1975	1982			1976	1984	1993	1975
Who influences or controls the following aspects of the company									
Staff numbers	*City*	*City*	*City*	*City*	*City*	*City*	*City*	*City*	*City*
Staff salaries	City	City	City	City		City	City	City	City
Tariffs		City							City
Selection of top management	City	Province	City		City		City	City	City
Budget for O & M	City	City	City	City	City	City	City		City
Budget for development		City	City	City	City	City	City		City
Utility responsibility	City	City	City	City	City	City	City	City	City

Table II - 2 Sumary of Educational Attainment

Education	*Can Tho*	*Hue*	*Hai Duong*	*Thai Nguyen*	*Da nang*	*Nha Trang*	*Phan Thiet*	*Ho Chi Minh*	
University Degree	3	11	2	7	5	4	2	37	23
College degree	15	2	8	9	6	22	21	1	1
Vocational degree	29	2	0	0	0	16	17	205	260
Unskilled labour	80	62	90	50	359	311	90	307	326
Sewerage/Sanitation staff size	127	77	100	66	370	353	130	550	610
No of staff trained abroad	0	3	0	0	0	0	0	2	0
Number of expatriates	0	1	0	0	0	0	0	0	0

Table II - 3 Salary levels of Utilities

No.	*Description*					*Utility*					*Total*
		1	2	3	4	5	6	7	8	9	
4	Salary/wage policy (average basic and total earnings at various levels). (VND/month)		No specific figures								Avrg
4 1	Management										
	- University degree	500000		400000	500000	300000	552000	400000	760000	1320000	591500
	- College degree			300000		250000			740000		430000
	- Vocational training										
	- Unskilled labour			300000		360000					330000
4 2	Administration and financial management										
	- University degree				500000		262000		720000	1275000	689250
	- College degree			300000	400000			250000		1250000	550000
	- Vocational training									1190000	1190000
	- Unskilled labour								530000	1160000	845000
4 3	Sewerage (O&M)										
	- University degree										
	- College degree										
	- Vocational training										
	- Unskilled labour			300000	300000	360000					320000
4 4	Waste water treatment (O&M)										
	- University degree										
	- College degree										
	- Vocational training										
	- Unskilled labour										
4 5	Removal/transportation of septage/nightsoil										
	- University degree										
	- College degree										
	- Vocational training										
	- Unskilled labour	200000		300000	340000	360000	300000	500000		980000	425714
4 6	Consumer relations and revenue collection.										
	- University degree								735000		735000

	- College degree							250000			250000
	- Vocational training										
	- Unskilled labour			250000	300000	200000					250000
4 7	Technical planning and design:										
	- University degree							400000			400000
	- College degree										
	- Vocational training										
	- Unskilled labour										
4 8	Construction.										
	- University degree										
	- College degree										
	- Vocational training								700000		700000
	- Unskilled labour								530000		530000
4 9	Installation										
	- University degree										
	- College degree										
	- Vocational training								700000		700000
	- Unskilled labour								530000		530000
4.10	Other (please, specify)·										
	- University degree										
	- College degree										
	- Vocational training										
	- Unskilled labour							500000			500000

Key				
1	Can Tho	Urban Public Works Co	AVERAGE SALARIES/ALL UTILITIES	
2	Hue	Urban Public Works Co		
3	Hai Duong	URENCO	- University degree	603938
4	Thai Nguyen	Urban Management Co	- College degree	410000
5	Da Nang	URENCO	- Vocational training	945000
6	Nha Trang	Urban Public Service Co	- Unskilled labour	487589
7	Phan Thiet	Urban Public Works Co		
8	Ho Chi Minh	Urban Drainage Co		
9	Ho Chi Minh	Urban Public Service Co		

Table II - 4 Water supply and sanitation projects

No.	Project	Location	Status/ Implementation	Invest. Million USD	Main Financier
1.	Water Supply Project	Hanoi, Haiphong, Quang Ninh, Danang	Preparation/ 1996-2000	163	IDA
2.	Provincial Towns Water Supply and Sanitation Project	Thai Nguyen, Thanh Hoa Sam Son, Pleiku, Nha Trang, Phan Thiet, Long Xuyen	Preparation/ 1995-1999	100	ADB
3.	Water Supply and Sanitation for Cities		Preparation/ 1995-1997		The Netherlands
4	Second Provincial Towns Water Supply and Sanitation Project	Ben Tre, Dong Hoi, Dong Ha, Ninh Binh, Qui Nhon, Tuyen Quang, Vinh	Preparation/ 1997-2001	100	ADB
5.	Ho Chi Minth City Water Supply and Sanitation Rehabilitation Project	Ho Chi Minth City	Implementation/ 1995-1999	81	ADB
6	Water Supply Project 1)	Bac Giang, Bac Ninh, Ha Tinh, Tra Vinh	Aid Agreement with Australia/ 1996-00	26	AIDAB
7.	Sewerage and Drainage Rehabilitation and Development	Hanoi	Masterplan ready/ 1995-2010	1,162	OECF

1) Information on a possible sanitation component is not available

AIDAB = Australian International Development Bureau

IDA = International Development Association

ADB = Asian Development Bank

OECF = Organization of European Council Fund

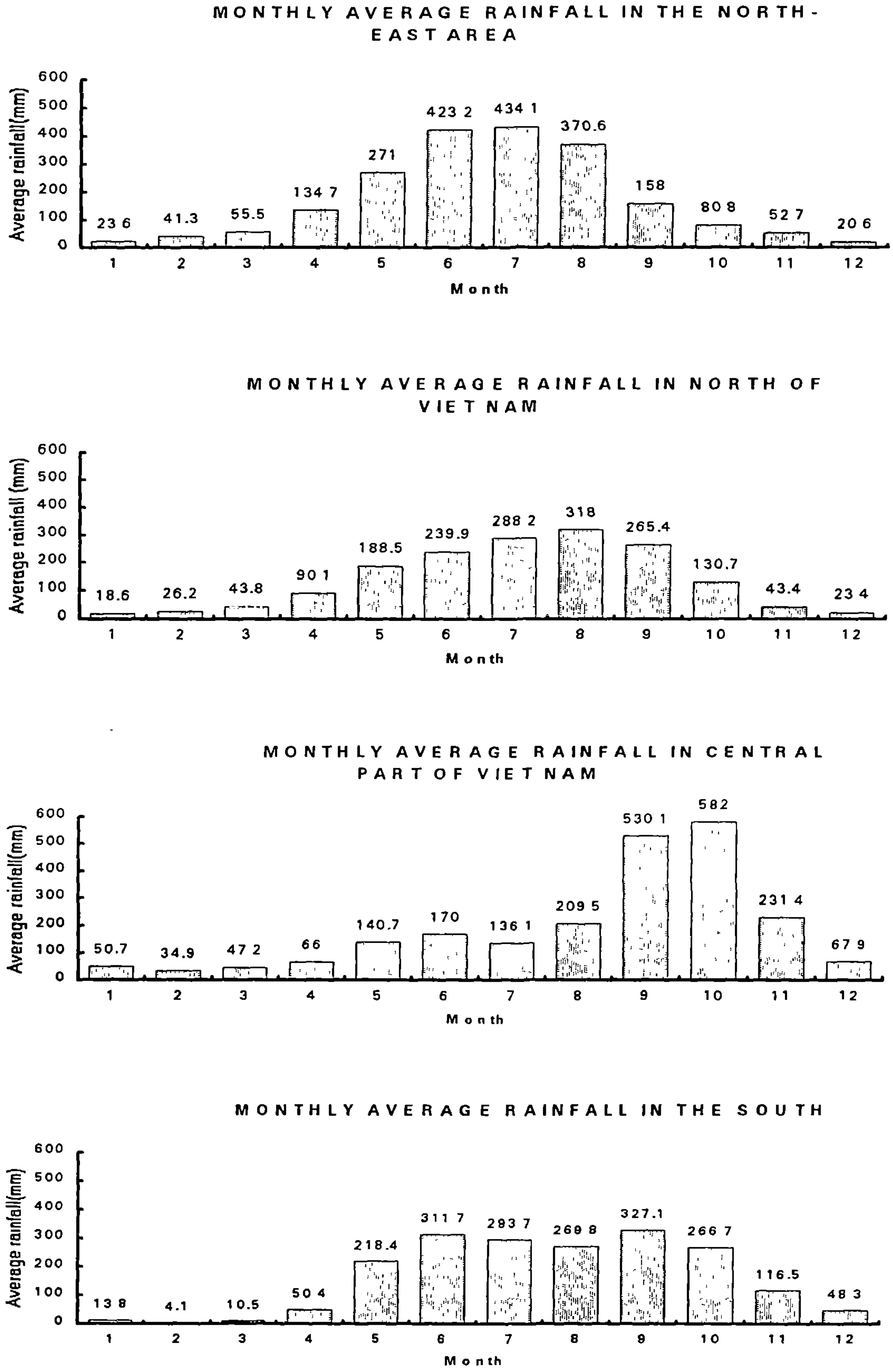


Figure II - 1 Monthly average rainfalls of the typical climatological zones of Vietnam.

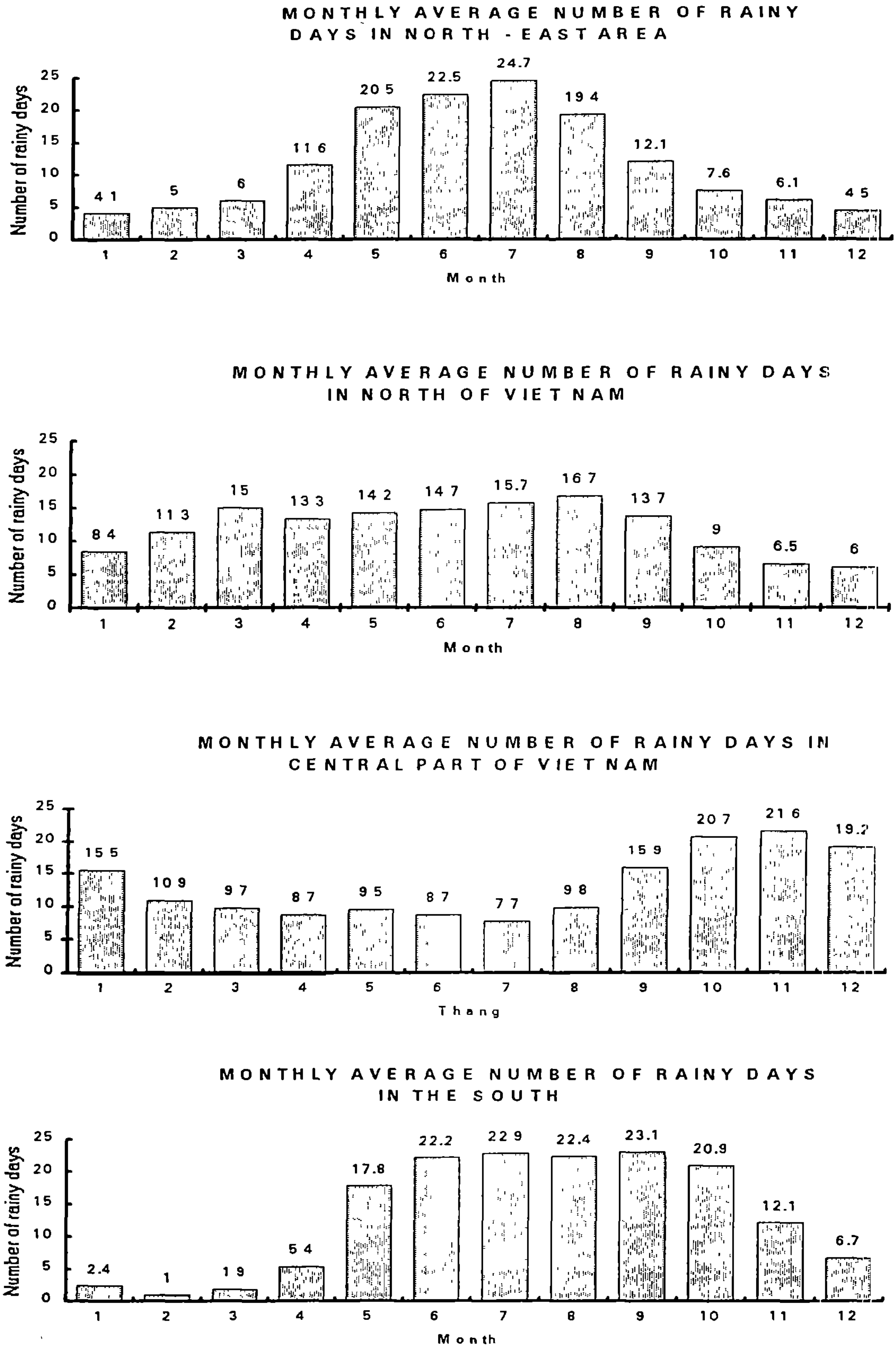


Figure II - 2 Monthly average number of rainy days of the typical climatological zones of Vietnam.

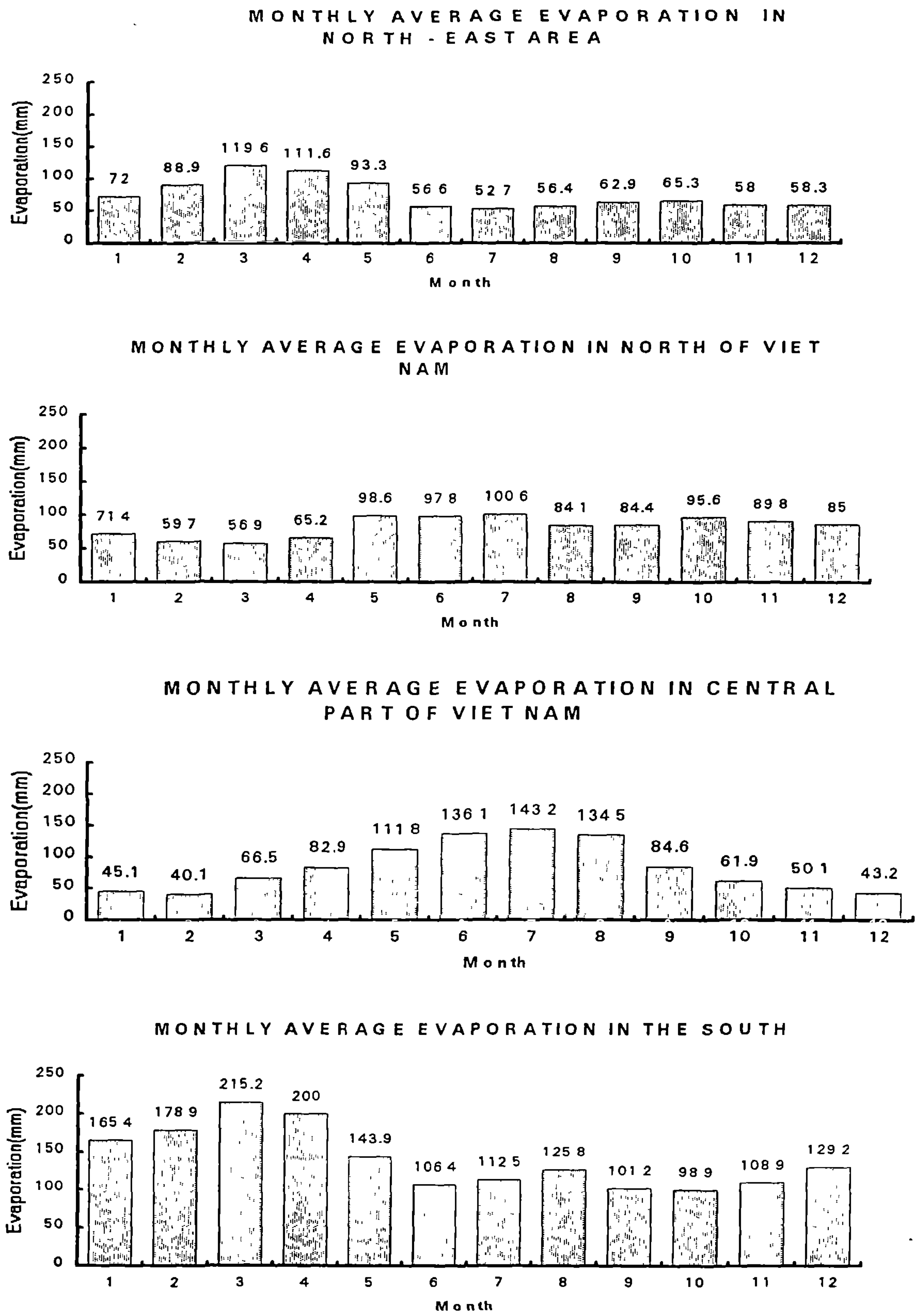


Figure II- 3 Monthly average evaporation of the typical climatological zones of Vietnam.

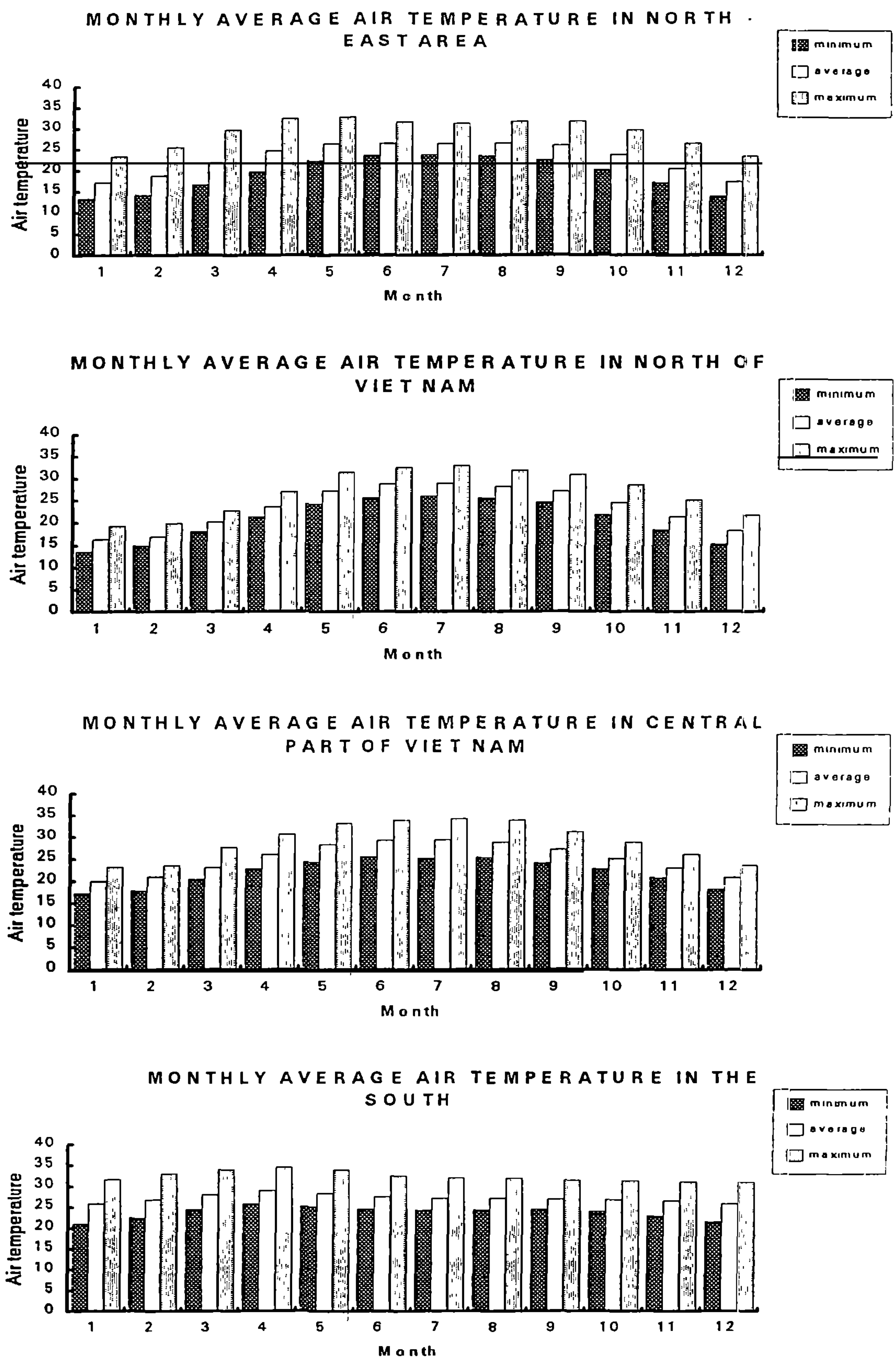


Figure II- 4 Monthly air temperature in South Vietnam

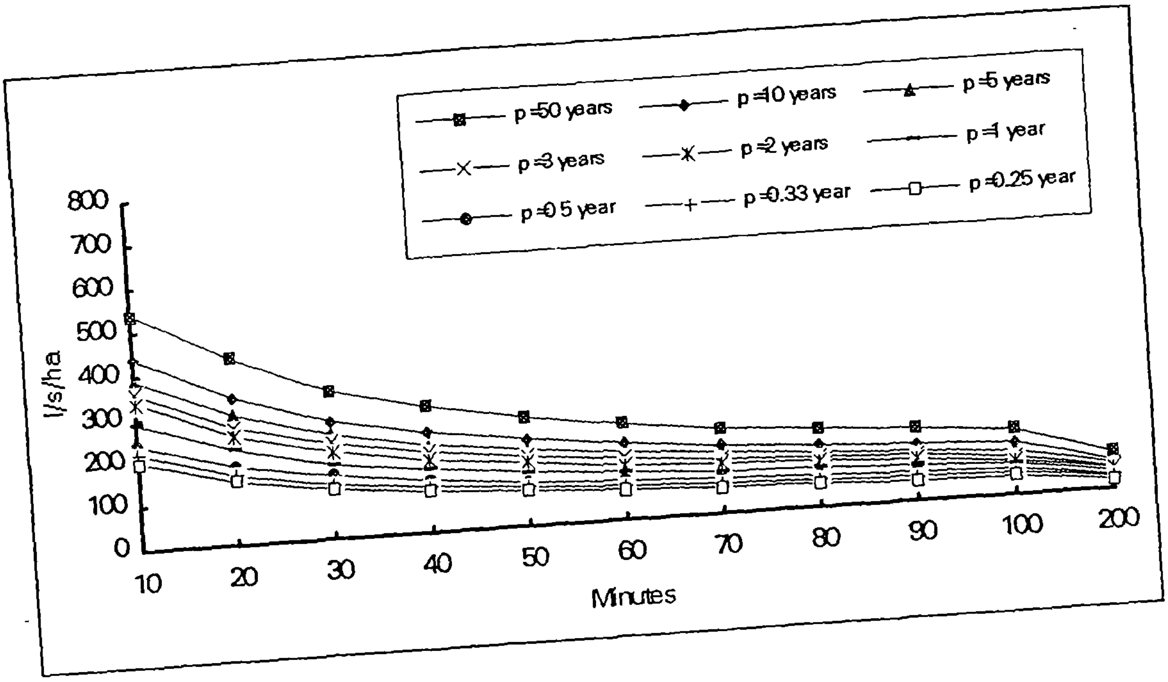


Figure II-5 Rain intesity and duration with return periods in North-Eastern part of Vietnam.

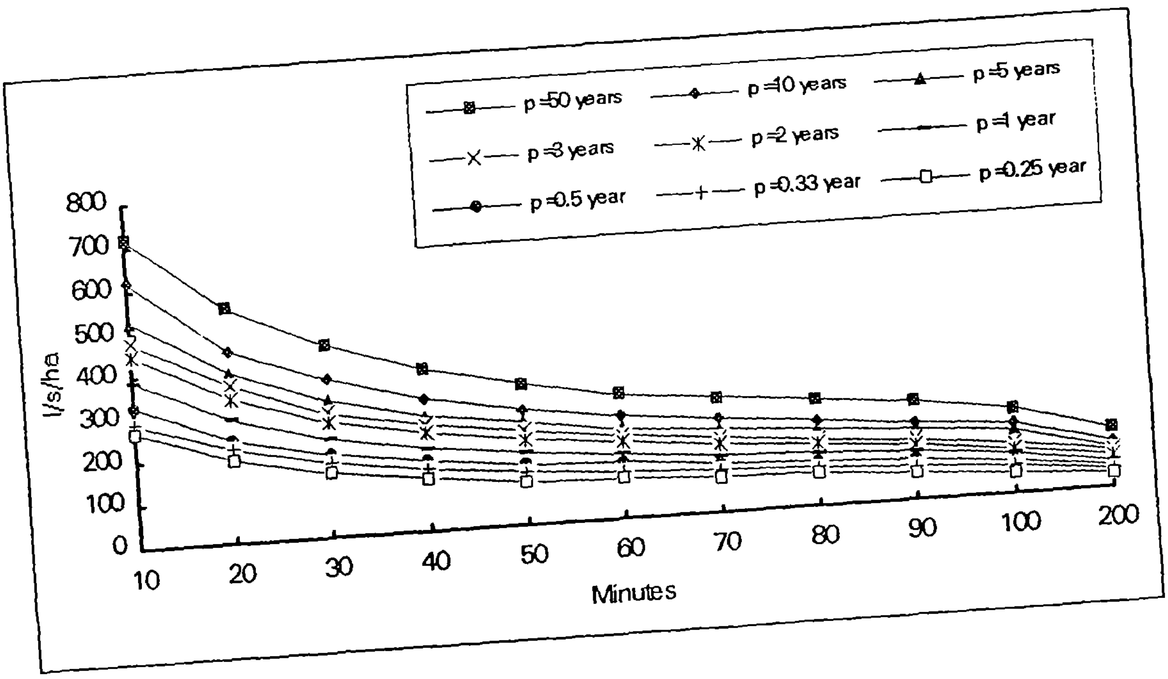


Figure II-6 Rain intesity and duration with return periods in Northern part of Vietnam.

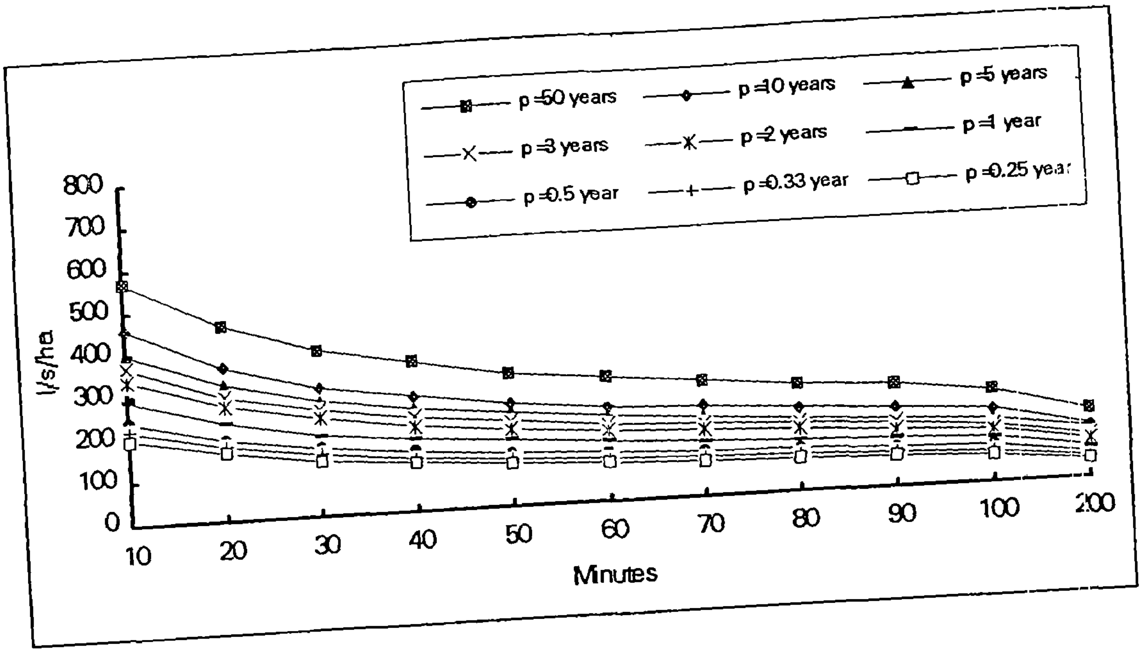


Figure II-7 Rain intesity and duration with return periods in Central part of Vietnam.

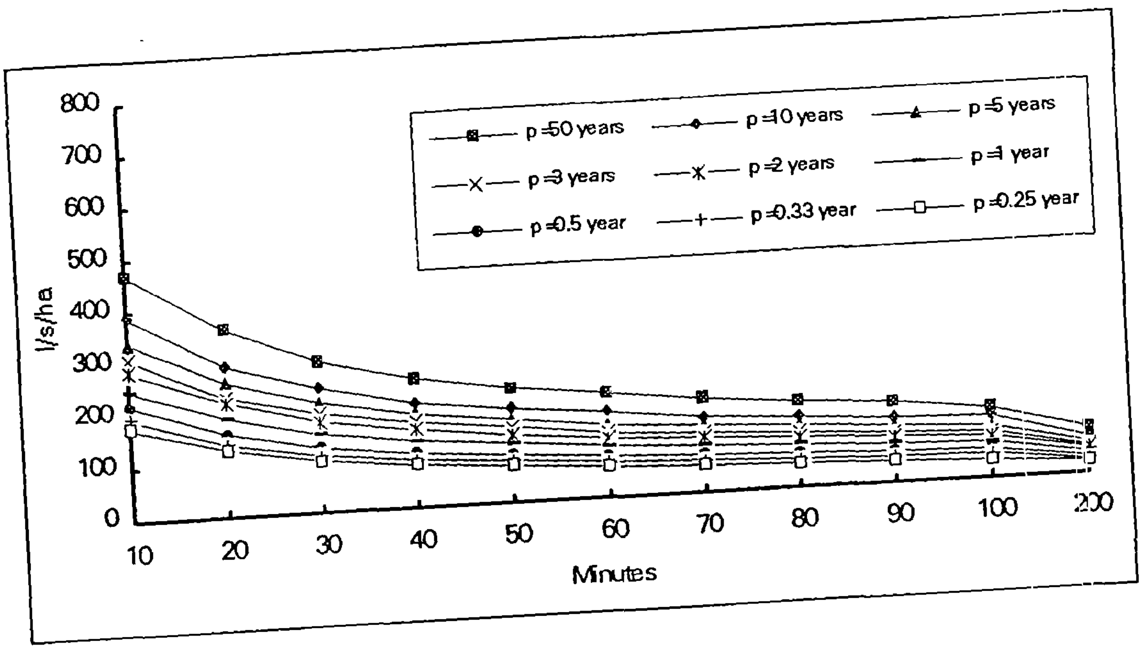


Figure II-8 Rain intesity and duration with return periods in Southern part of Vietnam.

NORTH-EAST AREA

KY CUNG RIVER

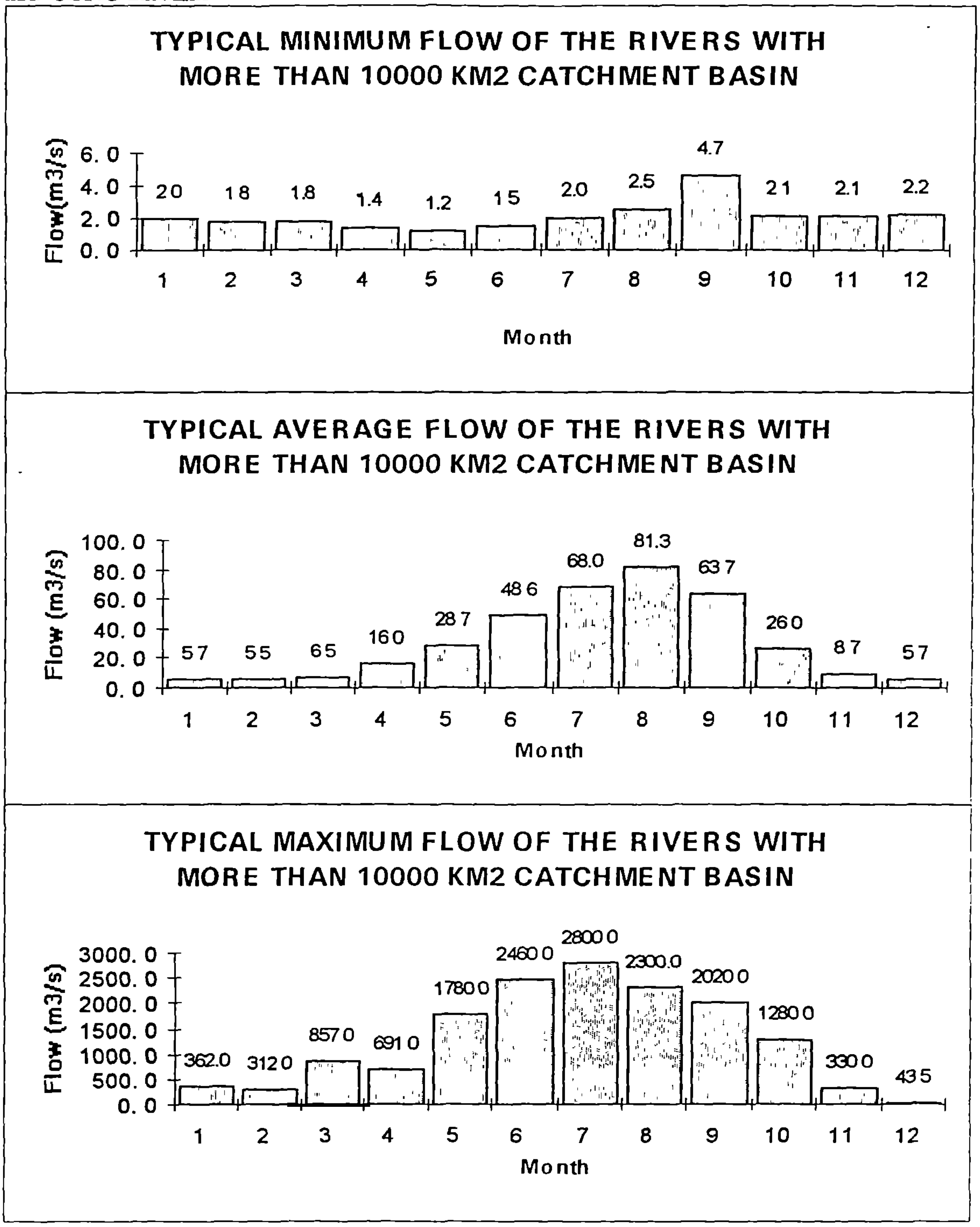


Figure II - 9 Typical monthly flows of the rivers in North-East area with a catchment area more than 10000 km²

TIEN YEN RIVER -1070 Km2

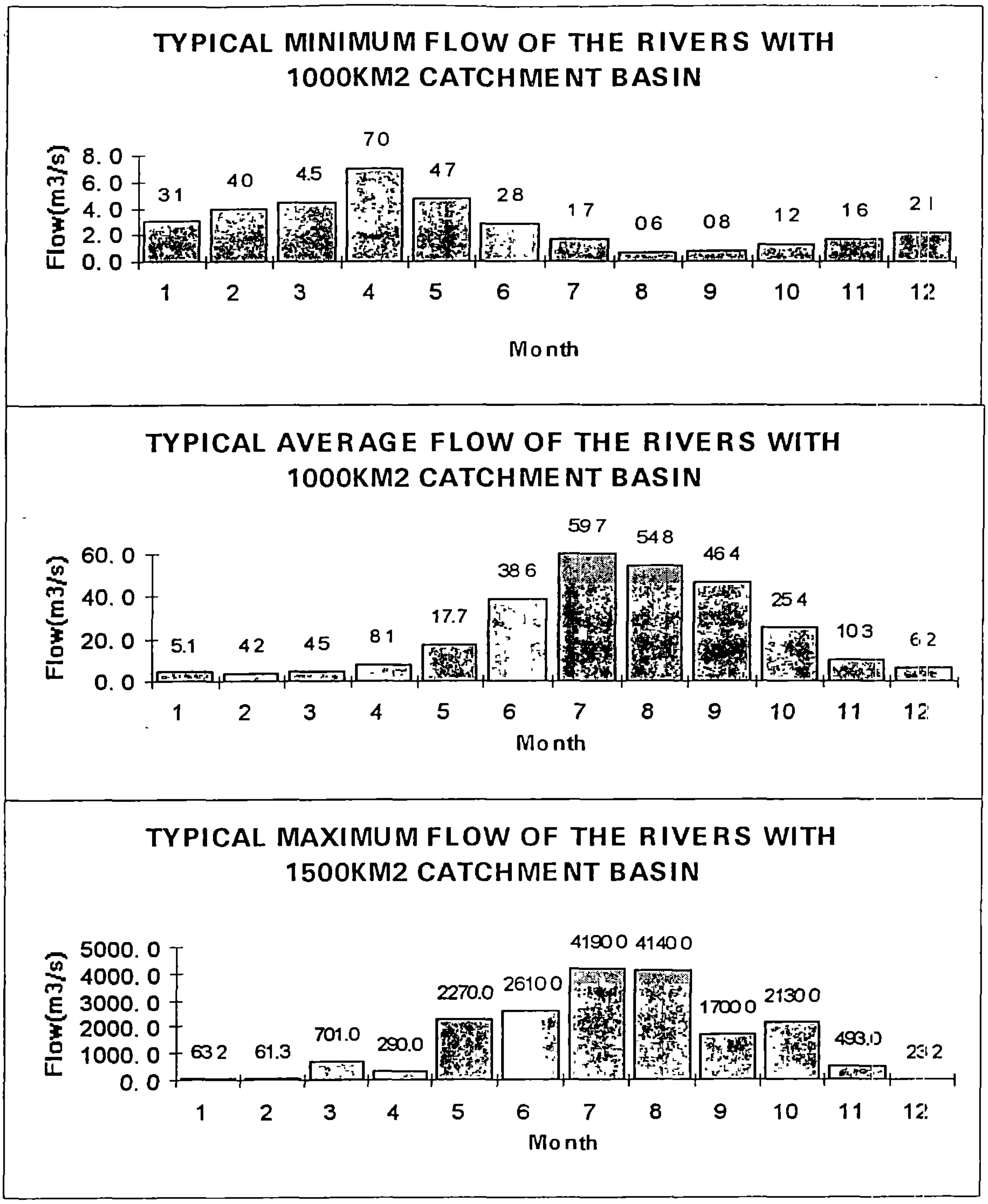


Figure II - 10 Typical monthly flow of the rivers in North-East area with a catchment of 1500 km^2

HA COI RIVER - 206 Km2

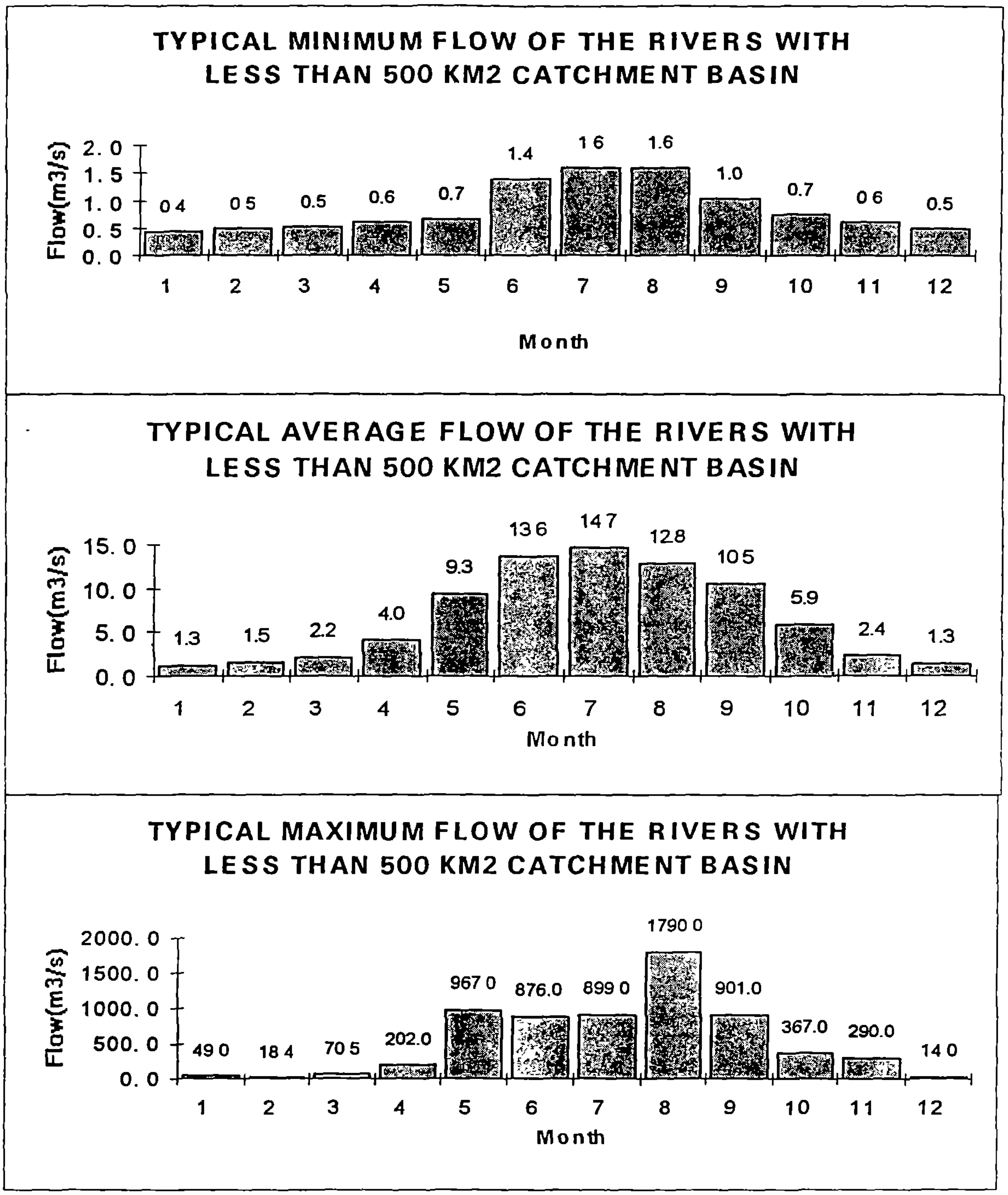
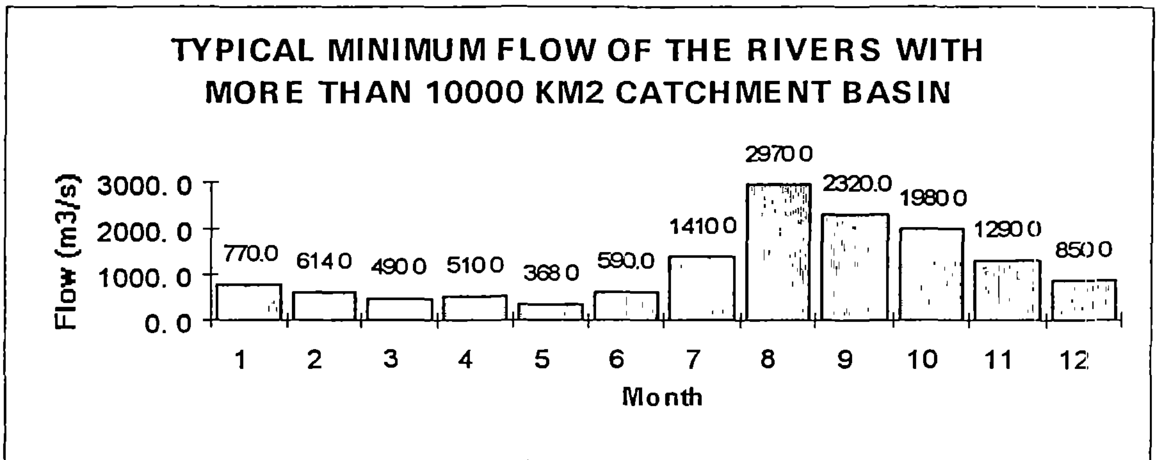
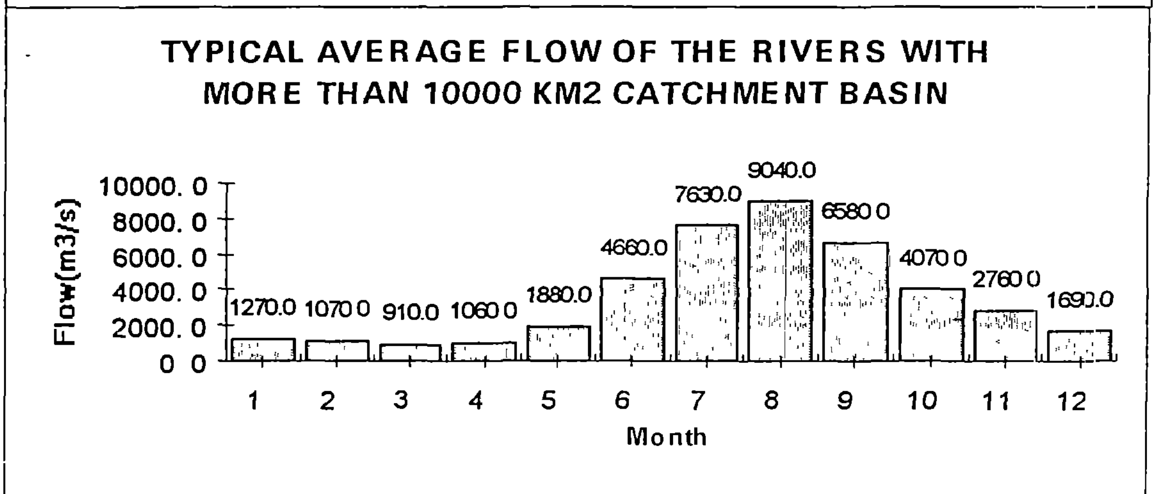


Figure II - 11 Typical monthly flow of the rivers in North-East with a catchment area of 500 Km^2

NORTH AREA

RED RIVER





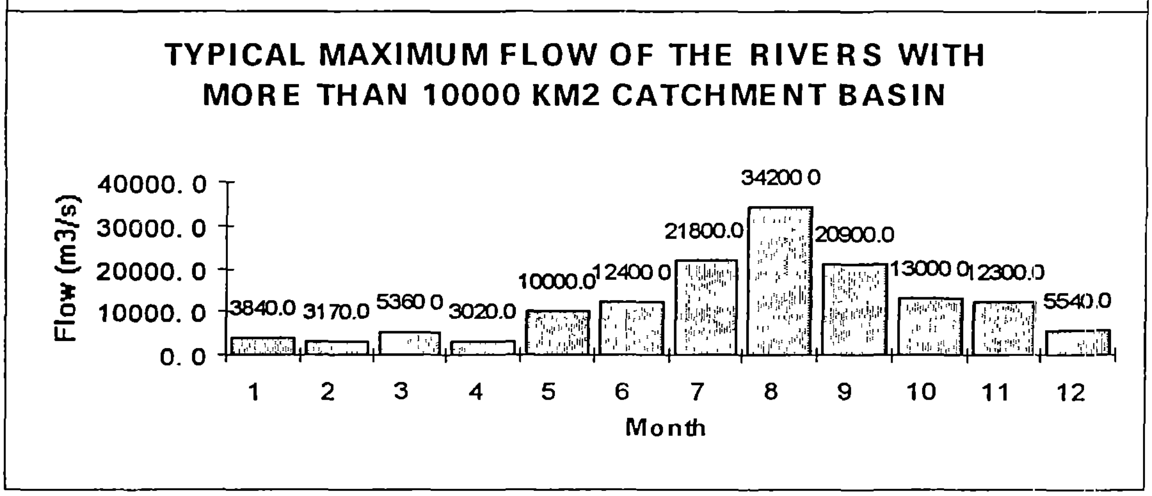


Figure II - 12 Typical monthly flow of a river in North area with a catchment area more than 10000 Km^2

BUA RIVER - 1190 Km²

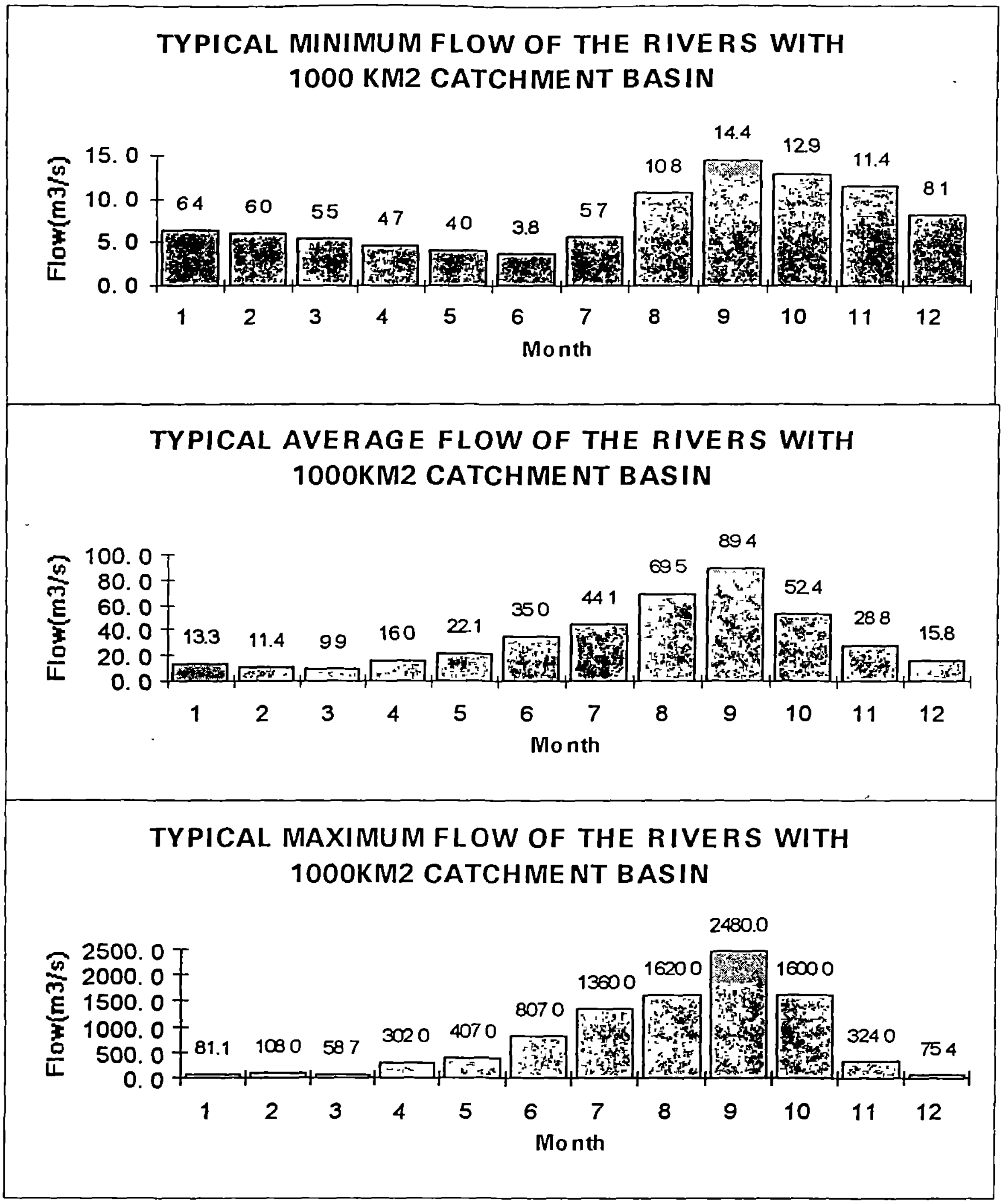
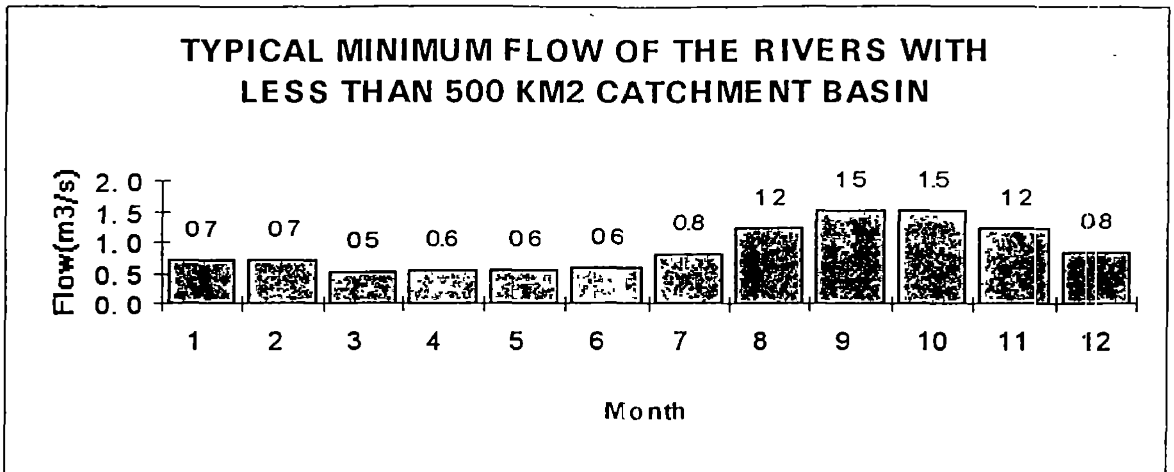
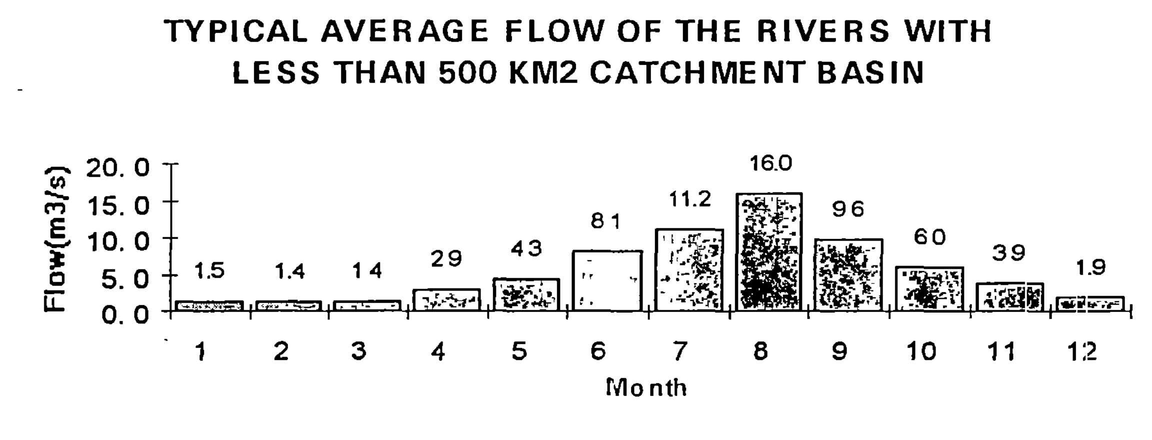


Figure II - 13 Typical monthly flow of the rivers in North area with a catchment area of 1000 Km2.

DU RIVER - 283 Km^2





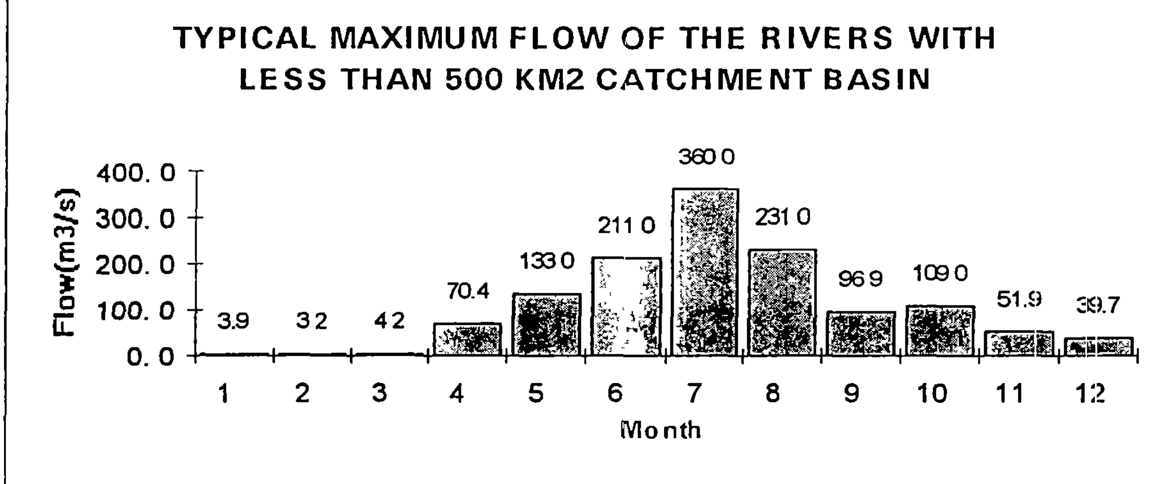


Figure II - 14 Typical monthly flows of the rivers in North area with a catchment area less than 500 Km^2.

CENTRAL PART OF VIETNAM

THU BON RIVER

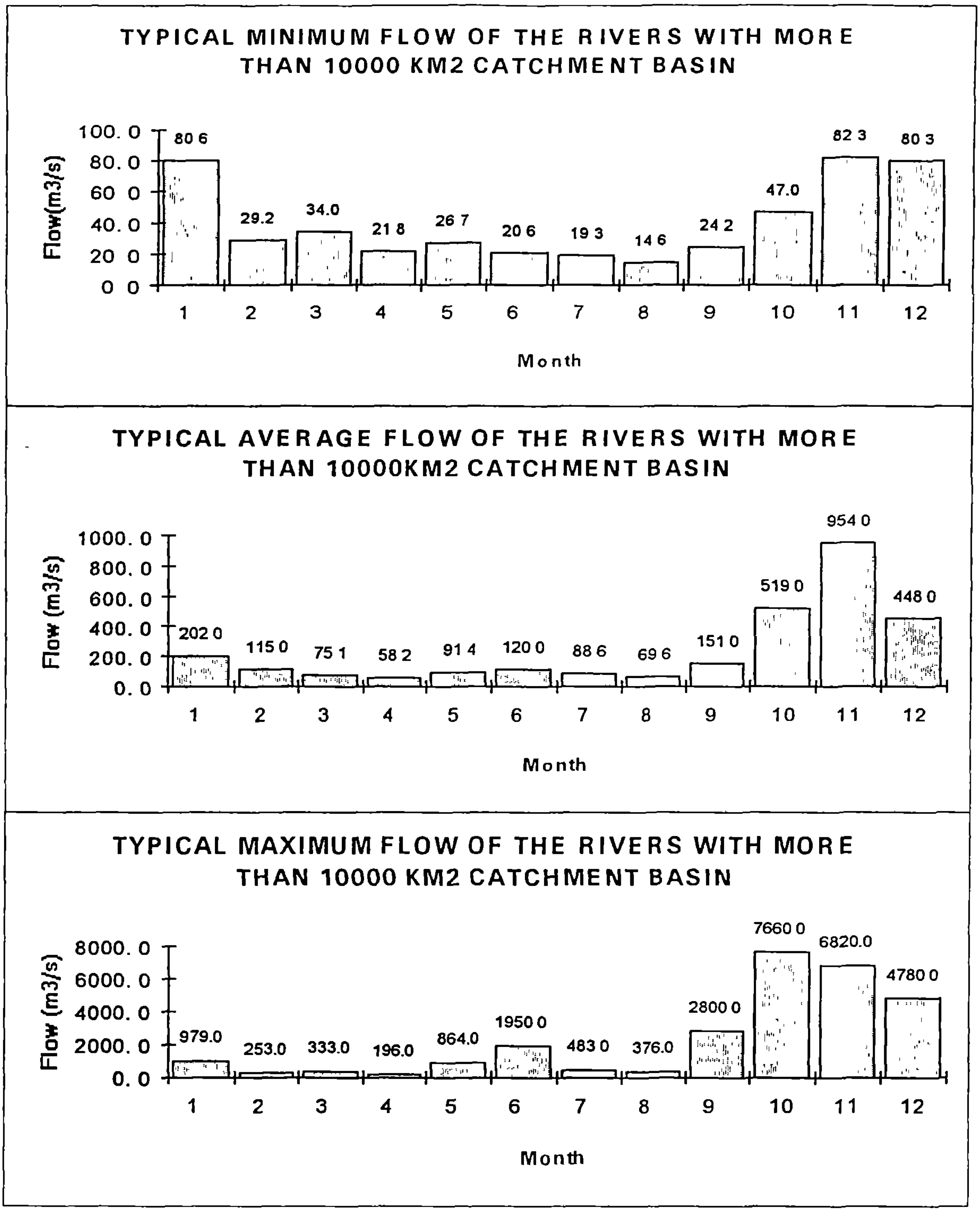


Figure II - 15 Typical monthly flow of the rivers in Central Part of Vietnam with a catchment area more than 10000 Km^2.

HIEU RIVER - 1500 Km²

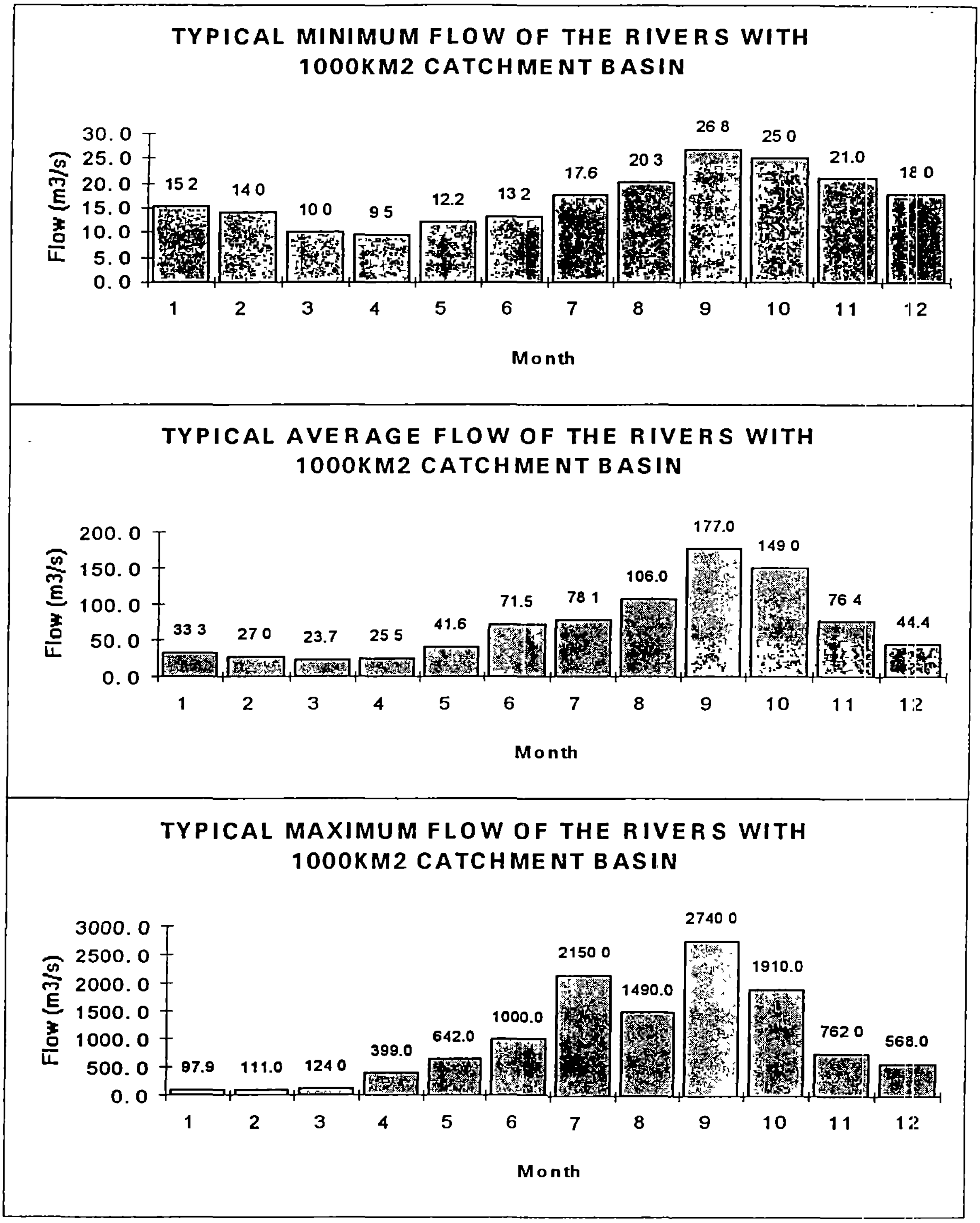


Figure II - 16 Typical monthly flow of the rivers in Central part of Vietnam with a catchment area of 1000 Km^2.

RAO CAI RIVER - 229 Km^2.

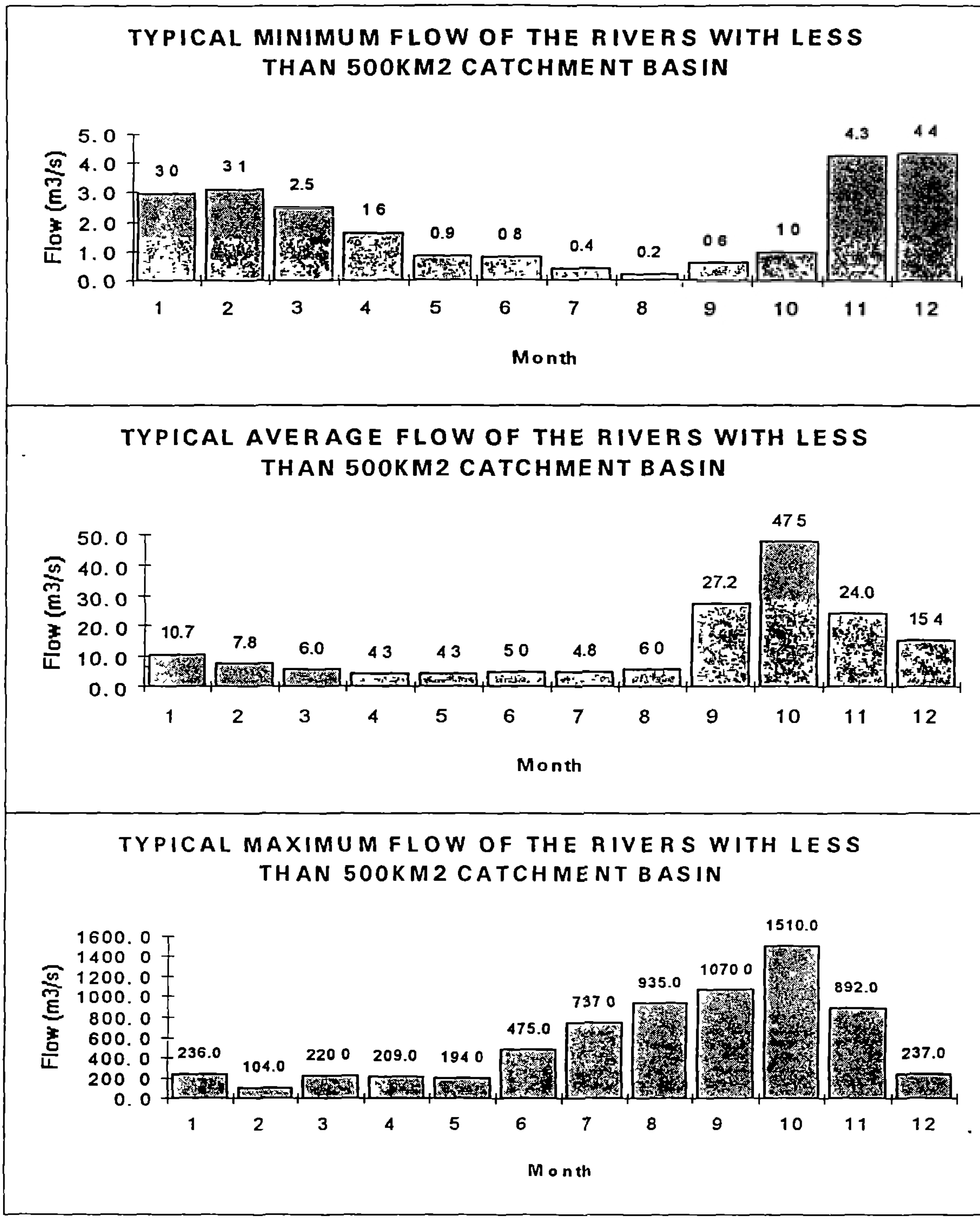


Figure II - 17 Typical monthly flows of the rivers in Central part of Vietnam with a catchment area less than 500 Km^2.

SOUTHERN AREA

DONG NAI RIVER

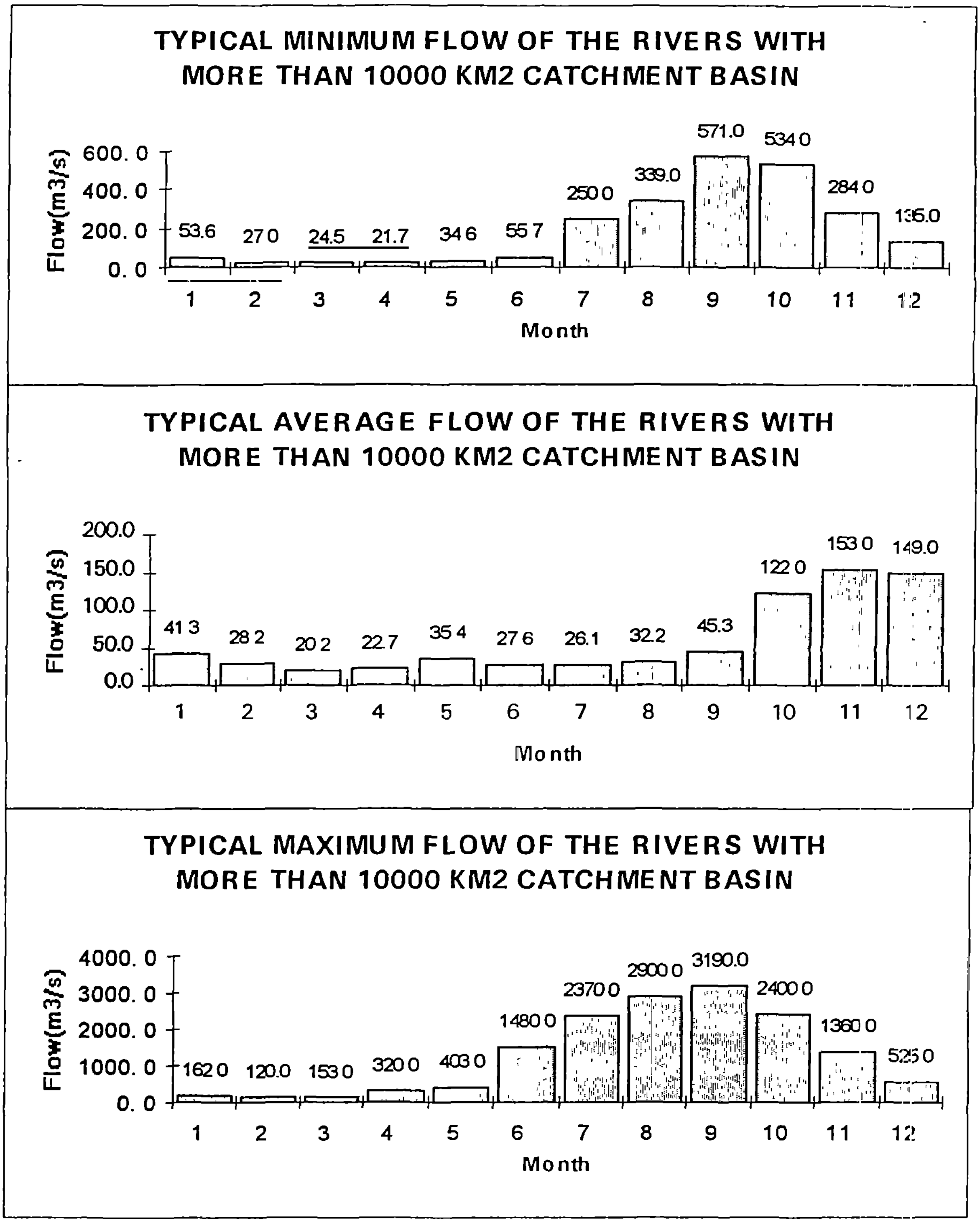


Figure II - 18 Typical monthly flows of the rivers in Southern area with a catchment area more than 10000 Km^2.

CAI RIVER - 1500 Km²

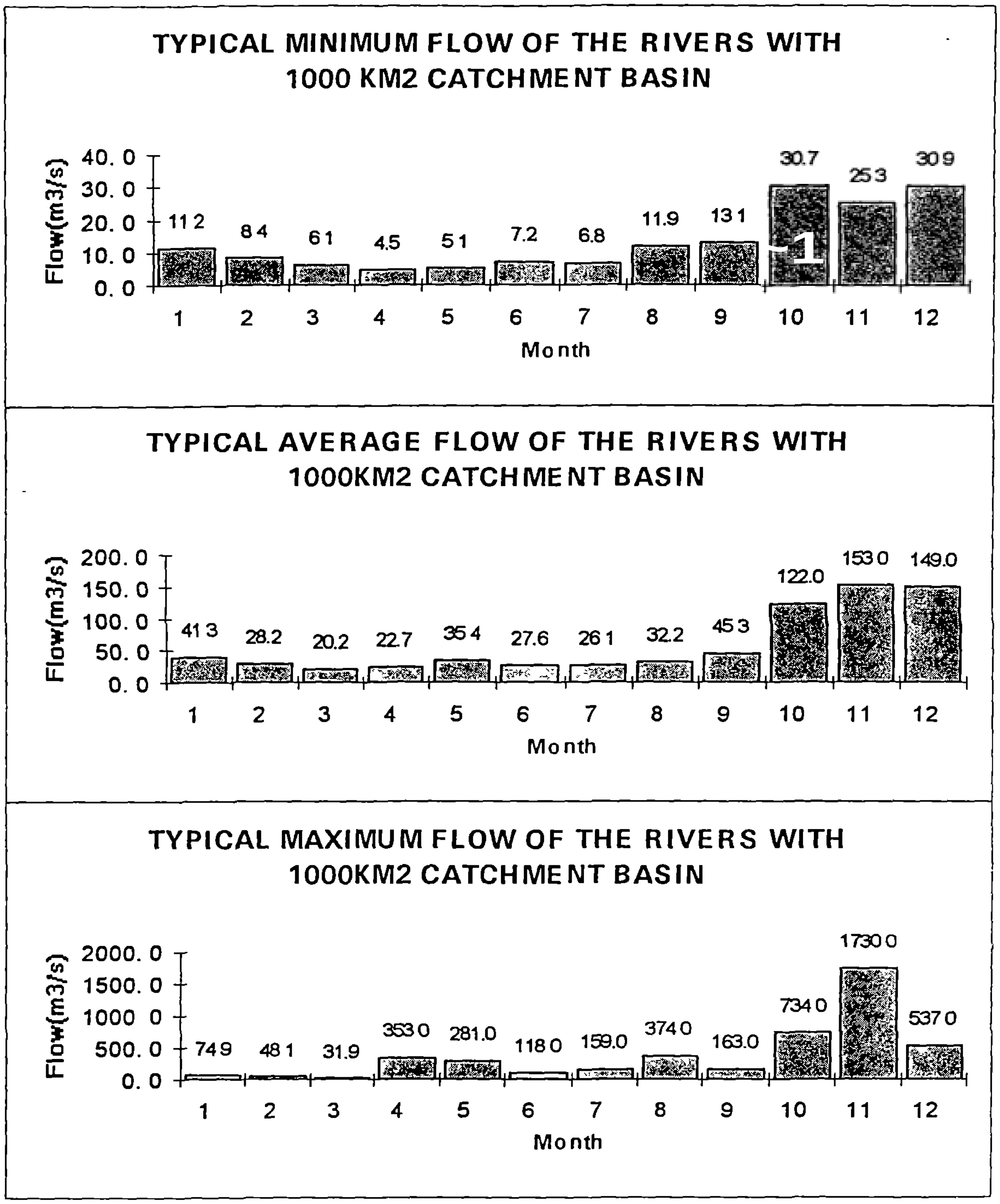


Figure II - 19 Typical monthly flows of the rivers in Southern area with a catchment area of 1000 Km².

CAMLY RIVER - 283 Km²

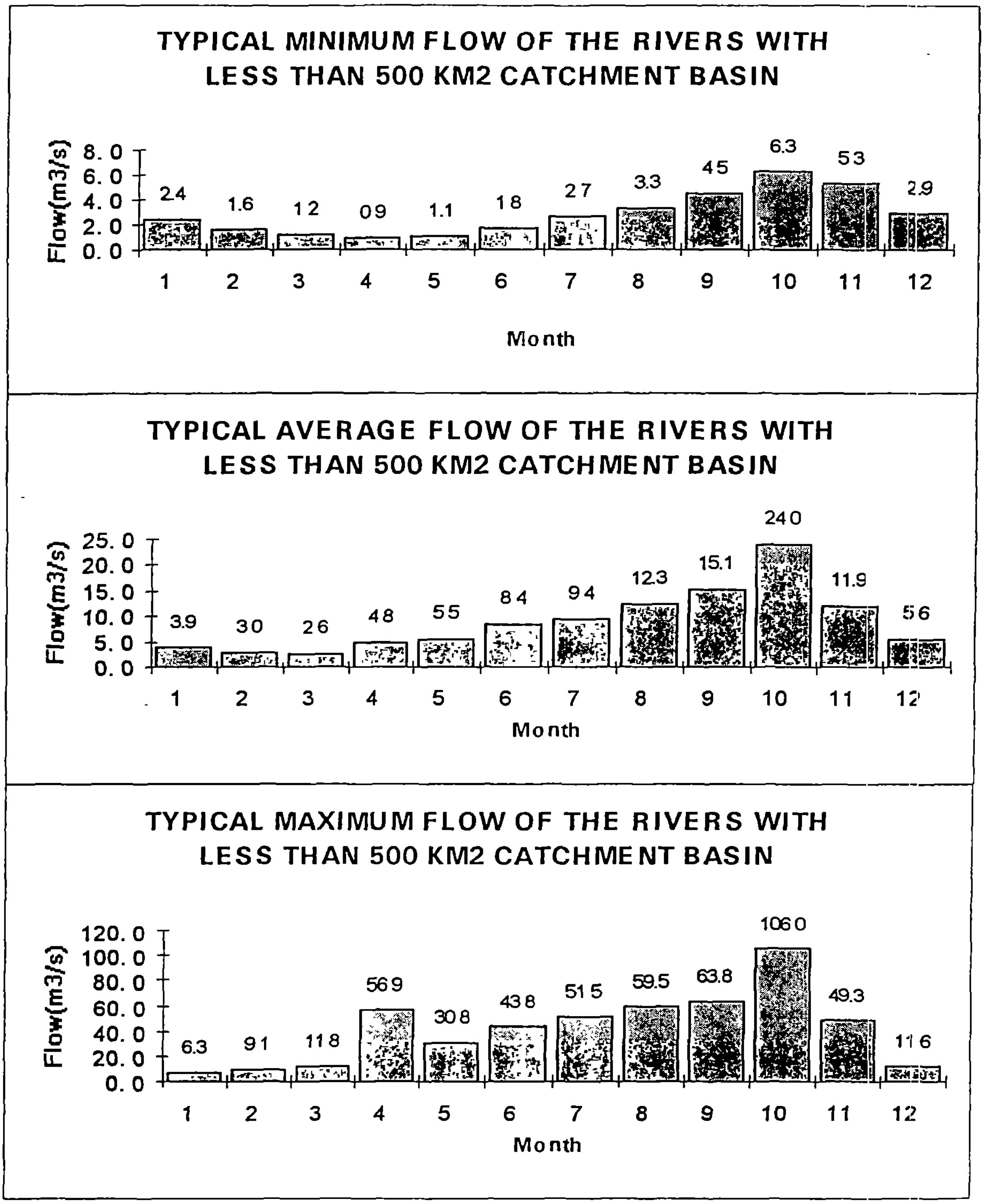


Figure II - 20 Typical monthly flows of the rivers in Southern area with a catchment area less than 500 Km².

Table II - 5 Hydrogeological conditions of surface layer

No.	Name of Urban center	Sub-regions	Depth of surface layer	Geo-stratigrafic corresponding	Main Lithology	Filtration (m/d0	Static groundwater level (m)	Geographical location
4	Hue	In city territory	26- 28 3	Holoxen	sand	1 8- 3 15	0.2- 9 0	Central coast of Northland
18	Thanh Hoa	In city territory	2.0- 12.0	Holoxen	clay-sand-stone	0 5- 3 5	0 5- 2.0	Central coast of Northland
50	Dong Ha town	seaside	28.4	Holoxen	sand	3.27- 3 42	0.7- 2.0	Central coast of Northland
26	Vinh city	In city territory	15.0- 20 0	Holoxen	sand-stone	0 1- 41	1.0- 5 0	Central coast of Northland
48	Bim Son town		2.0- 15 0	De Tu		1 0 - 10 0	1.1- 2.5	Central coast of Northland
20	Sam Son	In town territory	7.6- 32.9	Holoxen	sand	1 67- 34 12	1.56- 3.96	Central coast of Northland
61	Ha Tinh		2.0- 12.0	Holoxen	sand	0 5- 3 5	2.0- 10 0	Central coast of Northland
53	Dong Hoi		7 1- 16.1	Holoxen	sand	3 62- 37 2	2.0- 3.5	Central coast of Northland
66	Phan Rang		15.0- 20.0	Holoxen	sand	2 24	3.73	Central coast of Southland
69	Tuy Hoa town	Tuy Hoa seaside	7.0- 14 0	Holoxen	sand	2.1- 6 7	0 7- 2.0	Central coast of Southland
52	Hoi An town		7.0- 14 0	Holoxen	sand	2.7- 3 2	1 3- 3 25	Central coast of Southland
71	Tam Ky		5.0- 15 0	De Tu	sand	2.6	2.0- 3.0	Central coast of Southland
9	Phan Thiet	In town territory	2.6- 29 8	De Tu	sand	0 55- 1 09	2.0- 5 0	Central coast of Southland
6	Nha trang	In city territory	3.0- 27.6	De Tu	sand	0.7- 2 1	2.0- 6 0	Central coast of Southland
21	Quy Nhon	From Phu My to	5.0- 15 0	Holoxen	sand	0 89-3.93	2.0-3 0	Central coast of Southland
54	Tan An town		15.0- 20 0	Holoxen	clay-sand	0 95- 1.12	2.5- 3.0	Central coast of Southland
5	Da nang	In city territory	5 0- 10.0	Holoxen-pleistoxen	sand	0 85- 3 0	3 0- 5 0	Central coast of Southland
23	Buon Ma Thuot		55 3-160 0	Bazan	Bazan	0 05- 5 88	0.1- 28 6	Central Highland
67	Pleiku		89.2- 390	Bazan	Bazan	0.01- 2.76	0 2- 37.2	Central Highland
51	Kon Tum town	In town territory	21 0- 24.0	Neozen		0 8- 2.1	1.5- 5 56	Central Highland
31	Da Lat city		7 0- 10.0		clay	0 012	5.0- 6.0	Central Highland
22	Long Xuyen		15.0- 30.0	Holoxen	clay-sand	0 65	0.5- 3 0	Mekong River delta
34	Soc Trang town		aver. 20 0	Holoxen	clay-sand	0 75	0 5- 3 0	Mekong River delta
68	Rach Gia		15.0- 30.0	Holoxen	clay-sand	1 34	0 5- 3.0	Mekong River delta
70	Cao Lanh, Chau Doc, Sa Dec,Tra Vinh town	In territory of 4 towns	55	Holoxen	clay-sand	1 4	0.5- 3.0	Mekong River delta
37	Bac Lieu town		2.0- 25.0	Holoxen	clay-sand	0 63- 0 94	0 5- 3 0	Mekong River delta
33	Vinh Long town		aver. 15.0	Holoxen	sand	0 7- 1 5	0 5- 3 0	Mekong River delta
36	My Tho town		10 0- 30.0	Holoxen	clay-sand	0.82	0 5- 4 5	Mekong River delta
7	Can Tho	Inside city	20 0- 25 0	Holoxen	clay-powdery	0 63- 1 09	0 72- 2 23	Mekong River delta
35	Ca Mau town		5.0- 15.0	Holoxen	clay-sand	0 63- 0 94	1.0- 2.5	Mekong River delta
72	Ben Tre		9.0- 30.0	Holoxen	clay-sand	0.63- 0.94	1.45- 2.0	Mekong River delta
1	Ho Chi Minh		20.71	Holoxen	silt-clay-sand	0.72-1 11	0 4- 2 0	North east of Southland
74	Go Cong town		73- 135	Pleistoxen	sand	3.42	0 5- 2.35	North east of Southland
30	Bien Hoa city		10.0- 25.0	Pleistoxen	sand	1.92- 5 36	0 6- 2 0	North east of Southland
38	Thu Duc, Hocmon Nha Be, An Lac		15.0 - 20 0	Holoxen	clay-sand	0.92	0 7 - 2.5	North-east of Southland

32	Tay Ninh town		10.0- 25 0	Pleistoxen	sand	1.75- 4.01	1.10- 1 96	North east of Southland
24	Thu Dau Mot	In Dong Nai, Song Be,	60 0- 90 0	Pleistoxen	sand	0 6- 1 67	1.90- 1 96	North east of Southland
55	Vinh Yen town		5 0- 15 0	Pleistoxen	clay	0.06- 0 429	1 57	North mountain and midland
14	Lang Son		16- 18, max 30	Aluvi	stone,sand,clay	4.48- 5 5	3	North mountain and midland
12	Cam Pha town		5 0- 15 0	De Tu	clay-sand	1.69	0 0- 8.0	North mountain and midland
16	Bac Ninh		16 0 -25.0	Holoxen	sand-clay	1 24	0.16- 2.97	North mountain and midland
15	Cao bang		8	De Tu	rock-sand	27	0.5- 1.5	North mountain and midland
60	Ha Giang	In town territory	2.5- 14 5	De Tu	sand	0.285	0 85- 6.95	North mountain and midland
58	Lai Chau		7 0- 15 0	Eluvi	sand-clay	0.91	2.5- 4 1	North mountain and midland
73	Song Cong		3 0- 15 0	Eluvi, Deluvi	sand	1 25	3.0- 4.0	North mountain and midland
59	Lao Cai		8 0- 16 0	De Tu	sand	1.75	3 0- 4.5	North mountain and midland
25	Viet Tri city		2.0- 15 0	Pleistoxen	clay	0.0015-0 21	3 0- 5.0	North mountain and midland
10	Thai Nguyen		2.0- 10.0	De Tu	sand,clay	0.54- 2.50	3 0- 5 0	North mountain and midland
62	Phu Tho	Thao River side	7.0- 11.0	Holoxen	sand-stones	2 0- 3.7	3.0- 5.0	North mountain and midland
56	Tuyen Quang town	Around Lo River	7.0- 15 0	Holoxen	sand	aver 1.75	3.0- 5 0	North mountain and midland
45	Bac Giang town	In town territory	2.0- 3.0	Holoxen	clay	0 15	wet sea 1 5	North mountain and midland
47	Uong Bi town	Around town	2.0- 15 0	Pleistoxen	clay	0 06- 0 3		North mountain and midland
13	Hon Gai town		aver 10	De Tu	clay-sand	aver. 1 14		North mountain and midland
8	Hai Duong	In town territory	2.0- 6 0	Holoxen	clay-powdery	1 0- 10 0	0 05- 1 8	Red River delta
3	Hai Phong	In city territory	0 5- 15	Holoxen	clay-sand	1 0 - 10 0	0 05- 3.0	Red River delta
65	Hung Yen		7 5- 23.0	Holoxen	sand-clay	0 3- 7.25	0 3- 2 5	Red River delta
44	Thai Binh town		8 0- 10 0	Holoxen	clay-sand	3 33	0 5- 3 0	Red River delta
40	Soc Son townlet	In Western part	2 0- 10 0	Pleistoxen	clay	0 029-0 429	0 59- 1 23	Red River delta
27	Hoa Binh town		2.0- 15.0	Holoxen	sand	0 7- 3 0	1.2- 2	Red River delta
46	Kien An town		2.0- 10.0	Holoxen	clay-sand	0 75- 1.25	1 25- 2 0	Red River delta
17	Ha Dong	Western part		Pleistoxen	clay	0 002-0 01	1 43- 12 5	Red River delta
2	Hanoi	In city territory	5-12	Holoxen	clay-clay powdery	0 004-0 03	1 43- 12 53	Red River delta
42	Gia Lam townlet		2 0- 4 0	Holoxen	clay-sand	1 0- 10.0	1 5- 3 0	Red River delta
19	Do Son - Kien An	Che strem, Kienan	0 5- 8 0	Holoxen		1 0- 10.0	2 0 - 3 5	Red River delta
11	Nam Dinh city		1 0- 10 0	Holoxen	clay	0 63- 3.93	2.0- 5 0	Red River delta
57	Ninh Binh town		6 0- 13.0	Holoxen	sand-clay	0.73- 1.25	3.0- 4 0	Red River delta
29	Yen Bai town		7 0- 10 0	Eluvi	sand	0.75-2.10	3 0- 5 0	Red River delta
63	Son Tay		11 0- 31.6	Holoxen	clay-sand	5.92- 15 74	3.0- 5 0	Red River delta
49	Tam Diep		7 0- 24 3	De Tu	clay	0 2	3 0- 7 0	Red River delta
64	Phu Ly		6 0- 7 0	Holoxen	sand-clay	0 63- 2.99	4 0- 5 0	Red River delta
41	Cau Giay townlet		16	Pleistoxen	colour-clay	0.0015		Red River delta
28	Son la town	In town territory	4.0- 20.0	De Tu	clay	0.004		Red River delta
39	Dong Anh townlet		2.0- 10.0	Pleistoxen	clay	0.029		Red River delta
43	Van Dien townlet	In Southern part	2.0- 10.0	Holoxen	clay	0 004-0 031		Red River delta

Table II - 6 Land use characteristics of the cities investigated

City & Forecast period	Area			Population					Landuse						Housing		Infrastructure				
	Total ha	Urban ha	Suburban ha	Total Nos.	Urban Nos.	Suburban Nos	Growth rate %	Urban density pers/ha	residential %	industrial %	transport %	parks %	public %	other %	Area m²/pers	Stories average Nos	Roads km/km²	Electricity supply W/pers/d	Water supply l/pers/d	Sewers m/ha	Telephone no/1000
HCMC																					
existing	205 649	14 000	191 649	4 400 000	3 208 000	1 192 000	2.55%	229	50 0%	2.8%	5.5%	1.8%	1.8%	38.1%	5 0	1.4	1.75	416	150	7.4	
2000	205 649	14 000	191 649		4 006 000			286	65 7%	7.0%		2 4%			7.5	2.3	2.10	1900	200	15	
2005	205 649	14 000	191 649	5 000 000	4 333 000	667 000		310		11.1%		4.5%				2.8			250	15	
Hanoi																					
1995	5 102	4 300	802	1 100 000	993 417	106 583	2.50%	231	46 6%	9 7%	13.8%	7 8%	13.3%	8 8%							
2000	6 982			1 220 000			2.09%		43 0%	10.3%	12 4%	7.8%	13.4%	13 1%							
2010	8 325			1 500 000			2 09%		40 9%	10 7%	13 7%	8 0%	14 5%	12.2%							
Class I average																					
existing	105 376	9 150	96 226	2 750 000	2 100 709	649 292	2.53%	230	48%	6%	10%	5%	8%	23%	5.0	1.4	1.75	416	150	7.4	
2000	106 316							286	54%	9%		5%			7 5	2.3	2.10	1 900	200	15	
2010	106 987			3 250 000				310		11%		6%				2.8			250	15	
Hai Phong																					
existing	19 300	2 000	17 300	1 517 800	405 000	1 112 800		203	26 4%	19 9%	12.1%	2.5%	4 0%	35.1%	4 6		1.76	240	60	32	2.3
2000	33 000			1 767 300	550 000		5.23%		33 3%	22.7%	13.2%	5.0%	4.3%	21 4%	6 0		3.86	444	110	38	20
2010	51 000			2 151 300	750 000		3 93%		32 4%	23.3%	14.3%	8 8%	6 6%	14.5%	8 0	3.5	3 65	1000	150	70	50
Da Nang																					
existing	9 515	3 718	5 797	420 000	420 000		2 58%	113	32.3%	9.4%	41.2%	4 4%	4 7%	8 0%	6.3			100		21.2	
2000	22 372	5 092	17 280	565 700	482 000	81 700	2 61%	95	42.2%	11 4%	30.7%	2.2%	6 7%	6 8%	6 0		5.50	200		120	
2010	22 372	6 755	15 617	700 000	600 000	100 000	1.76%	89	41 5%	10.9%	28 5%	3 1%	10 4%	5.7%	6 7		6.50	1000		180	
Hue																					
existing	6 777	1 512	5 265	265 200	215 300	49 900	2 82%	142	64.8%	4.2%	8.2%	2.5%	4 0%	16.3%							
2000	6 777	1 592	5 185	297 200	241 200	56 000	2.30%	152	64 1%	4 4%	9.2%	2 7%	4 0%	15 6%							
2010	6 777	1 785	4 992	382 700	310 600	72 100	1.25%	174	62.2%	4.3%	10 9%	3.1%	5.2%	14.4%							
Can Tho																					
existing	5 318	3 018	2 300	230 000					25.1%	4.3%	4.1%	2 3%	4.5%	59.7%	6	2.5	3 50	50	100		
2000	5 546	3 926	1 620	270 000			2 71%		28 9%	5 9%	7 6%	5.5%	5.8%	46.3%	6	3		150	200		
2010																					
Class II average																					
existing	10 228	2 562	7 666	608 250	346 767		2 70%	153	37%	9%	16%	3%	4%	30%	5.6	2.5	2.6	130	80	27	2.3
2000	16 924			775 050	424 400		3.21%	123	42%	11%	15%	4%	5%	23%	6.0	3	4.7	265	155	79	20
2010	26 716			1 079 000	[illegible]		2 31%	131	45%	13%	18%	5%	7%	12%	7 4	3.5	5.1	1 000		123	50

Table II - 6 Land use characteristics of the cities investigated (Continued)

City & Forecast period	Area: Total ha	Area: Urban ha	Area: Suburban ha	Population: Total Nos	Population: Urban Nos	Population: Suburban Nos	Population: Growth rate %	Population: Urban density pers/ha	Landuse: residential %	Landuse: industrial %	Landuse: transport %	Landuse: parks %	Landuse: public %	Landuse: other %	Housing: Area m²/pers	Housing: Stories average Nos	Infrastructure: Roads km/km²	Infrastructure: Electricity supply W/pers/d	Infrastructure: Water supply l/pers/d	Infrastructure: Sewers m/ha	Infrastructure: Telephone no/1000
HCMC																					
existing	205 649	14 000	191 649	4 400 000	3 208 000	1 192 000	2.5[illegible]%	229	50.0%	2.8%	5.5%	1.8%	1.8%	38.1%	5.0	1.4	1.75	416	150	7.4	
2000	205 649	14 000	191 649		4 006 000			286	65.7%	7.0%		2.4%			7.5	2.3	2.10	1900	200	15	
2005	205 649	14 000	191 649	5 000 000	4 333 000	667 000		310		11.1%		4.5%				2.8			250	15	
Hanoi																					
1995	5 102	4 300	802	1 100 000	991 417	108 583	2.50%	231	46.6%	9.7%	13.8%	7.8%	11.3%	8.8%							
2000	6 982			1 220 000			2.09%		43.0%	10.3%	12.4%	7.8%	13.4%	13.1%							
2010	8 125			1 500 000			2.06%		40.9%	10.7%	13.7%	8.0%	14.5%	12.2%							
Class I average																					
existing	105 376	9 150	96 226	2 750 000	2 100 708	649 292	2.51%	230	48%	6%	10%	5%	8%	23%	5.0	1.4	1.75	416	150	7.4	
2000	106 316							286	54%	9%		5%			7.5	2.3	2.10	1 900	200	15	
2010	106 287			3 250 000				310		11%		6%				2.8			250	15	
Hai Phong																					
existing	19 300	2 000	17 300	1 517 800	405 000	1 112 800		201	26.4%	19.9%	12.1%	2.5%	4.0%	35.1%	4.6		1.76	240	60	32	2.3
2000	11 000			1 767 300	550 000		5.23%		33.3%	22.7%	13.2%	5.0%	4.3%	21.4%	6.0		3.86	444	110	38	20
2010	51 000			2 154 300	750 000		3.93%		32.4%	23.3%	14.3%	8.8%	6.6%	14.5%	8.0	3.5	3.65	1000	150	70	50
Da Nang																					
existing	9 515	3 718	5 797	420 000	420 000		2.58%	113	12.3%	9.4%	41.2%	4.4%	4.7%	8.0%	6.3			100		21.2	
2000	22 372	5 092	17 280	565 700	482 000	83 700	2.61%	95	42.2%	11.4%	10.7%	2.2%	6.7%	6.8%	6.0		5.50	200		120	
2010	22 372	[illegible]	[illegible]	700 000	600 000	100 000	1.76%	84	41.5%	10.9%	28.5%	3.1%	10.4%	5.7%	6.7		6.50	1000		180	
Hue																					
existing	6 777	1 512	5 265	265 200	215 300	45 000	2.82%	142	64.8%	4.2%	8.2%	2.5%	4.0%	16.3%							
2000	6 777	1 592	5 185	297 200	241 200	56 000	2.10%	152	64.1%	4.4%	9.2%	2.7%	4.0%	15.6%							
2010	6 777	1 785	4 992	382 700	310 000	72 100	1.25%	[illegible]	62.2%	4.3%	10.9%	3.1%	5.2%	14.4%							
Can Tho																					
existing	5 318	3 018	2 300	230 000					25.1%	4.3%	4.1%	2.3%	4.5%	59.7%	6	2.5	3.50	50	100		
2000	5 546	3 926	1 620	270 000			2.71%		28.9%	5.9%	7.6%	5.5%	5.8%	46.3%	6	3		150	200		
2010																					
Class II average																					
existing	10 228	2 562	7 666	608 250	346 767		2.70%	153	37%	9%	16%	3%	4%	30%	5.6	2.5	2.6	130	80	27	2.3
2000	16 924			725 050	424 400		3.21%	123	47%	11%	15%	4%	5%	23%	6.0	3	4.7	205	155	70	20
2010	25 716			1 079 000	551 533		2.31%	131	45%	11%	19%	5%	7%	17%	7.4	3.5	[illegible]	[illegible]		175	50

Table II - 7 NUSS-information collection sheet - Technology, Class I cities

No.	Description	Ho Chi Minh City	Hanoi	Average/typical
3 1	*General*			
3.1.1	Urban area, ha	14 036	4 300	9 168
3.1 2	Households in 1994, nos	737 000	220 000	478 500
3 1 3	Persons in district, nos			
3.1.3.1	1994	3 343 133	993 417	2168 275
3.1 3 2	2000	3 953 000	1 099 151	2526 075
3.1 3 3	2010	4 248 000	1 300 969	2774 484
3.1.4	Population density, nos./ha			
3.1.4 1	1994	238	231	237
3.1 4 2	2000	282	256	276
3 1.4 3	2010	303	303	303
3.1.5	Persons per household in 1994, nos	4.5	4.5	4.5
3 1.6	Type of industry and number of employees	700 industries		plenty and several types of industries
3 1 7	Name of hospital and number of beds	29 hospitals, 12 550 beds	3 150 beds	7 850
3 2	*Water Supply*			
3 2.1	*Public Water Supply:*			
3.2.1.1	Households connected to public network	450 000	150 000	300 000
3.2.1.2	Number of wells	26	132	79
3.2.1.3	Groundwater production, m³/day	60 000	330 000	195 000
3.2.1.4	Production from surface water sources, m³/day	650 000	20 000	335 000
3.2.1.5	Total production, m³/day	710 000	350 000	530 000
3.2.1.6	Domestic water consumption, m³/day	340 000	112 000	226 000
3.2.1 7	Industrial water consumption, m³/day	100 000	80 000	90 000
3.2.1.8	Total consumption, m³/day	440 000	192 000	316 000
3 2.1 9	Unaccounted for water, % of total production	38%	45%	40%
3 2.1 10	Service Coverage, public system, %	61%	68%	63%
3.2.1.11	Specific Domestic Water Consumption, l/pers.day	167	165	166
3 2.2	*Private Water Supply:*			
3.2.2.1	Number of private wells		250	
3.2.2.2	Households supplied			
3.2.2.3	Households without water supply, nos			
3 2.2.4	Estimated Water Consumption, m³/day		120 000	
3 3	*Wastewater*			
3.3 1	*Public Sewerage:*			
3.3.1.1	Households connected to combined sewers	400 000	55 000	227 500
3 3.1.2	Households connected to separate sewers			
3 3.1 3	Service Coverage, public system, %	54%	25%	48%
3 3 1.4	Domestic wastewater flow, m³/day	416 423	120 449	268 436
3 3.1 5	Industrial wastewater flow, m³/day	44 869	11 340	28 105
3.3.1 6	Total wastewater flow, m³/day	461 292	131 789	296 541
3.3.1 7	Ratio of Wastewater/Water Consumption, %	105%	69%	94%
	Ratio of Domestic Wastewater/Water Consumption, %	122%	108%	119%
3.3.1.8	Specific Wastewater Flow, l/pers day	175	113	156
3 3.1.9	Waste water treatment			
3.3.1 10	Primary treatments, m³/day			0
3 3 1.11	Secondary treatments, m³/day			0
3 3.1 12	Waste discharged without treatment, m³/day	461 292	250 000	355 646
3.3.1 13	Households with septic tanks connected to public sewers	400 000	40 000	227 500
3 3.1.14	Number of septic tanks with connection to sewers		9 200	
3.3 1 15	Number of public toilets connected to sewers		109	109
3 3 1.16	Number of public toilets not connected to sewers			0
3.3.1 17	Sludge produced in treatment plants, m³/day			0
	Sludge collected from sewerage/drainage system, m³/day	641		
3.3.1 18	Sludge collected from septic tanks, m³/day	81	60	71
3 3 1.19	Sludge collected from public latrines, m³/day			
3.3.1.20	Total sludge production, m³/day	723	60	391
3.3.1.21	Specific sludge production, kg/pers day	0.40	0.24	0 38
3.3.1.22	Sludge disposal method and location	- landfills, agriculture - composting plant		
3 3.1.23	Number of vacuum trucks with volume of tank (Xpcs/Ym³)	1pcs	3x5m³,6x4m³,2x2m	
3 3 1.23	Number of vacuum trucks with volume of tank (Xpcs/Ym³)	1pcs	3x5m³,6x4m³,2x2m	
3.3.2	*Private (on-site) Sanitation.*			

3 3 2.1	Households w/ septic tanks not connect to sewers	300 000	50 000	175 000
3.3.2.2	Coverage of individual wet toilet systems	41%	23%	37%
	Total public and individual wet system coverage	95%	48%	84%
3 3 2.3	Households using double vault latrines	0	40 000	20 000
3 3 2.4	Households using bucket latrines	0	36 000	18 000
3.3.2.5	Households using communal toilets		16 000	16 000
3.3 2.6	Nightsoil and sludge collection, m³/day	61	160	111
3 3.2.7	Nightsoil/sludge sold to farmers, m³/day			
3.3.2.8	Nightsoil/sludge sold to others, m³/day			
3.3 2.9	Price paid by farmers for nightsoil/sludge, VD/m³	60 000		60 000
3 3.2.10	Price paid by others for nightsoil/sludge, VD/m³			
3 3.2.11	Nightsoil/sludge treatment			
3 3 2.12	Nightsoil/sludge disposal method and location:	- sold to farmers - transported to landfills		
3.3 2.13	Specific nightsoil production, kg/pers day	0 04	0.35	0.12
3.3 2.14	Number of vacuum trucks with volume of tank (Xpcs/Ym³)	4x5m³, 5x2m³		
3 4	*Solid Waste Management*			
3 4 1	*Municipal Solid Waste Management (MSWM)*			
3.4 1 1	Households w/ municipal collection service, nos	540 105	92 000	316 053
3 4 1 2	Service Coverage, municipal system, %	73%	42%	66%
3 4 1.3	Total municipal solid waste collection, tonnes/day	1 600	319	960
3.4 1 4	Municipal solid waste generation, tonnes/day	2183	763	1453
3.4 1.5	Specific MSW generation, kg/pers day	0 65	0 77	0.67
3 4.1.6	Name and location of landfills	- 7 landfills	Cau Dien, Me Tri	
3 4 1 7	Amount of MS disposed of at landfills, tonnes/day	1 698	319	1 009
3 4 1.8	Amount of nightsoil/sludge disposed of, tonnes/day			
3.4.1.9	Remaining capacity in years of operation at landfill	- lacking		new landfills needed
3 4 1 10	Other treatment and disposal methods.	- dumping, burning, composting plant	- 30 000 m³/year composted	composting
3.4 2	*Private Solid Waste Management*			
3.4.2.1	Households without public service	196 895	128 000	162 448
3 4.2.2	MSW not collected, tonnes/day	583	444	493
3 4 2.3	How do households without collection service dispose of their waste?			
	In vacant lots	X	X	X
	Into rivers, canals or drains	X	X	X
	Burning	X		
	Other methods			
3 4 2 4	Industrial waste disposed of by the industry, tonnes/day	830	46	438
3 4 2.5	Industrial waste disposal methods	landfill	landfill	landfill
3 4.2.6	Hospital waste disposed of by the hospital, tonnes/day	6 2		
3.4 2.7	Hospital waste treatment/disposal method	burning	burning	burning
3.5	*Drainage*			
3 5 1	How extensive is drainage of surface water provided	59%	25%	42%
3.5 2	Type and length of drainage system.			
3 5 2.1	Combined sewage/surface water, m	980 000	125 000	552 500
3.5 2.2	Separate drainage system, m	0	in Kim Lien only	0
3 5 2.3	Open manmade canals, m		38 000	
3 5 2.4	Underground drains, m			
3.5.2.5	Natural channels, m	90 000	36 800	63 400
3 5 3	How often do flooding occur, nos./year?	5-6	5-10	5-8
3 5 4	How large is the area normally inundated, %?		50-70%	
3 5.5	Area of surface water bodies, ha	1 045	630	838
3.5 6	Area of surface water bodies, %	7 4%	15%	9.1%
3 6	*Priority Improvements*			
3 6 1	Describe what the district administrations consider to be the main problem area, and rank these according to priority of need for improvement (lack of water supply, sewerage,solid waste, flooding or other)			
3 7	*Health Statistics*			
3 7.1	Occurrences of Diarrhoea, rate/1000	2.78	2.41	2.60
3 7 2	Occurrences of Dysentheria, rate/1000	0 07	0 56	0 32
3 7 3	Occurrences of Typhoid, rate/1000	0 01	0 00	0 00
3 7.4	Occurrences of Shigellosis, rate/1000	0.00	0.00	0.00
3 7.5	Occurrences of Amoebiais, rate/1000	0.02	0 00	0 01
3.8	*Soil conditions*			
3.8 1	Prevailing surface soil type	fine sand, silt, clay	clay	
3.8 2	Top soil permeability, m/d	0.72 - 1.11	0.001 - 0 03	impermeable
3 8 3	Ground water table, m from ground surface	0 4 - 2.0	1.4 - 12.5	

Table II - 8 NUSS-information collection sheet - Technology, Class II cities

No.	Description	Haiphong	Da Nang	Hue	Can Tho	Average/typical (*
3.1	*General*					
3.1.1	Urban area, ha	2 000	2 830	6 770	5 540	4 285
3.1.2	Households in 1994, nos	100 000	80 635	35 000	37 500	63 284
3.1 3	Persons in district, nos					
3.1 3 1	1994	405 000	439 490	260 000	250 000	338 623
3.1.3 2	2000		600 000	415 000	420 000	428 465
3.1 3 3	2010		1 000 000	490 000		634 234
3.1.4	Population density, nos./ha					
3.1.4 1	1994	203	155	38	45	79
3.1.4 2	2000		212	61	76	100
3.1.4 3	2010		353	72		148
3.1.5	Persons per household in 1994, nos	4 1	5 5	7 4	6 7	5 4
3.1 6	Type of industry and number of employees	port machinery garment, food proc constr materials chemicals	textile, 2000 food process -ing 1000, wood processing, 1500	textile, 1000 rock & paint 500, brewery 300	28 factories, 3438 empl.	A few industries
3.1.7	Name of hospital and number of beds	22 hospitals, 4 900 beds	Provincial hospital, 1000 Hospital C, 400 Army hospital, 1000 Railway hospital, 100 Total 4 390 beds	Central hospital, 1200 City hospital, 200 Tradition medical hospital, 1000 Army hospital, 270 Total 1 190 beds	Can Tho, 1050 beds Total 1 795 beds	3 069 beds
3.2	*Water Supply*					
3.2.1	*Public Water Supply*					
3.2.1.1	Households connected to public network	67 000	31 780	12 000	25 400	34 045
3.2.1.2	Number of wells	0	14	0	4	5
3 2.1.3	Groundwater production, m³/day	0	4 000	0	750	1 188
3.2.1.4	Production from surface water sources, m³/day	117 000	48 000	28 000	35 000	57 000
3.2.1 5	Total production, m³/day	117 000	52 000	28 000	35 750	58 188
3 2.1.6	Domestic water consumption, m³/day	29 000	25 000	14 300	20 820	22 280
3.2.1.7	Industrial water consumption, m³/day	9 000	10 600	5 850	0	6 363
3.2.1.8	Total consumption, m³/day	38 000	35 600	20 150	20 820	28 643
3.2.1 9	Unaccounted for water, % of total production	68%	32%	28%	42%	51%
3.2.1.10	Service Coverage, public system, %	67%	39%	34%	68%	54%
3 2.1 11	Specific Domestic Water Consumption, l/pers day	107	144	160	123	122
3 2.2	*Private Water Supply*					
3.2.2.1	Number of private wells		17 214	15 000	377	10 864
3.2.2.2	Households supplied		15 000	15 000	3 770	11 257
3.2.2.3	Households without water supply, nos	280 000	33 855	8 000	8 330	17 982
3.2.2.4	Estimated Water Consumption, m³/day		4 905	6 686	1 508	3 614
3 3	*Wastewater*					
3.3 1	*Public Sewerage*					
3.3.1 1	Households connected to combined sewers	27 000	43 000	7 000	34 000	27 750
3 3.1 2	Households connected to separate sewers		0		0	0
3 3 1.3	Service Coverage, public system, %	27%	53%	20%	91%	44%
3 3.1 4	Domestic wastewater flow, m³/day	25 000	20 000	13 200		19 400
3 3 1.5	Industrial wastewater flow, m³/day	9 000	10 000	5 000		8 000
3.3 1 6	Total wastewater flow, m³/day	34 000	30 000	18 200		27 400
3.3 1.7	Ratio of Wastewater/Water Consumption, %	89%	84%	90%		96%

	Ratio of Domestic Wastewater/Water Consumption, %	86%	80%	92%		87%
3 3 1 8	Specific Wastewater Flow, l/pers.day	96	122	145		117
3 3 1.9	Waste water treatment					
3 3 1 10	Primary treatments, m³/day	0	0	300		100
3 3.1 11	Secondary treatments, m³/day	0	0	0		0
3.3.1 12	Waste discharged without treatment, m³/day	34 000	64 000	27 700		41 900
3.3.1.13	Households with septic tanks connected to public sewers, nos	19 000	3 000	1 750	34 000	14 438
3 3.1.14	Number of septic tanks with connection to sewers	5 500	3 000		34 000	14 167
3.3 1.15	Number of public toilets connected to sewers	425	0	0	6	108
3 3 1.16	Number of public toilets not connected to sewers		0	2	0	1
3.3 1 17	Sludge produced in treatment plants, m³/day					0
	Sludge collected from sewerage/drainage system, m³/d	8				8
3.3 1 18	Sludge collected from septic tanks, m³/day	18	20	12	11	15
3 3 1 19	Sludge collected from public latrines, m³/day		0		1.4	1
3.3 1 20	Total sludge production, m³/day	26	20	12 0	12.4	24 1
3 3 1.21	Specific sludge production, kg/pers.day	0.24	0 09	0 23	0 05	0 16
3 3.1 22	Sludge disposal method and location	- agricul - landfill	with refuse			landfill
3.3.1.23	Number of vacuum trucks with volume of tank (Xpcs/Ym³)	8 pcs/3.7m³	3 pcs/5m³	1x4,5m³, 1x3,5m³	2pcs/5 m³	3 pcs/4m³
3 3.2	*Private (on-site) Sanitation:*					
3.3 2.1	Households w/ septic tanks not connect to sewers	0	64 000	15 000	0	19 750
3 3 2.2	Coverage of individual wet toilet systems	0%	79%	43%	0%	31%
	Total public and individual wet system coverage	27%	83%	63%	91%	75%
3 3 2.3	Households w/ double-vault composting latrines	0	3 200	400		1 200
3.3 2.4	Households using bucket latrines	23 000	0	0	0	5 750
3.3.2.5	Households using communal toilets	0	8 000	0	0	2 000
3.3.2.6	Nightsoil and sludge collection, m³/day	35			0	18
3.3.2.7	Nightsoil/sludge sold to farmers, m³/day		0	12		6
3.3.2.8	Nightsoil/sludge sold to others, m³/day		0			0
3 3.2.9	Price paid by farmers for nightsoil/sludge, VD/m³	81 081	0	12 000		31 027
3 3 2.10	Price paid by others for nightsoil/sludge, VD/m³		0			0
3 3.2.11	Nightsoil/sludge treatment					
3.3.2.12	Nightsoil/sludge disposal method and location	- sold to farmers fresh - landfill				
3 3 2.13	Specific nightsoil production, kg/pers day	0 38				0 11
3 3 2.14	Number of vacuum trucks with volume of tank (Xpcs/Ym³)					
3 4	*Solid Waste Management*					
3 4 1	*Municipal Solid Waste Management (MSWM)*					
3 4 1 1	Households w/ municipal collection service, nos	78 000	60 000	20 000	25 500	45 875
3 4 1.2	Service Coverage, municipal system, %	78%	74%	57%	68%	72%
3.4 1 3	Total municipal solid waste collection, tonnes/day	250	300	37 5	100	172
3.4 1 4	Municipal solid waste generation, tonnes/day	321	403	66	147	237
3 4 1 5	Specific MSW generation, kg/pers day	0 79	0 92	0 25	0 59	0.70
3.4 1 6	Name and location of landfills	Thuong Ly, *10 ha*	Hoa Khang, *12 km west*	south-west *of city*	Bai Rang, 1.8ha, 13 km	
3 4 1 7	Amount of MS disposed of at landfills, tonnes/day	215	300	37 5	100	163
3 4 1 8	Amount of nightsoil/sludge disposed of, tonnes/day			0	10	5
3 4 1 9	Remaining capacity in years of operation at landfill	2-3	0	0	1.1	0 9
3 4 1 10	Other treatment and disposal methods				landfill and burning	
3.4 2	*Private Solid Waste Management*					
3 4 2 1	Households without public service	22 000	21 000	15 000	12 000	17 500
3 4 2.2	MSW not collected, tonnes/day	71	105	28	47	66
3 4 2 3	How do households without collection service dispose of their waste?					
	In vacant lots	X	X	X	X	X
	Into rivers, canals or drains	X	X	X	X	X
	Burning		X		X	X
	Other methods		dumping in gardens	dumping in gardens		dumping in gardens
3 4.2 4	Industrial waste disposed of by the industry, tonnes/day	96			3 26	50
3 4.2.5	Industrial waste disposal methods:	- landfill, burning, on-site disposal	with domestic refuse		landfill	landfill

3 4.2 6	Hospital waste disposed of by the hospital, tonnes/day			1	0.7	0.9
3 4.2 7	Hospital waste treatment/disposal method		burning	city landfill	burning and landfill	burning and landfill
3 5	*Drainage*					
3.5.1	How extensive is drainage of surface water provided (% of area)?		40%	90%		
3 5 2	Type and length of drainage system					
3.5.2.1	Combined sewage/surface water, m	170 500	72 000	33 000	41 234	79 184
3 5.2.2	Separate drainage system, m		0	0	0	0
3.5.2.3	Open manmade canals, m	6 100	42 000	20 000	0	17 025
3 5.2.4	Underground drains, m		10 000	13 000	10 000	11 000
3 5 2.5	Natural channels, m		20 000	70 000	5 000	31 667
3 5 3	How often do flooding occur, nos./year?	often	2-3	1	0	2
3 5.4	How large is the area normally inundated, %?		10%	20%		15%
3.5 5	Area of surface water bodies, ha	120	30	107	60	79
3.5.6	Area of surface water bodies, %	6 0%	1 1%	1 6%	1.1%	2.4%
3.6	*Priority Improvements*					
3 6.1	Describe what the district administrations consider to be the main problems areas, and rank these according to priority of need for improvement (lack of water supply, sewerage, solid waste, flooding or other)		1. Drainage/ flooding 2. Solid waste	1 Sewage /drainage 2. City landfill 3 Solid waste treat- ment plan	1. SW treatment plant 2. WW treatment plant	1 drainage 2. solid waste
3 7	*Health Statistics*					
3 7 1	Occurrences of Diarrhoea, rate/1000	3 28	4 29	4 20	1.23	3 25
3 7.2	Occurrences of Dysentheria, rate/1000	0 43	0 00	0 22	0.14	0 20
3 7 3	Occurrences of Typhoid, rate/1000	0.00	0 04	0.18	0.60	0 21
3.7.4	Occurrences of Shigellosis, rate/1000	0.00	1 05	0.96	0 10	0 53
3.7.5	Occurrences of Amoebiais, rate/1000	0.00	0 51	0 46	0.02	0 25
3 8	*Soil conditions*					
3.8 1	Prevailing surface soil type	loamy mud and clay	sand	sand	clay	
3.8.2	Top soil permeability, m/d	1 00	0 85 - 3 0	1 8 - 3.15	0 63 - 1 09	
3 8 3	Ground water table, m from ground surface	0 05 - 3 0	3.0 - 5.0	0 2 - 9 0	0 7 - 2 2	

Table II- 9 NUSS-information collection sheet-Technology, Class III cities

No.	Description	Phan Thiet	Nha Trang	Thai Nguyen	Hai Duong	Bac Giang	Average/typical (*
3.1	*General*						
3.1.1	Urban area, ha	1 188	665	3 562	4 000	1 200	2 123
3.1.2	Households in 1994, nos.	21 177	37 945	50 000	20 000	12000	28 224
3.1.3	Persons in district, nos						
3.1.3.1	1994	106 671	230 000	180 000	65 000	55 000	127 334
3.1.3.2	2000	127 400	260 000	287 000	76 500	70 000	149 406
3.1.3.3	2010	154 500	295 000	452 000	100 000	95 000	180 368
3.1.4	Population density, nos./ha						
3.1.4.1	1994	90	346	51	16	46	60
3.1.4.2	2000	107	391	81	19	58	70
3.1.4.3	2010	130	444	127	25	79	85
3.1.5	Persons per household in 1994, nos	5.0	6.1	3.6	3.3	4.6	4.5
3.1.6	Type of industry and number of employees	Sea food processing Brewery Brick factory ship yard	34 factories, 7128 empl	Steel& mechanical, 1500 paper, 200 metallurgy, 200 *constr material* s, 500, food processing, 1000	Porcelain factory, 1000 Mechanical factory 500, food processing 1500	- Chemical Fertilizer - Company, 3 500	A few industries
3.1.7	Name of hospital and number of beds	Phan Thiet, 500 beds	Khanh Hoa hospital	City hospital, 500 Provincial hospital 300, Steel Comp hosp 200, Tuberc Hospital 150 Total 1600 beds	Army hospital, 500 beds, provincial hospital 500, City hospital 50 Total 3330 beds	- 1 small hospital	1885 beds
3.2	*Water Supply*						
3.2.1	*Public Water Supply*						
3.2.1.1	Households connected to public network	6 493	15 532	20 000	11 000	1 700	10 945
3.2.1.2	Number of wells	0		5	2	0	2
3.2.1.3	Groundwater production, m³/day	0		10 000	1 000	0	2 750
3.2.1.4	Production from surface water sources, m³/day	6 500	18 500	220 000	21 000	2 400	53 680
3.2.1.5	Total production, m³/day	6 500	18 500	230 000	22 000	2 400	56 430
3.2.1.6	Domestic water consumption, m³/day	2 900	8 400	16 000	9 900	2 400	7 920
3.2.1.7	Industrial water consumption, m³/day	1 000	2 200	122 000	1 100	0	25 260
3.2.1.8	Total consumption, m³/day	3 900	10 600	138 000	11 000		33 180
3.2.1.9	Unaccounted for water, % of total production	40%	43%	40%	50%		41%
3.2.1.10	Service Coverage, public system, %	31%	41%	40%	55%	14%	39%
3.2.1.11	Specific Domestic Water Consumption, l/pers day	89	89	222	277	308	160
3.2.2	*Private Water Supply*						
3.2.2.1	Number of private wells			15 000	8 000	6 000	9 667
3.2.2.2	Households supplied			20 000	9 000	10000	13 000
3.2.2.3	Households without water supply, nos	14 684	22 413	10 000	0		4 279
3.2.2.4	Estimated Water Consumption, m³/day			4 320	1 500	2750	3519
3.3	*Wastewater*						
3.3.1	*Public Sewerage*						
3.3.1.1	Households connected to combined sewers	6 300	1 138	16 250	11 000	0	6 938
3.3.1.2	Households connected to separate sewers	0	0	0	0	0	0
3.3.1.3	Service Coverage, public system, %	30%	3%	33%	55%	0%	25%
3.3.1.4	Domestic wastewater flow, m³/day			10 500	5 000		
3.3.1.5	Industrial wastewater flow, m³/day			100 000	1 000		
3.3.1.6	Total wastewater flow, m³/day			110 500	6 000		
3.3.1.7	Ratio of Wastewater/Water Consumption,			80%	55%		73%
	Ratio of Domestic Wastewater/Water Cons			66%	51%		62%
3.3.1.8	Specific Wastewater Flow, l/pers day			178	151		118
3.3.1.9	Waste water treatment						

3 3 1 10	Primary treatments, m³/day	0		0	0	0	0
3 3 1 11	Secondary treatments, m³/day	0		0	0	0	0
3 3 1 12	Waste discharged without treatment, m³/day			110 500	6 000		58 250
3 3 1.13	Households with ST connected to public sewers, nos	6 300	1138	11 100	11 000	0	5 908
3 3.1 14	Number of septic tanks with connection to sewers	6 300		11 150		0	5 817
3 3 1 15	Number of public toilets connected to sewers	3	0	0	0	0	1
3 3.1.16	Number of public toilets not connected to sewers	0	5	17	0	0	4
3 3 1.17	Sludge produced in treatment plants, m³/day			0	0		0
3 3 1.18	Sludge collected from septic tanks, m³/day	3	1.1	5	1.14	0 05	2 1
3 3 1 19	Sludge collected from public latrines, m³/day	0	0				0
3 3 1 20	Total sludge production, m³/day	3.0	1.1	5 0	1 1	0.1	2.1
3 3.1.21	Specific sludge production, kg/pers day	0 09	0 16	0.09	0.03	0 00	0.07
3 3 1 22	Sludge disposal method and location.	farmland application		farmland application	agriculture	- given to farmers to be used as fish food 1pcs/m³	farmland application
3 3 1.23	Number of vacuum trucks with volume of tank (Xpcs/Ym³)	1pcs/5 m³	2x5m³, 2x3m³, 1x4m³	3 pcs/4m³	1 pcs/4 m³	1 pcs/3 m³	2 pcs/3,5 m³
3 3 2	*Private (on-site) Sanitation*						
3 3 2.1	Households w/ septic tanks not connect to sewers	1 352	30 000	1 900	0	30	6 656
3 3 2.2	Coverage of individual wet toilet systems	6%	79%	13%	0%	0 3%	24%
	Total public and individual wet system coverage	36%	82%	45%	55%	0.3%	48%
3.3 2 3	Households w/ double-vault composting latrines	0	0		6 600		2 200
3 3 2.4	Households using bucket latrines	0	0	12 000		11 970	5 993
3 3 2 5	Households using communal toilets	0		5 000			2 500
3 3 2 6	Nightsoil and sludge collection, m³/day	0	35 9		3	20	15
3 3 2.7	Nightsoil/sludge sold to farmers, m³/day	3	0		2		2
3.3 2 8	Nightsoil/sludge sold to others, m³/day	0					0
3.3 2.9	Price paid by farmers for nightsoil/sludge, VD/m³	60 000		0		20 000 /2 bike-buckets	30 000
3.3 2 10	Price paid by others for nightsoil/sludge, VD/m³						
3 3 2.11	Nightsoil/sludge treatment	0					
3 3 2.12	Nightsoil/sludge disposal method and location	0	landfill, Deo Ru Ri, 7km	farm & fishery use	as fertilizer for fields	sold to farmers fresh	farmland application
3.3 2.13	Specific nightsoil production, kg/pers.day		0 20	0 2	0.14	0.36	0.19
3 3.2.14	Number of vacuum trucks with volume of tank (Xpcs/Ym³)						
3 4	*Solid Waste Management*						
3.4.1	*Municipal Solid Waste Management (MSWM)*						
3.4 1.1	Households w/ municipal collection service, nos	21 177	37 700	15 000	15 000	6 000	18 975
3 4 1 2	Service Coverage, municipal system, %	100%	99%	30%	75%	50%	67%
3.4 1.3	Total municipal solid waste collection, tonnes/day	60	148	39	22	15	57
3 4 1 4	Municipal solid waste generation, tonnes/day	60	149	130	29	30	84
3.4 1 5	Specific MSW generation, kg/pers.day	0.56	0 65	0 72	0 45	0.55	0 66
3 4 1 6	Name and location of landfills	Binh Tu, 9ha, 6km	Deo Ru Ri, 3ha, 7km	landfill inside the city	City landfill, 0.57 ha, 5 km to south	- Quan Phuc 5 km from town	
3 4 1 7	Amount of MS disposed of at landfills, tonnes/day		148		22	~ 15	62
3.4 1 8	Amount of nightsoil/sludge disposed of, tonnes/day		37				

3 4 1 9	Remaining capacity in years of operation at landfill	1.6	short		3	full, looking for new	2
3 4 1 10	Other treatment and disposal methods		landfill and burning	burning in gardens		burning	burning
3 4 2	*Private Solid Waste Management*						
3 4 2.1	Households without public service	0	245	35 000	7000	6 000	9 649
3 4.2.2	MSW not collected, tonnes/day		1	91	10	15	29
3 4 2.3	How do households without collection service dispose of their waste?						
	In vacant lots	X	X	X	X	X	X
	Into rivers, canals or drains	X	X	X	X	X	X
	Burning		X	X	X		X
	Other methods			use as fertilizer	gardens, fields		gardens
3.4 2.4	Industrial waste disposed of by the industry, tonnes/day	0 7	1 2		2.5		1 5
3.4 2.5	Industrial waste disposal methods.	landfill	city landfill	steel factory waste disposal inside factory area	collected together with domestic waste	landfill	landfill
3 4.2.6	Hospital waste disposed of by the hospital, tonnes/day	0.9	1 5			0 3	0 9
3 4 2.7	Hospital waste treatment/disposal method	burning and landfill	burning and landfill	contract with UMCo	- " -	landfill	landfill
3.5	*Drainage*						
3 5 1	How extensive drainage of surface water (% of area)		30%	11%	50%	50%	35%
3.5 2	Type and length of drainage system						
3.5 2.1	Combined sewage/surface water, m	7 535	15 000	4 500	25 000	7 000	11 807
3.5 2.2	Separate drainage system, m	0	15 000		0	0	3 750
3 5 2.3	Open manmade canals, m	3 080	800	32 000	3 000	0	7 776
3 5 2.4	Underground drains, m	7 535	21 000		25 000		17 845
3 5 2.5	Natural channels, m	river		27 000	10 000	- two ponds with pumping stations	18 500
3 5 3	How often do flooding occur, nos./year?	5	1	not usual	3-5	floods last only 1-2 hrs heavier floods	2 5
3.5 4	How large is the area normally inundated, %?	10%	10%	5%	50%	20%	19%
3 5 5	Area of surface water bodies, ha	5.3					
3.5.6	Area of surface water bodies, %	0 4%					
3 6	*Priority Improvements*						
3 6 1	Describe what the district administrations consider to be the main problems areas, and rank these according to priority of need for improvement (lack of water supply, sewerage solid waste, flooding or other)	1 dredging Caty River 2.W treatment plant	1 SW treament plant 2. WW treatment plant	1 Drainage sys 2. lack of drinking water 3 Flooding 4 Solid waste disposal	1 raising public awareness 2. more invest. for refuse disp	1. Appr latrines 2. NS collection & treatment 3.Sewer & branches (400wells contaminated 4 SW trucks and processing facilities	1 solid waste 2. drainage
3 7	*Health Statistics*						
3 7.1	Occurrences of Diarrhoea, rate/1000	6 55	0 00	0 53	6 05	10 23	4 67
3 7.2	Occurrences of Dysentheria, rate/1000	0 00	0 00	0.15	2.52	0 97	0 73
3 7.3	Occurrences of Typhoid, rate/1000	0 01	0 00	0 00	0.00	0 00	0 00
3 7 4	Occurrences of Shigellosis, rate/1000	0 84	0 00	0 23	0 00	0 25	0 26
3 7.5	Occurrences of Amoebiasis, rate/1000	0.38	0.00	0 01	0 00	0 06	0 09
3 8	*Soil conditions*						
3 8.1	Prevailing surface soil type	sand	sand	sand, clay	clay	clay	
3 8 2	Top soil permeability, m/d	0.55 - 1 09	0 7 - 2.1	0 54 - 2.5	1.0	0.15	
3 8 3	Ground water table, m from ground surface	2 - 5	2 - 6	3 - 5	0 05 - 1.8	1 5	

Table II - 10 Characteristics of the cities investigated

PARAMETER	Unit	CITY CLASSIFICATION		
		I	II	III
General.				
Typical population, 1994	nos.	2 000 000	340 000	13000
Typical area, 1994	ha	9 000	4000	2000
Expected annual population growth	%	2.6%	4 0%	2 7%
Population density, 1994	nos/ha	237	79	60
Household size, 1994	nos/hh	4.5	5.4	4 5
Water Supply				
Groundwater supply	l/day/hh	125	19	97
Surface water supply	l/day/hh	700	901	1902
Total treated water supply	l/day/hh	825	919	1999
Domestic water consumption	l/day/hh	472	352	281
Specific domestic water consumption	l/day/pers	166	122	160
Unaccounted for water	%	40%	51%	41%
Public water supply coverage (hh)	%	63%	54%	39%
Private water supply coverage (hh)	%		18%	46%
Total water supply coverage (hh)	%		72%	85%
Sanitation and Drainage				
Public sewers and drains	m/ha	60	18	7.3
Public sewers and drains	m/hh	1.2	1.3	0 6
Public separate sewer connection (hh)	%	0%	0%	0%
Public drains connection (hh)	%	48%	44%	25%
Private sewerage connection (hh)	%	0%	0%	0%
Total sewerage connection (hh)	%	48%	44%	25%
HHs with water toilets (WC of pour flush)	%	84%	75%	48%
HHs with septic tanks	%	84%	54%	45%
HHs with bucket latrines	%	4%	9%	21%
HHs with double vault comp. latrines	%	4%	2%	8%
HHs without latrines	%	8%	14%	23%
Waste water treatment (P,BF,AS,O)	type	-	P	-
Waste water treatment	l/day/hh	0	1 6	0
Waste water/water consumption	%	94%	96%	73%
Domestic waste water/water consumption	%	119%	87%	62%
Nightsoil collection	l/day/hh (*	0 48	0 61	0.85
Septic sludge collection	l/day/hh (*	1.27	0.87	0.35
Total NS plus sludge collection	l/day/hh (*	1.10	0.96	0.72
Average time between emptying septic tanks	years	6 6	8 5	6 1
Main sanitation related diseases, 1993	rate/1000	2.61	4 03	5.03
Number of floodings per year	nos	5-8	2	2 5
Average area flooded per year	%		15%	19%
Area of water bodies	%	9.1%	2 4%	
Solid Waste Management.				
Service coverage (hh)	%	66%	72%	67%
Municipal waste collected	kg/day/hh (*	3.04	3.75	2 99
Specific waste collection	kg/day/per (*	0.67	0 70	0 66
Assumed waste generation	kg/day/per	1.00	0.90	0 80
Collection efficiency	%	67%	78%	83%
Industrial waste proportion to MSW	%	30%	21%	2%
Waste disposal method (LF, B, O)	type	LF	LF	LF
Priority Improvements		1 drainage 2 solid waste	1 solid waste 2. drainage	

Table II - 11 Sanitation Characteristics of the Cities Investigated 17.4.1995

City	Urban density	Soil permea-bility	Water supply coverage	Public sewers and drains		Toilet types				Occurrences of sanitation-related diseases (1993)	Flooding		Nightsoil & sludge collection		Municipal solid waste collection	
				length	coverage	flush or pour-flush	double vault	bucket latrine	other type or without toilet		frequency	area	served		served	
	pers/ha	m/d	% of hhs	m/ha	% of hhs	% of hhs	% of hhs	% of hhs	% of hhs	rate/1000	nos/year	%	% of hhs	l/d/pers	% of hhs	kg/d/pers
Class I																
Ho Chi Minh City	238	0 72	61%	70	54%	95%	0%	0%	5%	2 81	5-6		95%	0 25	73%	0 65
Hanoi	231	0 001	68%	29	25%	48%	18%	16%	18%	2 41	5-10	60%	83%	0 27	42%	0.77
Class I average	237		63%	60	48%	84%	4%	4%	8%	2.72	5-8		92%	0 25	66%	0.68
Class II																
Hai Phong	201	1 0	67%	85	27%	27%	0%	23%	50%	3 29	often		42%	0 36	78%	0.79
Da Nang	155	0 85	39%	25	51%	81%	4%	0%	13%	5 86	2-3	10%	83%	0 05	74%	0.92
Hue	38	1 8	34%	4 9	20%	63%	1%	0%	36%	5 62	1	20%	48%	0 10	57%	0.25
Can Tho	45	0 63	68%	7 4	91%	91%	0%	0%	9%	1 35	0		91%	0 05	68%	0.59
Class II average	79		54%	18 5	44%	75%	2%	9%	14%	4 14	2	15%	63%	0 18	72%	0.73
Class III																
Phan Thiet	90	0 55	31%	6 3	30%	36%	0%	0%	64%	7 77	5	10%	36%	0 08	100%	0.56
Nha Trang	346	0 7	41%	45	3%	82%	0%	0%	18%		1	10%	82%	0 20	99%	0.65
Thai Nguyen	51	0 54	40%	1 3	33%	45%	0%	24%	31%		not usual	5%	26%	0 11	30%	0 72
Hai Duong	16	1 0	55%	6 3	55%	55%	33%	0%	12%	6 05	3-5	50%	88%	0 07	75%	0 45
Bao Giang	46	0 15	14%	5 8	0%	0 3%	0%	100%	0%	10 54	0 1	20%	100%	0 36	50%	0.55
Class III average	60		39%	7 3	25%	48%	8%	21%	23%	7 75	2.5	19%	58%	0,14	67%	0.62
Average North	113		62%	22,0	27%	41%	12%	21%	27%	3,15	4.0	34%	66%	0 26	51%	0.75
Average South	149		57%	37 0	52%	91%	0%	0%	9%	3 24	2.8	13%	90%	0 21	74%	0.66
Average All	137		59%	32 1	44%	76%	4%	6%	14%	3 21	3.3	23%	83%	0 23	67%	0.68

Table II - 12 Patterns of mortality 1978, 1988 and 1993

Year	1978[1]		1988[1]		1993[2]	
Causes of Mortality	Rank	Rate per 10000	Rank	Rate per 100000	Rank	Rate per 100000
Tuberculosis	2	5	1	3.7	2	2.13
Malaria	1	7	2	2.7	6	1.35
Watery diarrhoea	-	-	3	1.9		
Heart diseases	-	-	4	1.4		
Dengue	4	1	5	1.2		
Bloody dysenteries	3	2	6	1.2		
Tetanus	5	0.8	7	1.0		
Pneumonia	-	-	8	0.9	7	0.92
Rabies	-	-	9	0.8		
Nutr disorders	-	-	10	0.8		
Still birth						
Traffic accident					1	5.83
Lung infection					3	1.75
Suicide					4	1.72
Hypertension					5	1.47
Viral meningitis					8	0.79
Open wounded					9	0.78
					10	0.77

[1] *Source: Ministry of Health, 1989*
[2] *Source Ministry of Health, 1993*

Table II - 13 Patterns of morbidity 1978, 1988 and 1993

Year	1978[1]		1988[1]		1993[2]	
Causes of Morbility Morbidity	Rank	Rate per 100000	Rank	Rate per 100000	Rank	Rate per 100000
Malaria	1	1,241	1	2,166	1	573
Watery diarrhoea	2	835	2	1,132		
Bloody diarrhoea	3	410	3	337		
Respiratory infections	5	119	4	257	6	151
Dengue	4	218	5	196		
Eye infections	-	-	6	140		
Tuberculosis	7	138	7	106	10	96
Pneumonia	8	77	8	88		
Peptic ulcers	-	-	9	73		
Nutr. disorders	-	-	10	44		
Intestinal diseases						
Intestinal diseases in children					2	384
Acute diseases in of respiratory system					3	219
Acute bronchitis					4	210
Oral cavity, salivary, jaws					5	180
Open wounded						
Traffic accidents					7	129
					8	100
					9	96

[1] *Source Ministry of Health, 1989*
[2] *Source Ministry of Health, 1993*

Table II - 14 Health centers visited for illness in the past 4 weeks by rural and urban area

Health Center	Rural	Urban	Total
Hospital	22.39	35.87	25.66
Doctor's office	2.61	9.60	4.31
Work place	0.23	1.09	0.44
Health Clinic	18.68	4.71	15.29
Officially reported	43.91	51.27	45.70
Pharmacist	0 81	0.36	0 70
Temple	0.29	0.18	0.26
Health practitioner's home	34.51	38.41	35.46
Patient's home	20.02	9.06	17.36
Other location	0.46	0.72	0.52
Not officially reported	56.09	48.73	54.30

Source: Vietnam living standards survey, 1992 - 1993
State Planning Committee - General Statistical Office, 1994

Table II - 15 Life expectancy and basic needs indicators, Vietnam and other countries.

Parameter	Vietnam	Indonesia	Thailand	China	All LDCs
Life expectancy (years)					
1960	44.2	41 2	52 3	47.1	46 2
1990	62 7	61.5	66 1	70 1	62 8
Female/male ratio, 1990 (%)	107.3	105.9	106.4	104	104.4
Child mortality under the age of five, 1989 (%)	8 4	10.0	3.5	4.3	11 6
Diet and nutrition					
Average calorie supply 1986	2,300	2,580	2,330	2,630	2,480
(per day)	105	116	105	111	107
As % requirement, 1984-86	117	117	101	137	111
Food production per ca index,1986-88 (1979-81 = 100)					
Health facilities					
Population with access to					
Health services, 1985-87	80	80	70	–	63
Safe water, 1985-88	46	46	66	--	72
Sanitation, 1985-88	--	39	78	--	27
Population					
Per doctor, 1984	1,000	9,460	6,290	1,000	4,590
Per nurse, 1984	620	1,260	100	1,710	1,910
Maternal mortality					
Per million live births, 1980-	14 0	45 0		4 4	29.0
87	58	45	66	74	52
Contraceptive prevalence, 1985-87(%)					
Child deprivation					
Children malnourished, 1990	3 9	10 7	1 5	22.8	17 7
(million)	6 0	8 1	6 3	41 7	300
Children not in school, 1990 (million)					

Table II - 16 Selected demographic indicators, Vietnam and other Asian countries[1]

	Vietnam	Indonesia	Thailand	China	All LDCs
Population, million					
1960	34 7	96.2	26.4	675.5	2,070 0
1990	68 2	184.3	55.7	1,139.1	4,070.0
2000 (forecast)	82.4	218.7	63.7	1,299.2	4,980.0
Annual growth rate, %					
1960-90	2 2	2 2	2 5	1.8	2 3
1990-2000 (forecast)	2 1	1.7	1.3	1.3	2 0
Fertility rate (%)					
1990	3.9	3 3	2.4	2 4	3 9
Crude death rate (%) 1990	8.9	8 9	6.8	6 6	9.5
Population density per 1,000 hectares, 1990	2,065	996	1,088	1,218	541
Urban population (%)					
1960	15	15	13	19	22
1990	22	31	23	33	37
2000 (forecast)	27	40	29	47	45
Urban growth (%p.a)					
1960-90	3.6	4 7	4.6	3.8	4 0
1990-2000 (forecast)	4.3	4 4	4 0	4 9	4 0

1 Mya Than & Tan, L H · *Vietnam's Dilemmas and options - The challenge of Economic Transition in the 1990s* - ASEAN Economic Research Unit, Institute of Southeast Asian Studies, 1993

Table II - 17 Local production of sanitary equipment with types of products and capacities.

Factory	Specifications	Capacity
Tan Long Construction Enterprise	- Cast iron products for water supply and drainage systems	- 10,000 t/year - Personnel 230
Daimo Construction Mechanical Engineering Factory	- Cast iron products, valves	
Gia Lam Construction and Mechanical Engineering Factory	- Marble products, bullets, cement, water pipes	- Personnel 325
Vibex Union for Concrete Construction Enterprise	- High pressure concrete water pipes, poles electric lines, floor tiles, concrete poles, concrete	
Thin Liet Concrete Factory	- Spun concrete poles, spun concrete pipes for drainage, floor tiles, concrete	
Concrete Pipe Manufacturing Plant	- Water and sewage pipes	- Personnel 250
Thanh Tri Sanitary wares Company	- Ceramic sanitary equipment	- Technology imported from Italy
Construction Union of Brick Tiles and Porcelain Enterprise	- Production of tiles, sanitary equipment, ceramics, water pipes	
Private small scale production	- Concrete bowl & slab	Not known
Binh Minh Plastic Factory, Vinaplast, HCMC	- Plastic consumer products, domestic appliances, sprayers, bottles, cans, medical appliances and PVC pipes (1/2" to 8") and fittings	- 2,000 t/a - Personnel 150
Plastic Joint Venture Enterprise, HCMC	- uPVC pipes with diameters 21, 27, 34, 42, 48, 60 and 95 mm	- 200 t/a - Personnel 40
Tifoplast, Haiphong	- uPVC pipes with diameters of 21..160 mm for water supply and sewer pipes and fittings	- 1,100 t/a, in 1992
Vinaplast, Hanoi	- Importing of raw material for plastic products	
HABAC Mechanical Plant	- Pumps, valves and equipment for water supply and drainage (cast iron)	
Pump factory, Hai Duong	- Pumps for industry and agriculture, valves, industrial fans and small hydraulic turbines	
Bien Hoa Chemical Factory	- Liquid chlorine, Aluminum sulfate	
Viet Tri Chemical Factory	- Liquid chlorine, washing detergents, Aluminum sulfate	- Personnel 700

3

The Socialist Republic of Vietnam

Ministry of Construction (MOC)

The Republic of Finland

Ministry for Foreign Affairs (FINNIDA)

SOIL AND WATER

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY STUDY

Volume 3

Household Demand for Improved Sanitation

Final Report

August 1996

SOIL AND WATER LTD
Consulting Engineers

VIWASE
Vietnam Consultant on Water Supply, Sanitation and Environment

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

VOLUME 3

HOUSEHOLD DEMAND FOR IMPROVED SANITATION

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ACRONYMS

ADB	*The Asian Development Bank*
AIDAB	*Australian International Development Bureau*
BOD	*Biological Oxygen Demand*
BOO	*Build - Own - Operate*
BOT	*Build Operate and Transfer*
C N	*Carbon and Nitrogen ration*
CC	*Central Coast*
CDC	*Consultants, Designers and Constructors*
CH	*Central Highland*
CS	*Construction Services*
CV	*Conveyance*
Doi moi	*Open Door Policy*
DS	*Disposal*
EIA	*Environmental Impact Assessment*
EPZ	*Export Processing Zone*
ESD	*East Southland Delta*
EU	*European Union*
FDI	*Foreign Direct Financing*
GDMH	*General Department of Meteorology and Hydrology*
GDP	*Gross Domestic Product*
HCMC	*Ho Chi Minh City*
HEC	*Hanoi Environmental Committee*
HH	*Household*
HRD	*Human Resources Development*
ICOR	*Incremental Capital Output Ratio*
IDA	*International Development Association*
IPZ	*Industrial Processing Zone*
IRCWD	*International Reference Centre for Waste Disposal*
MIS	*Management Information System*
MOARD	*Ministry of Agriculture and Rural Development*
MOC	*Ministry of Construction*
MOD	*Ministry of Defence*
MOE	*Ministry of Education*
MOFA	*Ministry of Foreign Affairs*
MOFI	*Ministry of Finance*
MOH	*Ministry of Health*
MOHI	*Ministry of Heavy Industry*
MOI	*Ministry of Industry*
MOLWISA	*Ministry of Labour, War Invalids and Social Affairs*
MOPI	*Ministry of Planning and Investment*
MOSTE	*Ministry of Science, Technology and Environment*
MOWR	*Ministry of Water Resources*
MRD	*Mekong River Delta*
MSMU	*Water Supply Management Unit*
MUSD	*Million United State Dollars*
MVND	*Million Vietnamese Dongs*

NB	*Neighborhood*
NC	*North Central*
NCNST	*National Center of Natural Science and Technology*
NGOs	*Non-Government Organizations*
NMM	*Northern Mountain and Midland*
NPK	*Nitrogen - Phosphate - Potassium*
NSC	*National Steering Committee of Clean Water Supply, Sanitation and Environment*
NUSS	*National Urban Wastewater Collection and Sanitation Strategy*
O & M	*Operation and Maintenance*
ODA	*Official Development Assistance*
OOG	*Office of the Government*
OS	*On-site*
P/F toilet	*Pour Flush Toilet*
PACCOM	*People's Aid Coordinating Committee*
Phuong	*Ward*
PPC	*People's Committee*
Quan	*Urban District*
RRD	*Red River Delta*
SCCI	*State Committee for Cooperation and Investment*
SCPA	*State Council for Project Appraisal*
SOE	*State Owned Enterprise*
SPC	*State Planning Committee*
SWOT	*Strength, Weakness, Opportunity and Threat*
TA	*Technical Assistance*
TM	*Treatment*
TOR	*Terms of Reference*
TUPWS	*Transport and Urban Public Works Services*
UN	*United Nations*
UNDP	*United Nations Development Program*
URENCO	*Urban Environmental Company*
USD	*United State Dollar*
VIWASE	*Vietnam Consult on Water Supply, Sanitation and Environment*
VND	*Vietnamese Dong*
VUSS	*Vietnam Urban Sanitation Strategy*
VWSA	*Vietnam Water Supply and Sanitation Association*
WASECO	*Water Supply and Sewerage Construction Company, HCMC*
WASENCO	*Construction Company for Water Supply and Sewerage, Hanoi*
WB	*World Bank*
WHO	*World Health Organization*
WSS	*Water Supply and Sanitation*
WTP	*Willingness-To-Pay*

NATIONAL URBAN WASTEWATER
COLLECTION AND SANITATION STRATEGY

VOLUME 3

HOUSEHOLD DEMAND FOR
IMPROVED SANITATION

1. INTRODUCTION

The functions of the demand information for the National Strategy

There are three major reasons why effective demand should be investigated. First, the development of urban areas along with national economic policy will increase the need for improved urban infrastructure to support economic activities and to protect the urban environment. Identifying the prospective demand for improved sanitation infrastructure from the perspective of the individual household is necessary to support national economic as well as urban development policy.

Second, currently the sanitation situation in cities is generally uncontrolled. Urban environments are dirty, a huge amount of household wastewater is discharged into roadside ditches and drains, and local streams are highly polluted. Sanitation improvement projects may be commonly accepted based on the assumption that everyone needs to have a clean, healthy environment and that an improved sanitation system is a public good; thus, providing even a costly sanitation technology can be justified. However, if users of the provided sanitation facilities prefer low cost sanitation technology and are satisfied without costly technology, this will result in inefficient allocation of scarce resources. Identifying what consumers prefer and need will provide insightful information for efficient use of the resources.

Third, according to the National Urban Development Strategy, one of the objectives for the project is that all households have a proper wastewater disposal system in order to protect public health and the environment. With scarce financial resources within local governmental units, this objective is unlikely to be accomplished. At the same time, the central government lacks the financial resources to provide a complete sanitation system. If individual private households are the major beneficiaries of improved sanitation conditions, the beneficiaries themselves must pay a significant portion of the cost. If improved sanitation services provide substantial public health improvements and environmental benefits, government will have to consider heavy subsidization for the public benefit. Estimating how much consumers value (willingness-to-pay) the benefits of an improved sanitation system is essential for formulating the financial strategy.

These three factors imply that in planning a strategy for the future, the conditions of a specific urban locality and the demand of its residents in detail should be integrated into the provision of improved sanitation systems. The approach should be able to incorporate the effective demand concerning who is going to pay for what type of sanitation service, how much, and what might be an adequate level of government subsidy, if necessary. Individual households have their own private needs and priorities for spending. If they are going to pay for a significant portion of the improved sanitation services, then the beneficiaries' opinions and needs should be incorporated into the strategy formulation.

In order to focus on the sanitation demand at the individual level, household surveys were implemented in two cities and one town; HCMC, Haiphong and ThuDuc (a suburban district of HCMC). Largely, the existing sanitation systems in urban areas are categorized into three types; (1) individual Pour-Flush (P/F) toilets, (2) individual dry-type toilets, and (3) public/communal latrines or no individual toilet. This chapter will focus on the sanitation practices and their effective demand from these three types of users. In order to understand effective demand, priorities of domestic concerns as well as environmental concerns by individual household level will be investigated. Using the Contingent Valuation Method[1], the following issues will be discussed for the users of each sanitary facility type;

1. How much are individual households paying for current sanitation systems? (To update knowledge of consumer expenditure for existing sanitation facilities.)

2. What is the quantity demanded and how much are individual households willing to pay for improved sanitation systems? (To identify effective demand at the household level for various types of sanitation improvement.)

3. How much can individual households afford to pay? (To estimate the affordability of sanitation improvement at the individual household level.)

Data Sources and Study Areas

In order to estimate effective demand of improved sanitation systems at the level of the individual household, the contingent valuation method was adopted, and household surveys were carried out in three urban areas; HCMC, Haiphong, and ThuDuc. (1) Haiphong was studied for the northern region as the second class city, (2) HCMC, the first class city, was selected for the

[1] For the details of the method, please refer to the following additional report· KyeongAe Choe, *Households Willingnes- to-Pay for Improved Sanitation Services Case Studies in Haiphong and HoChiMinh City, Vietnam*, NUSS project financed by FINNIDA, Hanoi, Vietnam, June 1995

southern region, and (3) ThuDuc in HCMC was selected for the third and fourth class cities. The two cities, Haiphong and HCMC, are regarded representative of typical urban sanitation conditions of cities within their respective regions. ThuDuc, the suburban area of HCMC, was studied because the development trend of the suburban district of HCMC is considered to be that of the lower class cities[2]. Most of the discussions and findings in this chapter are based on the results from the household surveys in these three selected urban areas. The data for the third class cities are drawn from other existing socio-economic household surveys, which were implemented under other relevant projects. These data for the third class cities are incorporated into the discussion when relevant.

2. CURRENT PAYMENT FOR SANITATION

Almost three quarters of the households in urban Vietnam are now using individual P/F toilets. In the southern region, up to 90% of households use individual P/F toilets. In the northern region, P/F toilets are used by over 45% of households, with an increase of more than 5% during the last five years. It was discovered from the household surveys that, in general, urban households spend about 1.5% to 2.5 % of their income for water at present. For overall utility bills including water, garbage disposal, fuel, electricity and sanitation, urban households spend about 5% to 6% of their income on average.

Meanwhile, household monthly expenditures for existing sanitation facilities are almost negligible at present. Table 2-1 through Table 2-4 summarize the patterns of current expenditures on water and sanitation, by the users of various sanitation facilities. Except for the users of public/communal dry-type latrines in Haiphong, a substantial percentage of households in all types of user groups spend very little for the management and maintenance of sanitation facilities; at most 2000 to 5000 VND per month, on average. Usually, low-income households use public/communal latrines. It should be noted that, while users of P/F toilets have a low current expenditure for sanitation, they have already borne the cost of their sanitation system at the time of installation.

2.1 Users of Individual Pour/Flush Toilets

A pour/Flush (P/F) toilet with a septic tank normally requires an emptying service every one to four years depending on its size and the number of users. In urban areas, septic tanks are not large and do not require frequent desludging services. Users of individual P/F toilets hardly consider the emptying of septic tanks as necessary maintenance; even if they do, it is often neither properly done nor done on a regular basis. For example,

[2] Development and Construction Regulation, 1994

- Over 10% of users of individual P/F toilets in the study areas have not installed septic tanks and discharge human excreta directly into the urban environment.
- Of households that had installed septic tanks, approximately 30% of individual P/F toilet users had a soakage system. Through these incomplete septic tanks, human wastes are infilterated into the ground. In addition, septic tanks are emptied irregularly.
- Though the rest (60%) of individual P/F toilet users in the samples answered that they installed completely sealed septic tanks, in practice only 50% of individual P/F toilet users had septic tanks with complete concrete walls and bottoms.

In other words, about half of the septic tanks did not have complete bottoms or walls.

Table 2-1 Current Expenditure Patterns on Water and Sanitation: the Users of Individual P/F Toilets

City Level Classification	Class I HCMC	Class II Haiphong	Class III or IV ThuDuc
Users of Pour-Flush or Flush Toilets (No of hh)	(520)	(312)	(109)
expenditure on sanitation			
% of hh with no sanitation expense	66%	92%	83%
average spending by those who incur costs (1000 d/month)	3 7	1 5	2 5
the ranges of spending for the middle two quintiles (1000 d/month)	1.0 ~ 4 2	1 5	0 4 ~ 1 0
% of income currently spent for sanitation	≈ 0 2%	≈ 0 1%	≈ 0.2%
current expenditure on water			
% of hh with no water expense	12%	25%	20%
average spending by those who incur costs (1000 d/month)	34	17	19
the ranges of spending for the middle two quintiles (1000 d/month)	15 ~ 40	7 ~ 20	9 ~ 30
% of income currently spent for water	2 1%	2 2%	1 5%

In summary, a significant portion of septic tank users keep using individual P/F toilets without properly managing their septic tanks, contaminating the urban environment; thus they incur very low costs (Table 2-1). In contrast to the sanitation expenditure, the current expenditure for water was about 15,000 to 34,000 VND/month.

In HCMC, about 60% of P/F toilet users have never emptied their septic tanks since they installed the tanks. On average, these households had gone 11 years without emptying their septic tanks. In the case of Haiphong, about 90% of septic tank users have not emptied their septic tanks, because most of these households have installed their septic tanks during the last five years. These septic tanks have not yet filled up, and thus there has been no cost for using them so far. As time passes, the average period for emptying septic tanks in

Haiphong may become longer, as in the case of HCMC, if no maintenance regulation is enforced.

Emptying costs are approximately 100,000 to 150,000 VND per service. The households with individual P/F toilets spend 1000 to 4000 VND per month at most, if they have emptied their septic tank (taking into account the individual interval period of emptying septic tank, and simply dividing up this one time charge into a series of equal monthly payments). Even if the users of individual P/F toilets emptied their septic tanks at regular five year intervals, the monthly expenditure may not be higher than 5000 VND per month on the average. Cash expenditure for sanitation is 0.2% of income, which is almost negligible

Table 2-2 Household Investment for Installing an Individual P/F Toilet with Septic Tank

City Level Classification	Class I HCMC	Class II Haiphong	Class III or IV ThuDuc
average size of septic tanks	2.6 m3	2.3 m3	2.9 m3
% of sample with completely sealed septic tanks	64%	72%	17%
average lump-sum investment at current price (1000 d)	2,100	2,600	1,700
monthly payment converted from the lump-sum investment (1000 d)[3]			
-applying I=12%, n=5 years	36	45	29
-applying I=6%, n=10 years	18	22	15

However, no direct cash outlay does not mean that individually owned P/F toilet users do not incur any costs at all. Table 2-2 shows the sunken-costs for installing an individual P/F with a septic tank. Households have already spent about 2 to 3 million VND to install a P/F toilet with a septic tank. The approximate annuity of this investment at current prices would be about 200,000 to 500,000 VND per year. Converting this lump-sum investment into a monthly installment, the opportunity cost of the forgone investment is equivalent to 15,000 to 22,000 VND per month (applying 6% interest rates for a ten year payback period; see Table 2-2). As the households have already paid for solving their private sanitation problem, their future demand for improved sanitation services would be affected. It is important in future sanitation planning to know whether these households might have chosen a public sewer line instead of installing a septic tank if the alternative were available.

[3] Assuming two different real interest rates for 5 or 10 years of payback periods, the average cost of installing a P/F with a septic tank today is converted into a series of constant monthly payments.

2.2 Users of Individual Dry-Type Toilets

Households using individual dry-type toilets (such as DVL, pit latrines, and bucket latrines) spend very little for existing sanitation facilities, even though this type of toilet system seems to require more frequent emptying and thus higher maintenance costs than the P/F system (Table 2-3). In ThuDuc, no households spend money for sanitation, and in Haiphong, more than 60% of households using individual dry-type toilets make no cash expenditure for their sanitation maintenance.

Table 2-3 Current Expenditure Patterns on Water and Sanitation: the Users of Individual Dry-Type Facilities

City Level Classification	Class I HCMC	Class II Haiphong	Class III or IV ThuDuc
Users of Individual dry-type toilets (No of hh)	(*)[4]	(53)	(17)
expenditure on sanitation			
% of hh with no sanitation expense	--	62%	100%
average spending by those who incur costs (1000 d/month)	--	10	--
the ranges of spending for the middle two quintiles (1000 d/month)	--	2 ~ 18	--
% of income currently spent for sanitation	--	1 2%	0%
current expenditure on water			
% of hh with no water expense	--	53%	53%
average spending by those who incur costs (1000 d/month)	--	20	14
the ranges of spending for the middle two quintiles (1000 d/month)	--	12 ~ 26	4 ~ 13
% of income currently spent for water	--	2 5%	1%

From the Haiphong household survey, less than half of the households using individual dry-type toilets call URENCO for emptying services. The remaining households with dry-type toilets arrange individually with scavengers (usually farmers) from city suburbs to empty the latrines. Households served by URENCO pay about 10,000 VND per month (or 2000 per bucket), *while those who make arrangements with farmers pay nothing for the emptying services.* These individual scavengers clean and empty the latrines in return for fresh nightsoil, which they use as fertilizer. There was no cash transaction involved in this type of arrangement.

[4] Since there were very few households in this category from the urban districts of HCMC, the data from these households are analyzed together with the relevant category from the suburban districts of HCMC.

In the third or fourth category cities, individual dry-type latrines are either emptied by owners into their fish-ponds or by farmers residing nearby. Compared to the northern region, in the southern region, the use of fresh nightsoil is not a common practice; when respondents were informally interviewed about the uses of nightsoil, almost all answers were negative.

The recent urbanization process in the first and second type cities increases new housing construction, and reduces agricultural activities in the suburban areas. The old dry-type latrines are not favored and individual P/F toilets are installed when new houses are built.

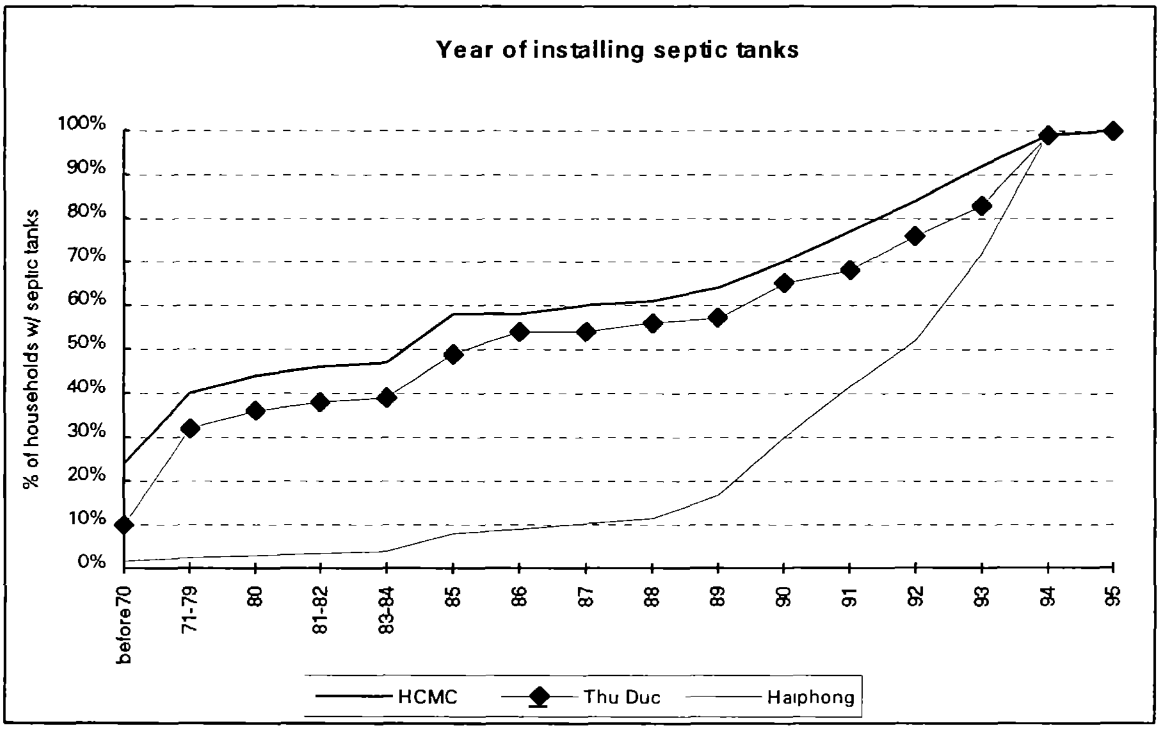


Figure 2-1 Trends in P/F Toilet and Septic Tank Installation over the last 25 years in HCMC, Haiphong and ThuDuc.

As shown in Figure 2-1, many individual households in HCMC, ThuDuc and Haiphong have installed individual P/F with septic tanks since the Housing Census in 1989. In HCMC and ThuDuc, more than 30% of individual P/F toilets were installed during the last five years, and in Haiphong, almost 70% of P/F systems were built during the same time period. Also, in Hanoi, individual P/F toilet users have increased by 20% while users of dry-type latrines have decreased by a similar magnitude for the last three years[5].The increase in P/F toilet use and the decrease in use of dry-type latrines compared

[5] *The Study on Urban Drainage and Wastewater Disposal System in Hanoi city, Progress Report* appendixes (results of interview survey), Feb. 1994, Nippon Koei Co., LTD & CTI Engineering Co LTD , for Japan International Cooperation Agency, and from a small household survey in Hanoi Feasibility Study, 1995.

to the 1989 housing census indirectly supports the view that the practice of composting and using nightsoil for agricultural purposes may become obsolete, if not totally abandoned. Both the providers and the users of fresh nightsoil are declining in the larger cities.

2.3 Users of Public/Communal Latrines or No Private Toilet

Though not all households using public/communal latrines have to pay for their use, a higher percentage of households using public/communal latrines incur monthly expenditures for sanitation than households using individual toilets. For example, in Haiphong, almost three quarters of public/communal latrine users had regular monthly sanitation expenditures, and about 20% of public/communal latrine users in HCMC made monthly payments for their use. Households using public/communal toilets paid about 3000 VND per month (Table 2-4).

Table 2-4 Current Expenditure Patterns on Water and Sanitation: the Users of Public/Communal Latrines or No Individual Toilet

City Level Classification	Class I HCMC	Class II Haiphong	Class III or IV ThuDuc
Users of Public/communal latrines or No individual toilet	(34)	(336)	(20)
expenditure on sanitation			
% of hh with no sanitation expense	74%	24%	95%
average spending by those who incur costs (1000 d/month)	3	3	5
ranges of spending for middle two qualities	2 ~ 4	2 ~ 3 5	5
% of income currently spent for sanitation	≈ 0 3%	≈ 0 3%	≈ 0 4%
current expenditure on water			
% of hh with no water expense	15%	36%	70%
average spending by those who incur costs (1000 d/month)	24	12	19
ranges of spending for middle two quintiles	10 ~ 30	4 ~ 15	10 ~ 30
% of income currently spent for water	1 8%	1 5%	1 4%

Payments are usually made to the head of a living quarter, which is the lowest administrative group managing neighborhood matters. On the average 35 to 50 families share a public/communal latrine, for which the total monthly revenue collection would be around 100,000 to 150,000 VND per month on the average. Very few households using the public/communal latrines pay per visit. In Hanoi, a small survey in 1995 reported that the average number of households sharing public/communal latrines was 5.7 families, but payment methods and the amounts were not investigated. The major types of public/communal latrines appear to be different, depending on urban conditions such as building density and housing structures, In cases where public/communal latrines are free of charge, the sanitary conditions of the facilities are so poor that the functions of latrines are almost halted. Even if users pay a neighborhood organization for use of the facilities, there is no guarantee that reasonable sanitary conditions are provided. The community organization does not function on a voluntary basis. The public/communal latrine users tend to think that the responsibility of maintenance is on the "public" users other than themselves, but not on "individual" users themselves.

2.4 Satisfaction Levels

Figure 3-1 (A, B and C) summarizes satisfaction levels for existing sanitation systems. In all the urban areas studied, the levels of satisfaction of the public/communal latrine users are substantially lower than that of the individual P/F toilet users. While the majority of respondents using public/communal latrines answered that they are not satisfied at all (e.g., over 70% in Haiphong and suburban HCMC, and about one-third in urban HCMC), only about 10% of respondents using individual P/F latrines indicated they are not satisfied at all. As individual households invested a lump-sum for the improvement of their own latrines, they tended to be content with the system, even if the facility might have a negative impact on public health in their area.

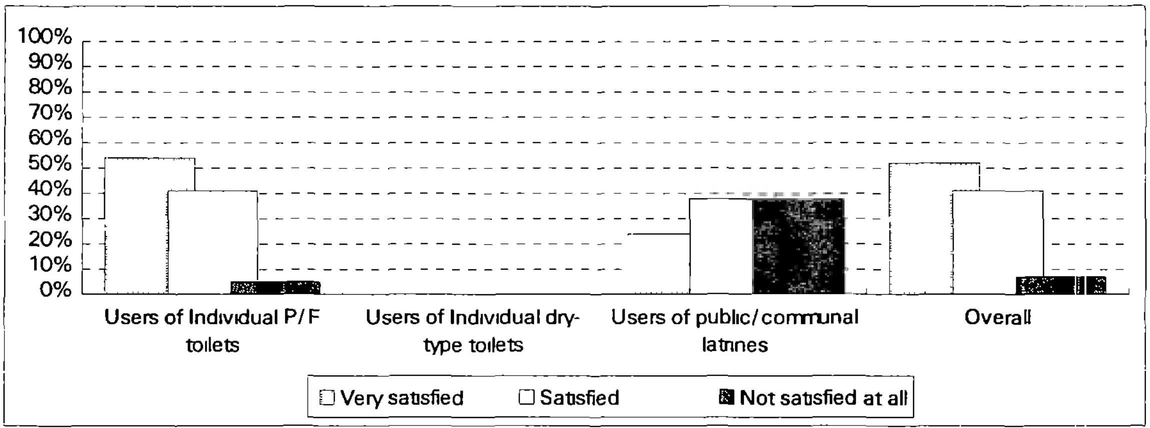
3. RELATIVE PRIORITY OF SANITATION IMPROVEMENT

In order to understand how households perceive sanitation compared to other private domestic priorities, respondents were given a list of seven private household investment needs and asked to indicate their priorities for improvement. Figure 3-2 summarizes the domestic investment priorities by each urban area. Within each urban area, the percentages of households who listed each problem as their first investment priority are plotted as a bar chart.

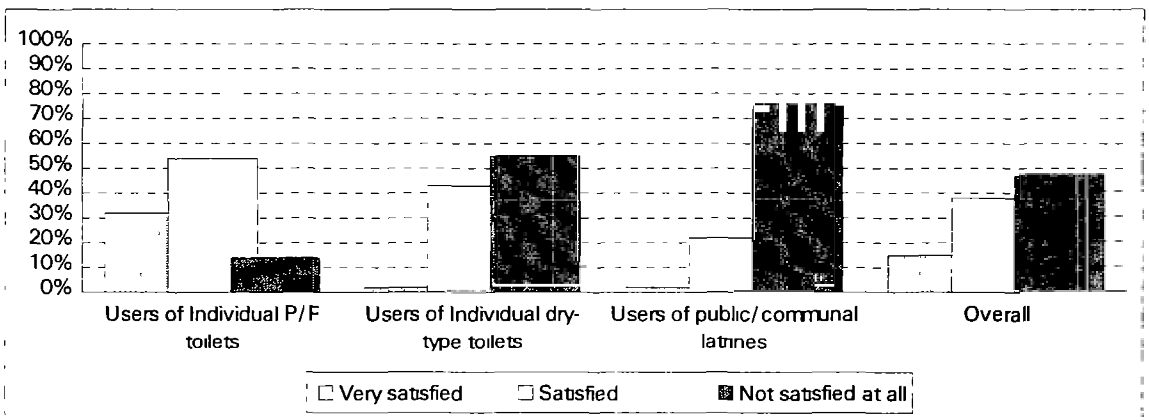
The problem that gets the highest vote for the first priority is different depending on local conditions. However, across all three urban areas, the problem of "installing water tap inside of a house" gets about 20% of votes as the first priority for domestic investment. From both Haiphong and ThuDuc respondents, "renovating toilet facility" gets the highest percentage of votes as the first priority of domestic investment, while from HCMC respondents, it gets only 6% of votes as the first priority. More than 90% of households in HCMC have been using individual P/F toilets, while less than 50% of households in Haiphong and ThuDuc still have to rely on individual dry-type or public/communal latrines. Thus, the residents of an urban area where the P/F toilet is not common would put a high priority on "renovating toilet facility" as their domestic investment concern.

Figure 3-1 Satisfaction Levels for Existing Sanitation Facilities

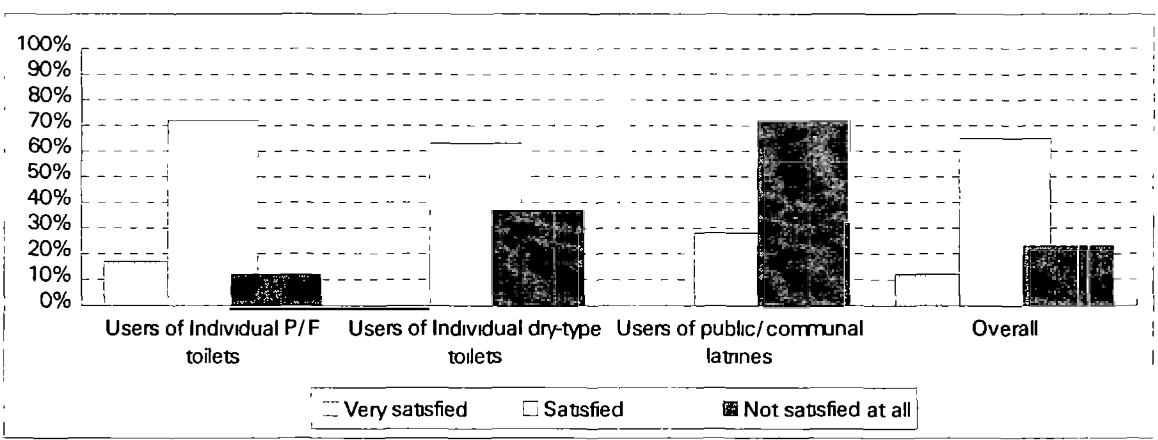
A. HoChiMinh City.



B. Haiphong.



C. Thu Duc District.



"Connecting to a sewer line" usually gets less than 10% of first priority votes from the sample respondents in all three urban areas. The higher coverage of drainage services in HCMC compared to other urban areas resulted in such a low percentage of first priority vote; i.e., there are immediate domestic concerns which demanded investment more than a sewer line connection, such as business investment or education. The percentage of households with an individual P/F toilet is rather low in Haiphong and ThuDuc. Thus, "renovating their private toilets" was considered more urgent than "connecting to a sewer line".

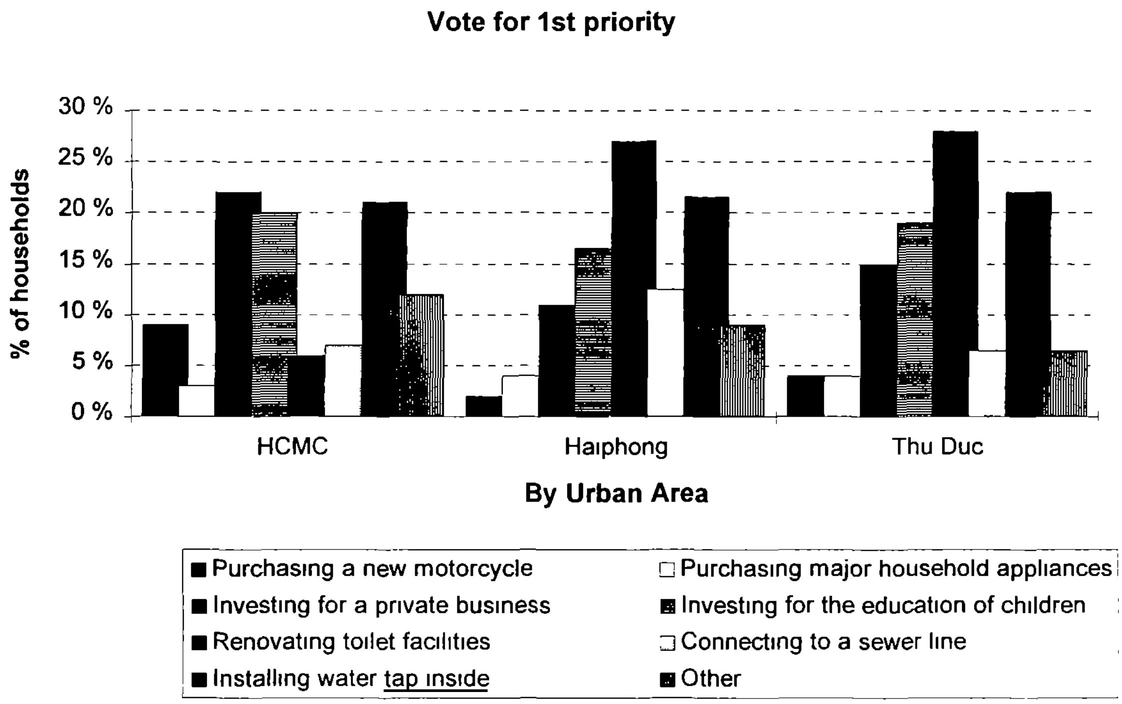


Figure 3-2 Relative Priority of Sanitation Improvement at the Household Level.

From all three urban areas, "purchasing household assets", such as a motorbike or VCR, gets the first priority from less than 5 percent of respondents, though fewer than 70% of the sample households own these goods. Improving housing conditions by renovating a toilet facility thus appears to be perceived as important, even though the average willingness-to-pay is low (see the following section 5 for detail).

To assess whether the respondents thoughtfully considered their domestic priorities, an additional analysis was implemented for the Haiphong sample. As indicated in Table 3-1, compared to the households currently using individual pour-flush toilets, an overwhelming percentage of respondents who are currently using bucket latrines voted for "renovating toilet facilities" as either first or second priorities (66% from the households with private bucket latrine, and 68% from the households with public bucket latrines). This suggests that improving their sanitation system is clearly an important domestic concern for those households with poor sanitary conditions.

Table 3-1 Priority Given to "Renovating toilet facilities" by Current Sanitation Conditions

	At the current sanitation condition.			
Current sanitation condition	No. of households in each sanitation condition	% of respondents which voted the renovation of toilet facilities as their **first priority**	% of respondents which voted the renovation of toilet facilities as their **second priority**	Total (vote for either **1st** or **2nd priorities**)
Individual bucket latrine	53	43%	25%	**68%**
Individual P/F toilet	312	**15%**	13%	28%
Public bucket latrine	218	39%	27%	**66%**
Public P/F latrine	118	25%	23%	48%
Total	701	26%	20%	46%

4. ENVIRONMENTAL ATTITUDE AND HEALTH CONCERNS

4.1 Priority of Environmental Issues

Figure 4-1 shows the percentage distribution of the first priority votes indicated by respondents from a list of eight environmental problems. Respondents' top environmental concern in all three urban areas was "ground water contamination due to lack of sewer system". The general tendency seems to be that the lower the percentage of respondents relying on a private water connection in an urban area, the greater the number of respondents who voted for the ground water contamination concern as their first priority. (Less than 45% of sample households in Haiphong and ThuDuc have a private water connection, while more than 70% of those in HCMC use a private tap.)

The next two priorities were "air pollution" and "surface water pollution." Though over one-quarter of the respondents in the Haiphong survey experienced flood damage during the last year, flood control received only 17% of votes for water as the first priority. Also in HCMC and ThuDuc, "flood control" gets less than 5% of first priority concern, though more than 30% of respondents had experienced flooding during the past year. This distribution confirms that people generally prefer a separate sewer system to a combined sewer service.

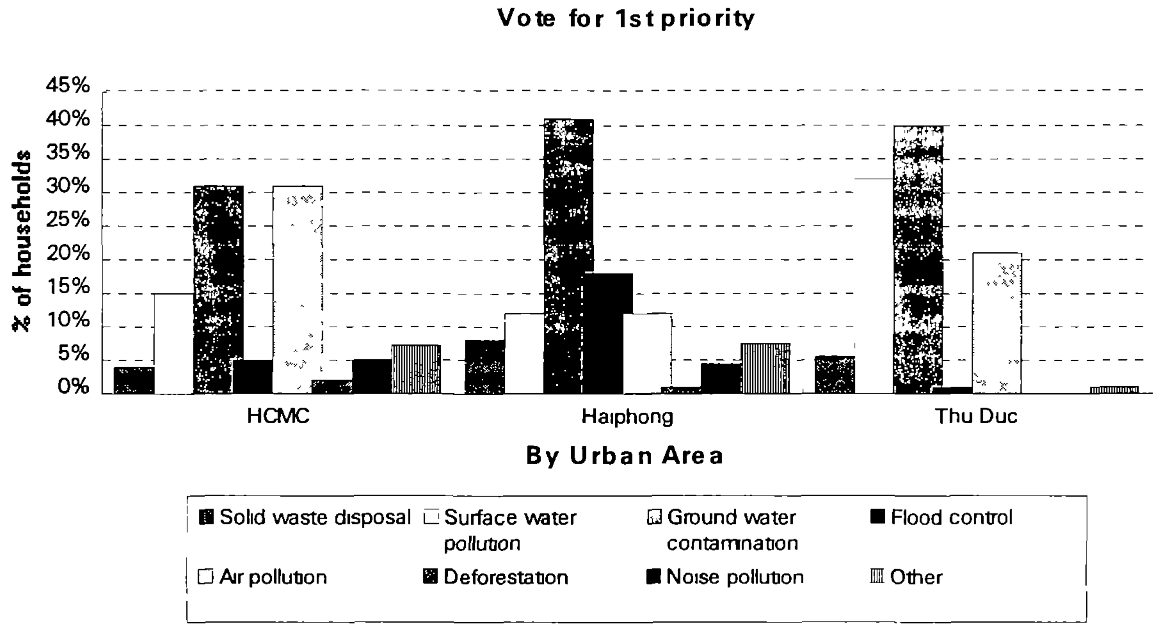


Figure 4-1 Environmental Priorities.

"Air pollution" gets the highest vote (30%) of first priority from respondents in HCMC, but not in other urban areas. The percentage of votes for "deforestation" were minimal in all the urban areas. These facts reflect that the respondents in the surveys carefully considered their environmental problems according to the current environmental conditions of their own residential areas.

Overall, these patterns suggest that respondents carefully considered environmental conditions, given that the "ground water contamination due to lack of a sewer system" was considered as the uppermost environmental problem. These environmental attitudes are consistent with respondents' preference for a separate sewer system.

4.2 Awareness of Health Environment

About 25% to 50% of the survey respondents answered that they clean the streets in front of their residences themselves. The majority of respondents also confirmed that they organized neighborhood-wide action to get rid of disease sources such as mosquito breeding ponds or rats. However, from field observations during the project, it is clear that neighborhood health campaigns have been ineffective since mosquito breeding ponds and rats are still in evidence in the neighborhood.

In the Haiphong household survey, enumerators asked each respondent whether the respondent knew that poor sanitary conditions increase the risk of contracting diseases or parasites. Almost 95 % of respondents already knew about diseases related to a poor sanitary conditions, such as hookworms, diarrhea, and dysentery. The average economic values for "improved collection service of human excreta" were not much different between those who knew and those who did not know about these diseases (6300 versus 6000 VND per month). Those households who did not know about the diseases and newly learned that improved excreta collection service may help to break the cycle of sanitation-borne diseases stated a slightly higher economic value (about 1000 more; 7300 versus 6300 VND per month) on the average. However, in practice, only one-tenth of the respondents knew that nightsoil needs to be stabilized for about six months in order to be safe for agricultural purposes. Thus, respondents' sanitation practices are not consistent with health safety, though they know the risk of getting sanitation-related diseases is high when sanitary management is poor.

Overall, respondents' knowledge gaps imply that respondents are aware of the health risks involved with poor sanitary conditions, but do not connect the benefits of improved sanitation with improvements in health conditions.

5. QUANTITY DEMANDED AND WILLINGNESS-TO-PAY

5.1 Estimation Method and Constraints

To estimate the demand of various types of sanitation improvement, the contingent valuation approach uses a referendum technique with an open-ended follow-up question to elicit respondents' willingness-to-pay for improved sanitation services. After an enumerator read aloud the description of the improved sanitation services that had been assigned to the household according to their current sanitation situation, the enumerator asked the respondent whether s/he was willing to pay (WTP) a monthly fee just like a water bill in order to install the service described to the respondent.

The improvement path for sanitation technology alternatives is assumed to proceed as follows: public/communal latrines (or no latrines) → dry-type individual latrine (bucket, pit, or DVL) → wet-type individual latrine (pour-flush/ flush with a septic tank) → and a sewer connection[6]. It is common that improvements are made directly to individual P/F toilets, but not to dry-type toilets. Usually, at the ease of water availability, a dry-type latrine is upgraded

[6] Kalbermatten, et al , *Appropriate Technology for Water Supply and Sanitation, Technical and Economic Options*, World Bank, 1980, page 23

to a wet-type latrine (such as P/F with a septic tank). Table 5-1 summarizes alternative sanitation improvement options offered to the sample households to estimate their WTP amount. The level of improvement is largely divided into two groups; on-site or off-site improvement.

Table 5-1 Alternatives for Sanitation Improvement by Various Types of Existing Conditions

	Various Types of Sanitation Improvement Alternatives				
Existing sanitation conditions	**on-site**		**off-site**		
	communal latrines	individual toilet system	wastewater collection system		wastewater collection and treatment
Individual P/F toilets	--	--	combined sewer line	separate sewer line	separate sewer line with a wastewater treatment plant
Individual Dry-type toilets	--	individual P/F toilet with a sealed septic tank	a sewer connection (to an individual toilet)		--
Public or communal P/F latrines	--	individual P/F toilet and connected to a sewer	a sewer connection (to public/communal latrines)		--
Public or communal dry-type latrines	communal P/F latrines with a communal sealed septic tank	individual P/F toilet sharing a communal septic tank	--		--

Typically, the availability and accessibility of water connections are major constraints for selecting technology options. On average, about 60% of the urban population in Vietnam is covered by a water supply system. Even though some households do not have water network connections, they have easy access to shallow-well water. Thus, those households without a water network connection are still able to have a wet-type (pour-flush) toilet facility. However, housing structures could become a limiting factor, since some houses have no space for individual toilet facilities.

The effective demand can be defined with two terms; (1) quantity demanded: how many households want to have improved sanitation systems, and (2) economic values-WTP: at what price households would pay for the service. Since the demand estimate is mainly based on three urban areas, effective demand for improved sanitation services would vary depending on the characteristics of individuals and on the conditions of the urban areas. Acknowledging these constraints of the data, the major objective of this discussion is to show the ranges of effective demand and how to incorporate WTP data into a sanitation improvement strategy.

5.2 Users of Individual Pour/Flush Toilets

For the households that already have their own P/F toilets, the next level of improvement may be to connect their sanitation facilities either with a combined sewer system or with a separate sewer system. During the contingent valuation survey, respondents were told advantages and disadvantages of each system so that they could make a decision which system they would prefer. It was explained that the major advantage of a combined sewer system was to handle storm water to reduce flooding, while the main advantage of a separate sewer system was to treat wastewater to reduce water pollution. Table 5-2 summarizes the results of the demand for sewer system from three urban areas.

Table 5-2 Willingness-to-Pay for Off-Site Sanitation Improvement; Users of Individual P/F Toilets

	WTP for off-site sanitation improvement...		
Users of Individual P/F toilets by city	a combined sewer line (or drainage service)	a separate sewer line (w/out a wastewater treatment plant)	a separate sewer line with a wastewater treatment plant
Class I: HCMC			
No of observations	520	--[7]	520
% of hh stated no need or ZERO WTP bids	40%	--	9%
avg. WTP from the effective demand (positive responses)	12,000 d/mo	--	16,000 d/mo.
WTP as % of hh monthly income	0 8%	--	1 0%
Class II: Haiphong			
No of observations	--	312	--
% of hh stated no need or ZERO WTP bids	--	29%	--
avg WTP from the effective demand (positive responses)	--	12,000 d/mo	--
WTP as % of hh monthly income	--	0.8%	--
Class III or IV: ThuDuc			
No of observations	109	--	109
% of hh stated no need or ZERO WTP bids	26%	--	24%
avg WTP from the effective demand (positive responses)	11,000 d/mo	--	13,000 d/mo
WTP as % of hh monthly income	0 8%	--	0 9%

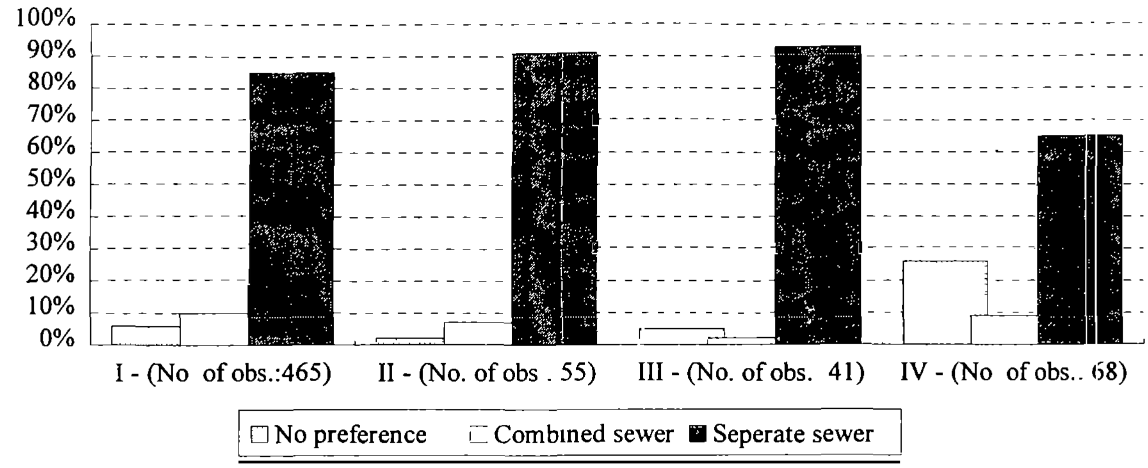
[7] For HCMC and ThuDuc, "WTP for a combined sewer line, or WTP for a separate sewer line with a wastewater treatment plant" were asked For Haiphong, "WTP for a separate sewer line without a wastewater treatment plant" was asked

Approximately three-quarters of sample households showed a demand for sewer improvement (either combined or separate system). In HCMC and ThuDuc, about 90% and 30% of the sample households, respectively, already had drainage service in HCMC and ThuDuc, respectively. Sixty percent (HCMC) and 74% (ThuDuc) of the total sample households demanded a combined sewer system. In Haiphong, the percentage of positive WTP bids from the sample was 71%, while the drainage coverage was about 85% of the total sample households. Thus, the higher the percentage coverage of drainage services, the lower the demand for a combined sewer service will be decreased.

On average, the WTP for improving sewer services was no more than 1% of household monthly income. However, it is important to note that the households with individual P/F toilets have been *implicitly* paying 2~3 % of their income for the removal of human waste from private residences, since they have invested a lump-sum for the installation of septic tanks.

In HCMC, households' mean WTP for a separate sewer line with a wastewater treatment plant was about 16,000 VND/month, while that for a combined sewer line (without any treatment plant) was 12,000 VND per month. Also in ThuDuc, respondents were willing to pay 2,000 VND more for a separate sewer system than for a combined sewer system. The higher willingness-to-pay for a separate sewer system implies that respondents appreciate the effect of a treatment plant to reduce water pollution. The average WTP for a separate sewer system without a wastewater treatment plant from Haiphong was 12,000 VND per month.

The distribution of preferences for a separate versus a combined sewer system is summarized by a comparison of the HCMC and ThuDuc areas in Figure 5-1. Overall, the household demand survey in HCMC indicates that the preference for a separate sewer system over a combined system was dominant; the majority (over 75%) of the households who owned P/F toilets preferred a separate sewer system to a combined sewer system. Regardless of the area where a drainage service is available, the preference for a separate sewer system is always dominant. In the case of ThuDuc, where the neighborhood area did not have a drainage service (or the households were not connected), a greater number of respondents stated that they did not need any kind of sewer service. One of the major reasons that the respondents had no preference or showed no demand for sewer improvement is well represented from their attitude towards the government; they usually respond by saying that they will follow a government decision.



LEGEND:
I -Urban District, Drainage system exists or is connected
II -Urban District, Drainage system does not exist or exists but not connected
III -Suburban District, Drainage system exists or is connected
IV -Suburban District, Drainage system does not exist or exists but not connected

Figure 5-1 Household Preferences for Separate versus Combined Sewer System; by the Existence of Current Drainage Service.

5.3 Users of Individual Dry-Type Toilets

For households using individual dry-type toilets, improvements are made by upgrading the existing dry-type individual toilet into a P/F toilet with a sealed septic tank at the site. The off-site improvement consists of connecting their sanitation facilities directly to a sewer line instead of installing a septic tank.

The results of the demand estimate for the users of dry-type toilets are summarized in Table 5-3. Eighty five percent of the households in Haiphong and 71% of the households in ThuDuc were willing to pay about 12,000 to 13,000 VND/month on average to upgrade the existing individual dry-type toilets into P/F toilets. The households using dry-type latrines also were willing to pay about 1% of their monthly income for the improvement of sanitation.

Table 5-3 Willingness-to-pay for Improving On/Off-Site Sanitation Services; from the Users of Dry-type Toilets at present

	WTP for Improving Sanitation	
	On-site	**Off-site**
Users of Individual dry-type toilets from	Individual P/F with a sealed septic tank	a separate sewer system connection instead of a septic tank[8]
Class II: Haiphong		
No. of observations	53	45
% of hh stated no need or ZERO WTP bids	15%	20%
% of hh stated positive WTP	85%	80%
% of hh WTP>=10,000 d/mo	50%	35%
avg. WTP from the effective demand (positive responses)	13,000 d/mo	10,000 d/mo.
WTP as % of hh monthly income	1 0%	0.8%
Class III or IV: ThuDuc		
No of observations	17	12
% of hh stated no need or ZERO WTP bids	29%	8%
% of hh stated positive WTP	71%	92%
% of hh WTP>=10,000 d/mo.	59%	58%
avg. WTP from the effective demand (positive responses)	12,000 d/mo	9,000 d/mo
WTP as % of hh monthly income	1 0%	0 8%

These households were also asked what percentage of their WTP bids was reserved for off-site sanitation improvement, i.e., for a sewer connection. Generally, the respondents answered that about one-third of their WTP bids (approximately 4,000 VND per month) could be allotted for an off-site sanitation improvement. Additionally, these dry-type individual latrine users were willing to pay about 5,000 to 6,000 VND per month more for the sewer connection if the service was available to them

Thus, for the financial analysis, the WTP bids from the dry-type individual latrine users can be interpreted into three components; about 8,000 VND for P/F toilet (upgrading), 4,000 to 5,000 VND for a septic tank, and about 9,000 to 11,000 VND (5,000 to 6,000 VND in addition to 4,000 to 5,000 VND for a septic tank) for a sewer connection if available.

Those who were willing to pay an additional amount for a sewer system replied that they would prefer the sewer system for pollution prevention. In case of Haiphong, about 75% of dry-type latrine users preferred a sewer

[8] In Haiphong, a separate sewer line without a treatment plant was asked. In ThuDuc, a separate sewer line with wastewater treatment plant is described

connection to a septic tank, if the service were to be available within the next five years.

5.4 Users of Public/Communal Latrines or No Private Toilet

Households using public/communal latrines (or no private toilet at all), have several alternatives to improve their sanitary condition. At the on-site level, the public/communal dry-type (bucket) latrine users may want (1) to upgrade to P/F latrines connected to a communal septic tank. Or, if the individual housing situation allows, then they may want (2) to install an individual P/F toilet connected to either a communal or a private septic tank. The off-site improvement option would be to connect (3) to a sewer. The effective demand for various types of improvement available to the public/communal latrine users is summarized in Table 5-4.

The demand for improving public/communal latrines depends on the specific conditions of a city. For example, in HCMC, 80 to 90% of households currently using public/communal latrines showed demand for an individual P/F toilet with a sealed septic tank or a sewer connection; meanwhile, only 35% to 62% of public/communal latrine users in Haiphong were willing to pay 17,000 VND on average. The main reason for such a low demand in Haiphong was that typical housing structures do not allow any space to build an on-site individual toilet.

Willingness-to-pay for on-site improvement (including installing an individual P/F toilet with either a communal or individual septic tank) is estimated to be about 17,000 to 18,000 VND per month per household. This amount represents from 1% to 1.5% of household monthly income.

As long as the improvement options include an individual P/F toilet, the average WTP for the improvement is about 6,000 to 7,000 VND higher than those improvement options without an individual P/F toilet. When the effective demand for a sewer connection only is estimated, the result consistently shows that the average household WTP for sewer service is about 9,000 to 12,000 VND per month, which is about 1% of monthly income. The same magnitude of willingness-to-pay bids was estimated from the users of the other types of sanitation facilities.

However, the WTP for improving the public/communal latrines from dry-type to P/F with a communal septic tank is estimated to be about 11,000 VND per month. Though this WTP amount per household may not be enough for the whole cost recovery of most types of improvement, the total number of households using one public toilet should be taken into account. For example, in Haiphong, the public/communal latrine users usually share their latrines with 35 to 40 households. Generally, one resident group consists of 40 to 50 households in an urban area. If households living in the same resident block share the cost for the public/communal latrine improvement, the total monthly WTP amount for improving a dry-type public/communal latrine becomes 500,000 VND per month.

Table 5-4 Willingness-to-pay for Various Levels of Sanitation Improvement: from the Users of Public/Communal Latrines

	WTP for the improvement of On-site...			**Off-site**
	upgrading dry-type public to P/F latrines with a communal septic tank	installing an individual P/F toilet and . .		
Users of Public/Communal latrines in the city..... ..		septic tank[9]	off-site sewer connection	off-site sewer connection only
Class I: HCMC				
No. of observations	n/a	34	n/a	27
% of hh stated no need or ZERO WTP bids	n/a	21%	n/a	19%
% of hh stated positive WTP	n/a	79%	n/a	81%
% of hh WTP>10,000 d/mo	n/a	74%	n/a	41%
avg. WTP from the effective demand (positive responses)	n/a	17,000 d/mo.	n/a	9,000 d/mo
WTP as % of hh monthly income	n/a	1.3%	n/a	0.9%
Class II: Haiphong				
No. of observations	218	199	41	118
% of hh stated no need or ZERO WTP bids	9%	38%	65%	6%
% of hh stated positive WTP	91%	62%	35%	94%
% of hh WTP>10,000 d/mo	58%	n/a	n/a	68%
avg WTP from the effective demand (positive responses)	11,000 d/mo	17,000 d/mo	18,000 d/mo.	12,000 d/mo
WTP as % of hh monthly income	1 1%	1.5%	1 5%	1 0%
Class III or IV: ThuDuc				
No. of observations	n/a	20	n/a	18
% of hh stated no need or ZERO WTP bids	n/a	10%	n/a	0%
% of hh stated positive WTP	n/a	90%	n/a	100%
% of hh WTP>10,000 d/mo.	n/a	85%	n/a	50%
avg WTP from the effective demand (positive responses)	n/a	17,000 d/mo	n/a	10,000 d/mo
WTP as % of hh monthly income	n/a	1 5%	n/a	0.9%

[9] In HCMC, the use of public latrines was not so extensive as in Haiphong. Since the number of households clustered for sharing public latrines in HCMC is too small, the willingness-to-pay questions for shared communal septic tank were not feasible in HCMC, in either urban or suburban areas. Thus, considering the current situation of public latrine users, the willingness-to-pay question for installing individual P/F toilets with a septic tank was asked instead of the question about improving public latrines

5.5 Demand for Improved Wastewater Collection and Excreta Collection

The demand for improving wastewater collection service by each class of city is summarized in Table 5-5. Generally, about 23~34% of households in the third class cities were not willing to pay any amount for the improvement of drainage service, while 40% of households in the first class city (HCMC) were not willing to pay for the service. For the lower class cities, only 7% of households in Tanh Hoa were not willing to pay for the improved drainage service[10]. This implies that the more developed an urban area becomes, the lower the demand for drainage service. However, as discussed in the section *Users of Individual P/F toilets*, the residents of higher class cities would like to improve their existing drainage services into an advanced separate sewer system.

Table 5-5 Willingness-to-pay for Improving Drainage Services, by City Class

from the hh of the following cities [11]	No of obser-vations	% of hh stating no need or ZERO WTP bids	% of hh covered by public drainage	% of hh WTP>= 10,000 d/mo	avg WTP from the posi-tive responses d/mo	WTP as % of hh' monthly income
Class I						
HCMC	520	40%	54%	37%	12,000	0.8%
Hanoi*	157	N/A	25%	59%	10,000	N/A
Class II						
Haiphong[12]	312	29%	27%	52%	12,000	0.8%
Class III						
NhaTrang*	522	34%	3%	10%	6,000	0.6%
LongNguyen *	322	30%	N/A	11%	7,000	0.6%
PhanThiet*	299	23%	30%	13%	7,000	0 7%
ThaiNguyen*	415	26%	33%	0%	5.000	0 8%
Class IV						
ThuDuc	109	26%	37%	40%	11,000	0 8%
TanhHoa*	299	7%	N/A	N/A	3.000	0 6%

[10] The higher percentages of ZERO WTP responses in ThuDuc and Haiphong are due to different sampling characteristics compared to those in other cities In ThuDuc (as well as Haiphong), the effective demand for improved drainage service was estimated from only those households who already had a septic tank, while the demand in the other cities was estimated from the households regardless of their existing sanitation facilities

[11].The WTP data marked with "*" are from the other existing studies; *Provincial towns water supply and sanitation project, feasibility study*; by CMPS & F., with Coffey MPW PTY LTD., Australia, June, 1994 *Study report on urban drainage system in Hanoi city*, May 1991, Nippon Koei Co , LTD These studies did not have an elaborate description of the sewer line, and generally asked their willingness-to-pay with questions such as, "Would you pay a fee every month to improve the *drainage of wastewater* in this town?" These other studies estimated household WTP bids from all types of sanitation users at present. Meanwhile for the NUSS surveys, WTP questions on sewer systems were asked for the samples of individual P/F toilet users

[12] In Haiphong, the demand for a separate sewer line (without a wastewater treatment plant) was estimated. Also, in Haiphong and ThuDuc, the average WTP for improving drainage service resulted in a higher amount than other cities, because only part of the sample respondents who are using individual P/F toilet have received this question.

It appears that the lower the city class, the lower the average effective WTP for improved drainage service. On the average, the households in the first and second class cities were willing to pay about 11,000 VND per month, and those in the third class cities were willing to pay about 6000 VND per month, which is only 0.6 to 0.8% of their monthly income. The residents in the fourth class city (TanhHoa) were only willing to pay about a half of the WTP amount specified by the residents in the third class cities. Though 70~80% of the sample households in the lower class cities were willing to pay some positive amount for the improvement of drainage service, only about 10% of these households agreed to pay 10,000 VND per month; this percentage is lower than that in the class one and two cities (10% versus 37% ~ 59%). It is noteworthy that the average WTP amounts from the class III city are estimated from all the sample households, but not particularly from the users of individual P/F toilets.

Figure 5-2 is based on the data in Table 5-5 in order to show the price elasticity of the demand for improved drainage service by city class. The vertical axis shows the percentage of respondents willing to pay at a specified price offered in the willingness-to-pay questions, and the horizontal axis shows the WTP amount. Blue and black lines indicate the first and second class cities, red lines indicate the third class cities, and the green line shows the fourth class city. Though this graph represents an approximation, and is based on various survey data, the results of the demand characteristics show interesting features for the demand of improved drainage service by city class.

For example, in HCMC, only about 60% of respondents would demand the improved drainage service even if it were offered as free of charge, and about 40% of the respondents were willing to pay more than 10,000 VND for improved drainage service. Meanwhile, for TanhHoa, more than 90% of respondents demanded the improved drainage service if the service were free of charge; but fewer than 5% of the respondents in TanhHoa would demand the service if the price increased to 5,000 VND per month.

The steeper the slope of the line, the more sensitive the demand for the service is to increase in price. This implies that even with a small increase in price, the number of households who demand the service will be significantly lower in the lower class cities than in the upper class cities. The sanitation strategy needs to incorporate these demand characteristics by city class, with the knowledge that a higher percentage of households would demand improved drainage service in the third and fourth class cities than in the first/second cities. However, the WTP amounts from the households in the third and fourth class cities are much less than these from the first/second class cities, and accordingly the same would be likely to happen for the cost recovery of the project

The demand for improved excreta collection service is estimated from all the sample households in the Haiphong survey. The average WTP for excreta collection service from all the respondents (regardless of their sanitation facilities) is 6,000 VND per month. About 20% of all the respondents were unwilling to pay anything for the improved collection service, because they were already satisfied with the current system (mainly P/F with a septic tank).

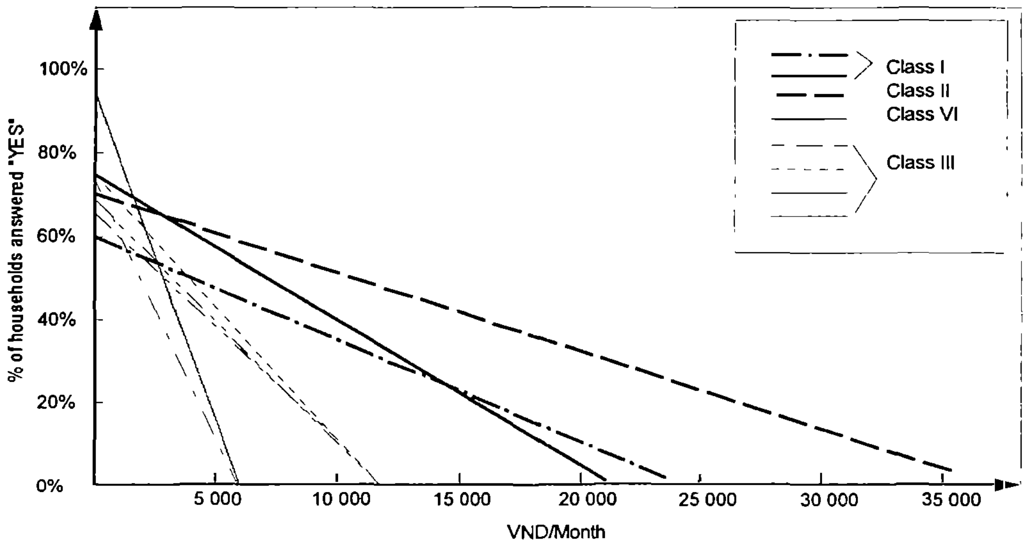


Figure 5-2 Demand for Improvement of Drainage Service by City Class.

6. AFFORDABILITY

6.1 Affordability from the Willingness-to-pay Data

Conventionally, affordability has been asserted by the evaluator, how much people "*ought to be able to have.*" The meaning of affordability is based on the concept "ability-to-pay (ATP)". The ATP is a subjective judgment of a project evaluator, base on an assumption of how much people "*ought to pay*". Thus, the ATP amount is not set by a consumer who actually pays, but by an evaluator. Conventional estimates assume that households in developing countries can typically "afford" to spend about 5 percent of their monthly income for improved water and sanitation services. If a household's income is low, then the assumed percentage may go down to 2 to 3 percent. Since the amount of affordability is asserted by an evaluator based on this assumption, the discrepancy between the evaluator's predicated assumption and the consumer's actual willingness to spend the amount has often been one of the sources for a project's financial failure.

An alternative approach is to view consumers' willingness-to-pay amount as their "capacity-to-repay" a loan[13]. The sanitary improvement requires a lump-sum investment at one time, which is generally difficult for ordinary households in developing countries to make due to their cash flow problems. An affordability index can be formulated from a household's revealed WTP by converting it to a lump-sum present value of a series of future payments. The costs of various alternative sanitation technologies then may be compared with the affordability index which shows the household's "capacity-to-repay", and the financial resources at the government's disposal. From the comparison, the NUSS strategy will narrow the range of feasible sanitation technologies.

The following illustrates how WTP data obtained from a household demand survey can be used in the assessment of various sanitation options. The purpose is not to provide a detailed analysis, but rather to guide the national strategy by providing underpinning information on the financial analysis.

Table 6-1 summarizes the assessment of household affordability for various sanitary improvements, by existing sanitation conditions. Based on the contingent valuation surveys from the three urban areas, the households' monthly willingness-to-pay information is converted into the net present values of an investment. The WTP amount represents constant monthly cash flow based on a *real* interest rate. The estimated present values then represent an affordability or "capacity-to-repay" a loan of a household for which the household were willing to pay.

If a household's time value of money (or preferred interest rate) and the economic life of the investment are known, it is a routine exercise to convert monthly costs to total capital costs. However, the financial market (if it exists) in Vietnam is highly distorted, and it is difficult to infer much about a household's rates of time preference or opportunity cost of capital from information on interest rates in the formal sector, especially for a long term investment.

Affordability is estimated by assuming four different annual interest rates and three economic lives of the investment;

1. Adopting the terms considered to be more or less normal for long term investment in industrialized countries, 6% with 10 years of a project life
2. Adopting the 6% interest rate with a shortened project life, 5 years
3 Adopting 5 years of project life, but with a higher interest rate, 12%, to see the sensitivity of household's affordability.
4. Adopting the interest rate as in informal financial markets in Vietnam, 30% with a 2 year payback period

[13] Robert C G Varley, *Financial Services and Environmental Health Household Credit for Water and Sanitation*, Environmental Health Project, Applied Study, No.2, Prepared for the Bureau for Global Programs, Field Support and Research Office of Health and Nutrition, U.S Agency for International Development under the EHP Activity No. 125, Washington, DC, January, 1995

Table 6-1 Assessing Households' Affordability for Various Sanitary Improvement from the Willingness-to-pay Data[14] (VND/month)

	on-site improvement of			off-site improvement of ..	
Affordable amount of capital costs from the users of	public/commu-nal latrines with communal shared septic tank	indivi-dual P/F toilets	individ-ual septic tanks	sewer line connecti on	sewer line with wastewater treatment plant
P/F individual toilet	-	-	-		
Avg. WTP (1,000 d/m/hh)				12	16
Affordable capital costs	-	-	-		
at i=6%, n=10 years				1,080	1,440
at I=6%, n=5 years				620	828
at i=12%, n=5 years				540	719
at I=30%, n=2 years				215	286
Dry-type individual toilet	-				-
Avg WTP (1,000 d/m/hh)		8	5	10	
Affordable capital costs	-				-
at i=6%, n=10 years		720	450	900	
at I=6%, n=5 years		414	259	517	
at i=12%, n=5 years		360	225	450	
at I=30%, n=2 years		143	89	179	
Public/communal latrines					
Avg. WTP (1,000 d/m/hh)	11	17		9	~ 12
Affordable capital costs					
at i=6%, n=10 years	990	1,531		810	~ 1,080
at I=6%, n=5 years	569	879		466	~ 621
at i=12%, n=5 years	495	764		405	~ 540
at I=30%, n=2 years	197	304		161	~ 215

The results of the affordability estimation are in Table 6-1. Overall, the longer the project life, the greater the household's affordability. The lower the real interest rate, the higher the household's affordability. The following discussion is based on the long term investment, 10 years, with 6% real interest rate as used in a normal financial market. For a moment, it is assumed that the operation and maintenance costs of improved sanitary facilities are excluded from the affordability estimation. However, once the economic life of a investment ends, the perpetual monthly payment that households were WTP can be used to recover operation and maintenance costs of the facilities for the following years.

For the users of Individual P/F toilets at present, the affordability of a sewer line connection (a combined or a separate sewer line only) is estimated as 1.08

[14] The present values of the affordable capital costs (1000 VND/hh) are estimated based on real interest rates and varying economic life of the project

million VND/hh, while that of a sewer system (which includes a treatment plant) turns out to be 1.44 million VND/hh. The affordability of the households in the lower class cities is expected to be half of these estimates. Since this user group has already solved their private sanitation problem by installing a P/F with a septic tank, the affordability implies that individual P/F toilet users are willing to pay for the public environmental improvement (i.e., it is not exclusive of the private benefits, such as no more need to empty individual septic tanks). A sewer system is an off-site improvement, which may largely bring public environmental benefit than private economic benefits. Therefore, the level of a government's subsidy for the off-site improvement should be compared to how much of economic benefits would result in by having a sewer system.

For the users of Individual dry-type toilets at present, the affordability of the sanitation improvement is estimated for three components: upgrading an individual dry-type toilet to a individual P/F toilet; installing an individual septic tank to P/F toilets, and connecting to a sewer line (without a wastewater treatment plant). For each component, a household's affordability is 0.72, 0.45, and 0.9 million VND/hh, respectively. If a household decides to improve only on-site facilities, the total affordability becomes 1.17 million VND/hh. But, if a household wants a sewer connection, then the total affordability becomes 1.62 million VND/hh (0.72 for P/F toilet and 0.9 for a sewer line connection). Generally, the survey respondents preferred a sewer connection to a septic tank.

It is interesting to note to the amount of the affordability for P/F toilets with a septic tank (1.17 million VND/hh) from the users of individual dry-type toilets. The current market price of installing a P/F toilet with a septic tank is around 1.7 million to 2.6 million VND depending on the locality and on the size (Table 2-2). The estimated affordability for the same unit is about 0.5 to 1.4 million VND lower than the current market price. Since the users of individual dry-type toilets were not able to afford the current market price of the P/F with a septic tank, they could not have improved their individual dry-type sanitation systems to the P/F toilet, yet.

For the users of public/communal latrines (or no private latrines), the affordability is estimated for all levels of improvement. This group of households can afford almost 1 million VND/hh for improving their existing latrines to a public/communal P/F latrines with a communal septic tank, and 1.5 million VND for installing individual P/F toilet with a septic tank. Depending on how many families share one public/communal latrine, this affordability amount should be multiplied by the number of families sharing and would provide a significant financial source.

The affordability amount for individual P/F toilets from the users of public/communal latrines (1.5 million VND) is slightly higher than that from the users of individual dry-type toilet (1.17 million VND); mainly because it is not for upgrading an existing individual toilets but installing a new one.

From the demand for the off-site improvement from the public/communal latrine users, it is estimated that they can afford about 0.8 to 1.1 million VND/hh for a sewer connection. The connection could be either to public toilet or to an individual toilet if a household had a space to install a P/F toilet. In the III and IV class urban areas, the affordability of a sewer connection is about one-third lower than in the first and second class cities.

6.2 Affordability from Income and Consumption Patterns

The average household monthly income in the southern area is generally 1.5 times higher than that in the northern area (Table 6-2). This implies that individual households in the southern urban areas would be willing to pay a slightly higher absolute amount than those households in the northern urban areas.

Table 6-2 Average Household Monthly Income by Urban Area, and by Region

	Average monthly income of the households in a city from (1,000 VND /month)			
Region	North		South	
Class of City	City	Avg Income	City	Avg. Income
Class I	--	--	HCMC	2,100
Class II	Haiphong	1,000	--	--
Class III	ThanNguyen	654	PhanTiet	994
	-	--	NhaTrang	985
	-	--	LongGuyen	1,160
Class IV	TanhHoa	585	ThuDuc	1,545

*The income data of Haiphong, HCMC, and ThuDuc are from the project surveys, Other income data were adopted from various reports mostly produced in 1994

The general rule of thumb for estimating how much a household can spend for improved water supply and sanitation in developing is 5 % of monthly income. In Vietnam, the results from the household surveys revealed that urban households generally spend 5 to 6 percent of their monthly income for all utility bills, which include not only water and sanitation but also electricity, fuel and solid waste disposal. Table 6-3 summarizes the expenditure patterns of urban households from the NUSS surveys as well as from the Vietnam Living Standard Surveys (1994). The expenditure patterns in all the available data consistently shows that the total utility expenditures are 5%~6% of household income.

The low percentage of utility bills in household expenditures could be influenced by three factors;

(i) Utilities such as water supply and electricity have been provided at the subsidized level of tariff structures. Also, consumers enjoy the benefits of using these utilities while paying for only part of their actual consumption, such as with flat rates. People tend to expect that infrastructure services would always be provided with a subsidy and are used to paying for less than what they actually consume;

(ii) The quality of service provision is poor, and consumers pay low prices accordingly; and

(iii) Some of the households have solved their problems without government help, and they do not need to pay utility bills; i.e., using private wells or installing an individual septic tank.

Table 6-3 Household's Consumption Patterns and Durable Goods Owned

Urban Areas	**HCMC**	**Haiphong**	**ThuDuc**	**Overall Urban Areas**[15]
Average household monthly income (1000 d/month)	***2,024***	***1,000***	***1,545***	***750***
consumption patterns (%)				
food and clothing	47	67	61	53
housing-rent and taxes	1	2	1	14
utilities	6	6	5	6
transportation	4	1	4	4
education	8	6	5	4
entertainment	3	2	2	-
savings	11	6	6	-
special occasions	7	3	8	-
miscellaneous	13	7	8	-
others	-	-	-	19
total	100	100	100	100
Average cash savings per hh (1000 VND/month)	***220***	***60***	***93***	***(N/A)***
% of sample hh with non-zero savings	***41%***	***20%***	***47%***	***69%***
Average number of durable goods owned				
Motorbike	1 2	0 3	0 8	(N/A)
Bicycle	1 5	1 7	1.9	(N/A)
Color TV	0 9	0 8	0.7	(N/A)
VCR	0.7	0 5	0.2	(N/A)

[15] *Vietnam Living Standards Survey, 1992-1993*, State Planning Committee, General Statistcal office, 1994

If these problems are addressed and resolved, household affordability for improved sanitation could be increased.

As shown in Table 6-3, on average sample households save approximately 6% to 11 % of their monthly income in HCMC, Haiphong, and ThuDuc. At the same time *Vietnam Living Standards Survey* (1994) reported that urban households have about 180,000 VND of cash savings. This is not to suggest that urban households actually deposit their monthly savings or any cash savings into a bank account. Besides, not every household sets cash aside for savings; for example, about 55% of sample households in HCMC area do not have monthly savings, while more than 80% of the sample households in Haiphong do not have monthly savings. Overall, about 30% of urban households do not have any cash savings. Even though some households may have a significant amount of cash savings, their spending priority may not always be for sanitary improvement.

7. GOVERNMENTAL COMMITMENT AND CONCERNS

In order to understand what kind of government actions are required to efficiently deliver the improved sanitation services, a series of questions were asked during the survey. One of the important issues for the sanitation demand side is whether individual households as sanitation consumers are able to pay for the service. First, respondents were asked if they prefer a lump-sum payment for receiving improved sanitation services. The majority (more than 90%) of the respondents answered that they prefer a monthly payment to a lump-sum payment. The reasons for this preference on the monthly payment scheme are well reflected in the financial market situation. About one-fifth of respondents stated they borrowed money from relatives or friends free of interest during the last two years. Only 5 % of the respondents answered that they borrowed money from a bank or from a money lender during the last two years. The rest had not borrowed any money during the last two years.

The major problem with borrowing was that household income is not sufficient to repay in time, followed by the fact that lending institutions charge a high interest rate. This implies that the payment method for subscribing improved sanitation services should be carefully reviewed, and designed so that the households' have access to a lending needed.

When respondents were asked who they would like to be responsible for managing urban sanitation services, the majority stated the existing institution URENCO as the preferred managing institution for urban sanitation services. However, there were significant differences on people's attitude on the managing institution. In Haiphong, an urban area located in the north, very few people indicated a private company as a management institution. Meanwhile, in HCMC and ThuDuc, which are in the southern region, more than one-third of the respondents specified a private company as a management institution, especially for garbage collection and excreta collection services.

Since the cost of delivering improved sanitation services is high, even those households showing effective demand may not actually be able to afford all the costs. Voluntary labor is often used for construction of improved sanitation systems, which reduces costs. The respondents were asked whether they were willing to contribute their labor in exchange for having the improved service in their neighborhood. Almost 80% of the respondents in the surveys answered positively. The average daily wage for an unskilled, healthy male laborer was estimated at about 14,000 (in Haiphong, in the northern region) to 20,000 VND (in HCMC, southern region) per day, which comes to roughly 900,000 to 1,200,000 VND of monthly household income for a family with two wage earners. Labor costs could be reduced if the NUSS strategy were to adopt a self-help approach for sanitary improvements.

Even so, more than 65% of respondents indicated that financial assistance was what they needed most from the government in order to participate in a self-help sanitation project. Thus, the sustainability of a sanitary improvement project would be largely influenced by financial markets and the government's role in providing some type of financial market or assistance.

8. SUMMARY AND POLICY IMPLICATIONS

Generally, the WTP amount for improved sanitation services at the private household level is around 6,000 to 17,000 VND per month per household, depending on the type of improved service and the conditions of urban areas. Based on WTP data, a household's affordability index for an improved sanitary system is estimated at 810,000 to 1,500,000 VND (assuming 6% real interest annually, and project life of 10 years).

Approximately 70% of urban households in Vietnam valued the benefits of improved sanitation facilities by revealing their positive WTP amount, which was normally greater than their current spending for existing sanitary conditions.

However, the estimated average WTP is only 1% (at most 1.5%) of monthly household income. In the first and second class cities, average WTP as the percentage of income is close to 0.8% to 1.0%. In the third and fourth class cities, the average WTP amount seems to be lower (0.6% to 0.8% as revealed in the demand for improved drainage service) than that in the first and second class cities. However, 0.1%~0.2% of income differences across the different level of cities can only be stated as the general tendency of lower WTP amount in the lower class cities, and the percentage differences are not intended to provide the precise estimation here

The results of household surveys in HCMC, Haiphong and Thu Duc are summarized in Table 8-1. Though the results reflect the demand situation in only these three urban areas, and not for the whole nation's urban areas, in general, 1% of income seems to reasonably reflect the overall WTP amounts for national urban sanitation improvement. Other existing studies support that the average WTP is not more than 1% of household monthly income.

Table 8-1 Summary of Average WTP Bids and Quantity Demanded for Various Types of Improved Sanitation; at the Household Level (VND/month)

	Average WTP bid and % of positive WTP responses for the...				
	on-site improvement of....			**off-site improvement of....**	
Users of....	public/communal latrines with a shared septic tank	indivi-dual P/F toilets	individual septic tanks	a sewer line connection	a sewer line with a treatment plant
P/F individual toilet	-	-	-	12,000 (60~90%)	16,000 (75~90%)
Dry-type individual toilet	-	8,000 (70~85%)	4,000 ~ 5,000 (70~85%)	10,000 (80~90%)	-
Public/communal latrine	11,000 (90%)	17,000 (60~90%)		9,000 ~ 12,000 (80~100%)	-

- At the city level, the demand for improved sanitation services range from 60% to 95% of the sample respondents. These percentage differences could be influenced largely by the existing types of major sanitary facilities in a city, priorities in environmental concerns or domestic concerns, and household income level, among many other factors. A detailed investigation at the city level is thus necessary before implementing a project at each locality
- At the individual household level, the differences in WTP amounts for the various alternative options are rather small in absolute terms.

The effective demand at the household level based on the surveys is summarized as follows:

- **For on-site improvement**
  1. improving dry-type public/communal latrines to P/F type: 90% of the public/communal latrine users were willing to pay an average of 11,000 VND/month/hh;
  2. upgrading a private dry-type latrine into a P/F with a septic tank: 70% to 85% of the individual dry-type toilet users were willing to pay 12,000 to 13,000 VND/month/hh;
  3. installing new individual P/F toilet (either connecting to a shared communal septic tank or a private septic tank): 60% to 90% of the public/communal latrine users were willing to pay 17,000 VND/month/hh;
- **For off-site improvement**
  4. connecting to a sewer line: approximately 60% to 90% of the sample respondents were willing to pay 9,000 to 12,000 VND/month/hh; and
  5. connecting to a sewer system with a wastewater treatment plant· 75% to 90% of the individual P/F toilet users were willing to pay 16,000 VND/month/hh.

While acknowledging the limited degree of accuracy, the NUSS recommends that a detailed and precise magnitude of effective demand for specific sanitary improvements in an urban area should be investigated prior to implementation.

From the major findings, the policy implications are as follows;

- Approximately 75% of urban residents in the nation have already solved their private sanitary problems by installing individual P/F toilets and septic tanks. The guidance and regulations for the proper maintenance of existing septic tanks are imperative to reduce ground/surface water contamination in an urban environment from the improper installation of septic tanks.

- More than 20% of existing individual P/F toilets in each urban area have been installed during the last 5 years in the studied areas. This increasing trend of installing individual P/F toilets with a septic tank indicates that the demand for improved sanitation has been strong. In the future, those who have not improved their individual sanitation systems may follow the same trends; thus a quick action is needed from the government to make the national urban sanitation strategy as effective as possible.

- The WTP amount for a separate sewer is greater than that for a combined sewer. Also, survey results show that people prefer a separate sewer system to a combined sewer. This preference is consistently represented by their environmental concern about reducing ground water contamination by improving a separate sewer system. Flood control gets very little attention at the household level, though more than 30% of the respondents had experienced flooding during the last year. This distribution confirms that people generally prefer a separate sewer system to a combined sewer service.

- In the third and fourth class cities, the demand for improved drainage service was high (over 70% usually), but the percentage of households willing to pay over 10,000 VND per month was very low (less than 20% in general). The NUSS should consider on-site improvements for the lower class cities, since the subsidy for public environmental problems may be less justifiable in the lower class cities than in the first and second class cities.

- Individual P/F toilet users are mostly satisfied. Those who are using either individual dry-type toilets or public/communal latrines are not satisfied with their current sanitation services; thus, they tend to identify "renovating individual toilet facilities" as their first domestic concern. The NUSS should target this user group as its first priority since respondents in the group specified strong needs as well as relatively higher WTP amounts (about 17,000 VND/month for installing a new individual P/F toilets with a septic tank).

- The respondents were aware of the health risks of poor sanitation, but rarely connected improved sanitation with improvement of health conditions in practical sense. It is also observed during the surveys that individual respondents are aware of "what they should be doing to have a clean health environment"; but, it does not mean that "what they are actually doing in practice to make the environment clean". Therefore, the public communication support component should emphasize the connection between "knowledge and practice."

- More than 65% of the sample respondents indicated that financial assistance is what they need most from the government to participate in a self-help sanitation project. Considering the difficulties of access to formal financial institutions for ordinary people, one important role of the government is to provide easily accessible financing for individual households.

4

The Socialist Republic of Vietnam

Ministry of Construction (MOC)

The Republic of Finland

Ministry for Foreign Affairs (FINNIDA)

SOIL AND WATER

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY STUDY

Volume 4

Technology Alternatives

Final Report

August 1996

SOIL AND WATER LTD
Consulting Engineers

VIWASE
Vietnam Consultant on Water Supply, Sanitation and Environment

NATIONAL URBAN WASTEWATER COLLECTION AND SANITATION STRATEGY

VOLUME 4

TECHNOLOGY ALTERNATIVES

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ACRONYMS

ADB	*The Asian Development Bank*
AIDAB	*Australian International Development Bureau*
BOD	*Biological Oxygen Demand*
BOO	*Build - Own - Operate*
BOT	*Build Operate and Transfer*
C : N	*Carbon and Nitrogen ration*
CC	*Central Coast*
CDC	*Consultants, Designers and Constructors*
CH	*Central Highland*
CS	*Construction Services*
CV	*Conveyance*
Doi moi	*Open Door Policy*
DS	*Disposal*
EIA	*Environmental Impact Assessment*
EPZ	*Export Processing Zone*
ESD	*East Southland Delta*
EU	*European Union*
FDI	*Foreign Direct Financing*
GDMH	*General Department of Meteorology and Hydrology*
GDP	*Gross Domestic Product*
HCMC	*Ho Chi Minh City*
HEC	*Hanoi Environmental Committee*
HH	*Household*
HRD	*Human Resources Development*
ICOR	*Incremental Capital Output Ratio*
IDA	*International Development Association*
IPZ	*Industrial Processing Zone*
IRCWD	*International Reference Centre for Waste Disposal*
MIS	*Management Information System*
MOARD	*Ministry of Agriculture and Rural Development*
MOC	*Ministry of Construction*
MOD	*Ministry of Defence*
MOE	*Ministry of Education*
MOFA	*Ministry of Foreign Affairs*
MOFI	*Ministry of Finance*
MOH	*Ministry of Health*
MOHI	*Ministry of Heavy Industry*
MOI	*Ministry of Industry*
MOLWISA	*Ministry of Labour, War Invalids and Social Affairs*
MOPI	*Ministry of Planning and Investment*
MOSTE	*Ministry of Science, Technology and Environment*
MOWR	*Ministry of Water Resources*
MRD	*Mekong River Delta*
MSMU	*Water Supply Management Unit*
MUSD	*Million United State Dollars*
MVND	*Million Vietnamese Dongs*

NB	*Neighborhood*
NC	*North Central*
NCNST	*National Center of Natural Science and Technology*
NGOs	*Non-Government Organizations*
NMM	*Northern Mountain and Midland*
NPK	*Nitrogen - Phosphate - Potassium*
NSC	*National Steering Committee of Clean Water Supply, Sanitation and Environment*
NUSS	*National Urban Wastewater Collection and Sanitation Strategy*
O & M	*Operation and Maintenance*
ODA	*Official Development Assistance*
OOG	*Office of the Government*
OS	*On-site*
P/F toilet	*Pour Flush Toilet*
PACCOM	*People's Aid Coordinating Committee*
Phuong	*Ward*
PPC	*People's Committee*
Quan	*Urban District*
RRD	*Red River Delta*
SCCI	*State Committee for Cooperation and Investment*
SCPA	*State Council for Project Appraisal*
SOE	*State Owned Enterprise*
SPC	*State Planning Committee*
SWOT	*Strength, Weakness, Opportunity and Threat*
TA	*Technical Assistance*
TM	*Treatment*
TOR	*Terms of Reference*
TUPWS	*Transport and Urban Public Works Services*
UN	*United Nations*
UNDP	*United Nations Development Program*
URENCO	*Urban Environmental Company*
USD	*United State Dollar*
VIWASE	*Vietnam Consult on Water Supply, Sanitation and Environment*
VND	*Vietnamese Dong*
VUSS	*Vietnam Urban Sanitation Strategy*
VWSA	*Vietnam Water Supply and Sanitation Association*
WASECO	*Water Supply and Sewerage Construction Company, HCMC*
WASENCO	*Construction Company for Water Supply and Sewerage, Hanoi*
WB	*World Bank*
WHO	*World Health Organization*
WSS	*Water Supply and Sanitation*
WTP	*Willingness-To-Pay*

1. SANITATION TECHNOLOGY ALTERNATIVES

1.1 INTRODUCTION

This Volume 4 Technology Alternatives of the National Urban Wastewater Collection and Sanitation Strategy will discuss the various sanitation technology alternatives that are likely to find application in an urban environment in Vietnam, and thus are important for strategy formulation.

The objectives of sanitation and sewerage systems are broader than protection of public health and the environment. People would not be willing to invest as much as they do in private sanitation facilities, if they were not motivated by reasons such as increased convenience and comfort. This is probably a more important motivating factor than public health concerns. It was found in the willingness to pay survey that most people were dissatisfied with the use of communal toilets, although these could give the same public health protection as a private toilet, but clearly not the same convenience and comfort.

It is unavoidable that a growing population, increased affluence and industrialization will increase environmental pollution. The objective will be to minimize the negative environmental impacts and to find the best beneficial uses of land and water resources, including final disposal of wastewater.

An efficient way to protect the environment from wastewater pollution, is to minimize wastewater flows through effective water conservation measures and policies, such as using toilets and sewers that require a minimum of flushing and transportation water, and by resource reclamation and reuse.

2. SANITATION SYSTEM COMPONENTS

Urban sanitation and sewerage systems will be developed in stages, and the various components that these systems comprise of, will each contain a number of technology options that are interdependent. Figure 2-1 depicts the various options that have been considered. The component options may be combined in a number of different ways, as will be discussed in this chapter.

The system components and designations used in use in this study are:

(i) on-site facilities (OS) for removal of wastewater and sludge from the site, or treatment and disposal on-site;
(ii) neighborhood collection system (NB) are designed to remove wastewater and sludge from larger areas within a city, in

neighborhood areas, such as real estates, residential subdivisions, industrial parks, development zones, and resorts;

(iii) conveyance system (CV), or the major sewers and drains that are used to collect wastewater from the neighborhood levels, and to convey it to treatment facilities and/or final disposal points. Separate sludge collection and transportation system are also included in this component category;

(iv) wastewater and sludge treatment methods (TM); and

(v) reuse of treated wastewater and sludge, and final disposal (DS).

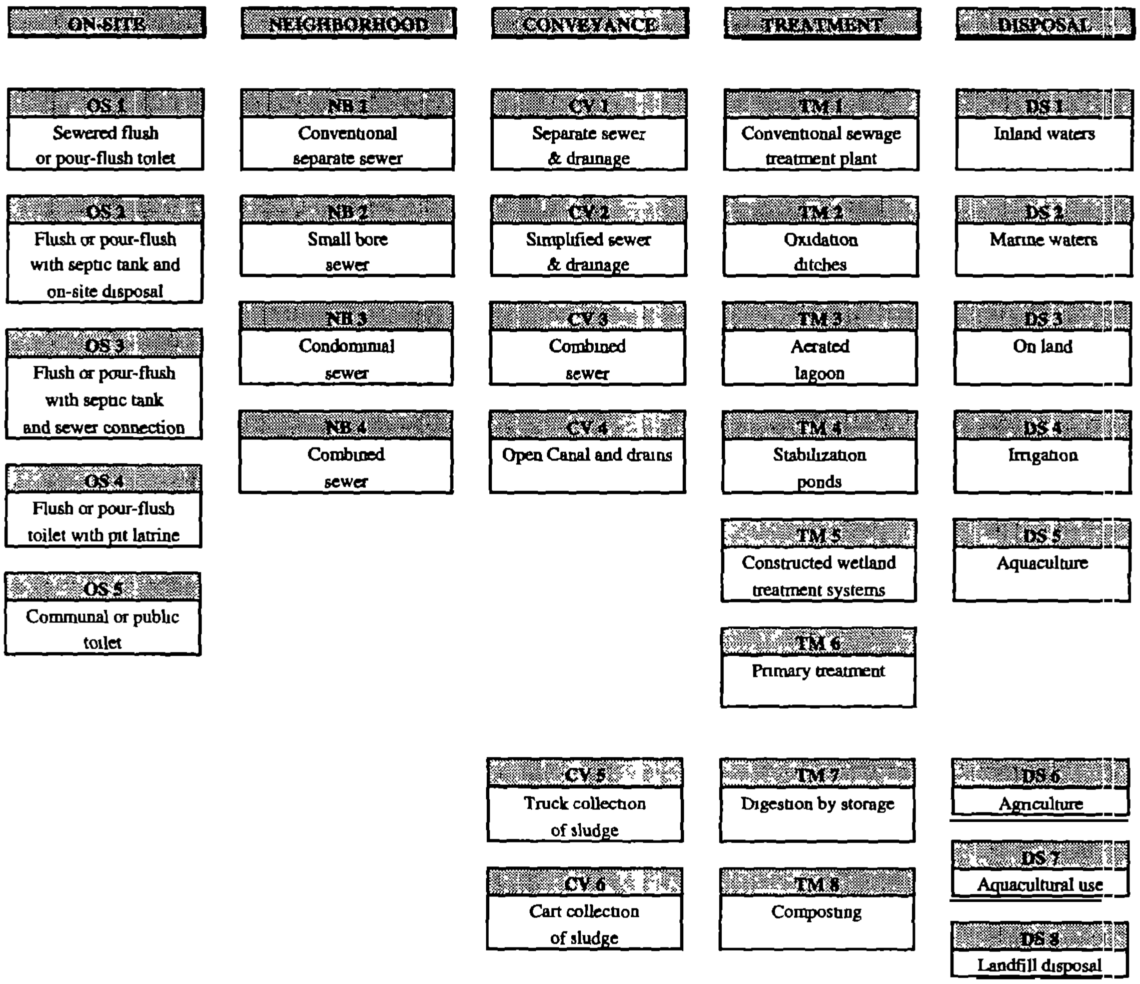


Figure 2-1 Sanitation technology options.

3. DESCRIPTION OF TECHNOLOGIES

Separate *TECHNOLOGY SHEETS*, annexed to this volume, have been prepared for each of the applicable options, containing information on:

(i) technology description;
(ii) principal design parameters,
(iii) next or down stream system component option;
(iv) assessment of the pros and cons for the selected technology; and
(v) investment and annual operating and maintenance cost.

At this stage, cost estimates have been prepared for comparable levels of service for each component. Unit costs have been prepared by the Ministry of Construction, Design Company for Water Supply and Sanitation Systems. Storm water drainage systems have also been included in the cost estimates, because otherwise it would not be possible to make economic comparison of combined and separate systems.

Quantifiable economic benefits associated with the various technologies have been identified and taken into account. It is assumed that the various selected options will provide safe collection and disposal, and therefore the same public health impact will accrue from each of them. Economic benefits are, therefore, primarily associated with the reuse of treated wastewater for irrigation and aquaculture and use of sludge as compost and soil conditioner.

3.1 ON-SITE SANITATION (OS)

The purposes of on-site sanitation systems are:

(i) to remove wastewater (sewage and sullage) from the property through a service connection to an outside sewer or drain, or
(ii) to collect, treat and dispose of wastewater on-site.

On-site systems can be individually owned and operated, or shared by a few neighbors, or they may be communal facilities that are owned and/or managed and operated by a community organization, or public toilets that are provided by the local government. For cost estimating purposes in-house toilet bowls or squatter plates and service connection have been included. The field surveys that were carried out for this study demonstrated that dry type toilets, such as bucket, double vault composting and ventilated pit latrines, have by large been replaced with wet type toilet facilities in South Vietnam, and is on-going in the North, and that people do not favor this type of facility. Therefore, dry type toilets will not be considered viable options and are excluded for further considerations in this study.

The following on-site technology options have be considered:

(i)	Flush toilet with sewer connection	OS 1
(ii)	Flush toilet with septic tank and on-site disposal	OS 2
(iii)	Flush toilet with septic tank and sewer connection	OS 3
(iv)	Flush toilet with pit latrine	OS 4
(v)	Communal or public toilet	OS 5

3.1.1 Flush Toilets Without Septic Tanks

Flush toilets without septic tank in Vietnamese conditions should be connected to separate sewers, and are not appropriate for combined sewers due to the operation and maintenance problems caused by unsettled wastewater and pipes with small gradient. The main advantage to the house-owners or users with this system is avoidance of expensive septic tanks, it requires hardly any maintenance, sewage and sullage can be disposed together, and the system is independent of soil, groundwater or flooding conditions. It does not require separate sludge handling system, as there is no sludge produced on-site. A house connection requires very little space, and may therefore be used with all housing densities. The main disadvantage is that it requires off- sewerage system.

3.1.2 Flush Toilets With Septic Tanks and On-site Disposal

Flush toilets with septic tanks and on-site disposal are widely used in Vietnam. Often the sullage is also lead to the septic tank, although this is not recommendable. The septic tanks are build as underground concrete chambers with two, or sometimes three, compartments. The purpose is to retain the wastewater to allow the solids to settle out and to digest the accumulated sludge. The septic tank will, when properly operated, give about 35% reduction of biochemical oxygen demand (BOD) and 65% reduction of suspended solids, which is equivalent to primary treatment. The effluent contains high concentrations of pathogenic organisms and it is septic and prutrescible. Solids free effluent should be lead to a soakaway pit or drainfield for ground infiltration, and not as today to use a septic tank with open bottom that will clog up quickly. The septic tanks will require regular desludging, approximately biannually.

The main advantages of these systems are that they do not require government investments, can be installed on an individual basis, and are easily upgraded to a sewerage system by connection of the effluent pipe. The main disadvantages are:

(i) relatively high initial investments and maintenance cost to the houseowner, and are therefore affordable only to the medium and high income level households;
(ii) it requires open space and good access for desludging vehicles;
(iii) will only function well under special soil and ground conditions;
(iv) there is a risk of groundwater pollution, and
(v) it cannot readily be applied in densely developed areas.

3.1.3 Septic Tanks With Sewer Connection

Septic tanks with sewer connections are found in urban areas with combined sewers, or areas where the sanitation is upgraded to separate neighborhood system, as described in Section 3.2. The advantage of this system is that it may improve the environment in an area where the ground infiltration systems are no longer functioning satisfactorily by connecting the septic tank overflow pipe to an existing combined sewer, to an extension of the existing system, or to a new separate sewer.

3.1.4 Pour Flush Toilets With Pit Latrines

Pour flush toilets with pit latrines will provide satisfactory environmental and hygienic conditions, and the necessary convenience and comfort when properly build and operated. The systems consist of a pour flush toilet with piped connections to a diversion box, where the flow is directed to two soakaway pits. Only one pit should be in operation at a time, allowing the accumulated sludge in the other pit to decompose. Clogging of most soakaway systems is caused by a mat of organic material, bacteria, that grows on or in the walls of the soakaway pit. When the pit is resting, i.e. not in operation, the wastewater drains out of the pit, and aerobic conditions develop. This allows the organic mat to decompose, and the infiltration capacity will be restored. The infiltration capacity and the useful life of a dual soakaway pit are thus significantly enhanced. Typically the operation of the pits will be alternated every second year or so. This will also provide enough time for destruction of most pathogens and helminth eggs in the accumulated sludge. The sludge can then safely be manually removed, and the humus like material, that is rich in nutrients, may be applied to gardens or used in agriculture.

The bowls should be of a type that will be flushed with a minimum of water, and sullage should not be drained into the pits. It does not require piped water, but water for flushing must be readily available.

The pit latrine is cheaper to build and operate than the septic tank system, and superior from a water conservation and resource recovery point of view. The drawbacks are the same as for the septic tank/soakaway system with respect to soil conditions, flooding and population density. It is mostly used in low to medium income residential areas. Systems with several houses sharing the soakaway pits, but with individual toilets, have been used in urban areas.

3.1.5 Communal or Public Toilet

In high density areas where sufficient land for individual septic tank or pit latrines cannot be found, and in areas where the residents cannot afford individual solutions, a communal or public toilet may be the only feasible solution. Communal toilets with septic tanks or other types of on-site treatment, such as the anaerobic upflow anaerobic sludge blanket reactor (UASBR), may be connected to a public sewerage or drainage system, and in some cases discharged to an adjacent wetland area. The principal advantages are that a sufficiently hygienic and environmentally acceptable solution can be offered, where there are no other affordable or practical solutions. The UASBR has so far not found widespread use, but installations are in use in Indonesia and India. It is recommended that a pilot project is carried out to test applicability of the UASBR in Vietnam.

3.2 NEIGHBORHOOD SANITATION (NB)

In this study the term *Neighborhood* sanitation is used to describe that part of a sewerage system that contains most of the house connections, as opposed to a conveyance system which principal function is to convey the collected wastewater to a treatment plant or disposal point. A neighborhood system may be collectively owned, financed and/or operated by the community, neighborhood, housing estates, development or industrial zones. Labor contribution through self-help projects will ease private financing of community based neighborhood systems.

The system designations used are:

(i)	Conventional Separate sewers	NB 1
(ii)	Small bore sewers	NB 2
(iii)	Condominial sewers	NB 3
(iv)	Combined sewers	NB 4

3.2.1 Separate Sanitary Sewers

Separate sanitary sewers are specially designed to carry suspended solids in wastewater. They are constructed with water-tight joints to prevent groundwater from entering and wastewater from leaving the sewers.

3.2.2 Separate Storm Water Drainage Systems

Separate storm water drainage systems are designed and constructed to carry storm water run off only. The storm water drainage system may consist of natural drains, constructed open canals, ditches and gutters, and closed storm water sewers. A full separate sanitation and storm water sewer system will normally be more expensive to construct, but may still be more economical taking into account the operating costs, and the savings in on-site facilities.

In areas that are already served by septic tanks with on-site disposal, and where there is a need to upgrade, a **small bore, simplified or condominial sewer system** may be the most cost effective solution. These are built as separate sewers and connected to the septic tank overflow pipes. Storm water should be conveyed separately.

3.2.3 Small Bore Sewer or Simplified Sewer

The small bore sewer or simplified sewer system is designed for solids free flows, a smaller flow rate and less pipe velocity than the conventional separate sewer, and for a lesser peaking factor due to buffering effect in the septic tank. The maintenance costs of the sewers are reduced because there is less risk of clogging and solids accumulation in the pipes. Another major advantage is that primary treatment has already been provided in septic tanks, which reduces the cost of final treatment and disposal. However, it requires more control with the septic tanks and enforced regular desludging.

3.2.4 Condominial Sewer System

The condominial sewer system is also designed for solids fee flows, and therefore needs smaller diameter pipes than conventional sewers. The condominial sewer is installed in the backyard of the houses of the properties that are sewered. Wastewater from an entire block may, therefore, be collected and discharged at one point to the public street sewer.. The sewer system will normally be planned, partly built and maintained by the people in the community on a participatory basis, by contributing own labor. This system is more demanding in terms of organization of the neighbors, ensuring sufficient cooperation, and legal arrangements, than for convention, small-bore or simplified sewer systems. The condominial sewer systems may find application in old city centers and densely and irregularly constructed housing blocks.

3.2.5 Combined Sewer System

The combined sewer system conveys both storm water runoff and wastewater in the same pipe. These systems are mostly found in old urban areas or in newer areas sewered by extensions of an existing combined system. Originally these systems were developed as drainage systems, but illegal and legal connections from septic tanks made these into combined sewers. The main advantage is that investment in new sewers and house connections in the urban old areas are avoided. The disadvantages are mainly:

(i) Increased pollution and public health risks caused by frequent sewer clogging and street flooding. This problem is exacerbated by drains often being mis-used for solid waste disposal.
(ii) Higher hydraulic loads on treatment facilities will increase the cost of construction and operation of treatment plants.
(iii) Increased concrete corrosion due to hydrosulfuric attack reduces the useful lives of concrete drains and structures.
(iv) Aesthetic problems in connection with foul odor from gutters and manholes.
(v) The old sewers are not constructed with tight joints, and leakage from the pipe may pollute the groundwater, while inflow of groundwater may increase the hydraulic load on the system.

3.3 CONVEYANCE SYSTEMS (CV)

Conveyance System is in this study construed as the macro wastewater collection system between the neighborhood systems and the treatment plant or final disposal point. Technology sheets have been prepared for the following conveyance systems for wastewater;

(i)	Separate sewers	CV 1
(ii)	Simplified sewers	CV 2
(iii)	Combined sewers	CV 3
(iv)	Open canals and drains	CV 4

The description of the conveyance systems is give in previous Chapter 3.2.

A system for collection, transportation and treatment of septic sludge will have to be arranged. Presently this system is not working satisfactorily. Large tank-trucks with suction pumps and hoses cannot negotiate some of the narrow alleys. In these areas push carts can be used, but if the transportation distance to the disposal point is long, a transfer to a tank-truck will be necessary. This complicates the sludge collection and may result that sludge is dumped illegally and haphazardly. Possibilities to privatize septic sludge collection and testing suitability of small motorized vacuum tankers in Vietnamese conditions is recommended by the Study Team. Meanwhile, only two options described in the technology sheets are:

(i)	Truck collection of sludge	CV 5
(ii)	Cart collection of sludge	CV 6

3.4 TREATMENT METHODS (TM)

Treatment method refers in this study to off-site treatment of wastewater and of sludge collected from septic tanks. On-site treatment has already been dealt with under Section 3.1. Effluent standards, permissible pollutant loading on the receiving water body or wastewater and sludge reuse and recycling requirements will determine what level of treatment and what type of treatment processes that may be applicable. The following treatment systems will be considered:

(i)	Conventional wastewater treatment plants	TM 1
(ii)	Oxidation ditches	TM 2
(iii)	Aerated lagoons.	TM 3
(iv)	Stabilization ponds	TM 4
(v)	Constructed wetland treatment systems	TM 5
(vi)	Primary treatment plants	TM 6
(vii)	Sludge digestion by storage	TM 7
(viii)	Sludge composting	TM 8

3.4.1 Conventional Wastewater Treatment Plants

Conventional wastewater treatment plants provide primary and secondary treatment. The first stage comprises physical settling of solids. The second stage is normally a biological process – trickling filter, biorotor, or activated sludge, etc. – that converts soluble organic material to biological organisms that can be removed from the liquid by sedimentation and/or filtration. The overall treatment efficiency is typically 90% BOD and suspended solids removal. The removal of pathogenic organisms will exceed 90%, but the concentration is still high, and chemical disinfection is sometimes used to bring the content of pathogens down to a safe level. Sludge from the primary and secondary treatment stages is normally stabilized in separate anaerobic digesters or aerobic reactors, and the stabilized sludge will need to be either mechanically dewatered or placed in open air drying beds.

Tertiary treatment to produce a water quality suitable for industrial uses, such as cooling water, can be added to a conventional wastewater treatment plant.

The advantages of conventional treatment plant are low land requirement, considerable economies of scale, and, therefore they are economical for large sewage flows. The disadvantages are that it is mechanical rather than labor intensive, high foreign cost, high energy consumption, and it requires skilled operators. The biological process is sensitive to toxic substances in the wastewater and to shock loading, and the effluent still contains large concentrations of pathogens, and is therefore suitable only for restricted irrigation.

3.4.2 Oxidation Ditch

The oxidation ditch is a special adaptation of the activated sludge process. It requires more land, less mechanical equipment, the process is less sensitive to shock loading, simpler to operate and therefore less demand for skilled operators. The sludge is normally stabilized or mineralized in the ditch itself. Therefore much less excess sludge will result from this type of plant than from the conventional type. The construction cost of an oxidation ditch is about 60% of that of a conventional activated sludge plant.

3.4.3 Aerated Lagoons

Aerated lagoons also provide biological treatment. It consists of series of ponds. The first pond is normally an anaerobic pond, where wastewater with high BOD and suspended solids concentrations are treated more efficiently than in aerobic ponds. The pond depth is several times deeper than aerobic or facultative ponds, and the anaerobic ponds require less area. However, there may be problems with foul odor. In a separate system where septic tanks or pit latrines have been used, the anaerobic pond will normally not be required. The next treatment step is a lagoon where oxygen for the biological decomposition of organic material is supplied by means of mechanical aeration. The substrate used for decomposition is mainly algae, while the activated sludge process used bacteria. Soluble organic material in the wastewater is thus converted to algae that will have to be removed, otherwise the solids concentration in the effluent would be unacceptably high, typically 150 to 300 mg/l, and the organic material, as well as nitrogen and phosphorous would be released when the algae die off in the receiving water. Algae are difficult to remove by sedimentation. The most common and economical way is to use a fish pond stocked with a suitable fish type, such as the carp and tilapia, that feed on algae, and then to harvest the fish.

The advantages of aerated lagoons are as follows; system is not sensitive to shock loads, and the construction cost is relatively low compared to conventional treatment plants, ease of operation, and that it lends itself well to fishfarming. One disadvantage is that the ponds will occupy a large area, and it would be difficult to find sufficient land in a built up urban area. The most likely location would be in urban fringe and agricultural areas, where the ponds could be used for fish farming or the effluent used for irrigation.

3.4.4 Stabilization Ponds

Stabilization Ponds normally consists of a series of three to four ponds in the following order:

(i) Anaerobic pond of depth 3-5 m, only used for high strength waste, and where the solids have not been removed in septic tanks or pit latrines. The treatment is provided by means of simple sedimentation of suspended material and biological decomposition of soluble organic material.
(ii) Facultative pond that has a depth of 1-3 m. These have an aerobic upper zone where soluble organic material is taken up by algae through a photosynthetic process, and a lower anaerobic biological decomposition process.
(iii) Maturation pond with depth of about 1 m, where oxygen is supplied from the air through diffusion and from the algae photosynthesis process. These ponds are normally stocked with fish in order to remove suspended algae.

Stabilization ponds require very large areas, but they are much cheaper to construct and operate than conventional treatment plants. They have no mechanical equipment, and do not require skilled operators. The disadvantage is primarily that it is difficult to find suitable land and space. Sludge production is low and the final ponds may be used for aquaculture. The content of pathogenic organisms and helminths is low, and the effluent is suitable for unrestricted irrigation. Stabilization ponds will, therefore, mainly find application in urban fringe areas, in smaller cities and rural areas, close to agricultural land, and where value of land is low.

3.4.5 Constructed Wetland Treatment

Constructed wetland treatment consists of pretreatment to remove coarse and heavy solids, followed by a facultative or aerated lagoon, and finally a series of shallow ponds where suitable aquatic plants, such a Duckweed of Hyacinth are grown and harvested. The reduction of BOD and suspended solids are similar to that of conventional wastewater treatment (90%), but the removal of nutrients is much better (20-70%), depending on the design, number of series of ponds and plant harvest efficiency. The removal of pathogens is high, and the effluent can be used for unrestricted irrigation. The principal advantages of this system are:

(i) high treatment efficiency,
(ii) very good buffer capacity against hydraulic and pollution loads,
(iii) simple operation that does not require skilled labor,
(iv) low or no energy requirement if pumping can be avoided,
(v) construction and operation costs only a quarter or so of conventional treatment methods, and
(vi) the effluent is suitable for irrigation and aquaculture.

The disadvantages are mainly that it requires very large areas of land, 10 to 20 ha/1000 persons, and that large quantities of biomass are produced that can be difficult and costly to handle, unless it can be composted or used as fodder. The pond may also be mosquito habitat. This treatment method is likely to be appropriate only in small cities and towns, and possibly in fringe urban areas, where effluent be used for irrigation or aquaculture.

3.4.6 Septic Sludge Treatment

Sludge removed from septic tanks will need to be treated before final disposal. The most obvious method is co-treatment in wastewater treatment plants in the future. For cost estimating purpose sludge digestion of dewatered sludge in a series of storage tanks, and co-composting with selected municipal solid waste have been considered..

Sludge digestion is a biological process to stabilize the organic matter of sludge prior to ultimate disposal. Anaerobic digestion of sludge consists of two distinct stages that occur simultaneously in digesting sludge. The first consists of hydrolysis of the high molecular weight organic compounds and conversion to organic acids by acid forming bacteria. The second stage is gasification of the organic acids to methane and carbon dioxide by the acid splitting methane forming bacteria. Aerobic digestion of sludge is a process to stabilize waste sludge solid by long term aeration, thereby reducing BOD and destroying volatile solid. Customary methods for disposal of digested sludge are spreading on farmland, lagooning, and drying on sand drying beds. Aerobic digestion is accomplished in one or more tanks mixed by diffused aeration. The volume of air supplied for aerobic digestion is normally in the range of 15-30 cfm/1000 ft^3 of digester.

Co-composting is a process in which septic sludge is mixed with other materials prior feeding into the compost heap. Because the septic sludge is low in C/N ratio and high in moisture content, therefore, it is only used as additive material to adjust moisture content and C/N ratio of compost material and killing pathogen present in septic sludge. Composted products, after that, are applied on land as fertilizer or soil conditioner.

3.5 LAND TREATMENT METHODS

Land treatment uses the natural soil and plant system to reduce pollutants, render pathogens ineffective, and to remove excess nutrients that may cause eutrophication in natural water systems. Effluent is treated in a number of physiological, chemical and bacteriological processes when applied to land. Pathogens are killed primarily by ultra violet radiation and by organisms in the soil itself. Organic material is oxidized and decomposed by soil micro-organisms. Mineralized, soluble substances, such as nitrogen, phosphorus, and potassium, that are valuable nutrients, are taken up by the plant metabolism. Chemicals and fine particles that penetrate into the subsoil may be attenuated in the soil through ion exchange processes, adhesion and absorption. Finally, particulate matter is filtered out by the soil, depending on the soil porosity. Excess water after evaporation and uptakes in the plants may percolate into and recharge the groundwater, or it may run off the surface. Limiting factors are soil permeability, groundwater level, groundwater use, soil characteristics, topography and vegetation.

Socioeconomic benefits will normally accrue from land treatment, because the wastewater is used for irrigation, fishfarming, and groundwater recharge. Reference is made to *Volume 1, Section 3.4.*

The most common, controlled land treatment methods are:

3.5.1 Slow Rate Irrigation

The primary reasons for using treated wastewater in agriculture are irrigation and fertilization of plant, pastures and trees. Treated domestic wastewater contains relatively high concentrations of nutrients even after secondary biological treatment, and will typically contain about 15 mg/l total nitrogen and 3 mg/l total phosphorous. Slow rate irrigation is used on agricultural land, pastures and forested land with unsaturated, fine soil with relatively low permeability. Fine textured soil can be very effective in removing viruses and soluble chemicals, especially clayey and silted soils with a high cation potential. The effluent may be applied by overland flow, spray irrigation or drip irrigation depending on crop and soil type, natural rainfall, and economic considerations. Maximum application rate is 100-150 mm/week. Pretreatment of the wastewater is only required to prevent maintenance and operation problems with the conveyance and applications system, such as pumps, pipes and sprinklers. But secondary treatment is recommended due to public health and environmental concerns, see *Chapter 7.4.*

3.5.2 Rapid Infiltration

This may be a cost effective final disposal method in areas with coarse, sandy soil, and where the upper aquifer is not used as domestic water supply. Such conditions are normally found in coastal areas of Vietnam. In some areas forced groundwater recharge can be used to build up a barrier against saltwater intrusion, and thereby protect a scarce fresh water resource. Crops are seldom grown in such areas, but subsurface irrigation with wastewater effluent my sustain some type of agriculture or park developments.

3.5.3 Overland Flow

Overland flow may be used on a gently sloping surface of moderate to low permeability soil, or rice paddies on a very slight slope. The nutrient removal and pathogen die-off rates are not high for overland flow systems, because fairly large areas are required. This treatment method will only be suitable for relatively small wastewater flows and/or large paddy fields.

3.6 REUSE OF EFFLUENTS

Reuse of wastewater and sludge is beneficial from a natural resource conservation and environmental protection point of view. The use of nightsoil in agriculture and aquaculture has long traditions in Vietnam. However, the present practice does not meet today's standards for public health and environmental protection. Also, as fewer people are now using dry type toilets, this resource is less readily available, and last but not least, commercial fertilizes preferred by the farmers are rapidly replacing nightsoil. The demand for fresh nightsoil is declining.

Controlled and hygienic reuse of treated wastewater and sludge is, nevertheless, an important objective for proper wastewater and environmental management in a country such as Vietnam, where the majority of the population live in rural areas, and where agriculture plays such an important role in the country's economy.

Human and animal wastes have been used as feed for pond-raised fish in Asia for several hundred years, and is widely practiced in Vietnam where water is abundant. Wastewater may also be used for production of aquatic plants, such as water chestnuts, water hyacinth, duckweed, lotus, and water calthrop. Same public health concerns apply to aquaculture as for irrigation.

Maturation ponds used as the last step of the treatment of wastewater in either stabilization ponds or aerated lagoons provide a good environment for aqua-culture. Species such as tilapia and carp have high economic value and crops up to 3 tons/ha per year can be achieved. These fishes are also necessary to remove the algae from the pond. Fish farming, therefore, has a dual function.

The economic benefits accruing from fishfarming will normally be higher than the operation and maintenance cost of the ponds, reference is made to *Volume 1, Section 3.4.*

4. COST COMPARISONS

4.1 PRESENT EXPENDITURE AND WTP

The separate sewerage system has been found to be more economical in the long run than the combined system, and also superior from a public health and environmental point of view. Yet, only the combined system has been used in Vietnam until now, but it is interesting that when people where asked which system they preferred, they would choose a separate system, and they were willing to pay more for a separate system.

The average willingness to pay (WTP) for upgrading toilet facilities based on the household surveys in Haiphong and Ho Chi Minh City are summarized in Table 4-1. People said they were willing to pay about 12,000 VND per month for a sewer connection, and 16,000 VND per month, if connected to a system with treatment plant. Householders that are using public or communal toilets today were willing to pay 17000 VND per month for an individual pour flush toilet. Households have been installing pour flush toilets with own septic tanks at a very fast rate, indeed, over the last decade. What is the cost of these systems?

Table 4-1 Average WTP amount for various types of improved sanitation, VND/month/household.

User of	On-Site Improvement		Off-Site Improvement	
	Public/Communal P/F toilet	**Individual P/F toilet**	**Sewer Connection**	**Sewerage with Treatment Plant**
Individual P/F toilet	-	-	12,000	16,000
Individual Dry Toilet	-	8,000	10,000	-
Public/Communal Dry Toilet	11,000	17,000	9-12,000	-

Notes:
1. P/F = pour flush

Table 4-2 below summarizes the cost per household for a number of possible sanitation technology options. The investments, operation and maintenance cost have been converted to monthly annuities with repayment over 15 years at 6% interest per year. Pour flush toilets with individual septic tanks (OS 2) are estimated to cost 43,000 VND per month. This amount is, perhaps, slightly higher than what most households have actually been paying, because it includes a separate soakaway and a yearly cost for flushing water and desludging the tank. Adjusted for these items the comparable cost would be 30-35,000 VND per month. Which is about three times the found WTP; quite obviously there is a significant market distortion.

Table 4-2 Technology Option Cost Summary, 1000 VD/month/household.

Technology Group	*Designation*	*HH Labor Contribution*	*Foreign Cost*	*Mat'l/Labor*	*Total Cash Req'd*	*O&M per HH/year*	*HH Payment per mnth*
On-site Sanitation (flush toilets)							
P/F with Sewer Connection	OS 1	150	0	1060	1060	55	9
P/F with Individual Septic Tank	OS 2	250	0	4984	4984	55	43
P/F with Shared Septic Tank	OS 3b	150	0	2110	2110	55	18
P/F with Septic Tank and Connection	OS 3	250	0	4060	4060	55	35
P/F with Pit Latrine and Soakaway	OS 4	400	0	1590	1590	37	14
Communal toilet w/sewer connection	OS 5	0	0	1872	1872	178	16
Neighborhood Sanitation							
Separate Sewer, 400per/ha	NB 1	0	0	750	750	4	6
Separate Sewer, 100per/ha	NB 1	0	0	1500	1500	10	13
Separate Drainage, 400per/ha	NB 1b	0	0	2150	2150	77	18
Separate Drainage, 100per/ha	NB 1b	0	0	6650	6650	105	57
Small-Bore Sewer, 400per/ha	NB 2	0	0	188	188	4	2
Small-Bore Sewer, 100per/ha	NB 2	0	0	400	400	10	3
Condominial Sewer, 400per/ha	NB 3	0	0	100	100	3	1
Condominial Sewer, 100per/ha	NB 3	0	0	270	270	5	2
Combined Sewer, 400per/ha	NB 4	0	0	2150	2150	38	18
Combined System, 100per/ha	NB 4	0	0	6650	6650	75	57
Conveyance System							
Separate System, 400per/ha	CV 1	0	150	70	220	10	2
Separate System, 100per/ha	CV 1	0	150	200	350	11	3
Separate Drainage, 400per/ha	CV 1b	0	0	735	735	3	6
Separate Drainage, 100per/ha	CV 1b	0	0	2940	2940	9	25
Simplified Sewer, 400per/ha	CV 2	0	75	53	128	6	1
Combined System, 400per/ha	CV 3	0	150	791	941	13	8
Combined System, 100per/ha	CV 3	0	150	3040	3190	22	27
Open Drainage System, 400per/ha	CV 4	0	0	341	341	3	3
Open Drainage System, 100per/ha	CV 4	0	0	1365	1365	12	12
Truck Collection for Sludge	CV 5	0	300	0	300	24	3
Cart Collection for Sludge	CV 6	0	0	19	19	19	0
Sewage Treatment							
Conventional Treatment	TM 1	0	1988	730	2833	154	24
Oxidation Ditch	TM 2	0	625	1241	1866	51	16
Aerated Lagoons	TM 3	0	510	795	1305	35	11
Stabilization Ponds	TM 4	0	150	941	1091	-15	9
Wetland Treatment	TM 5	0	150	621	771	19	7
Primary Treatment	TM 6	0	150	338	488	11	4
Sludge Treatment							
Sludge Digestion by Storage	TM 7	0	0	19	19	3	0.16
Composting	TM 8	0	0	40	40	8	0.34
HH financing, interest rate	6%						
HH financing, repayment period	15 years						

Table 4-2 shows that toilet systems with on-site disposal vary in cost per household from 43,000 VND per month for individual septic tanks to 14,000 VND per month for a double pit latrine solution. In a city there will be a number of options to choose from, depending on people's preference, income and local conditions, but a typical cost for an on-site facility, either with septic tank or pit latrine, is in the range of 30,000 VND per month. To this amount should be added the cost of a macro drainage system; a system based on open ditches and canals (CV 4) will cost from 3,000 to 12,000 VND per household per month, depending on the population density. It has been assumed that no drainage system will be required at the neighborhood level. This corresponds to the service level provided today. It is, therefore, concluded that today's sanitation and drainage system would cost in the order of 34,000 - 42,000 VND per month per household.

4.2 SEPTIC TANK VS CONVENTIONAL SYSTEM

The major difference between conventional separate system and septic tank system is that septic tanks have to desludged, i.e. they need a sludge collection, transportation and disposal system. Sludge vehicles with suction pump and hose (CV 5), and land disposal after storage treatment (TM 7) are likely to be the most common system. This would cost about 3,200 VND per month per household. It can now be concluded that the total cost for properly managed system with septic tanks with macro system based on open ditches and canals averages 37,000-46,000 VND per month per household.

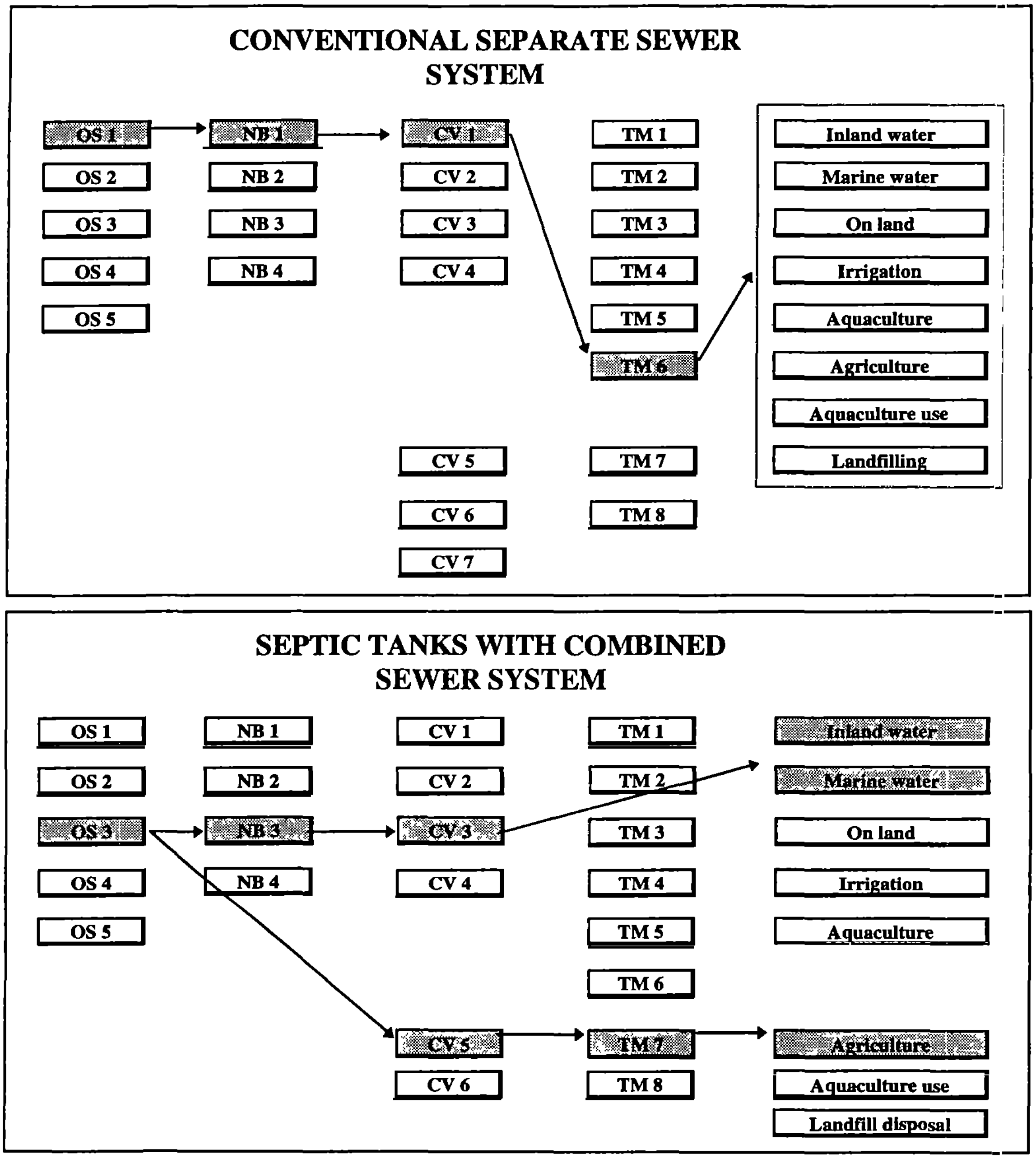


Figure 4-2 Illustration of septic tank system and separate system options.

This will be compared to a sewerage and drainage system in an area with 100 to 400 people per hectare, as shown in Table 4-3.

Table 4-3 Total monthly cost per household for separate sewerage by different population densities.

System Component	100 pers/ha	400 pers/ha
Pour flush toilet with sewer connection, OS 1	VD 9,000	VD 9,000
Neighborhood separate sewer, NB 1	13,000	6,000
Public separate sewer, CV 1	3,000	2,000
Open drainage system, CV 4	12,000	3,000
Primary treatment plant, TM 6	4,000	4,000

Note: *The above includes only macro drainage CV and not at the neighborhood level*

A comparable separate sewerage system would cost slightly less than the on-site sanitation and open drainage systems widely used today.

4.3 COMBINED VS SEPARATE SYSTEM

The following Table 4-4 shows a comparison of a combined and a separate sewerage system in an area with 400 pers/ha.

Table 4-4 Total monthly cost for separate and combined systems, 400 pers/ha.

System Component	Separate System	Combined System
Sewer connection, OS 1	VND 9,000	
Septic tank with combined sewer, OS 3, 4		VND 25,000
Separate sewer, NB 1	6,000	
Separate drainage, NB 1b	18,000	
Combined sewer, NB 4		18,000
Conveyance system, separate, CV 1	2,000	
Conveyance system, drainage, CV 1b	6,000	
Conveyance system, combined, CV 3		8,000
Primary treatment plant, TM 6	4,000	
Sludge handling, CV 5 + TM 7		3,200
Total	**VND 45,000**	**VND 54,200**

Primarily due to the high cost of septic tanks, a combined system is more expensive than a separate system. However, the distribution of cost between households and the government is quite different, the government's share would be much higher for the separate system, while the households pay the major share in a combined system, as seen from Figure 4-3.

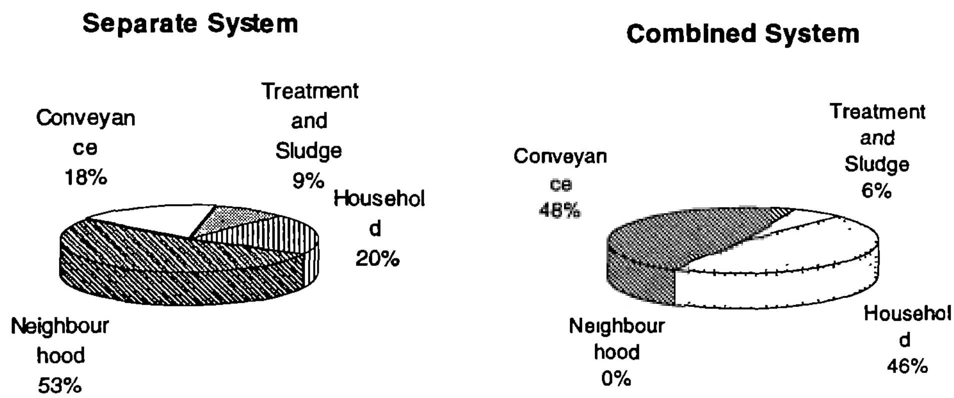


Figure 4-3 Distribution of costs of separate and combined systems.

4.4 PHASING OF SANITATION IMPROVEMENTS

Septic tanks with on-site infiltration within city centers are normally a temporary or transitional solution. Increasing urbanization, higher population densities, and limited space for septic tanks and infiltration systems, plus the fact that all infiltration systems will eventually clog up, will sooner or later demand a piped, either combined or separate sewerage system. It is, therefore, of interest to see how this transition can be accommodated, and what it will cost in relation to installing a separate system right away. *Annex 2* compares the following alternative developments:

(i) Building a separate sewer and drainage system right away, with primary treatment plant, and upgrading to a secondary treatment plant in year 2005.

(ii) Building an on-site disposal system with septic tanks, drainage, and sludge collection and disposal systems now, and then upgrading to small-bore neighborhood collection and simplified sewer conveyance systems, plus secondary treatment in year 2005.

It can be seen from *Annex 2* that the conventional separate system is still the most economical, and that the deferred investments for installation of small bore and simplified sewers and the secondary treatment plant do not change this. It is, therefore, concluded that the separate system should be selected for equal service standards. However, small bore, simplified and condominial sewers will all be cheaper than conventional sewers in those areas that already have septic tanks with on-site disposal, and which need to be upgraded to a sewered system. Which of these systems that should be selected, depends on the local conditions and must be determined in each case.

Up to now the drainage systems have been made for the purpose of conveying runoff, including sewerage, away from the streets and built up areas to the nearest creek or river, consequently there are many individual and small drainage systems. With increasing pollution and environmental concern, wastewater must be collected and treated at central points, and transportation over long distances will require pumping. In a combined system the pumping costs will be much higher than for a separate system, due to the higher hydraulic load, even if overflow systems are used to discharge flows in excess of approximately 2 to 4 times the dry weather flows. In Vietnam with long periods with and high amounts of yearly rainfall, the additional flow that would have to intercepted, pumped and conveyed would be relatively large, resulting in substantial increases in construction and operation costs. A separate system is, therefore, preferable in this respect as well.

5. FUTURE TREATMENT REQUIREMENTS

The final effluent disposal may be to marine or inland waters or on land. The effluent quality requirement will depend on the capacity of receiving waters to assimilate the pollutants without adverse environmental or public health impacts. Some countries have adopted uniform effluent standards regardless of the effluent volume and the assimilative capacity of the recipient. The advantage of this approach is simplicity and ease of control, monitoring and enforcement. However, it is not cost effective, and may also have negative environmental impacts, as some recipients may be overloaded, while in others the assimilative capacity is under utilized. Today, with better knowledge and understanding of how the various types of pollutants will affect natural water quality in the short and long term perspectives, it is recognized that it is more cost effective to determine the sustainable capacity of a water basin and to regulate the total discharges accordingly. This means that effluent loading per day, month or year is given for each polluter category, and that these permits will need to be reviewed and updated regularly.

5.1 PRESENT ORGANIC LOAD

The project survey of existing conditions showed that about 35% of all urban households have septic tanks connected to public sewers, and 30-40% have on-site disposal facilities of some kind. Based on this information it is estimated that removal of organic material from domestic wastewater is roughly 20%, and the remaining 80% is discharged to natural water bodies. This has resulted in heavy pollution of lakes, rivers and creeks in the urban areas, and made these into repulsive due to discoloration, foul odor and floating garbage, instead of the attraction they could have been.

The total present urban population of towns included in the scope of this study is about 10.8 million. Based on an average per capita discharge of 60 g BOD/day, the total production would be 640 tons/day, and of these 500 tones/day of BOD is discharged to the rivers, lakes, etc.

5.2 PROJECTED ORGANIC LOAD

Urban population is projected to reach 15-20 million in year 2010. The estimated production of organic material from this population is about 900-1200 tons BOD/day. Presently there is not sufficient information to develop effluent quality criteria, but it is possible to assume different treatment scenarios and estimate what the total organic load would be for each case, as described in Table 5-5.

Table 5-5 Different treatment scenarios from 1996 to year 2000.

A.	♦ **Status quo**, no change from present wastewater management and development practices.
B.	♦ Effluents from existing developments remain as in 1996. ♦ **Primary treatment** for effluents from all new developments. ♦ 20% on-site disposal in Class I/II cities, 40% in the other cities.
C.	♦ **Secondary treatment for Class I and II cities** before 2010, otherwise as for Scenario B.
D.	♦ **Secondary treatment for all** existing and new developments in all classes of cities before year 2010.

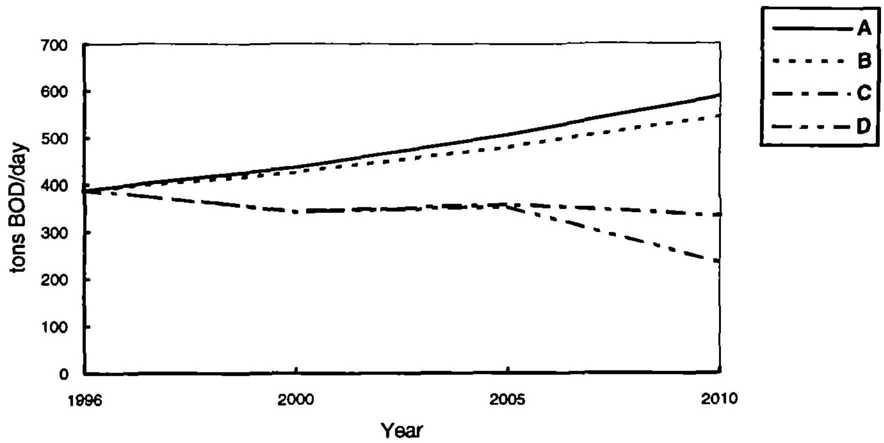


Figure 5-4 Development of domestic BOD load from urban areas to surface water bodies with different treatment scenarios, tons BOD/day.

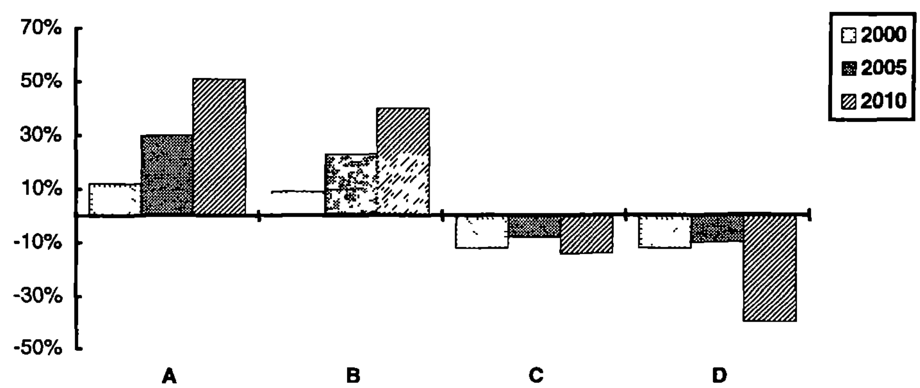


Figure 5-5 Change of domestic BOD load compared to present, %.

Figure 5-4 shows the estimated amounts of organic waste that would be discharged year by year from the present and up to year 2010. Figure 5-5 shows the percentage change from the present situation for the various scenarios for the years 2000, 2005 and 2010. The **status quo** (A) situation is obviously the worst scenario. The pollution load will increase by 50%, and the pollution level is already critical today. It should be noted that very little environmental improvement will be achieved if **primary treatment** (B) alone is implemented for new developments, which is not surprising since the present system provides nearly the equivalent of primary treatment. If primary treatment was implemented in new developments before year 2000, and **secondary treatment could be introduced between year 2005 and 2010 in Class I and II cities only** (C), which are mainly situated in the growth corridors, it would result in slight decline in the total pollution load from the present level. At least the situation would not deteriorate. If **secondary treatment for all** (D) developments, new or old, in all cities would be provided, i.e. an over the board requirement for secondary treatment for all waste discharges, a significant environmental improvement would be achieved.

It does not seem feasible to introduce secondary treatment for all new developments (D), as this would not be affordable. It will, therefore be necessary to prioritize. The larger cities in the growth corridors are likely to attract most foreign and local industries and real estate developers. It is possible that it would be feasible to develop these areas according to internationally accepted infrastructure and environmental standards, namely separate sewerage systems and secondary treatment. It is proposed by the Study Team that a development according to Scenario D would be followed. This would entail:

Table 5-6 Proposed general development path for domestic wastewater treatment in urban areas.

Class I and II Cities:

- Existing households continue with present on-site sanitation, connect to sewers where feasible, phase out of bucket latrines, and develop communal or public toilets for people living in non-permanent dwelling.
- 20% of future population will use on-site disposal sanitation facilities.
- Septic tanks or sewerage with minimum primary treatment for the remaining 80% population in new developments starting immediately.
- Upgrade to secondary treatment between year 2000 and 2010.

Class III and IV Cities:

- Existing households continue with present on-site sanitation, connect to sewers where feasible, phase out of bucket latrines, and develop communal or public toilets for people living in non-permanent dwelling.
- 40% of future population will use on-site sanitation facilities.
- Septic tanks or sewerage with minimum primary treatment for the remaining 60% population in new developments.

6. ECONOMIC BENEFITS

Economic benefits of wastewater collection and sanitation are difficult to estimate accurately. In the following only the economic benefits of improved health and increased crop yields from the treatment and reuse of excreta and wastewater are quantified. The calculations do not take into account indirect benefits such as decreased costs of health care, improved nutrition, improved productivity due to improved health situation or other derived benefits. The calculations are based on the present income level and market values of agriculture products, which may undervalue the real economic benefit due to distorted pricing.

Other benefits such as increased property values, amenities, scenic values, an improved environmental situation, well being, etc. are not quantified because their values completely depend on time, location, and mostly on the evaluator. These values have increased considerably in developed countries during the last decades, due to deterioration of the environment and big investments for pollution control have been done or are being implemented.

A town with a population of 50,000 inhabitants is used as a basis for comparison of options. The quantified part of economic benefits of wastewater collection and sanitation varies from 4 to 660 MVND per year, depending on the end products produced. These quantified values are rather small, and those unquantified may be much bigger.

6.1 IMPROVED PUBLIC HEALTH

The actual public health importance of reuse can be assessed only by determining whether it results in an incidence, prevalence, or intensity of diseases measurably in excess of that which occurs in its absence. If it does not, its public health importance is negligible. On the other hand, if it does, the magnitude of its importance will depend upon the balance between the public health significance of the measured excess incidence, prevalence, or intensity and its public health benefits. Benefits may include

(i) improved nutrition situation
(ii) improved health situation and reduced health care costs
(iii) low risk of epidemics
(iv) less absence from work and higher productivity
(v) etc.

Epidemiological studies to measure the actual excess incidence, prevalence, or intensity of diseases are methodologically difficult; relatively few well-designed studies have been carried out. The Vietnamese health statistics clearly show that the incidence rate of sanitation related diseases correlates with service coverage, physical environmental factors, and reuse of incorrectly treated or composted night soil and septic sludge.

Based on limited available data it is impossible to calculate the exact total economic benefit for the provision of different types of sanitation technologies. Therefore, in this connection the economic benefit of improved sanitation is roughly estimated as follows:

(i) The annual occurrence of sanitation related diseases is estimated to decrease from 6-10 cases per 1000 persons to 2 cases per 1000 (Figure 2-9, Volume 2) and 50% of the decreased incident rate is assumed to be derived from improved sanitation situation

$(8-2)^{x}$ 0.5 cases per 1000 persons per year = 3 cases/1000 per year,
for a city of 50,000 persons, it gives 150 days per year.

(ii) Based on Haiphong household survey the average monthly income of a household is VND 1,000,000, and there are 2.12 income earners in a household of 4.9 persons, i.e. 40% of sick persons are income earners.

(iii) Total loss of working days per sickness is 3 days.

(iv) The economic benefit of improved health situation through sanitation improvements valued on lost working time for a city of 50,000 people is estimated to be **3.5 MVND/per year.**

This amounts only to VND 70 per inhabitant per year or 7 manmonths, using the average income of Haiphong household survey. The estimate is very rough and does not take into account the indirect economic benefit of health care or risks for any outbreak of serious health epidemics such as cholera, etc. The economic losses of those kinds of epidemics are extremely greater than those estimated.

6.2 INCREASED CROP YIELDS[1]

Wastewater and excreta can be treated to meet the Engelberg criteria and thus reduce risk of the transmission of excreta related diseases resulting from reuse. Also system design and precautions can be provided where the Engelberg criteria do not need to be met to achieve low disease transmission risk. The quality of the wastewater itself is not determining disease transmission alone, but also how the wastewater is handled or contacted, that results in disease transmission. A pragmatic approach to improving public health in Vietnam would suggest that urban collection alone will significantly improve public health, and a low level of wastewater pretreatment and land application system will further improve public health compared to no in-plant treatment or land application system. However, better wastewater treatment prior to land application or reuse may be ideal and practical in the long term.

With proper management of such systems, the crop yields can be increased and environmental pollution reduced. Here only the increased crop yields are quantified based on the literature and knowledge on the Vietnamese conditions. The environmental improvements are not evaluated. Similarly, the indirect benefits of improved nutrition, public health, and increased productivity are not taken into account.

6.3 WASTEWATER REUSE IN AGRICULTURE

Many studies from around the world show that crop yields are significantly increased by application of wastewater and waste solids. For instance in India long term field experiments showed that irrigation with wastewater produced 28% to 47% higher yields than irrigation with freshwater and NPK fertilizer (Table 6-7).

[1]In this chapter references are mainly made to the book: Duncan Mara, Sandy Cairncross (1989), *Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture*, WHO in collaboration with the UNEP

Table 6-7 Results from long term field experiments on crop yields with different types of irrigation water in India.

Irrigation water	Crop Yields (tons per hectare per year)			
	Wheat	Rice	Potato	Cotton
Raw wastewater	3.34	2.97	23.11	2.56
Settled wastewater	3.45	2.94	20.78	2.30
Stabilization pond effluent	3.45	2.98	22.31	2.41
Fresh water+NPK	2.70	2.03	17.16	1.70
Ratio of Stabil./Fresh.+NPK	1.28	1.47	1.30	1.42

In Vietnam paddies are commonly irrigated with a mixture of fresh water and untreated sewage. Therefore, the yields of rice crops already include some degree of the fertilizing effect obtained from wastewater irrigation. The average, maximum, and minimum yields of paddies from 1989 to 1990 by provinces are shown in Table 6-8.

Table 6-8 Production of paddy fields by provinces from 1989 to 1990 in Vietnam, tons per hectare per year.

PROVINCE	1989	1990	1991	Avg	max/avg
Whole Country	3.23	3.19	3.11	**3.18**	
max	3.64	3.67	3.68	3.66	
min	2.47	2.27	1.95	2.23	
North Mountain Midland	**2.61**	**2.27**	**1.95**	**2.28**	**1.18**
max	3.10	2.61	2.32	2.68	
min	1.84	1.43	1.63	1.63	
Red River Delta	**3.54**	**3.42**	**2.93**	**3.30**	**1.26**
max	4.41	4.32	3.77	4.17	
min	3.08	2.99	2.42	2.83	
Central Coast of Northland	**2.33**	**2.42**	**2.42**	**2.39**	**1.23**
max	2.96	2.80	3.03	2.93	
min	1.66	1.90	1.79	1.78	
Central Coast Southland	**3.24**	**3.25**	**3.42**	**3.30**	**1.34**
max	4.40	4.48	4.38	4.42	
min	2.64	2.75	3.03	2.81	
Central Highland	**2.47**	**2.33**	**2.53**	**2.44**	**1.16**
max	2.84	2.72	2.95	2.84	
min	2.06	1.95	2.08	2.03	
North-East of Southland	**2.67**	**2.60**	**2.73**	**2.67**	**1.16**
max	3.27	2.99	3.00	3.09	
min	1.79	1.80	1.82	1.80	
Mekong River Delta	**3.64**	**3.67**	**3.68**	**3.66**	**1.21**
max	4.35	4.55	4.39	4.43	
min	3.08	2.87	3.11	3.02	
Average					**1.22**

Source: Statistical Yearbook 1992, General Statistical Office.

Rice crops vary as a result of many factors including, among others, climate, sunlight and temperature, pests, fertility of soils, know how, and genetic quality of plants. It can be seen that on average the ratio between average yield of the respective area and the maximum yield of a province is 1.22, i.e. the best yield of a province is approximately 22% higher than the average yield in the area. This may be related to water and nutrient supply problems on some sites. On some sites wastewater irrigation will increase yield greatly while on others the yield increase may be marginal. For estimating the economic benefit of irrigation of rice paddies with wastewater an increase in yield of up to 47% can be expected (Table 6-7). In locations where availability of water is limited, as in the dryer areas of south central Vietnam, yield increases are likely to be much greater.

Assuming, that average yield (excluding Mekong and Red River Deltas, because they are benefiting continuous supply of water with high nutrients) can be increased by 22-47% by using stabilized wastewater for irrigation, the estimated economic benefit of irrigation of rice paddies could be as follows:

(i) average annual yield is 2,610 kg/ha;
(ii) improved yield 22-47% i.e. 3,180 - 3,840 kg/ha;
(iii) wastewater generation of a town of 50,000 inhabitants (150 l/cd) is 7500 m^3/d;
(iv) 1 month peak irrigation of 0.7 - 1.6 l/s/ha;
(v) irrigated area 55 - 125 ha;
(vi) increased yield about 30 - 150 tons/year
(vii) price of rice 3.5 MVND/ton
(viii) estimated economic benefit of a town of 50,000 inhabitants is approximately **105 - 525 MVND/year**

This amounts to VND 2,100 - 10,500 per inhabitant per year or 210 - 1050 man-months, using the average income of the Haiphong household survey.

6.3.1 Wastewater Reuse in Aquaculture

The mean yield of fish ponds containing Chinese Grass Carp is 3,200 kg per hectare per year, while well-managed ponds containing several species of fish can yield up to 7,000 kg per hectare per year. Most of the lakes and ponds in Hanoi receive high amounts of wastewaters, and the mean annual yields in those waterbodies vary from 2,800 to 3,200 kg/ha.

Fish can be successfully raised in the maturation ponds of a series of waste stabilization ponds, and annual yields of up to 3,000 kg/ha have been observed.

The estimated economic benefit of fish farming in the maturation ponds of a town of 50,000 inhabitants is as follows:

(i) area of maturation ponds is 11 ha;
(ii) estimated value of fish 20,000 VND/kg;
(iii) annual yield of fish is 3,000 kg/ha; and
(iv) total estimated economic benefit is approximately **660 MVND per year**.

This amounts to VND 13,200 per inhabitant per year or 1,320 man-months, using the average income of the Haiphong household survey.

6.3.2 Excreta Use in Agriculture

Excreta use in agriculture is very common in Vietnam and experience has been gained over thousands of years. It is very likely that these practices will continue near the towns during the design period. Excreta contains nutrients and when added to soil increases the humus and total organic matter content of the soil, which can improve soil structure and waterholding capacity leading to improved plant growth and nutrient retention and cycling.

Experiments in China have shown that with application rates from 15 to 40 tons/ha of excreta-derived compost can substantially increase crop yields: maize 29%, millet 48%, potato 89%, sorghum 85%, soy bean 23%, and wheat 39%.

Increased productivity in Vietnamese conditions is estimated on the basis of ratio between the average productivity in typical areas and the maximum yields of the respective provinces. The ratios are calculated for the same areas and time period as presented earlier in Table 6-8.

Table 6-9 Estimated increase of productivity of maize, soy bean, and sweet potatoes in Vietnam.

Crop	Average yield tons/ha per year	Average ratio avg/max yield	Increased yield tons/ha per year
Maize	1.57	1.30	0.50
Soy bean	0.79	1.30	0.25
Sweet potato	5.95	1.40	2.40

The economic benefit of treated excreta can be estimated as follows:

(i) generated septic sludge 2,000 tons/a;
(ii) amount of digested sludge 300 tons/a;

(iii) application rate 15 - 40 tons/ha;
(iv) cultivated area 7.5 - 20 ha;
(v) estimated economic benefit of cultivating

maize (5,000 VND/kg)	**MVND 20 - 50 per year**
soy bean (12,000 VND/kg)	**MVND 20 - 60 per year**
sweet potato (2,000 VND/kg)	**MVND 35 - 100 per year.**

This amounts only to VND 400-2,000 per inhabitant per year or 40-200 man-months, using the average income of the Haiphong household survey. This amount is much lower than the other calculated benefits. One of the reasons may be that these crops are not valued by the consumers as much as the other crops. Another reason may be that wastewater supernatant contains high amounts of nutrients, which can be applied to the fields, but are not taken into account in the calculation.

6.4 OTHER BENEFITS

Amenity impacts such as a clean environment are appreciated for their esthetic values as well as for their positive contributions to human health, productivity, and ecology. The intrinsic value of national, historical and cultural heritage constitutes an amenity value as well.

The existence of a collection system will create favorable conditions for such benefits that are difficult to quantify, such as convenience, increased property values, decreased nuisance problems, etc.

The above mentioned values are difficult to be quantified and they are dependent on personal opinions, time, and location. Some people are willing to forego expenditures on other goods and services to protect the environment and enjoy the benefits of a pristine environment for themselves and for future generations. This has already happened in developed countries where so called "green products" are widely preferred, although they are more expensive than "non-green" products. The NUSS household survey revealed that environmental concerns are arising in Vietnam as well, where people were willing to pay more for a sewer connection with wastewater treatment than without treatment.

7. GUIDELINES FOR TECHNOLOGY SELECTION

7.1 GENERAL

As shown in Figure 2-1 that there are a large number of possible technology options for each component of the sanitation/sewerage and drainage systems, but they are not necessarily all compatible. The right choice of technology depends on a number of evaluation factors, which may be grouped into general or site specific factors, as shown in Table 7-10.

Table 7-10 Technology selection evaluation factors

General Factors	Site Specific Factors
♦ Construction cost	♦ Land requirements
♦ Operation and maintenance cost	♦ Soil and groundwater conditions
♦ Cost of imported materials or goods	♦ Flooding frequency
♦ Economies of scale	
♦ Possibilities for self-help or own labor contribution	♦ Present use of groundwater resources
♦ Amenity impacts	♦ Existing water supply, sewerage, sanitation, and drainage system
♦ Health and environmental impacts	
♦ Technology sophistication and reliability.	♦ Compatibility with present developments and suitability for future land use and developments
♦ Skills and labor requirements	
♦ Compatibility with the preceding and proceeding system component	♦ Effluent disposal requirement or Standards
♦ Upgrading possibility	
♦ Need for government intervention or financing	♦ Reuse opportunities

The most cost effective system for a given service or service level should be selected. However, from a financial point of view it matters whether the system requires high investments or high operation and maintenance costs, and whether the costs require foreign currency or not. Some of the system components have considerable economies of scale. On-site disposal facilities can be shared by neighboring houses, and thus substantially reduce the required investments for each of them. Sewers and drains have substantial economies of scale for diameters larger than the minimum acceptable for proper maintenance purpose. Most types of wastewater and sludge treatment methods also have considerable economies of scale.

Some general guidelines for selecting appropriate technology in different environments are presented in the following chapters.

7.2 SELECTION OF ON-SITE AND OFF-SITE COLLECTION SYSTEM

One of the major impediments to wide spread implementation of sewerage systems is lack of funds. However, this problem can be eased if there were a number of alternative technologies on the market and people where informed. For example, the pour flush pit latrine costs only half the price of a septic tank with a soakaway pit or septic tank with a sewer connection, yet it should give the same service satisfaction. People may also be able to reduce the cash expenditure requirements by contributing their own labor. This is most feasible in connection with their own on-site facilities, or for neighborhood systems that are implemented on a shelf-help basis.

The amenity aspect has been the most dominant motivation for people to upgrade their sanitation facilities from a bucket latrine or some other types of dry latrines, to the mechanically flushed or pour flush toilets with septic tank. Most probably their dominant concerns have not been personal health or environment, but for reasons of convenience and comfort, possibly also status. One can expect, that this attitude will prevail also in the future, particularly as people become more affluent and can better afford to upgrade their living standards.

The disposal of effluent from existing individual septic tanks is primarily disposed of on-site. Most private facilities have been built for ground infiltration of the effluent from the septic tanks. These systems are cost effective, but will work well and satisfactorily only if the soil is sufficiently permeable (>10^{-7} m/sec), the groundwater table is sufficiently low below the surface (about >2 m), the area is not too prone to frequent flooding, and finally that the upper aquifer is not used for water supply. The only environmental impact apart from the possible groundwater pollution, will be due to treatment and disposal of sludge removed from the septic tanks.

If the ground conditions are not suitable, or the infiltration system clog up due faulty design of the septic tank and infiltration system, or for lack of sludge removal, the septic tank overflow pipe is normally connected to a public sewer or storm drain, if this is available within a reasonable distance, or the effluent may be conveyed directly to the street gutter or on the ground. In this case the on-site system provides less than primary treatment and very little bacteriological reduction. The public health, environmental and amenity impacts are then considerable.

Until now the Government's efforts have by large been to provide storm water drainage systems only in the central city districts and in areas that are specially flood prone where on-site sanitation systems will not function satisfactorily. As more and more households convert to pour flush toilets, and the nuisance, public health and environmental problems due to insufficient sanitation infrastructure become more apparent, it is expected that people will start to demand public sewerage and drainage systems.

The housing or development characteristics are very important for selection of a suitable sanitation technology. In the old city centers or very densely populated and built-up areas, and where there is little or no space for individual on-site disposal facilities, a piped wastewater collection system and off-site treatment and disposal may be required in such areas. The right choice of technology depends on the characteristics of the areas, economics and people's preference. The NUSS household survey demonstrated, that most people prefer a separate sewerage system. In existing areas with combined sewers it may be uneconomical to install separate sewers. Upgrading and extension of the combined system may be most appropriate in those areas.

In other areas with existing on-site systems, that need to be upgraded to a sewered system, the most important system selection factors are:

(i) the need for surface water drainage;
(ii) housing density and characteristics, and
(iii) final disposal requirements.

In new development areas the first level of decision is to determine whether on-site or off-site system is the most appropriate. The on-site system will normally be economical only in low density, medium to high income residential areas (<200 people/ha). In commercial, industrial and residential areas with high population density a piped sewerage system will usually be the most appropriate, and the choice of using a separate or combined system will be based on economic and environmental consideration, as well as people's preference and willingness to pay.

Suitability of various technologies can be summarized as follows;

Table 7-11 Evaluation of technology options.

Technology Group	Designation	Existing Ground and Service Conditions						Existing Urban Area			New Urban Area				
		High water table	Low infiltration	Flood Prone	No sewers or drains	No water mains	Ground water used	Old city centers	Developed >1954	City outskirts	EPZ&IPZ, & Tourism	Commercial centers	Residential area by income level: High	Medium	Low
On-site Sanitation (flush toilets)															
P/F with Sewer connection	OS 1	H	H	H	L	L	H	H	M	M	H	H	H	H	L
P/F with Individual Septic Tank	OS 2	M	M	M	H	M	L	M	M	M	L	L	L	M	H
P/F with Septic Tank and Connection	OS 3&3b	H	H	H	L	L	H	H	M	M	H	H	H	H	L
P/F with Pit Latrine and Soakaway	OS 4&4b	M	M	M	H	M	L	M	M	M	L	L	L	M	H
Communal toilet with sewer connection	OS 5	H	H	H	L	L	H	H	H	M	L	L	H	M	L
Neighborhood Sanitation															
Conventional Separate Sewer	NB 1&1b	H	H	H		L	H	L	L	L	H	H	H	H	M
Ditto, without drainage pipes	NB1	L	L	L			L								
Small Bore Sewer, Separate System	NB 2&2b	H	H	H		M	H	H	H	M	M	M	M	H	H
Ditto, without drainage pipes	NB2	L	L	L			L								
Condominal Sewer, Separate system	NB 3&3b	H	H	H		M	H	L	M	M	L	L	M	M	M
Ditto, without drainage pipes	NB3	L	L	L			L								
Combined System	NB4	H	H	M		M	H	H	H	H	L	L	L	M	M
Conveyance System															
Separate System	CV 1&1b	H	H	H		L	H	L	L	L	H	H	H	M	L
Ditto, without drainage	CV1	L	L	L		L	L	L	L	L	L	L	L	L	L
Simplified Sewer System	CV 2&2b	H	H	H		L	H	M	M	M	L	L	H	M	M
Ditto, without drainage	CV2	L	L	L		L	L	L	L	M	L	L	L	L	M
Combined System	CV3	H	H	H		H	H	H	H	H	L	L	M	M	H
Open Canals and Ditches	CV4	M	M	M		M	M	L	L	M	L	L	M	M	M

Notes.

1 Suitability/demand
High
Moderate
Low

2 A blank evaluation means that the specific condition does not affect the technology selection
3. Low permeability means <10 liters/m^2/day (1.15*10 ^{7}m/sec)
4 High water table mean < 2 m from ground surface
5 IPZ means centralized Industrial Processing Zone
6 EPZ means Export Processing Zone

7.3 SELECTION OF TREATMENT METHOD

The determinant factors for making a choice of treatment method are, of course, the composition of the raw wastewater and the required effluent quality. Figure 7-6 illustrates the key components that should be taken into account when determining the need for wastewater treatment. The most important factors are (i) natural purification capacity of receiving water, (ii) use of receiving water and its quality requirement and (iii) the total load of the urban area. Generally speaking when effluent from a big city is discharged into a small river the risk of pollution is much bigger than in a case where a small city or townlet is located next to a river with big flow.

Thus the Study Team recommends that effluent standards and regulations should be site specific and be based on the local conditions. The standards based on only concentrations should be avoided.

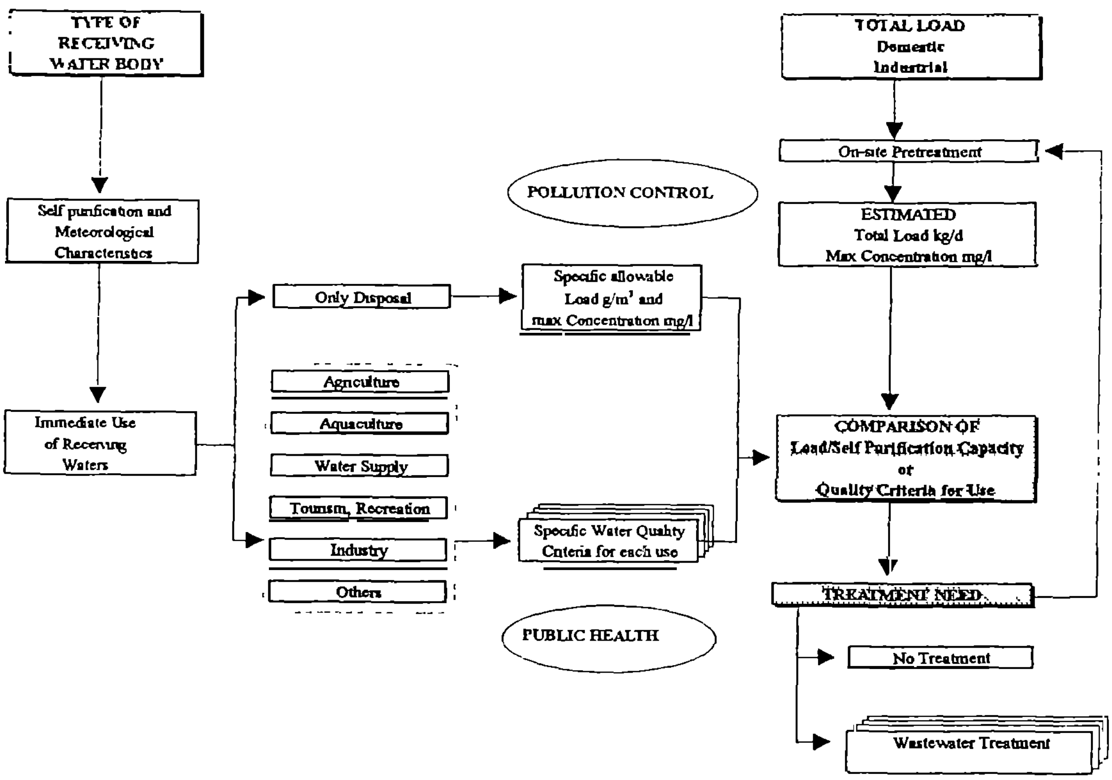


Figure 7-6 Pollution control and need for wastewater treatment.

For a given effluent quality the selection should be based on economic considerations. However, some treatment methods may not be appropriate in Vietnam at the moment. Primary treatment plants do not involve sophisticated chemical or biological processes, and the operation does not require very skilled personnel. Most chemical and biological plants, on the other hand, involve complicated processes that require substantial skill to operate. Typically the cost of chemicals and energy normally goes up if the operators do not have the necessary competence to optimize the process, or the treatment efficiency is low.

Secondary treatment using biological treatment will certainly become necessary in most large cities within foreseeable future. Generally, the longer the process time is the less sensitive biological plants become to process disturbances due to shock loading or toxic substances of the influent. Conventional secondary treatment using the activated sludge process has a few hours of reaction time in the aeration chamber, and the stability of the process is quite delicate, as the biological process cannot adjust itself quickly enough to changing hydraulic and organic loads. Such a plant requires highly skilled operators. Stabilization pond plant, on the other hand, has retention times of several days to weeks, and the system itself has a very good buffer capacity, and is not very sensitive to variations in the composition or quantity of the raw wastewater. There is normally no mechanical equipment involved, and the operator skill requirements are very low.

The total economic cost of the plant is, of major importance, and there are many factors to consider. The most important cost factors are the need for mechanical equipment, instrumentation, and space. Conventional treatment plants are highly mechanized that mostly will have to be imported, but they are also very space efficient. Where land is very expensive, this may be the most economical solution. Therefore, they may find application in some of the new industrial development zones, isolated tourist resorts, and possibly in the largest cities.

Oxidation ditches and aerated lagoons require less mechanical equipment than conventional plant, are less costly to construct and operate, but require more land. Stabilization ponds are relatively simple to construct, the construction and operation costs are comparatively low, but the require very much land, and this could be a limiting factor in many urban areas. The maturation ponds can be used for fishfarming, and the effluent is suitable for irrigation, therefore this type of treatment plant is considered most suitable in urban fringe areas, adjacent to agricultural areas.

Wetland treatments are special applications that would take advantage of existing natural water bodies, and may provide a very low cost and adequate solution. The area requirement is very much higher than for the other systems.

Suitability of sewerage treatment options can be summarized as follows;

Table 7-12 Evaluation of wastewater treatment technologies.

Technology Group	*Designation*	*Space Efficiency*	*Reuse Opportunity*		
			Irrigation	*Aquac*	*Industry*
Conventional Treatment	TM 1	H	M	M	H
Oxidation Ditch	TM 2	H	M	M	M
Aerated Lagoon	TM 3	M	M	M	H
Stabilization Ponds	TM 4	M	H	H	M
Wetland Treatment	TM 5	L	M	M	M
Primary Treatment	TM 6	H	M	M	L

Key: *H High* *M Moderate* *L Low*

7.4 MICROBIOLOGICAL QUALITY GUIDELINES FOR REUSE OF WASTEWATER

Treated domestic wastewater will normally have high contents of disease causing protozoa, helminth, bacteria and viruses, and for this reason there are public health concerns about use of effluents on cultivated land. A study carried out by the World Bank, the World Health Organization and the International Reference Center for Waste Disposal in 1985, concluded that the bacteria contamination risk had previously been overrated, and that the principle health risk was associated with helminthic diseases. The following so called Engelberg quality guidelines for use of treated wastewater in agriculture and aquaculture were proposed, and are now widely used throughout the world.

Table 7-13 Engelberg Microbiological Quality Guidelines.

Reuse process	Intestinal nematodes[a] (arithmetic mean no. of viable eggs per liter)	Fecal coliforms[b] (geometric mean no. per 100 ml)
Restricted irrigation Irrigation of trees, industrial crops, fodder crops, fruit trees[d], and pasture [e]	≤ 1	not applicable
Unrestricted irrigation Irrigation of edible crops, sport fields, and public parks[f]	≤ 1	≤ 1000 [g]
Fish culture	0[h]	$< 10^4$
Aquatic macrophyte culture	0[h]	$< 10^4$

[a]Ascaris, Trichuris, and hookworms.
[b]In fish and aquatic macrophyte culture this guideline assumes that there is one $\log_{10}$ unit reduction in fecal coliforms occurring in the pond, so that in-pond concentrations are < 1000 per 100 ml. If consideration of pond temperature and retention time indicates that a higher reduction can be achieved, the guideline may be relaxed accordingly.
[c]A minimum degree of treatment equivalent to at least a 1-day anaerobic pond followed by a 5-day facultative pond or its equivalent is required in all cases.
[d]Irrigation should cease two weeks before fruit is picked, and no fruit should be picked off the ground.
[e]Irrigation should cease two weeks before animals are allowed to graze.
[f]Local epidemiological factors may require a more stringent standard for public lawns, especially hotel lawns in tourist areas.

[g]When edible crops are always consumed after cooking, this recommendation may be less stringent.
[h]Clonorchis, Fasciolopsis, and Schistosoma consideration need to be given only in endemic areas.

MOA and MOSTE have some general guidelines on physical and chemical quality of water to be used for irrigation, these standards are plant/crop specific, and not reviewed in this connection.

Table 7-14 below gives an indication of which treatment methods that would meet the restricted and unrestricted irrigation quality guidelines without further health protection. However, it may still be possible to use effluent from primary or conventional secondary treatment plants to grow selected crops without risk to the consumers, provided additional measures are taken to protect the agricultural workers and crop handlers.

Table 7-14 Required treatment to meet the Engelberg Quality Guidelines

Restricted Irrigation	**Unrestricted Irrigation**
♦ Stabilization ponds,	♦ Primary treatment
♦ Aerated lagoons, and	♦ Conventional secondary treatment
♦ Wetland treatment	♦ Oxidation ditch

Table 7-15 provides guideline as to suitable land application or irrigation methods that could be used with the various types of wastewater and cops, while Table 7-16 indicates the relationship between natural resources, land treatment method, reuse options and design constraints.

Table 7-15 Recommended Application Methods for Various Classes of Wastewater and Crops.

APPLICATION METHOD	USE AND IMPLICATIONS
Flood irrigation of bordered areas where a large amount of the area is irrigated under saturate flow	Suited to: 1. Rapid infiltration systems. 2. Irrigation of treated wastewater (comply with < 1 viable Helminths (including intestinal nematodes) egg per liter and, 1000 Fecal coliform bacteria per 100 ml) onto all crops, but when the wastewater is below these treatment standards it should not be applied by flood irrigation.
Furrow irrigation where wastewater travels between mounds of soil wetting furrows and unsaturated flow	Suitable for many applications including where contract between the crops and the wastewater needs to be avoided. The method can provide a very effective wastewater distribution system that offers some cost advantages of spray irrigation. Suitable when uniform application is required for tress or vegetable crops.
Low pressure sprinklers and localized drippers and bubbler irrigation	Requires a high degree of wastewater filtration to avoid blockages and a large amount of piping to achieve uniform ground cover. Creates low disease transmission risk to workers because low aerosol production results. Appropriate where minimum water application for maximum benefit is required.
High pressure sprinklers	Not to be used when wastewater does not comply with <1 viable intestinal nematode egg per liter and, 1000 Fecal coliform bacteria per 100 ml and crops grown are green fodder, fruit, and pasture. Sprinkler irrigation is very suitable for forest land treatment and where high hydraulic loading rates are used.
Sub surface irrigation	Expensive, practical for sports fields or similar public use areas.

Table 7-16 Land Treatment Technology Application and Natural Resources.

AVAILABLE CLOSE TO URBAN AREA	APPROPRIATE LAND TREATMENT OPTIONS	REUSE OPTIONS AND DESIGN CONSTRAINTS
Coastal sands and inland sands under certain conditions	Rapid infiltration	No people living between treatment/ reuse area the ocean who rely on well water supply. Wastewater will enter groundwater after treatment and diffuse into the ocean. Shellfisheries need to be monitored and safeguarded.
Coastal Sands and inland sands	Slow rate irrigation possible. Add on fish pond culture of laterally moving recharges groundwater an option.	Large increases in crop production will result, irrigation will need to be via low volume frequent appellations and renovation of pathogens will be low, especially during periods of heavy rain washing applied wastewater rapidly to groundwater.
Deep free draining soil with gentle topography	Slow rate irrigation with or without further down stream use such as stream and impoundment recharge.	Agriculture and forestry cropping with resulting high yields and high levels of wastewater renovation. Drinking water standard discharge/drainage can be achieved allowing water draining a slow system on suitable soils to be used for irrigation of salad crops and for drinking water supply.
Steep soils with moderate to high permeability	Slow rate irrigation with or without further down stream use such as stream and impoundment recharge	Agriculture crops are not suitable for steep land unless terracing is provided. Forestry crops are well suited to slow rate irrigation of steep slopes.
Moderately permeable soil with flat or low grade	Slow rate irrigation by flood irrigation	As for other slow rate irrigation, but all crops can be considered if irrigation standards are met.
Low permeability soil or appropriate lining material available. Wetlands/ponds and wasteland (e.g. after brick making)	Ponds and constructed wetland	Cultivation of a range of wetland plants and fish provided certain high quality wastewater resulting for crop irrigation.
Slow infiltration rate soils with slight grade	Overland flow treatment with recollection for subsequent disposal or reuse	Crops suited to saturate or partially/periodically saturated soil and high nutrient conditions can be grown but not for direct consumption without cooking.

Paddy land	Irrigation with primary settled wastewater and composed sludge	High yields and long term sustain ability can be assured.
Relatively deep soils over bed rock or watertable, groundwater quality not required to meet drinking water standards	Septic tanks or similar type units	There are a range of drainage or disposal systems that can be used to further treat and recycle components of the waste, such as evapotranspiration mounds, subsurface irrigation of crops and straight drainage to groundwater.
Small homegarden areas	Movable toilets, or bucket toilets emptied into holes	Recycling of nutrients and increased crops
Available land and waste organic matter	Composting	Application to homegardens, paddy, agriculture crops and forestry.

ANNEX I

TECHNOLOGY AND COST SHEETS

TECHNOLOGY SHEET

OS 1

Level:	On site
Technology:	**Flush or pour-flush toilet with sewer connection**
Next component technology options:	Separate Sewer, NB1
Description:	Pedestal or squat-type toilet bowl with a water seal. Requires 2-5 liters of water for flushing after each use. Service connection to sewer system

PROS

Technical:	+ reliable and simple + possible to locate conveniently inside the house + sullage can be led to the same facility + independent of local groundwater, soil and flooding conditions
Implementation:	+ low construction skills needed
O&M:	+ easy to maintain + no need for sludge collection
Others:	+ suitable for high-density areas + suitable for all housing types + minimal risk to public health + low construction cost

CONS

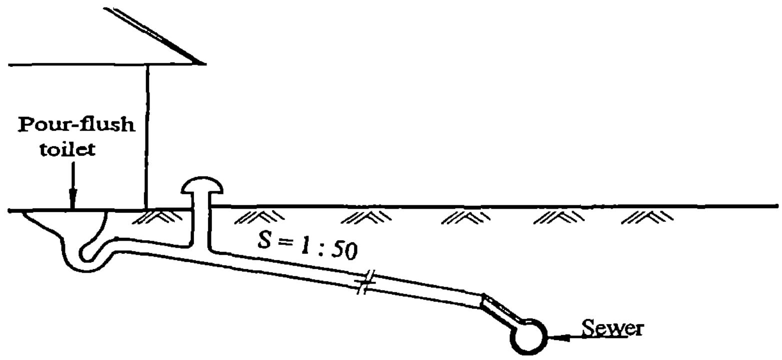
Technical:	– high water use to provide adequate flushing – no pretreatment on site , thus higher load to secondary treatment or receiving waters – limited choice of next phase
Implementation:	– requires manufactured parts (water seals, toilet bowls)
O&M:	- very low O & M requirements
Others:	– not all anal cleansing materials accepted

Investment costs:	22 USD/person
Operating costs:	1.0 USD/person/year

COST ESTIMATE SHEET

OS 1

Flush and pour-flush toilet with sewer connection



- average household size 5 persons
- average flushing water consumption 15 l/person/day
- average distance to sewer system 20 m

Investment:	toilet bowl	1	pc a	60,000	VD =	60,000	VD
	pipes, PVC 100	20	m a	50,000	"	1,000,000	"
	labour cost			150,000	"	150,000	"
					=>	1,210,000	VD
					=>	**110**	**USD**
O & M:	flushing water	27	m^3 a	2,000	VD =	54,750	VD/year
					=>	54,750	VD/year
					=>	**5.0**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **158** **USD**

=> **32** **USD/pers**

TECHNOLOGY SHEET

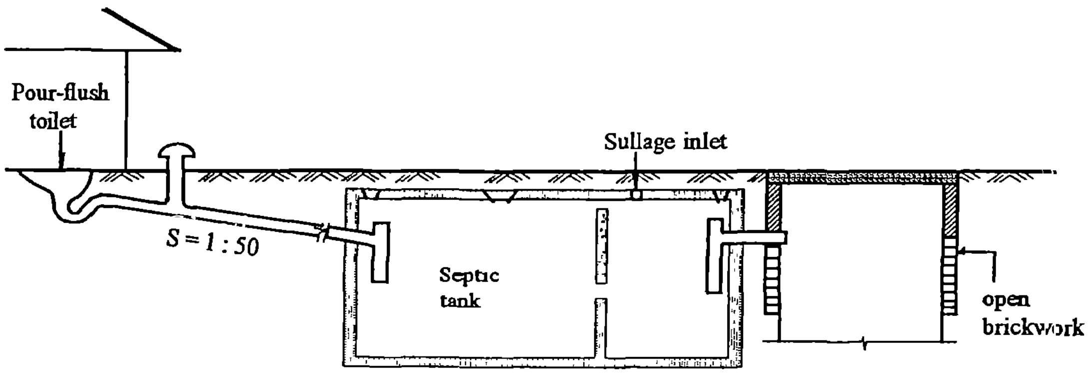
OS2

Level:	On site
Technology and:	**Flush or pour-flush toilet with septic tank with soakaway pit**
Next component technology options:	On-site disposal - sludge removal CV5 or CV 6
Description:	Pedestal or squat-type toilet bowl with a water seal. Requires 2-5 liters of water for flushing after each use. Sewage is retained in a 2 to 6 m^3 rectangular chamber with two compartments, where it is settled and anaerobically digested. This reduces the sludge volume and provides preliminary treatment (about 35% BOD reduction and 65% SS removal). The tank has to be desludged at some years intervals. Service connection to a separate soakaway or drainfield.
PROS	
Technical:	+ reliable + low flushing water need + sullage can be led to the second compartment of the tank + several low cost options for effluent collection
Implementation:	+ low construction skills needed + municipal involvement can be limited to design and maintenance guidelines
O&M:	+ easy to maintain
Others:	+ with proper soakaway pit minimal risk to public health
CONS	
Technical:	– requires water supply to provide adequate flushing water – required soil permeability of 10^{-7} m/sec – nearby shallow wells can't be used for drinking water supply – availability fail due to clogging of the soil – groundwater table must be about 1.0 m below soakaway pit – not suitable for flood prone areas
Implementation:	– requires manufactured parts (water seals, toilet bowls) – requires construction control
O&M:	– requires periodic desludging – requires septic sludge transportation and disposal – requires access for collection carts or vehicles
Others:	– not all anal cleansing materials accepted – requires space in the property for installation
Investment costs:	95 USD/person
Operating costs:	1.0 USD/person/year

COST ESTIMATE SHEET

OS 2

Flush or pour-flush toilet with septic tank and on-site disposal



- average household size	5	persons
- sludge accumulation rate	0.04	m^3/person/year
- average water use	150	l/person/day
=> septic tank volume	3	m^3
=> desludging period	5	years
=> soakaway pit D = 1.2m	3	m^3
- average flushing water consumption	15	l/person/day
- needed piping	20	m

Investment:	toilet bowl	1	pc a	60,000	VD =	60,000	VD
	pipes, PVC 100	20	m a	50,000	"	1,000,000	"
	septic tank	3	m^3 a	1,000,000	"	3,000,000	"
	labour cost			250,000	"	250,000	"
	soakaway pit	3	m^3 a	300,000	"	900,000	
					=>	5,210,000	VD
					=>	**474**	**USD**
O & M:	flushing water	27	m^3 a	2,000	VD =	54,750	VD/year
					=>	54,750	VD/year
					=>	**5.0**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate:		**522**	**USD**
	=>	**104**	**USD/pers**

TECHNOLOGY SHEET

OS3

Level:	On site
Technology and:	**Flush or pour-flush toilet with septic tank and sewer connection**
Next component technology options:	Separate sewer, NB1 - sludge removal, CV5 or CV6 Small bore sewer, NB2 Condominial sewer, NB3 Combined sewer, NB4
Description:	Pedestal or squat-type toilet bowl with a water seal. Requires 2-5 liters of water for flushing after each use. Sewage is retained in a 2 to 6 m^3 rectangular chamber with two compartments, where it is settled and anaerobically digested. This reduces the sludge volume and provides preliminary treatment (about 35% BOD reduction and 65% SS removal). The tank has to be desludged at some years intervals. Service connection to sewer or drain.

PROS

Technical:

+ reliable
+ low flushing water need
+ sullage can be led to the second compartment of the tank
+ no dependence on soil conditions or groundwater level
+ several low cost options for effluent collection

Implementation:

+ low construction skills needed

O&M:

+ easy to maintain

Others:

+ minimal risk to public health
+ suitable for high population densities

CONS

Technical:

- requires water supply to provide adequate flushing water

Implementation:

- requires manufactured parts (water seals, toilet bowls)
- requires construction control

O&M:

- requires periodic desludging
- requires septic sludge transportation and disposal
- requires access for collection carts or vehicles

Others:

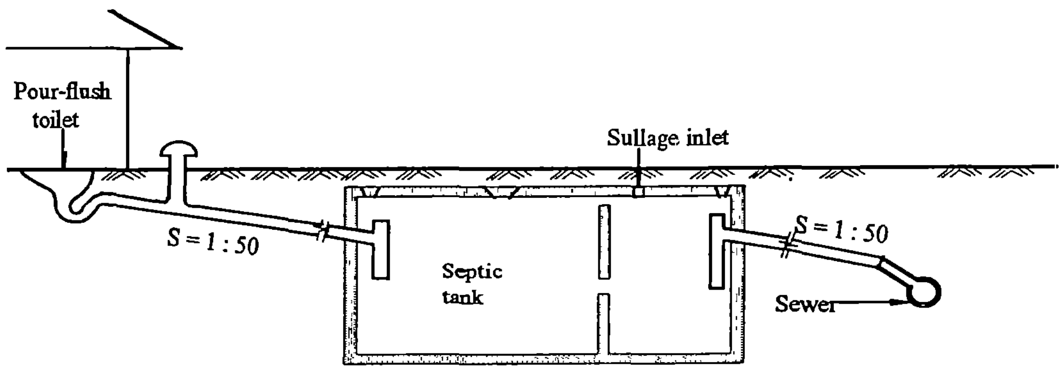
- not all anal cleansing materials accepted
- requires space in the property for installation

Investment costs:	78 USD/person
Operating costs:	1.0 USD/person/year

COST ESTIMATE SHEET

OS 3

Flush or pour-flush toilet with septic tank and sewer connection



- average household size	5	persons
- sludge accumulation rate	0.04	m^3/person/year
- average water use	150	l/person/day
=> septic tank volume	3	m^3
=> desludging period	5	years
- average flushing water consumption	15	l/person/day
- average distance to sewer system	20	m

Investment:	toilet bowl	1	pc a	60,000	VD	=	60,000	VD
	pipes, PVC 100	20	m a	50,000	"		1,000,000	"
	septic tank	3	m^3 a	1,000,000	"		3,000,000	"
	labour cost			250,000	"		250,000	"
						=>	4,310,000	VD
						=>	**392**	**USD**
O & M:	flushing water	27	m^3 a	2,000	VD	=	54,750	VD/year
						=>	54,750	VD/year
						=>	**5.0**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **440 USD**

=> **88 USD/pers**

TECHNOLOGY SHEET

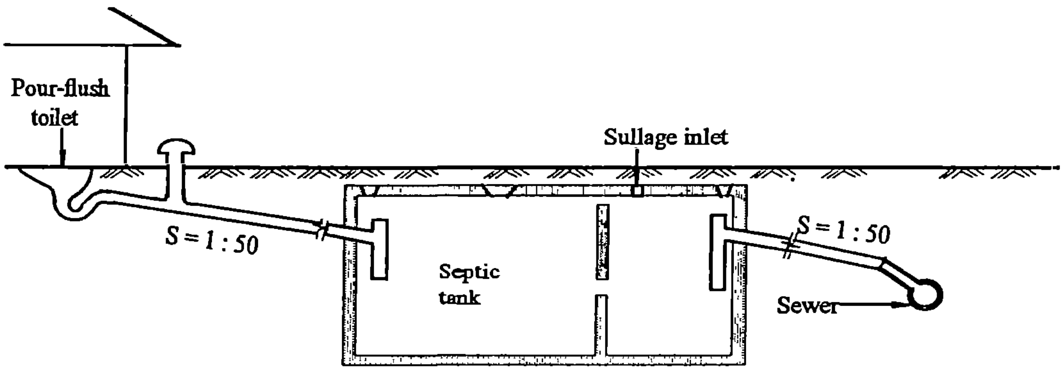
OS3b

Level:	Neighborhood
Technology and:	**Flush or pour-flush toilet with shared septic tank and sewer connection**
Next component technology options:	Separate sewer, NB1, - sludge removal CV5 or CV6 Small bore sewer NB2 Condominial sewer NB3 Combined sewer NB4
Description:	Flush or pour-flush toilet connected to a septic tank shared by several households. The tank consists of two or three compartments, where sewage is settled and anaerobically digested. This reduces the sludge volume and provides preliminary treatment (about 35% BOD reduction and 65% SS removal). Each compartment is sized to provide a minimum of one day hydraulic retention time. The tank has to be desludged at intervals. Service connection to sewer or drain.
PROS	
Technical:	+ reliable + can be used with combined and separated systems + independent of local groundwater or soil conditions
Implementation:	+ low construction skills needed
O&M:	+ easy to maintain
Others:	+ minimal risk to public health + suitable for high population densities + suitable for all housing types
CONS	
Technical:	
Implementation:	– requires construction control
O&M:	– requires periodic desludging – requires access for sludge collection carts or vehicles – Households must come into agreement on sharing of cost of O&M
Others:	
Investment costs:	41 USD/person
Operating costs:	1.0 USD/person/year

COST ESTIMATE SHEET

OS 3b

Flush or pour-flush toilet with shared septic tank and sewer connection



- number of households sharing septic tank	24	
- average household size	5	persons
- sludge accumulation rate	0.04	m^3/person/year
- average water use	150	l/person/day
- average flushing water consumption	15	l/person/day
=> septic tank volume	25	m^3
=> desludging period	0.75	years
- average piping distance	20	m

Investment:	toilet bowls	24	pc a	60,000	VD	=	1,440,000	VD
	pipes, PVC 100	480	m a	50,000	"		24,000,000	"
	septic tank	25	m^3 a	1,000,000	"		25,200,000	
	labour cost	24	pc a	150,000	"		3,600,000	"
						=>	54,240,000	VD
						=>	**4,931**	**USD**
O & M:	flushing water	657	m^3 a	2,000	VD	=	1,314,000	VD/year
						=>	1,314,000	VD/year
						=>	**119**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **6,091** **USD**

=> **51** **USD/pers**

TECHNOLOGY SHEET

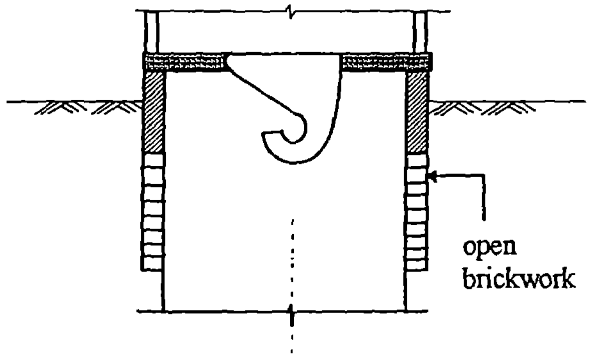
OS 4

Level:	On site
Technology:	**Flush or pour-flush toilet with pit latrine**
Next component technology options:	(May be upgraded and connected to sewer at a later stage)
Description:	Pedestal or squat-type toilet bowl with a water seal. Requires 2-5 liters of water for flushing after each use. Sludge accumulates in a pit, typically 2 to 3 m deep and one meter across, which is sufficient for an average family for 5 years. To prevent collapse, pit walls should be lined with suitable material like bricks. Liquids are infiltrated to surrounding soil through the bottom and holes in the lining The pit has to be desludged when sludge reaches two-thirds depth.
PROS	
Technical:	+ reliable + low flushing water need
Implementation:	+ low construction skills needed + municipal involvement can be limited to information on design and maintenance guidelines
O&M:	+ easy to maintain + sullage can be used for flushing
Others:	+ with proper soakaway, minimal risk to public health + high potential for upgrading to sewered system
CONS	
Technical:	– requires water supply to provide adequate flushing water – requires separate sullage disposal facilities – requires stable and soil permeable conditions of 10^{-7} m/sec – not suitable in flood prone areas – groundwater table must be about 1 0 m below soakaway pit – risk of clogging and overflow
Implementation:	– requires manufactured parts (water seals, toilet bowls)
O&M:	– requires periodic desludging – requires septic sludge transportation and disposal
Others:	– not all anal cleansing materials accepted – unsuitable for medium to high-density areas (>200 pers/ha depending on soil conditions) – leachate may contaminate groundwater
Investment costs:	36 USD/person
Operating costs:	0.7 USD/person/year

COST ESTIMATE SHEET

OS 4

Flush or pour-flush toilet with pit latrine



- average household size	5	persons
- sludge accumulation rate	0.04	m^3/person/year
- desludging period	5	years
=> pit volume m^3	2.6	m^3
- average flushing water consumption	10	l/person/day
- average water use	150	l/person/day
- average distance to drainage system	10	m
=> sullage flow	0.7	m^3/day

Investment:	toilet bowl	1	pc a	60,000	VD =		60,000	VD
	pipe PVC 100	10	m	50,000	"		500,000	"
	cement	155	kg a	1,080	"		167,400	"
	brick for two pits	2300	pcs	375	"		862,500	"
	labor cost			400,000			400,000	"
						=>	1,989,900	VD
						=>	**181**	**USD**
O & M:	flushing water	18	m^3 a	2,000	VD =		36,500	VD/year
						=>	36,500	VD/year
						=>	**3.3**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 **years at** 6% **interest rate:** **213** **USD**

=> **43** **USD/pers**

TECHNOLOGY SHEET

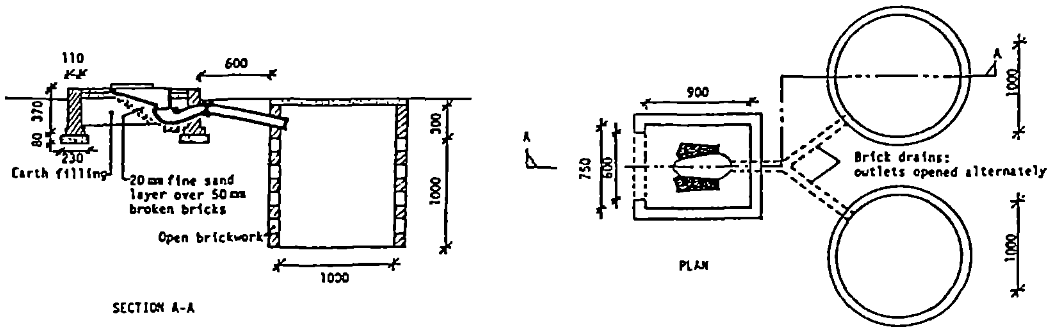
OS 4b

Level:	On site
Technology:	**Flush or pour-flush toilet with dual soakaway pits**
Next component technology options:	None
Description:	Pedestal or squat-type toilet bowl with a water seal. Requires 1-2 liters of water or sullage for each flush. Many different designs, but would commonly consist of a pipe from the toilet to a diversion box, from here connections to two separate soakaway pits. One pit in operation, while the other is resting and digesting the sludge before removal. Operation of the pits alternate every second year. Sludge accumulates in pits. Recommended effective pit volume is 0.5-1.0 m^3 per household, and typically 2 to 3 m deep and one meter across, which is sufficient for an average family for 3 years. To prevent collapse, pit walls should be lined with suitable material like bricks. Liquids are infiltrated to surrounding soil through the bottom and holes in the lining. The pit has to be desludged when sludge reaches two-thirds depth.
PROS	
Technical:	+ little odors or insect breeding + possible to locate pit inside the house if access for sludge removal + low flushing water need
Implementation:	+ low construction skills needed + municipal involvement can be limited to information on design and maintenance guidelines
O&M:	+ easy to maintain + sullage can be used for flushing
Others:	+ with proper soakaway, minimal risk to public health + high potential for upgrading + digested sludge can safely be used as soil conditioner
CONS	
Technical:	– requires water supply to provide adequate flushing water – requires separate sullage disposal facilities – required soil permeability 10^{-7} m/sec – groundwater table must be about 1.0 m below soakaway pit
Implementation:	– requires manufactured parts (water seals, toilet bowls)
O&M:	– requires periodic desludging – requires septic sludge transportation and disposal
Others:	– not all anal cleansing materials accepted – unsuitable for high-density areas (in excess of 150-200 pers/ha depending on soil conditions) – leachate may contaminate groundwater
Investment cost	34 USD/person
Operating cost	0.7 USD/person

COST ESTIMATE SHEET

OS 4b

Flush or pour-flush toilet with dual soakaway pits



- average household size	5	persons
- sludge accumulation rate in dry pits	0.06	m^3/person/year
=> desludging period	3	years
=> number of pit	2	
=> pit volume 2 x 1.3 m^3	2.6	m^3
=> soakaway pit D = 1.2m	3	m^3
- average flushing water consumption	10	l/person/day
- average distance to sewer system	20	m
=> sullage flow	0.75	m^3

Investment:	toilet bowl	1	pc a	60,000	VD	=	60,000	VD
	overflow pipe- P	24	m a	50,000	"		1,200,000	"
	bricks	2800	pc a	375	"		1,050,000	"
	labour cost			400,000	"		400,000	"
	cement	160	kg	1,080	"		172,800	"
						=>	2,882,800	VD
						=>	**262**	**USD**
O & M:	flushing water	18	m^3 a	2,000	VD	=	36,500	VD/year
						=>	36,500	VD/year
						=>	**3.3**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **213** **USD**

=> **43** **USD/pers**

TECHNOLOGY SHEET

OS 5

Level:	On site
Technology:	**Communal or public toilet**
Next component technology options:	Separate sewer, NB1, - sludge removal, CV5, CV6 Small bore sewer, NB2 Condominial sewer Combined sewer, NB3
Description:	A toilet facility shared by a group of households, consisting of several flush toilet compartments and a septic tank.

PROS

Technical:

Implementation:

+ reliable and simpler technology
+ low flushing water needed
+ potential for self-help of the user community
+ low land requirement

O&M:

Others:

+ suitable for high density areas
+ located in public land when no private land is available
+ can be combined with ablution facilities

CONS

Technical:

– privacy may be questionable
– reluctance of the shareholders to use in the night or during illness or heavy rain
– requires supply for water and electricity
– requires regular sludge removal

Implementation:

O&M:

– tendency to get fouled due to little commitment by individual users to keep the facility clean
– attendants needed to keep in good operational order
– O&M difficult to organize, no clear responsibility for ownership

Others:

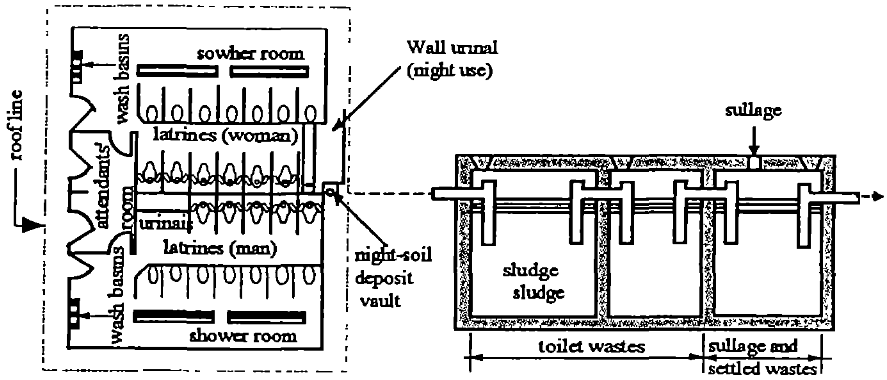
– low for upgrading
– health risk if not used and maintained properly
– normally not appreciated by the users

Investment costs:	34 USD/person
Operating costs:	2.8 USD/person/year

COST ESTIMATE SHEET

OS 5

Communal toilet



- number of households sharing a toilet	60	
- average household size	5	persons
- sludge accumulation rate	0.04	m^3/person/year
- average flushing water use	15	l/person/day
- average washing water use	40	l/person/day
=> septic tank volume	35	m^3
=> desludging period	0.75	years
- persons per latrine	25	persons
- area per latrine & washing facility	5	m^2
=> latrines (or urinals) needed	12	pc
=> area of the facility	60	m^2

Investment:	toilet house	60	m^2 a	1,250,000	VD =	75,000,000	VD
	septic tank	35	m^3 a	1,000,000	"	35,000,000	"
	toilet bowls	5	pc	60,000	"	300,000	
	pipes PVC	40	m	50,000	"	2,000,000	VD
					=>	**112,300,000**	**VD**
						10,209	**USD**
O & M:	flushing water	1643	m^3 a	2,000	VD =	3,286,000	VD/year
	attendants	2	pc a	300,000	"	7,200,000	"
	electricity, etc	2%	of	112,300,000	"	2,246,000	VD/year
					=>	12,732,000	VD/year
					=>	**1,157**	**USD**

Foreign/local expenditure: all local

Present value for 15 **years** 6% **interest rate:** **21,694** **USD**

TECHNOLOGY SHEET

NB1

Level: Conveyance

Technology: **Conventional separate sewer, no drainage**

Next component technology options: separate sewer, CV1

Description: Wastewater led to sanitary sewers separate from storm drains. Dimensioning is based on per capita sewage production with a peaking factor. Some allowance also made for infiltration. Minimum pipe diameter 200 mm, minimum velocity 0.6 m/s. Manholes located at about 100 m intervals at junctions and changes of gradient, size, or alignment.

PROS

Technical:

+ allows the sewers to be smaller than in combined system
+ allows the drains to be shallower than in combined system
+ less water needing pumping and treatment than in combined system
+ wastewater quality and flows rather constant
+ no need for septic tanks
+ no problem of sewer overflows due to flooding

Implementation:

O&M:

Others:

+ street waste has no entry to sewers and thus less risk of clogging
+ minimal risk to public health
+ suitable for high population densities
+ serves well possible secondary wastewater treatment
+ secondary treatment without pretreatment

CONS

Technical:

- two piped systems needed
- drainage system can be classified for more frequent flooding

Implementation:

- low potential for self-help
- implementation in old city centers difficult due to disruption to traffic, residents, and other underground utilities

O&M:

- pumping needed in flat areas

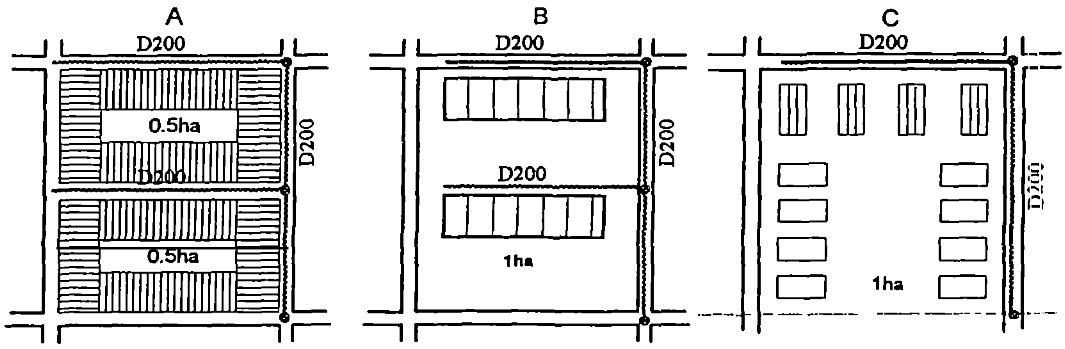
Others:

	Pop. density A	Pop. density B	Pop. density C
Investment costs:	17 USD	31 USD	60 USD/pers
Operating costs:	0.23 USD	0.27 USD	0.36 USD/pers/y

COST ESTIMATE SHEET

NB 1

Conventional separate sewer, no drainage



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average flow rate	0.69	0.35	0.17	l/s/ha
- average legth of sewer line	300	240	150	m/ha
- average depth of pipes	1.0	1.0	1.0	m
- average length of drains				
concrete 400	0	0	0	m/ha
concrete 800	0	0	0	m/ha

Investment:

pipes, pvc 200	300	240	150	m a	200,000 VD
drains, 400	0	0	0	"	260,000 "
drains, 800	0	0	0	"	1,200,000 "
=>	60	48	30	MVD	
=>	**5,455**	**4,364**	**2,727**	**USD**	

O & M:

dredging, sewers	300	240	150	m a	1,000 VD
dredging, drains	0	0	0	"	10,000 "
=>	0 3	0.2	0 2	MVD/year	
=>	**27**	**22**	**14**	**USD/year**	

Foreign/local expenditure: all local

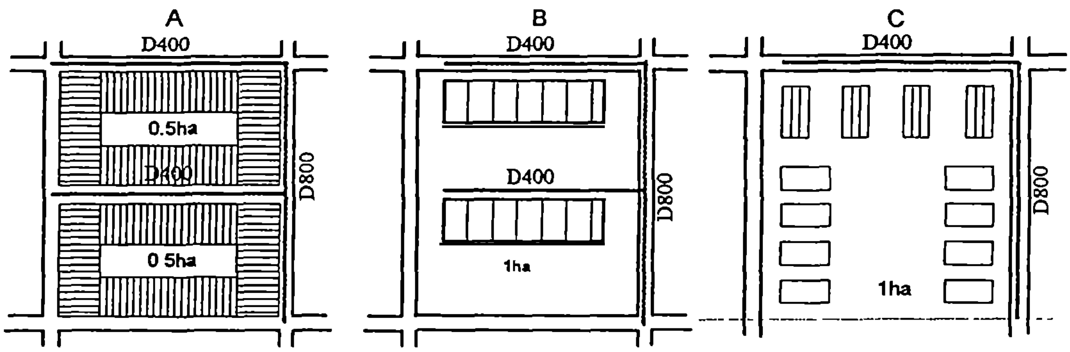
Present value for 15 **years at** 6% **interest rate:**

	5,719	**4,576**	**2,860**	**USD**
=>	**14**	**23**	**29**	**USD/pers**

COST ESTIMATE SHEET

NB 1b

Conventional separate sewer, only drainage



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average flow rate	0.69	0.35	0.17	l/s/ha
- average legth of sewer line	0	0	0	m/ha
- average depth of pipes	0.0	0.0	0.0	m
- average length of drains				
concrete 400	200	140	50	m/ha
concrete 800	100	100	100	m/ha

Investment:

	A	B	C			
pipes, pvc 200	0	0	0	m a.	200,000	VD
drains, 400	200	140	50	"	260,000	"
drains, 800	100	100	100	"	1,200,000	"
=>	172	156	133	MVD		
=>	**15,636**	**14,218**	**12,091**	**USD**		

O & M:

	A	B	C			
dredging, sewers	0	0	0	m a	1,000	VD
dredging, drains	300	240	150	"	10,000	"
=>	3.0	2 4	1.5	MVD/year		
=>	**273**	**218**	**136**	**USD/year**		

Foreign/local expenditure: all local

Present value for 15 **years at** 6% **interest rate:**

	A	B	C	
	18,285	**16,337**	**13,415**	**USD**
=>	**46**	**82**	**134**	**USD/pers**

TECHNOLOGY SHEET

NB 2

Level:	Neighborhood
Technology:	**Small bore sewer**
Next component technology options:	Separate sewer, CV1 Simplified sewer, CV2 Combined sewer, CV3 Open canal sewer, CV4
Description:	Sewer pipes designed to have less diameter and slope than conventional sewers. Minimum diameter is 100 mm and minimum velocity 0.3 m/s, to be used with primary treatment (solids free) waste water.

PROS

Technical:
+ possible to install at shallow depths in residential areas
+ small deviations from continuous downward gradient allowed
+ lower secondary treatment requirements due to pretreatment in the septic tanks

Implementation:
+ compared to conventional sewers, less disturbance to existing residents, utilities, and traffic
+ under supervision possible to implement on self-help basis

O&M:
+ suitable for neighborhood level O&M responsibility

Others:
+ minimal risk to public health
+ suitable for high population densities
+ upgradable to simplified sewers

CONS

Technical:
- requires pretreatment (septic tanks) at on site level
- flood, prone areas, and high density population areas requires separate drainage
- must be placed outside areas with traffic load or specially protected at road crossings

Implementation:
- requires technical skills
- requires high community involvement during implementation and O&M

O&M:
- clogging easily if pretreatment is not working properly

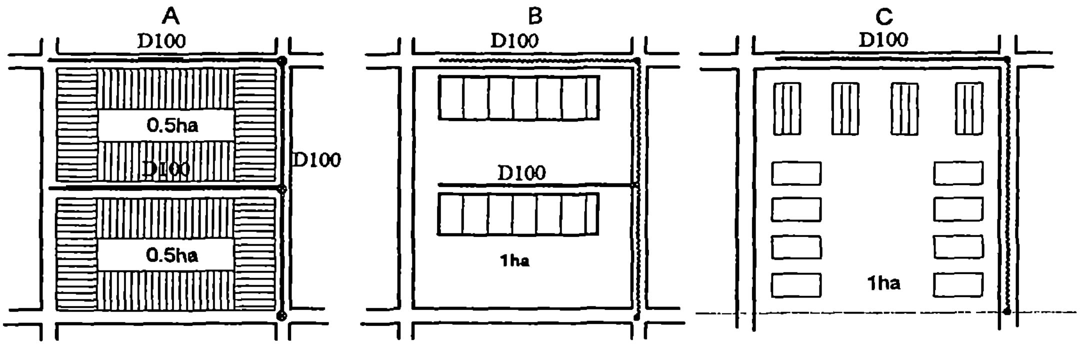
Others:
- institutionally difficult and risk of conflicts

	Pop. density A	**Pop. density B**	**Pop. density C**
Investment costs:	3.4 USD/pers	5 USD/pers	7 USD/pers
Operating costs:	0.3 USD/pers/y	0 5 USD/pers/y	0.7 USD/pers/y

COST ESTIMATE SHEET

NB 2

Small bore sewer, no drainage



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average flow rate	0.69	0.35	0.17	l/s/ha
- average legth of sewer line	300	240	150	m/ha
- average depth of pipes	0.8	0.8	0.8	m
- average length of drains				
concrete 400	0	0	0	m/ha
concrete 800	0	0	0	m/ha

Investment:

	A	B	C			
pipes, pvc 100	300	240	150	m a	50,000	VD
drains, 400	0	0	0	"	260,000	"
drains, 800	0	0	0	"	1,200,000	"
=>	15	12	8	MVD		
=>	**1,364**	**1,091**	**682**	**USD**		

O & M:

	A	B	C			
dredging, sewers	300	240	150	m a	5,000	VD
dredging, drains	0	0	0	"	10,000	"
=>	1.5	1.2	0.8	MVD/year		
=>	**136**	**109**	**68**	**USD/year**		

Foreign/local expenditure: all local

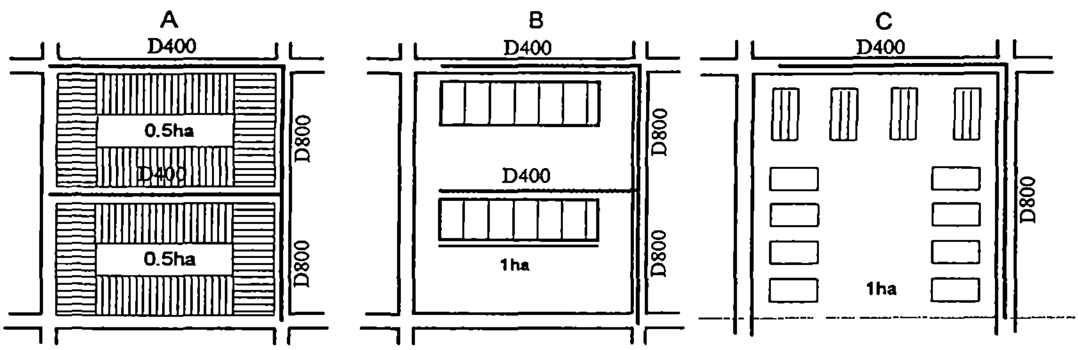
Present value for 15 **years at** 6% **interest rate:**

	A	B	C	
	2,688	**2,150**	**1,344**	**USD**
=>	**7**	**11**	**13**	**USD/pers**

COST ESTIMATE SHEET

NB 2b

Small bore sewer, only drainage



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average flow rate	0.69	0.35	0 17	l/s/ha
- average legth of sewer line	0	0	0	m/ha
- average depth of pipes	0.0	0,0	0,0	m
- average length of drains				
concrete 400	200	140	50	m/ha
concrete 800	100	100	100	m/ha

Investment:

pipes, pvc 100	0	0	0	m a	50,000	VD
drains, 400	200	140	50	"	260,000	"
drains, 800	100	100	100	"	1,200,000	"
=>	172	156	133	MVD		
=>	**15,636**	**14,218**	**12,091**	**USD**		

O & M:

dredging, sewers	0	0	0	m a	5,000	VD
dredging, drains	300	240	150	"	10,000	"
=>	3.0	2.4	1 5	MVD/year		
=>	**273**	**218**	**136**	**USD/year**		

Foreign/local expenditure: all local

Present value for 15 **years at** 6% **interest rate:**

	18,285	**16,337**	**13,415**	**USD**
=>	**45.7**	**81.7**	**134.2**	**USD/pers**

TECHNOLOGY SHEET

NB 3

Level:	Neighborhood
Technology:	**Condominial sewer**
Next component technology options:	Separate sewer, CV1 Simplified sewer, CV2 Combined sewer, CV3 Open canal sewer, CV4
Description:	Typically 100 mm sewer line installed in the backyards of the houses, within the beneficiaries' properties. Ll house discharges are made to small connecting boxes along the line. The wastewater of an entire block discharges into a street sewer at a single point connection.

PROS

Technical:
- \+ total length of the piping significantly less than in a conventional system
- \+ due to the absence of vehicular traffic, pipes can be laid at shallow depths

Implementation:
- \+ suitable for self-help

O&M:
- \+ high motivation of the residents to find solutions to possible problems
- \+ obstruction of sewer lines by solid waste minimal due to group pressure on the person causing a blockage

Others:
- \+ minimal risk to public health
- \+ suitable for high population densities
- \+ suitable for low income areas

CONS

Technical:
- – on site pretreatment (septic tanks) needed
- – drainage and flood control require separate drainage system

Implementation:
- – high technical skills needed
- – depends on readiness for people participation at community level
- – needs a lengthy process of consultation among residents
- –

O&M:
- – clogging easily if pretreatment is not working properly

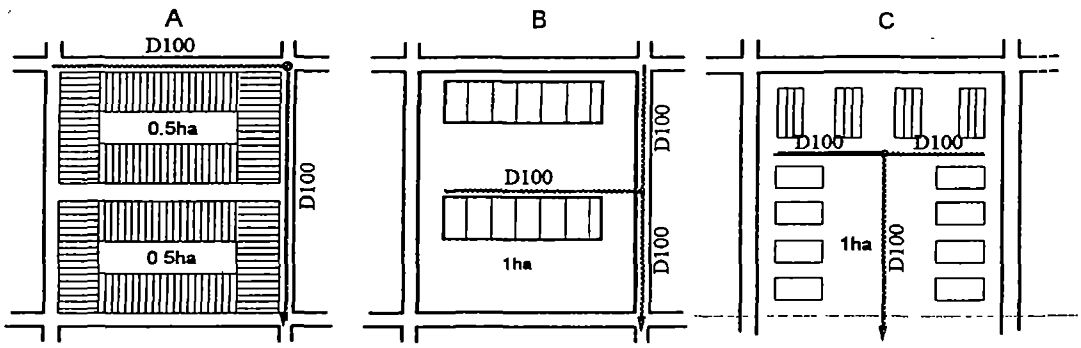
Others:
- – institutionally difficult and risk of conflicts

	Pop. density A	Pop. density B	Pop. density C
Investment costs:	1.8 USD	2.9 USD	5.8 USD/pers
Operating costs:	0.2 USD	0.4 USD	0.7 USD/pers/y

COST ESTIMATE SHEET

NB 3

Condominial sewer, no drainage



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average flow rate	0.69	0.35	0 17	l/s/ha
- average legth of sewer line	200	160	160	m/ha
- average depth of pipes	0.5	0.5	0.5	m
- average length of drains				
concrete 400	0	0	0	m/ha
concrete 800	0	0	0	m/ha

Investment:

	A	B	C			
pipes, pvc 100	200	160	160	m a	40,000	VD
drains, 400	0	0	0	"	260,000	"
drains, 800	0	0	0	"	1,200,000	"
=>	8	6	6	MVD		
=>	**727**	**582**	**582**	**USD**		

O & M:

	A	B	C			
dredging, sewers	200	160	160	m a	5,000	VD
dredging, drains	0	0	0	"	10,000	"
=>	1.0	0.8	0 8	MVD/year		
=>	**91**	**73**	**73**	**USD/year**		

Foreign/local expenditure: all local

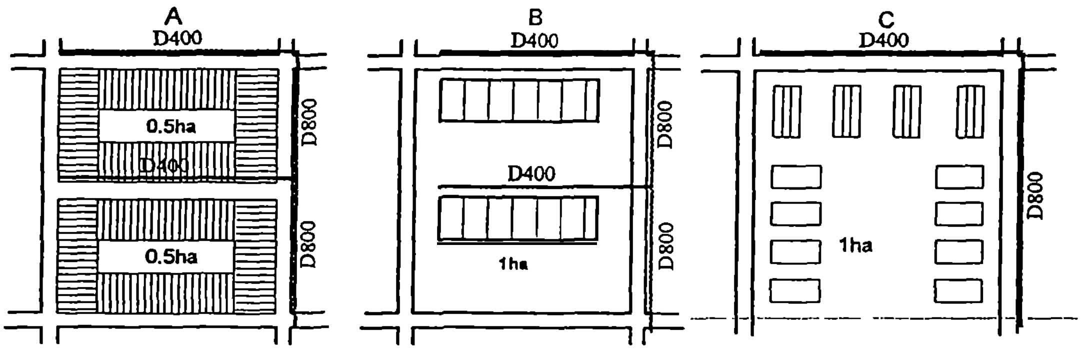
Present value for 15 **years at** 6% **interest rate:**

	A	B	C	
	1,610	**1,288**	**1,288**	**USD**
=>	**4**	**6**	**13**	**USD/pers**

COST ESTIMATE SHEET

NB 3b

Condominial sewer, only drainage



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average flow rate	0.69	0.35	0.17	l/s/ha
- average legth of sewer line	0	0	0	m/ha
- average depth of pipes	0.0	0.0	0.0	m
- average length of drains				
concrete 400	200	140	50	m/ha
concrete 800	100	100	100	m/ha

Investment:

pipes, pvc 100	0	0	0	m a	40,000 VD
drains, 400	200	140	50	"	260,000 "
drains, 800	100	100	100	"	1,200,000 "
=>	172.0	156.4	133.0	MVD	
=>	**15,636**	**14,218**	**12,091**	**USD**	

O & M:

dredging, sewers	0	0	0	m a	5,000 VD
dredging, drains	300	240	150	"	10,000 "
=>	3.0	2.4	1.5	MVD/year	
=>	**273**	**218**	**136**	**USD/year**	

Foreign/local expenditure: all local

Present value for 15 **years at** 6% **interest rate:**

	18,285	**16,337**	**13,415**	**USD**
=>	**46**	**81.7**	**134.2**	**USD/pers**

TECHNOLOGY SHEET

NB4

Level:	Conveyance
Technology:	**Combined sewer**
Next component technology options:	Combined sewer CV3 and open canal CV4
Description:	single-pipe underground network collecting and transporting both domestic wastewater and stormwater runoff. Flow rates during wet weather very high compared to dry weather flow. Dimensioning is based on a chosen rainfall event. Interceptors are required for conveyance to treatment facilities. The flow in excess of the interceptor capacity causes overflow, normally discharged directly into receiving waters.

PROS

Technical:
+ simple and reliable technology
+ less interference with the underground utilities than for separate sewerage
+ less space needed than for separate systems

Implementation:

O&M:

Others:
+ suitable for high population densities
+ suitable in old center areas, where upgrading to separate sewers would be difficult

CONS

Technical:
– pipes laid deeper and larger than separate sewers
– larger treatment facilities needed than for separate system
– interceptors needed before treatment to regulate the flow, large enough for at least the most concentrated first flush

Implementation:

O&M:
– prone to clogging, desludging necessary sometimes
– in flat areas, extensive pumping needed
– odor problems of street

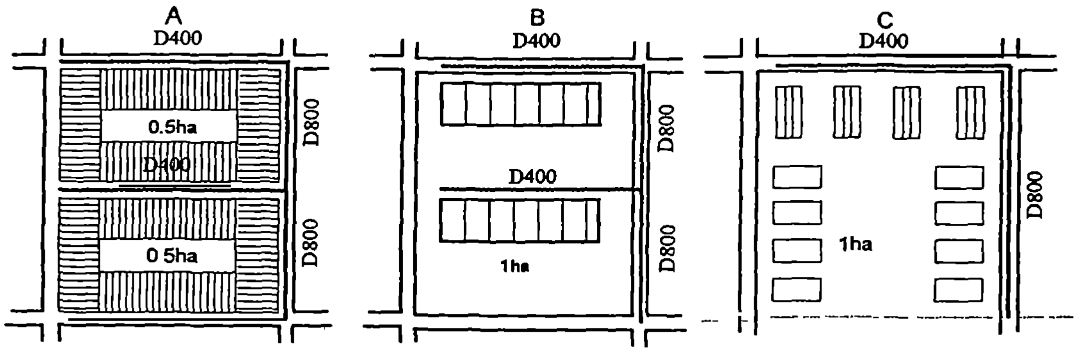
Others:
– pollution caused by sewer overflows during rain events
– street debris entering the system will cause clogging and pollution

	Pop. density A	**Pop. density B**	**Pop. density C**
Investment costs:	39 USD	71 USD	121 USD/pers
Operating costs:	0.7 USD	1.1 USD	1 4 USD/pers/y

COST ESTIMATE SHEET

NB 4

Combined sewer



	A:	B:	C:	
- population densities	400	200	100	persons/ha
- average water use	150	150	150	l/person/day
=> average sewage flow	0.69	0.35	0.17	l/s/ha
- dimensioning storm flow	200	200	200	l/s/ha
- average legth of drains				
concrete 400	200	140	50	m/ha
concrete 800	100	100	100	m/ha

Investment:

drains, 400	200	140	50	m a	260,000	VD
drains, 800	100	100	100	"	1,200,000	"
=>	172	156	133	MVD		
=>	**15,636**	**14,218**	**12,091**	**USD**		

O & M:

dredging, drains	300	240	150	m a	10,000	VD
=>	3.0	2.4	1.5	MVD/year		
=>	**273**	**218**	**136**	**USD/year**		

Foreign/local expenditure: all local

Present value for 15 **years at** 6% **interest rate:**

	18,285	**16,337**	**13,415**	**USD**
=>	**46**	**82**	**134**	**USD/pers**

TECHNOLOGY SHEET

CV1

Level:	Conveyance
Technology:	**Separate sewer and drainage**
Next component technology options:	Treatment and /or final disposal
Description:	Wastewater led to sanitary sewers separate from storm drains. Dimensioning is based on per capita sewage production with a peaking factor. Some allowance also made for infiltration. Minimum pipe diameter 200 mm, minimum velocity 0 6 m/s. Manholes located at about 100 m intervals at junctions and changes of gradient, size, or alignment.

PROS

Technical:

+ allows the sewers to be smaller than in combined system
+ allows the drains to be shallower than in combined system
+ less water needing pumping and treatment than in combined system
+ wastewater quality and flows rather constant
+ no need for septic tanks
+ no problem of sewer overflows due to flooding

Implementation:

O&M:

+ street waste has no entry to sewers and thus less risk of clogging

Others:

+ minimal risk to public health
+ suitable for high population densities
+ serves well possible secondary wastewater treatment

CONS

Technical:

– two piped systems needed
– drainage system can be classified for more frequent flooding

Implementation:

– low potential for self-help
– implementation in old city centers difficult due to disruption to traffic, residents, and other underground utilities

O&M:

– pumping needed in flat areas

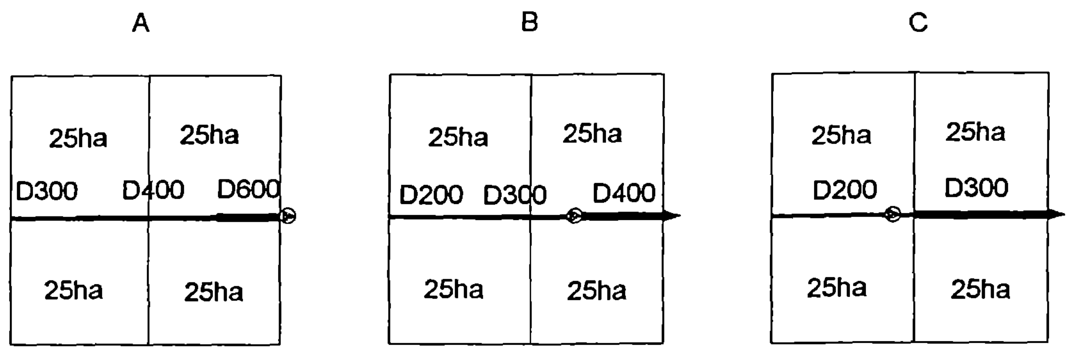
Others:

	Pop. density A	Pop. density B	Pop. density C
Investment costs:	4 USD	4.7 USD	6.0 USD/pers
Operating costs:	0.2 USD	0.2 USD	0.2 USD/pers/y

COST ESTIMATE SHEET

CV 1

Separate sewer, no drainage



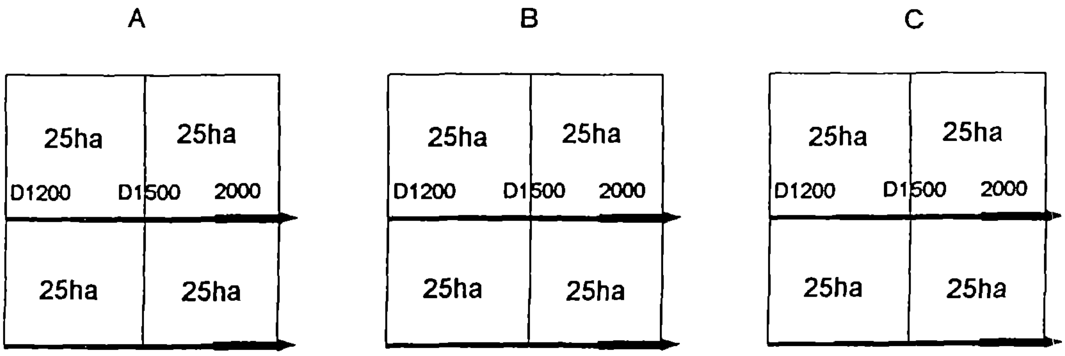
		A:	B:	C:	
- population densities		400	200	100	persons/ha
- average water use		150	150	150	l/person/day
- average legth of sewer line					
PVC 200	a 400,000 VD/m		200	500	m/100 ha
concr. 300	a 400,000 "	200	500	500	"
concr. 400	a 500,000 "	600	300		"
concr. 600	a 900,000 "	200			"
- pumping station		12,000	6,000	3,000	m^3/d/100 ha
- average length of drains					
concr.1200	a 2,000 1000 VD/m	0	0	0	m/100 ha
concr.1500	a 2,800 "	0	0	0	"
concr.2000	a 5,000 "	0	0	0	"

			A	B	C	
Investment:	sewers		560,000	430,000	400,000	1000 VD
	drains		0	0	0	"
	pumping station		1,200,000	600,000	300,000	"
		=>	1,760,000	1,030,000	700,000	1000 VD
		=>	**160,000**	**93,636**	**63,636**	**USD**
O & M:						
sewers	1,000 VD/m/year		1,000	1,000	1,000	1000 VD
drains	10,000 "		0	0	0	"
energy	750 VD/kWh		81,378	40,689	20,345	"
		=>	82,378	41,689	21,345	1000 VD
		=>	**7,489**	**3,790**	**1,940**	**USD/year**
Foreign expenditure:			**109,091**	**54,545**	**27,273**	**USD**
Present value for	15	**years at**	6%	**interest rate:**		
			232,735	**130,445**	**82,482**	**USD**
		=>	**6**	**7**	**8**	**USD/pers**

COST ESTIMATE SHEET

CV1b

Separate sewer, only drainage



			A:	B:	C:	
- population densities			400	200	100	persons/ha
- average water use			150	150	150	l/person/day
- average legth of sewer line						
PVC 200	a 400,000	VD/m				m/100 ha
concr. 300	a 400,000	"				"
concr. 400	a 500,000	"				"
concr. 600	a 900,000	"				"
- pumping station			0	0	0	m³/d/100 ha
- average length of drains						
concr.1200	a 2,000	1000 VD/m	600	600	600	m/100 ha
concr.1500	a 2,800	"	600	600	600	"
concr.2000	a 5,000	"	600	600	600	"
Investment:	sewers		0	0	0	1000 VD
	drains		5,880,000	5,880,000	5,880,000	"
	pumping station		0	0	0	"
		=>	5,880,000	5,880,000	5,880,000	1000 VD
		=>	**534,545**	**534,545**	**534,545**	**USD**
O & M:						
sewers	1,000	VD/m/year	0	0	0	1000 VD
drains	10,000	"	18,000	18,000	18,000	"
energy	750	VD/kWh	0	0	0	"
		=>	18,000	18,000	18,000	1000 VD
		=>	**1,636**	**1,636**	**1,636**	**USD/year**
Foreign expenditure:			**0**	**0**	**0**	**USD**
Present value for	15	**years at**	6%	**interest rate:**		
			550,438	**550,438**	**550,438**	**USD**
		=>	**13.8**	**27.5**	**55.0**	**USD/pers**

TECHNOLOGY SHEET

CV 2

Level: Conveyance
Technology: **Simplified sewer and drainage**
Next component technology options: Treatment and /or final disposal

Description: separate sewer system designed with relaxed standards developed for developing countries to avoid costly and conservative solutions Dimensioning is based on per capita sewage production with a small peaking factor and no allowance for infiltration. Minimum pipe diameter is 100 mm and minimum velocity 0.3 m/s. Manhole requirements less dense than conventional; curved alignment permitted between manholes

PROS

Technical:
+ smaller pipe diameters than in conventional sewer system thanks to buffering effect and pretreatment of septic tanks
+ less water with less quality and flow fluctuations than in combined system
+ no problem of sewer overflows due to flooding

Implementation:

O&M:
+ street waste has no entry to sewers, thus less risk of flooding

Others:
+ minimal risk to public health
+ suitable for high population densities
+ serves well possible secondary wastewater treatment without pretreatment

CONS

Technical:
– separate drainage system needed

Implementation:
– low potential for self-help
– requires high quality pipes and good workmanship

O&M:
– pumping needed in flat areas
– prone to clogging if septic tanks not functioning properly

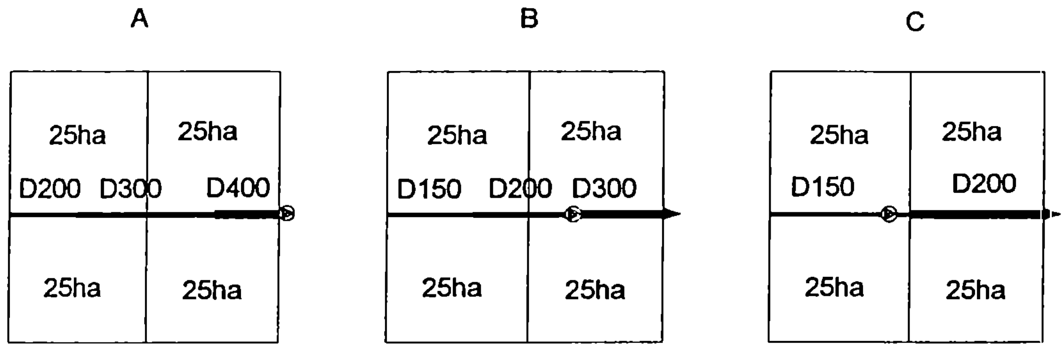
Others:
– low potential for upgrading

	Pop. density A	Pop. density B	Pop. density C
Investment costs:	2.32 USD	3.0 USD	4.3 USD/pers
Operating costs:	0.1 USD	0.1 USD	0.1 USD/pers/y

COST ESTIMATE SHEET

CV2

Simplified sewer, no drainage



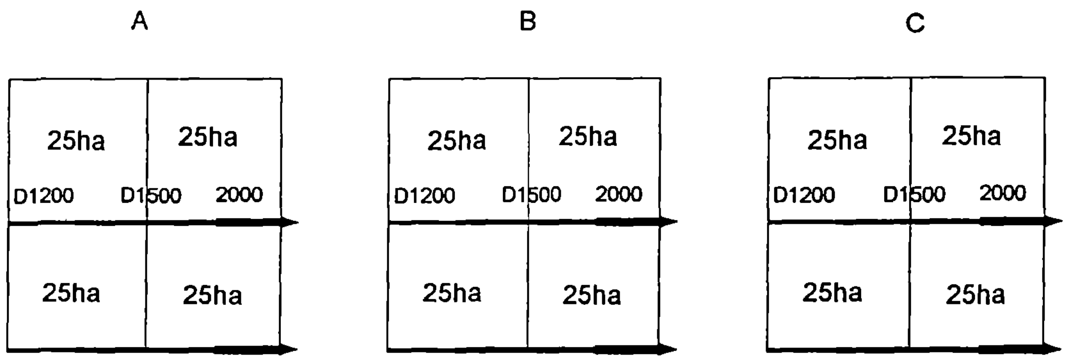
				A:	B:	C:	
- population densities				400	200	100	persons/ha
- average water use				150	150	150	l/person/day
- average legth of sewer line							
PVC 150	a	250,000	VD/m		200	500	m/100 ha
PVC 200	a	400,000	"	200	500	500	"
concr. 300	a	400,000	"	600	300		"
concr. 400	a	500,000	"	200			"
- pumping station				6,000	3,000	1,500	m^3/d/100 ha
- average length of drains							
concr.1200	a	2,000	1000 VD/m				m/100 ha
concr.1500	a	2,800	"				"
concr.2000	a	5,000	"				"

Investment:	sewers		420,000	370,000	325,000	1000 VD
	drains		0	0	0	"
	pumping station		600,000	300,000	150,000	"
		=>	1,020,000	670,000	475,000	1000 VD
		=>	**92,727**	**60,909**	**43,182**	**USD**
O & M:						
sewers	5,000 VD/m/year		5,000	5,000	5,000	1000 VD
drains	10,000 "		0	0	0	"
energy	750 VD/kWh		40,689	20,345	10,172	"
		=>	45,689	25,345	15,172	1000 VD
		=>	**4,154**	**2,304**	**1,379**	**USD/year**
Foreign expenditure:			**54,545**	**27,273**	**13,636**	**USD**
Present value for	15		**years at**	6%	**interest rate:**	
			133,068	**83,287**	**56,578**	**USD**
		=>	**3**	**4**	**6**	**USD/pers**

COST ESTIMATE SHEET

CV 2b

Simplified sewer, only drainage



- population densities			A:	B:	C:	
			400	200	100	persons/ha
- average water use			150	150	150	l/person/day
- average legth of sewer line						
PVC 150	a 250,000	VD/m				m/100 ha
PVC 200	a 400,000	"				"
concr. 300	a 400,000	"				"
concr. 400	a 500,000	"				"
- pumping station						m^3/d/100 ha
- average length of drains						
concr.1200	a 2,000	1000 VD/m	600	600	600	m/100 ha
concr.1500	a 2,800	"	600	600	600	"
concr.2000	a 5,000	"	600	600	600	"

Investment:	sewers		0	0	0	1000 VD
	drains		5,880,000	5,880,000	5,880,000	"
	pumping station		0	0	0	"
		=>	5,880,000	5,880,000	5,880,000	1000 VD
		=>	**534,545**	**534,545**	**534,545**	**USD**
O & M:						
sewers	5,000 VD/m/year		0	0	0	1000 VD
drains	10,000 "		18,000	18,000	18,000	"
energy	750 VD/kWh		0	0	0	"
		=>	18,000	18,000	18,000	1000 VD
		=>	**1,636**	**1,636**	**1,636**	**USD/year**
Foreign expenditure:			**0**	**0**	**0**	**USD**
Present value for	15		**years at**	6%	**interest rate:**	
			550,438	**550,438**	**550,438**	**USD**
		=>	**13.8**	**27.5**	**55.0**	**USD/pers**

TECHNOLOGY SHEET

CV3

Level: Conveyance

Technology: **Combined sewer**

Next component technology options: Treatment and/or final disposal

Description: single-pipe underground network collecting and transporting both domestic wastewater and stormwater runoff. Flow rates during wet weather very high compared to dry weather flow. Dimensioning is based on a chosen rainfall event. Interceptors are required for conveyance to treatment facilities. The flow in excess of the interceptor capacity causes overflow, normally discharged directly into receiving waters.

PROS

Technical:

+ simple and reliable technology
+ less interference with the underground utilities than for separate sewerage
+ less space needed than for separate systems

Implementation:

O&M:

Others:

+ suitable for high population densities
+ suitable in old center areas, where upgrading to separate sewers would be difficult

CONS

Technical:

- pipes laid deeper and larger than separate sewers
- larger treatment facilities needed than for separate system
- interceptors needed before treatment to regulate the flow, large enough for at least the most concentrated first flush

Implementation:

O&M:

- prone to clogging, desludging necessary sometimes
- in flat areas, extensive pumping needed
- odor problems of street

Others:

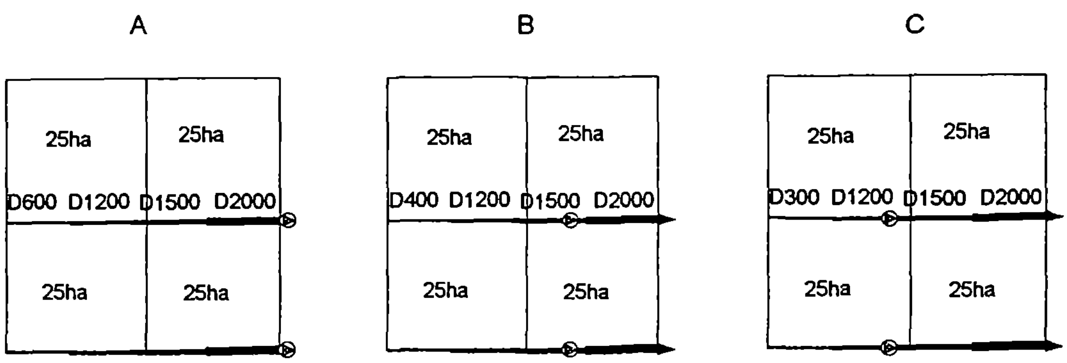
- pollution caused by sewer overflows during rain events
- street debris entering the system will cause clogging and pollution

	Pop. density A	Pop. density B	Pop. density C
Investment costs:	17 USD	31 USD	58 USD/pers
Operating costs:	0.2 USD	1.2 USD	0.4 USD/pers/y

COST ESTIMATE SHEET

CV 3

Combined sewer



- population densities		A:	B:	C:	
		400	200	100	persons/ha
- average water use		150	150	150	l/person/day
=> average sewage flow		0.69	0.35	0.17	l/s/ha
- dimensioning stormwater flow		5.8	5.8	5.8	m^3/s/50 ha
- average legth of combined sewer line					
concr.1200 a 2,000	1000 VD/m	600	600	600	m/100 ha
concr.1500 a 2,800	"	600	600	600	"
concr.2000 a 5,000	"	600	600	600	"
concr. 600 a 900	"	500			"
concr. 400 a 500	"		500		"
concr. 300 a 400	"			500	"
- pumping station for dry weather flow		12,000	6,000	3,000	m^3/d/100 ha

Investment:	combined sewer pipes	6,330,000	6,130,000	6,080,000	1000 VD
	pumping station	1,200,000	600,000	300,000	"
	=>	7,530,000	6,730,000	6,380,000	1000 VD
	=>	**684,545**	**611,818**	**580,000**	**USD**
O & M:					
drains	10,000 VD/m/year	23,000	23,000	23,000	1000 VD
energy	750 VD/kWh	81,378	40,689	20,345	"
	=>	104,378	63,689	43,345	1000 VD
	=>	**9,489**	**5,790**	**3,940**	**USD/year**
Foreign expenditure:		**109,091**	**54,545**	**27,273**	**USD**
Present value for	15	**years at**	6%	**interest rate:**	
		776,704	**668,051**	**618,270**	**USD**
	=>	**19**	**33**	**62**	**USD/pers**

TECHNOLOGY SHEET

CV 4

Level: Conveyance

Technology: **Open canals and drains**

Next component technology options: Treatment and /or final disposal

Description: Combined sewerage systems, where both wastewater and stormwater are conveyed in open canals or covered trenches. Regulating ponds serve as a buffer against flooding during wet weather

PROS

Technical:
+ no need for underground pipeline systems
+ less interference with underground utilities

Implementation:
+ low technical skills needed
+ natural ponds and watercourse systems can be used

O&M:
+ low O&M skills needed
+ easy access for inspection and maintenance

Others:
+ canal and pond system provides some degree of biological treatment which can be intensified by adding mechanical aerators or constructing cascades along the system

CONS

Technical:
- larger treatment facilities needed than for separate system
- wet weather flows in excess of the canal system capacity cause flooding and pollution

Implementation:

O&M:
- dredging needed due to sedimentation and general misuse of the canals for solid waste disposal

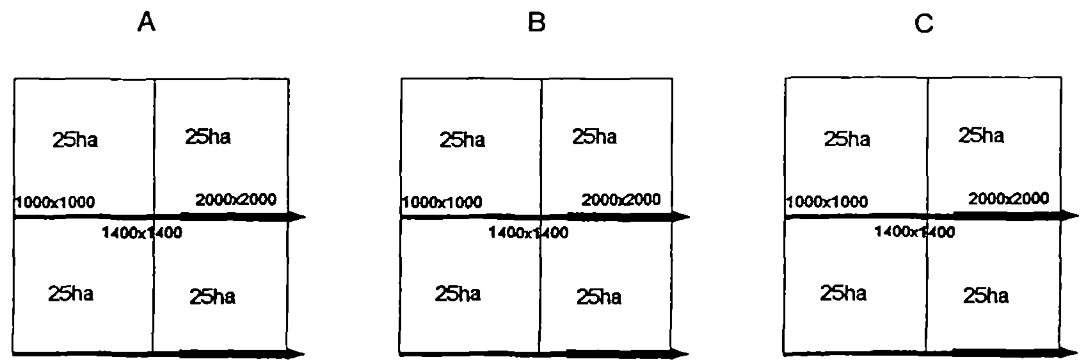
Others:
- possibility for human contact with the wastewater flow, which is a risk for public health
- anesthetic appearance of the canals

	Pop. density A	Pop. density B	Pop. density C
Investment costs:	6.2 USD	12 USD	25 USD/pers
Operating costs:	0.05 USD	0.1 USD	0.2 USD/pers/y

COST ESTIMATE SHEET

CV 4

Open canals and drains



		A:	B:	C:	
- population densities		400	200	100	persons/ha
- average water use		150	150	150	l/person/day
=> average sewage flow		0.69	0 35	0 17	l/s/ha
- dimensioning stormwater flow		5.8	5.8	5.8	m^3/s/50 ha
- average legth of open canal sewers					
1000x1000	a 800,000 VD/m	600	600	600	m/100 ha
1400x1400	a 1,000,000 "	600	600	600	"
2000x2000	a 1,500,000 "	1100	1100	1100	"

			A	B	C	
Investment:	canals		2,730,000	2,730,000	2,730,000	1000 VD
		=>	2,730,000	2,730,000	2,730,000	1000 VD
		=>	**248,182**	**248,182**	**248,182**	**USD**
O & M:						
canals	10,000 VD/m/year		23,000	23,000	23,000	1000 VD
		=>	23,000	23,000	23,000	1000 VD
		=>	**2,091**	**2,091**	**2,091**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 **years at** 6% **interest rate:**

	268,489	**268,489**	**268,489**	**USD**
=>	**6.7**	**13**	**27**	**USD/pers**

TECHNOLOGY SHEET

CV 5

Level:	Conveyance
Technology:	**Truck collection of sludge**
Next component technology options:	Digestion by storage Composting Sewage treatment plant Landfill disposal
Description:	Collection of sludge from septic tanks with vacuum trucks and transportation for treatment. Trucks can also be equipped with dewatering equipment.

PROS

Technical:	+	efficient and fast way of emptying septic tanks
Implementation:		
O&M:	+	requires less labor than cart collection
Others:	+	more hygienic than cart collection as it provides less possibilities for human contact with excreta

CONS

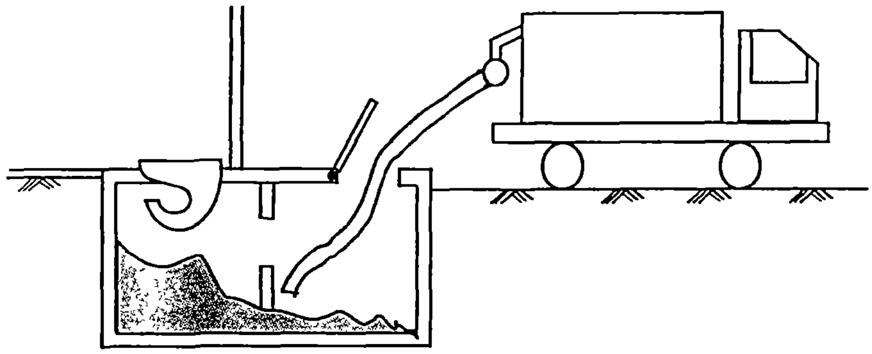
Technical:	–	requires good access road for vehicles
Implementation:	–	vehicles may be imported.
O&M:	–	requires efficient operation and maintenance, spare parts storage, and regular replacement of old vehicles
Others:	–	not suitable for developments with access from narrow alleys

Investment costs:	5.5 USD/person
Operating costs:	0.4 USD/person/year

COST ESTIMATE SHEET

CV.5

Truck collection of sludge



- population	50,000	person equivalent
- septic sludge accumulation	0.04	m^3/person/year
=> sludge generation	6.4	m^3/workday
- average size of a vacuum truck	4	m^3
- average number of trips/day	1.5	
- vehicle utilization rate	60%	
=> collection fleet required	2	trucks
- drivers & assistants per truck	3	
=> total number of workers	6	employees
- average transportation distance (one way)	6	km
- average fuel consumption rate	30	l/100 km
=> fuel consumption per year	1,800	l/year

Investment:

vacuum trucks,	2	pcs a	1.50E+09	VD =	3,000,000	1000 VD
				=>	3,000,000	1000 VD
				=>	**272,727**	**USD**

O & M:	workers,	6	pers a	300,000	VD =	21,600,000	VD/year
	fuel,	1,800	l a	3,000	"	5,400,000	"
	vehicle maintenance	7%	of	3.00E+09	"	210,000,000	"
					=>	237,000,000	VD/year
					=>	**21,545**	**USD/year**

Foreign/local expenditure: **272,727** **USD**

Present value for 15 years at 6% interest rate: 481,982 USD

=> **9.6** **USD/pers**

TECHNOLOGY SHEET

CV 6

Level: Conveyance

Technology: **Cart collection of sludge**

Next component technology options:
Digestion by storage
Composting
Sewage treatment plant
Landfill disposal

Description: Collection of nightsoil and sludge from bucket latrines, pit latrines, and double vault latrines, as well as septic tanks inaccessible for collection trucks. Pits, vaults, or tanks are emptied by laborers manually into carts. Buckets may be completely removed and replaced by empty, disinfected ones. Carts are then drawn for treatment, composting, or landfill, or emptied for further transportation in trucks.

PROS

Technical:
+ reliable and economical emptying of accumulated excreta from toilets
+ no need for broad access roads

Implementation:
+ no need for imported equipment

O&M:
+ system is simple to operate and maintain

Others:
+ suitable for all population densities

CONS

Technical:

Implementation:

O&M:
– requires intensive labor

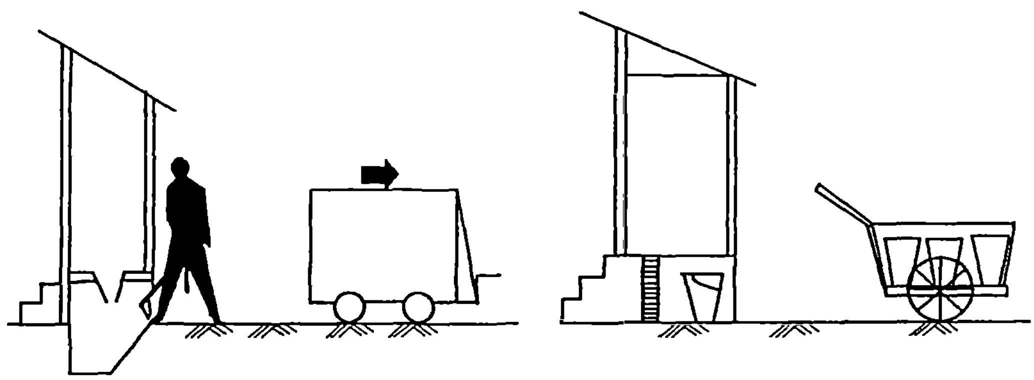
Others:
– shoveling nightsoil to carts typically involves spillage which pollutes the area and can cause a health risk especially to collectors
– offensive sight and smell
– not acceptable for use in special areas without vehicle access and short distance to disposal point

Investment costs: 0.3 USD/person
Operating costs: 0.4 USD/person/year

COST ESTIMATE SHEET

CV 6

Cart collection of sludge



capacity	50,000	person equivalent
- septic sludge accumulation	0.04	m^3/person/year
=> sludge generation	6.4	m^3/workday
- average size of a pushcart	0.25	
- average number of trips/day	2.0	m^3
- capacity of truck for sludge transport	6.4	m^3
- vehicle utilization rate	90%	
=> collection fleet required	14	carts
=> garage area required 12 m^2/cart =	168	m^2
- workers per cart	2	
=> total number of workers	31	employees
=> plus 10% of admin. of staff		

Investment:

pushcarts,	14	pcs a	1,000,000	VD =	14,000	1000 VD
garage,	168	m^2 a	1,000,000	"	168,000	"
land cost	340	m^2 a	10,000	"	3,400	"
				=>	185,400	1000 VD
				=>	**16,855**	**USD**

O & M:

workers,	31	pers a	300,000	VD =	111	MVD/year
vehicle maintenance	5%	of	14,000	"	1	"
sludge transport	1	trip/da	250,000		78	"
					190	MVD/year
				=>	**18,387**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **195,434 USD**

=> **3.9 USD/pers**

TECHNOLOGY SHEET

TM 1

Level:	Secondary treatment
Technology:	**Conventional treatment plant**
Next component technology options:	Reuse Discharge to natural waters
Description:	Primary sedimentation followed by activated sludge process or fixed growth system and secondary sedimentation. Layout is compact with concrete basins equipped with mechanical scrapers. Retention times less than 24 hours are facilitated through mechanical aeration and extensive sludge recycling. Sludge from primary treatment needs to be stabilized, normally in either anaerobic or aerobic digesters. Reductions are typically more than 90% for BOD and SS.

PROS

Technical:	+ provides good BOD and SS reduction + low land requirement
Implementation:	
O&M:	
Others:	+ suitable for handling large volumes of wastewater in areas where land cost is high + upgradable for nutrient removal and other advanced treatment systems, and industrial reuse

CONS

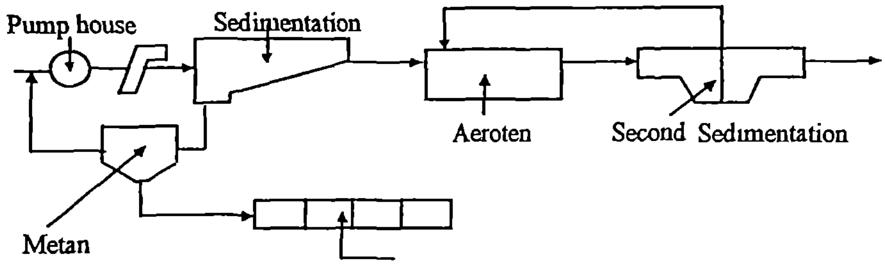
Technical:	– poor removal of bacteria and other pathogens without chlorination
Implementation:	– requires imported, high-cost equipment – requires large construction works
O&M:	– requires high skills both in maintenance of the equipment and operation of the complex treatment process – requires substantial amounts of electric power – requires foreign spare parts
Others:	– reuse for irrigation requires further treatment

Investment costs:	55 USD/person
Operating costs:	2.8 USD/person/year

COST ESTIMATE SHEET

TM 1

Conventional treatment plant



capacity	50,000	person equivalent			
- average water use	150	l/person/day			
=> wastewater generation	7,500	m^3/day			
=> dimensioning wastewater flow	707	m^3/h			
- surface loading rate for primary settling	2.0	m/h			
- retention time for primary settling	1.5	h			
=> area and depth of settling tank	354	m^2,	3.0	m	
- typical BOD of pretreated sewage	150	mg/l			
- organic loading rate for aeration tanks	1.0	g BOD/g MLSS/day			
- aeration time	4.0	h			
=> volume of aeration tanks	2,829	m^3			
- surface loading rate for sec. settling	0.7	m/h			
- retention time for secondary settling	2.0	h			
=> area and depth of sec. settling tank	1,010	m^2,	1.4	m^3	

Investment:	pumping st.	15,000	m^3/d	100,000	VD =	1,500,000	1000 VD
	concr. tanks	5,300	m^3 a	1,250,000	"	6,625,000	"
	mech. equip.	300%	of	6.625E+9	"	19,875,000	"
	sludge beds	8,300	m^2 a	250,000	"	2,075,000	"
	land cost	16,000	m^2 a	15,000	"	240,000	"
					=>	30,315,000	1000 VD
					=>	**2,755,909**	**USD**
O & M:	supervisor	1	a	600,000	VD =	7	MVD/year
	labourers	10	a	300,000	"	36	"
	energy	1,395,000	kWh	750	"	1,046	"
	repairs	1.5%	of	30.315E+9	"	455	"
					=>	1,544	MVD/year
					=>	**140,380**	**USD/year**
Foreign/local expenditure:				**1,943,182**	/	**812,727**	**USD**
Present value for	**15**	**years at**	**6%**	**interest rate:**		**4,119,310**	**USD**
					=>	**82**	**USD/pers**

TECHNOLOGY SHEET

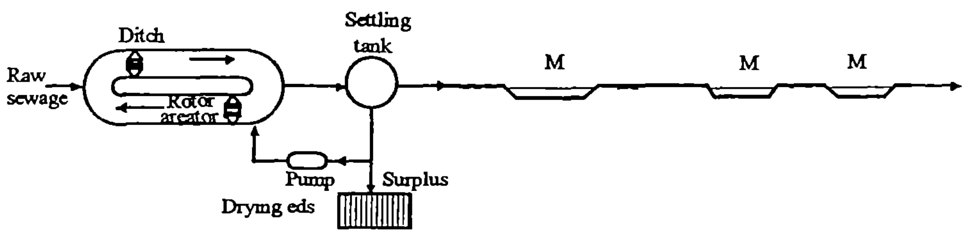
TM 2

Level:	Secondary treatment
Technology:	**Oxidation ditches**
Next component technology options:	Reuse Discharge to natural waters
Description:	erated lagoons built in an continuous channel form, which allows the wastewater to be circulated. velocity of 0.3-0.4 m/s is provided by rotating cylindrical brushes that also provide aeration. Effluent from the ditch is settled in a secondary sedimentation tank from where about 95% of the sludge is returned to the ditch. This facilitates 1-3 days retention times, whereas sludge retention is 20-30 days. Excess sludge produced is highly mineralized and needs no further digestion. Effluent BOD is typically less than 15 mg/l.
PROS	
Technical:	+ provides good BOD reduction + relatively compact system with low land requirements
Implementation:	
O&M:	+ produce low sludge volumes
Others:	
CONS	
Technical:	– poor removal of bacteria and other pathogens – requires pretreatment to remove coarse solids (screens, grit chambers, grease traps)
Implementation:	– requires rather complex machinery
O&M:	– requires substantial amounts of electric power – requires routine operation – requires foreign spare parts – requires skilled operation staff
Others:	– reuse for irrigation requires further treatment
Investment costs:	34 USD/person
Operating costs:	1.0 USD/person/year

COST ESTIMATE SHEET

TM 2

Oxidation ditches



capacity	50,000	person equivalent			
- average water use	150	l/person/day			
=> wastewater generation	7,500	m^3/day			
- retention time for oxidation ditch	3	days			
- depth of oxidation ditch	1.5	m			
=> area required for oxidation ditch	15,000	m^2			
- surface loading rate for secondary settlin	0 7	m/h			
- retention time for secondary settling	3 0	h			
=> area and depth of sec. settling tank	564	m^2,	2.1	m^3	
- retention time for a maturation pond	5	days			
- depth of maturation ponds	1.0	m			
=> total area for 3 maturation ponds	11.3	ha			

Investment:	pumping st.	15,000	m^3 a	100,000	VD =	1,500,000	1000 VD
	oxid. ditch	22,500	m^3 a	40,000	"	900,000	"
	settling tank	1,184	m^3 a	1,000,000	"	1,184,000	"
	mach. & eq.	300%	of	2.084E+9	"	6,252,000	"
	sludge beds	8,300	m^2 a	250,000	"	2,075,000	"
	ponds	112,500	m^3 a	40,000	"	4,500,000	"
	land cost	150,000	m^2 a	15,000	"	2,250,000	"
					=>	18,661,000	1000 VD
					=>	**1,696,455**	**USD**
O & M:	supervisor	1	a	600,000	VD =	7	MVD/year
	labourers	5	a	300,000	"	18	"
	energy	425,000	kWh	750	"	319	"
	repairs	1.0%	of	18.661E+9	"	187	"
					=>	531	MVD/year
					=>	**48,233**	**USD/year**
Foreign/local expenditure:				**704,727**	/	**991,727**	**USD**
Present value for		**15 years at**	**6%**	**interest rate:**		**2,164,903**	**USD**
					=>	**43**	**USD/pers**

TECHNOLOGY SHEET

TM 3

Level:	Secondary treatment
Technology:	**Aerated lagoons**
Next component technology options:	Reuse Discharge to natural waters
Description:	erobic or facultative ponds for biological wastewater treatment. Oxygen is introduced artificially by means of mechanical or diffused air aerators. Typical retention time is four days, which will result in 85-90% BOD removal. The lagoon develops a flocculated suspension of bacterial cells, which has to be removed by maturation ponds before discharge.

PROS

Technical:	+ provides treatment similar to stabilization ponds + effluent from maturation ponds can have less than 100 coliforms/100 ml + requires less space than stabilization ponds + less sensitive to shock loads than a conventional treatment system
Implementation:	+ natural ponds can be utilized
O&M:	
Others:	+ high potential for effluent reuse in agricultural irrigation and aquaculture

CONS

Technical:	– requires pretreatment to remove coarse solids (screens, grit chambers, grease traps)
Implementation:	– requires mechanical and electrical equipment
O&M:	– requires routine operation – requires imported equipment and spare parts – requires skilled operator
Others:	

Investment costs:	24 USD/person
Operating costs:	1.2 USD/person/year

COST ESTIMATE SHEET

TM 3

Aerated lagoons

capacity	50,000	person equivalent
- average water use	150	l/person/day
=> wastewater generation	7,500	m^3/day
- retention time for aerated lagoon	4	days
- depth of aerated lagoon	3.0	m
=> area required for aerated lagoon	10,000	m^2
- retention time for maturation ponds	5	days
- depth of maturation ponds	1.0	m
=> area of a maturation pond	37,500	m^2
=> total area for 3 maturation ponds	11.3	ha

Investment:	pumping st.	15,000	m^3 a	100,000	VD =	1,500,000	1000 VD
	screens, meters, etc.			50,000,000	"	50,000	"
	ponds	142,500	m^3 a	40,000	"	5,700,000	"
	aeration equipment			3.600E+9	"	3,600,000	"
	land cost	147,000	m^2 a	15,000	"	2,205,000	"
					=>	13,055,000	1000 VD
					=>	**1,186,818**	**USD**
O & M:	supervisor	1	a	600,000	VD =	7	MVD/year
	labourers	5	a	300,000	"	18	"
	energy	790,000	kWh	750	"	593	"
	repairs	0.5%	of	13.055E+9	"	65	"
					=>	683	MVD/year
					=>	**62,089**	**USD/year**
Foreign/local expenditure:				**463,636**	/	**723,182**	**USD**
Present value for		**15 years at**	**6%**	**interest rate:**		**1,789,838**	**USD**
					=>	**36**	**USD/pers**

TECHNOLOGY SHEET

TM 4

Level:	Secondary treatment
Technology:	**Stabilization ponds**
Next component technology options:	Reuse Discharge to natural water bodies
Description:	Biological sewage treatment ponds are operated in series from anaerobic to facultative and aerobic ponds. The most common type are facultative ponds, 1-3 m deep with an aerobic upper zone and anaerobic lower zone. naerobic ponds of 3-5 m depth serve as pretreatment for septage and high strength sewage, decreasing the land requirement of subsequent ponds. Shallow aerobic ponds are used for maturation of the effluent from previous phases, to increase microbiological quality.
PROS	
Technical:	+ provides high-quality effluent with very low levels of helminth eggs and other pathogens, i.e. possible to meet the Engelberg guideline + absorbs hydraulic or organic shock loading
Implementation:	+ low technical skills needed + natural ponds can be utilized
O&M:	+ low O&M skills needed + no machinery or energy input needed + desludging needed only every 10-20 years for facultative ponds and every 3-5 years for anaerobic ponds
Others:	+ high potential for effluent reuse in agricultural irrigation and aquaculture
CONS	
Technical:	– high land requirements (0.3-0.4 ha/1000 persons) – high SS concentration of the effluent due to algae may require separate SS removal before discharge
Implementation:	
O&M:	
Others:	– if not properly maintained, the banks may become breeding habitats for snails and mosquitoes – occasional odor problems
Investment costs:	20 USD/person
Operating costs:	0.4 USD/person/year; fish production 0.6 USD/person/year

COST ESTIMATE SHEET

TM 4

Stabilization ponds

capacity	50,000	person equivalent
- average water use	150	l/person/day
=> wastewater generation	7,500	m^3/day
- typical BOD of sewage	300	mg/l
- volumetric loading rate for anaer. ponds	250	g BOD/m^3/day
- depth of anaerobic ponds	4.0	m
=> area required for anaerobic pond	2,250	m^2
- surface loading rate for facult. ponds	300	kg BOD/ha/day
- depth of facultative ponds	1.2	m
=> area required for facultative pond	3.8	ha
- retention time for maturation ponds	5	days
- depth of maturation ponds	1.0	m
=> area of a maturation pond	37,500	m^2
=> total area for 3 maturation ponds	11.3	ha

Investment:	pumping st.	15,000	m^3 a	100,000	VD =	1,500,000	1000 VD
	screens, meters, etc.			50,000,000	"	50,000	"
	ponds	166,500	m^3 a	40,000	"	6,660,000	"
	land cost	180,000	m^2 a	15,000	"	2,700,000	"
					=>	10,910,000	1000 VD
					=>	**991,818**	**USD**
O & M:	labourers	10	a	300,000	VD =	36	MVD/year
	Fish farming	3000 kg/	a	10,000	VD/k	(338)	"
	energy	135,500	kWh	750	VD =	102	"
	repairs&mai	0.5%	of	10.9E+9	"	54.6	"
					=>	(145)	MVD/year
					=>	**(13,211)**	**USD/year**
Foreign/local expenditure:				**136,364**	/	**855,455**	**USD**
Present value for	**15 years at 6% interest rate:**					**863,506**	**USD**
					=>	**17**	**USD/pers**

TECHNOLOGY SHEET

TM5

Level:	Secondary treatment
Technology:	**Constructed wetland treatment system**
Next component technology options:	Reuse Discharge to natural waters
Description:	Biological sewage treatment by systems of aquatic plants, such as water-hyacinth or duckweed. Treatment is based on the plants' ability for assimilating nutrients as well as creating favorable conditions for different microbial processes. A sequence of different wetland lagoons can be used to exploit the specific advantages of each plant system. Reductions for BOD and SS are similar to conventional treatment plants (up to 95%) and for P and N generally 20-50%. With multistage systems 70-80% nutrient removals and full nitrification can be achieved.

PROS

Technical:

+ high treatment level accomplished
+ good removal of pathogens
+ process is flexible and not susceptible to shock loading

Implementation:

+ low technical skills needed
+ natural ponds and wetlands can be utilized

O&M:

+ low O&M skills needed
+ low energy requirements

Others:

+ high potential for effluent reuse in agricultural irrigation and aquaculture
+ harvested biomass can be used as an energy source, compost, or animal fodder
+ suitable for decentralized solutions

CONS

Technical:

– high land requirements (10-20 ha/1000 persons)
– pretreatment needed to remove coarse solids (screens, grit chambers, grease traps)

Implementation:

O&M:

– produces large quantities of biomass, which in some cases is difficult to handle

Others:

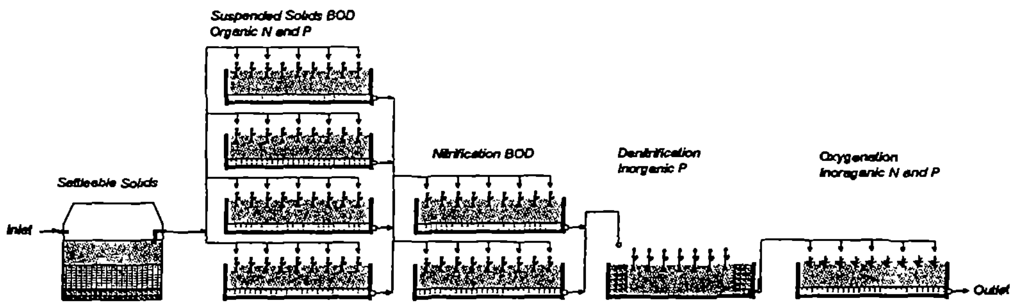
– some stages may provide habitats for mosquito breeding

Investment costs:	14 USD/person
Operating costs:	0.6 USD/person/year

COST ESTIMATE SHEET

TM 5

Constructed wetland treatment system



capacity	50,000	person equivalent
- average water use	150	l/person/day
=> wastewater generation	7,500	m^3/day
Anaerobic pond for settling:		
- typical BOD of sewage	300	mg/l
- volumetric loading rate for anaer. ponds	250	g BOD/m^3/day
- depth of anaerobic ponds	4.0	m
=> area required for anaerobic pond	2,250	m^2
Wetland system:		
- average land requirement	2	m^2/person
=> area required for wetland lagoons	10 0	ha
Biomass of water hyacinth	25g/m2/day	
- bulk density of water hyacinth	350kg(dry weight)/m3	

Investment:	pumping st.	15,000	m^3 a	100,000	VD =	1,500,000	1000 VD
	screens, meters, etc.			50,000,000	"	50,000	"
	pretreatment	9,000	m^3 a	40,000	"	360,000	"
	lagoons	100,000	m^3 a	40,000	"	4,000,000	"
	land cost	120,000	m^2 a	15,000	"	1,800,000	"
					=>	7,710,000	1000 VD
					=>	**700,909**	**USD**
O & M:	labourers	7	a	600,000	VD =	50	MVD/year
	energy	135,500	kWh	750	VD =	102	"
	repairs	0.5%	of	7.710E+9	"	39	"
	transportatio	2	trips	250,000		156	MVD/year
	of biomass				=>	347	MVD/year
					=>	**31,545**	**USD/year**
Foreign/local expenditure:				**136,364**	/	**564,545**	**USD**
Present value for	**15 years at**	**6%**	**interest rate:**			**869,174**	**USD**
					=>	**17**	**USD/pers**

TECHNOLOGY SHEET

TM 6

Level:	Secondary treatment
Technology:	**Primary treatment**
Next component technology options:	Discharge to natural waters
Description:	Removal of coarse solids by screens and grit chambers and physical settling of suspended solids in concrete basins. Provides about 30% BOD and 60% SS removal. Sludge removed from the tank bottom needs to be stabilized, normally in either anaerobic or aerobic digesters.

PROS

Technical:	+ low land requirements
Implementation:	
O&M:	
Others:	+ suitable for handling large volumes of wastewater in areas where land cost is high + upgradable to secondary treatment

CONS

Technical:	– effluent still contains considerable amounts of BOD – poor removal of bacteria and other pathogens
Implementation:	– requires mechanical and electrical equipment
O&M:	– requires routine operation and skilled operator
Others:	– low potential for effluent reuse – satisfactory solution only with open coastal receiving waters or large rivers

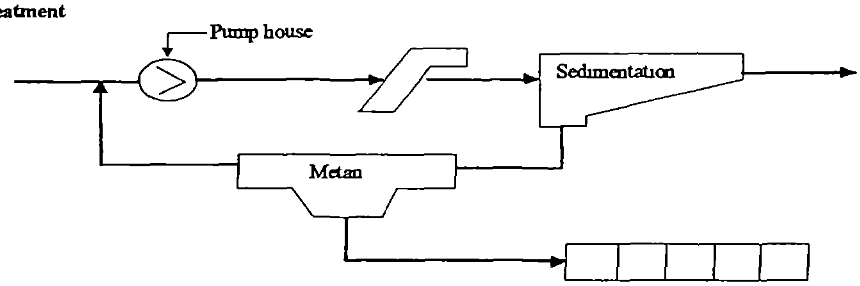
Investment costs:	9 USD/person
Operating costs:	0.2 USD/person/year

COST ESTIMATE SHEET

TM 6

Primary treatment

Primary treatment



capacity	50,000	person equivalent		
- average water use	150	l/person/day		
=> wastewater generation	7,500	m^3/day		
=> dimensioning wastewater flow	707	m^3/h		
- surface loading rate for primary settling	2 0	m/h		
- retention time for primary settling	1 5	h		
=> area and depth of settling tank	354	m^2,	3.0	m
- sludge bed requirement	0.17	m^2/person		
=> area of sludge beds	8,300	m^2		

Investment:	pumping st.	15,000	m^3/d	100,000	VD =	1,500,000	1000 VD
	screens, meters, etc.			50,000,000	"	50,000	"
	settling tank	1,061	m^3 a	1,000,000	"	1,060,855	"
	sludge beds	8,300	m^2 a	250,000	"	2,075,000	"
	land cost	13,000	m^2 a	15,000	"	195,000	"
					=>	4,880,855	1000 VD
					=>	**443,714**	**USD**
O & M:	supervisor	1	a	600,000	VD =	7	MVD/year
	labourers	3	a	300,000	"	11	"
	energy	135,500	kWh	500	"	68	"
	repairs	1.0%	of	4.881E+9	"	49	"
					=>	135	MVD/year
					=>	**12,233**	**USD/year**
Foreign/local expenditure:				**136,364**	/	**307,350**	**USD**
Present value for	**15 years at 6% interest rate:**					**562,520**	**USD**
					=>	**11**	**USD/pers**

TECHNOLOGY SHEET

TM 7

Level:	Secondary treatment
Technology:	**Sludge digestion by storage**
Next component technology options:	Reuse or disposal on land
Description:	Dewatering and storage of septic sludge in order to achieve the guideline for helminthic quality (< 1viable egg/100g). For dewatering, sludge is first settled for one week in a sequence of three storage tanks – one being filled, one undergoing settling, and one in use fter this, the supernatant is ready for farm use. Sludge settled to the bottom must be additionally stored in piles, typically 1-1.8 m in height, for one year during which it will be stabilized by anaerobic digestion. The minimum storage period of one year may be reduced if elevated temperatures can be used

PROS

Technical:	
Implementation:	+ easy to construct
O&M:	+ simple to operate and maintain + low energy requirement
Others:	+ produces methane gas, which may be used for cooking or heating

CONS

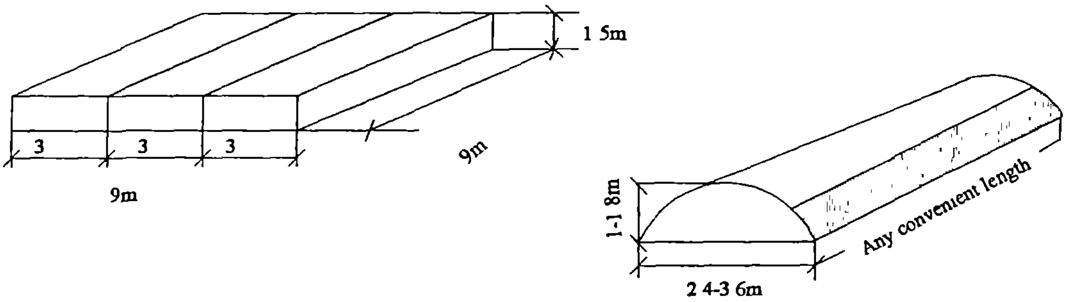
Technical:	– process is slower and more unreliable pathogen removal efficiency than for aerobic composting – high land requirement due to long storage period – unpleasant odors may be produced
Implementation:	
O&M:	
Others:	

Investment costs:	0.35 USD/person
Operating costs:	0.01 USD/person/year

COST ESTIMATE SHEET

TM 7

Sludge digestion by storage



capacity	50,000	person equivalent
- septic sludge accumulation	0.04	m^3/person/year
=> sludge generation	38	m^3/week
- dewatering in one week's settling tank of	38	m^3
from sludge concentration	3%	
to sludge concentration	10%	
=> sludge to be stored	12	m^3/week
- pile cross-section 3,6 x 1,8 /2 =	3.24	m^2
=> pile length	3.6	m/week
=> area required for one year storage	670	m^2

Investment:	3 concrete basins	115 m^3	1,000,000	VD =	115,385	1000 VD
	screens, gates, etc.		50,000,000	"	50,000	"
	spades, wheel-barrows		5,000,000	"	5,000	"
	land cost	1340 m^2 a	15,000	"	20,100	"
				=>	190,485	1000 VD
				=>	**17,317**	**USD**
O & M:	workers	8 a	300,000	VD =	29	MVD/year
	50% value of incr. crops (20 -100)MVD/year				(25)	"
				=>	4	MVD/year
				=>	**345**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **20,672** **USD**

=> **0.4** **USD/pers**

TECHNOLOGY SHEET

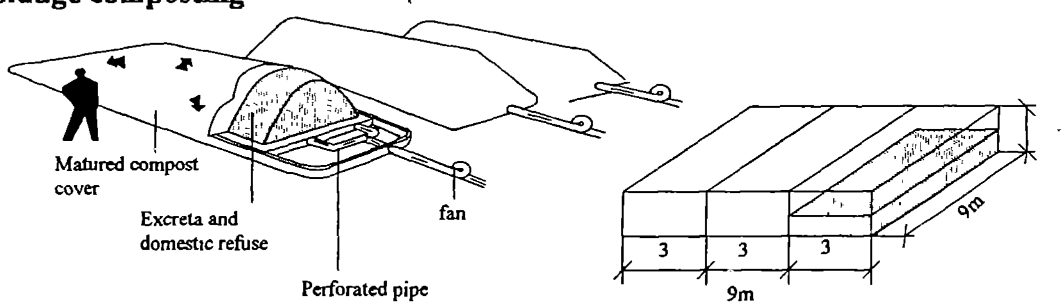
TM 8

Level:	Secondary treatment
Technology:	**Sludge composting**
Next component technology options:	Reuse and disposal in land
Description:	Co-composting of sludge with domestic refuse, straw, or sawdust in aerated static piles, typically 1 5-2 m high, 2-4 m wide, and 10-50 m long erobic digestion will rise the temperature to 55-60 °C. fter one month storage the helminthic guideline requirement will be met. further maturation for 2-4 months at ambient temperature provides a stable compost suitable for general agricultural use If not aerated, the compost needs frequent turning to maintain aerobic conditions (a method suitable for small-scale composts).
PROS	
Technical:	+ produces stable, pathogen-free humus of high nutrient content + requires less land area than anaerobic storage + little odor nuisance
Implementation:	
O&M:	
Others:	+ good soil conditioner and retains moisture when applied to land + suitable for small cities near agricultural land
CONS	
Technical:	– requires substantial amounts of sorted domestic refuse or other organic matter to adjust moisture content and C/N-ratio
Implementation:	– requires construction of foundation and aeration systems and leachate control
O&M:	– maintaining aerobic process requires careful monitoring – requires energy input – skilled labor required
Others:	– if not properly covered and founded, possibility for fly breeding
Investment costs:	0.7 USD/person
Operating costs:	0 05 USD/person/year

COST ESTIMATE SHEET

TM 8

Sludge composting



capacity	50,000	person equivalent
- septic sludge accumulation	0.04	m^3/person/year
=> sludge generation	38	m^3/week
- dewatering	38	m^3
from sludge	3%	
to sludge concentration	10%	
=> sludge to be composted	12	m^3/week
- sludge percentage of the compost	25%	
=> total sludge & other refuse	46	m^3/week
- pile cross-section 4 x 2 /2 =	4	m^2
=> pile length	12	m/week
=> area required for one month composting + two months storage	590	m^2
=> area for bulking agent store (2 weeks)	70	m^2

Investment:	3 concrete basins	115	m^3 a	1,000,000	VD =	115,000	1000 VD
	screens, gates, etc.			50,000,000	"	50,000	"
	spades, wheel-barrows			15,000,000	"	15,000	"
	foundations	200	m^2 a	1,000,000	"	200,000	"
	aeration pipes	72	m a	50,000	"	3,600	"
	land cost	1180	m^2 a	15,000	"	17,700	"
					=>	401,300	1000 VD
					=>	**36,482**	**USD**
O & M:	workers	10	a	300,000	VD =	36	MVD/year
	electricity	3500	kWh	750	"	3	"
	50% value of incr. crops (20 -100)MVD/year					(25)	"
	repairs	3.0%	of	401.3E+6	"	12	"
					=>	26	MVD/year
					=>	**2,333**	**USD/year**

Foreign/local expenditure: all local

Present value for 15 years at 6% interest rate: **59,141** **USD**

=> **1.2** **USD/pers**

ANNEX II

COSTS OF DEVELOPMENT SCENARIOS

Table II - 1 Cost estimate for alternative development scenarios, 100 VND per household

	Alternative		Present Value	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
	Population Density per 400/ha																	
A	Flush Toilet w/Sewer Connection	OS 1	1482	1060	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	Separate Sewers, Neighborhood	NB 1	743	750	4	4	4	4	4	4	4	4	4	4	4	4	4	4
	Separate Drains, Neighborhood	NB 1b	2704	2150	77	77	77	77	77	77	77	77	77	77	77	77	77	77
	Separate Sewers, Conveyance	CV 1	295	220	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Separate Drains, Conveyance	CV 1b	720	735	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Primary Treatment	TM 6	557	488	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Secondary Treatment	TM 1	1672	0	0	0	0	0	0	0	0	0	2345	154	154	154	154	154
	Total		*8172*	5403	160	160	160	160	160	160	160	160	2505	314	314	314	314	314
B	On-site Systems	OS	3310	3000	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	Sewer Connection	OS	642	0	0	0	0	0	0	0	0	0	1150	0	0	0	0	0
	Small Bore Sewer	NB 2	114	0	0	0	0	0	0	0	0	0	188	4	4	4	4	4
	Separate Drains, Neighborhood	NB 1b	2704	2150	77	77	77	77	77	77	77	77	77	77	77	77	77	77
	Simplified Sewer	CV 2	86	0	0	0	0	0	0	0	0	0	128	6	6	6	6	6
	Separate Drains	CV 1b	720	735	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Secondary Treatment	TM 1	1944	0	0	0	0	0	0	0	0	0	2833	154	154	154	154	154
	Sludge Collection	CV 5	437	300	24	24	24	24	24	24	24	24	24	0	0	0	0	0
	Sludge Treatment	TM 7	37	19	3	3	3	3	3	3	3	3	3	0	0	0	0	0
	Total		*9994*	6204	162	162	162	162	162	162	162	162	4461	299	299	299	299	299
	Population Density per 100/ha																	
A	Flush Toilet w/Sewer Connection	OS 1	1482	1060	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	Separate Sewers, Neighborhood	NB 1	1503	1500	10	10	10	10	10	10	10	10	10	10	10	10	10	10
	Separate Drains, Neighborhood	NB 1b	7194	6650	105	105	105	105	105	105	105	105	105	105	105	105	105	105
	Separate Sewers, Conveyance	CV 1	427	350	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Separate Drains, Conveyance	CV 1b	2853	2940	9	9	9	9	9	9	9	9	9	9	9	9	9	9
	Primary Treatment	TM 6	557	488	11	11	11	11	11	11	11	11	11	11	11	11	11	11
	Secondary Treatment	TM 1	1672	0	0	0	0	0	0	0	0	0	2345	154	154	154	154	154
	Total		*15687*	12988	201	201	201	201	201	201	201	201	2546	355	355	355	355	355
B	On-site Systems	OS	3310	3000	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	Sewer connection	OS	861	0	0	0	0	0	0	0	0	0	1500	10	10	10	10	10
	Small Bore Sewer	NB 2	247	0	0	0	0	0	0	0	0	0	400	10	10	10	10	10
	Separate Drains, Neighborhood	NB 1b	7194	6650	105	105	105	105	105	105	105	105	105	105	105	105	105	105
	Simplified Sewer	CV 2	556	0	0	0	0	0	0	0	0	0	941	13	13	13	13	13
	Combine Sewer	CV 3	3202	3190	22	22	22	22	22	22	22	22	22	22	22	22	22	22
	Secondary Treatment	TM 1	1944	0	0	0	0	0	0	0	0	0	2833	154	154	154	154	154
	Sludge Collection	CV 5	437	300	24	24	24	24	24	24	24	24	24	0	0	0	0	0
	Sludge Treatment	TM 7	37	19	3	3	3	3	3	3	3	3	3	0	0	0	0	0
	Total		*17789*	13159	209	209	209	209	209	209	209	209	5883	369	369	369	369	369