Annexes

Annex 1[1]

Environmental Sanitation and Health

1.1 Water-related Disease(s)

It is said that the biggest threat to public health is poor environmental sanitation. This is supported by the fact that the incidence of infectious and parasitic diseases is lower in the industrial countries compared to the developing countries because of the generally improved conditions of sanitation and hygiene.

Of the estimated 51 million deaths in 1993 (WHO, 1995):

- Communicable diseases accounted for about 20 million, or 40% of global deaths, and 99% of these occurred in the developing world.
- Non-communicable diseases accounted for 19 million, or 36% of the total, with both the developing and developed world sharing the burden more or less equally.

The difference between infectious and non-communicable diseases is very marked. One in two deaths in the developing world is due to communicable diseases, but in the developed world three out of every four deaths are due to non-communicable diseases.

Children are usually more vulnerable to poor sanitation than are adults. As a result, 11,475 million children under the age of five die every year in developing nations as a result of tainted drinking water, poor sanitation, environmental pollution and malnutrition (WHO, 1995). Out of these, three million children under five die of diarrhoea. Every small child in the developing countries suffers an average of three diarrhoeal attacks a year — and such repeated attacks, even if they do not cause death, lead to malnutrition which stunts physical and mental growth. Across the globe, there are an estimated 1.8 billion episodes of childhood diarrhoea annually, mostly in developing countries (WHO, 1995).

Most of these diseases arise from the contamination of drinking water by human wastes, as a result of poor sanitation. Most people in the developing countries do not have clean drinking water or proper sanitation facilities. The provision of safe water and the management of wastewater has a central role to play in reducing the incidence of many water-related communicable diseases.

[1] Source: International Environmental Planning Center, Tokyo, Japan

There are three crucial concerns in the relationship between water and health. The first is the shortage of water availability, the second is the maintenance of water quality, and the third is the direct link between water and health. Rapidly increasing populations with increasing *per capita* water demands will create strong pressure on water availability. Assurance of the safety of available water is a prime concern, especially in the face of growing demand. Insufficient supplies and poor-quality drinking water, in combination with inadequate wastewater disposal, lead to outbreaks of many diseases.

1.1.1 Scarcity of Water

Despite the fact that the volume of fresh water available worldwide is only a small fraction of the total global water (97% of which is saline), it still exceeds present and projected future needs. However, its geographical and seasonal distribution is uneven. For instance, most of the flood waters that pass rapidly through India and Bangladesh during the monsoon are not available for use the rest of the year, so that scarcity of water is a problem in the two countries during the dry seasons. But other factors causing shortages in the supply of water are man-made, e.g. inadequate management of water-supply systems, especially water losses. Water losses from water-distribution systems may be very high, mainly in the developing countries. Unaccounted-for water ranges from 51% to as high as 62% in five of the largest Asian cities, while it is only 8% in Singapore.

1.1.2 Water Quality

Basically, the four most important sources of water pollution are caused by the discharge of sewage, industrial effluents, urban run-off, and agricultural run-off. In some countries, mines and the production of oil and energy are major contributors.

In the developed world, sewage and industrial effluents are usually treated before disposal into the environment. In the developing world, in addition to pollution carried by urban and agricultural run-off, insufficient sanitation and solid wastes are largely responsible for inadequate drinking-water quality, as well as the lack of enforcement of pollution standards concerning industrial effluents.

Agriculture contributes to the pollution of water due to use of fertilizers and pesticides. Ten percent of the rivers monitored under the Global Environment Monitoring System (GEMS) have nitrate concentrations higher than the WHO guidelines for drinking water. High levels of nitrates in drinking water can lead to serious, even fatal, consequences in infants below six months of age. In some instances, dieldrin and DDT were also found in drinking water.

The sight, smell and taste of water is affected by the chemicals it contains. The chemical quality of drinking water can lead to disease if concentrations of essential constituents are too low (iodine, *etc.*) or, more commonly, if they are too high (metallic ions, nitrate, *etc.*). Standards for the quality of drinking water have been issued by many governments, and international guidelines have been issued by the World Health Organization (see Annex 2).

1.1.3 Communicable Diseases Associated with Water

An infectious disease is one which can be transmitted from one person to another or, sometimes, to or from an animal. All infectious diseases are caused by micro-organisms, i.e. bacteria and viruses, or parasites, and transmitted by the passing of these organisms, directly or indirectly, from one person to another.

Most of the diseases associated with water are communicable. In most cases, the pathogens are discharged in animal or human excreta, usually faeces and occasionally urine. The most common route of infection is fecal-oral contact, either by ingestion with food or water, or by contaminated fingers or utensils. Once ingested, most pathogens multiply in the alimentary tract and subsequently cause disease in the host person. Without proper sanitation, the pathogens then excreted find their way into water, and without safe water supplies, can infect many people. Some pathogens can even survive outside the host body for a long period of time, e.g. in sewage and occasionally in the soil, from where they may be retransmitted to water and food. Some other diseases may be transmitted by vectors. Therefore, the collection, transport, treatment and disposal of excreta are the essential technology in the protection of health in any community.

Bradley suggested that diseases associated with water can be classified into four categories based on the role of water in the transmission (White, 1972):

Water-borne diseases: These diseases are transmitted when the water drunk or used for the preparation of food is contaminated by human or animal faeces or urine containing pathogenic micro-organisms. Sometimes, direct fecal-oral contact, food contamination or contact of abraded skin with infected water may cause transmission also. Water-borne diseases include the classical infections, notably cholera and typhoid, but also include a wide range of other diseases, e.g. infectious hepatitis, diarrhoeas, and the dysenteries.

Water-washed diseases: People can be infected due to the use of infected water for domestic purposes other than drinking — due to the unhygienic handling of water which, before mishandling, was safe. Scarcity and the inaccessibility of water make washing and personal cleanliness difficult and infrequent. A water-washed disease may be defined as one whose transmission will be reduced following an increase in the volume of water used for personal hygiene. All water-borne disease can also be water-washed, but this category also includes some vector-borne diseases.

Water-washed diseases are of three main types. Firstly, some are infections of the intestinal tract, and are fecal-oral in their transmission. The second type affects the skin or eyes. Bacterial skin sepsis, scabies, and fungal infections of the skin are extremely prevalent in many hot climates, while eye infections such as trachoma are also common and may lead to blindness. They are related to poor hygiene and cannot be water-borne. Thus, they relate primarily to water quantity rather than to water quality. The third type of water-washed infection is also not fecal-oral and therefore can never be water-borne. These are infections carried by lice which may be reduced by improving personal hygiene. Louse-borne epidemic typhus is transmitted by body lice, which cannot persist on people who regularly launder their clothes. Louse-borne relapsing fever may also respond to changes in personal hygiene, especially the increased use of water for washing.

Water-based diseases: Water provides the habitat for intermediate hosts (water snails or other aquatic animals), in which some parasites pass part of their life cycle. The infective larval forms of these parasites are released in the fresh water and find their way into humans by boring through skin, ingestion of water flora or of fish eaten raw or inadequately cooked. All of these diseases are caused by parasitic worms (helminths) which depend on aquatic intermediate hosts to complete their life cycles. Examples are schistosomiasis and guinea worm infections.

Water-related vector-borne diseases: Water may provide a habitat for vectors such as mosquitos and flies. Some of the vectors prefer relatively clean water, while many others thrive in polluted water such as the pools around flooded pit-latrines or muddy swamps. Malaria, yellow fever, dengue, and onchocerciasis (river blindness) are transmitted by insects breeding in water, while West African sleeping sickness is transmitted by the riverain tsetse fly, which bites near water.

The environmental strategies for disease control appropriate to water-related diseases are shown in Table A1.1.

Table A1.1 Preventive Strategies for Water-related Diseases

Preventive Strategies for Water-related Diseases	
Category	**Preventive Strategies**
Water-borne	Improve quality of drinking water Prevent casual use of unprotected sources
Water-washed	Increase water quantity used Improve accessibility and reliability of domestic water supply Improve domestic and personal hygiene
Water-based	Reduce contact with infected water Control snail populations Reduce contamination of surface waters
Water-related vector	Improve surface water management Destroy breeding sites of insects Reduce need to visit breeding sites Use mosquito netting

Source: Cairncross & Feachem, 1993, "Environmental Health Engineering in the Tropics". 2nd edition, John Wiloy & Sons, UK

1.2 The Control of Infectious Diseases

The basic objective of proper sanitation is to keep the infectious diseases away from the people. For the environmental engineer, it is convenient to group the diseases into classes related to engineering methods of control. Four broad general classes can be identified, namely water-related, excreta-related, refuse-related and housing-related infections. The water-related infections are described in Section 1.1 of Annex 1. Poor refuse disposal will encourage the breeding of flies and other vectors of disease, and may thus promote the transmission of fecal-oral infections. Some species of mosquitoes breed on uncollected refuse or on wastewater near garbage, and may transmit filariasis, dengue and yellow fever. All housing-related infectious disease can be prevented by appropriate housing design and construction. However, excreta-related diseases are more directly related to sanitation.

All the diseases in the fecal-oral category mentioned earlier, as well as most of the water-based diseases and several others not related to water, are caused by pathogens transmitted in human excreta, normally in the faeces. The excreta-related diseases can be controlled by improvements in water supply and hygiene, and by a whole gamut of measures for excreta disposal, ranging from the construction or improvement of toilets and latrines, on the one hand, to water-borne methods for transport and the treatment and final disposal or re-use of the excreta, on the other hand. Table 1.2 summarizes control measures available to "build out" infections by improved environmental health.

Table A1.2 Excreta-related Infections: Classification, Transmission and Control

Excreta-related Infections: Classification, Transmission and Control			
Class	Infection	Transmission	Control
Fecal-oral, non-bacterial	Poliomyelitis Hepatitis A Rotavirus diarrhoea Amoebic dysentery	Person-to-person contact Domestic contamination	Domestic water supply Improved housing Toilets and latrines Health education Personal hygiene
Fecal-oral, bacterial	Diarrhoeas and dysenteries Enteric fevers	Person-to-person contact Domestic contamination Water contamination Food contamination	Domestic water supply Improved housing Toilets and latrines Excreta treatment Health education Food hygiene
Soil-transmitted helminths	Round worm Whip worm Hook worm	Soil contamination Yard contamination	Toilets and latrines Excreta treatment Health education
Helminths, Animal intermediate hosts	Tape worm	Soil contamination Yard contamination Food contamination	Toilets and latrines Excreta treatment Health education Food hygiene
Water-based helminths	Schistosomiasis Liver fluke Fish tapeworm Intestinal fluke Lung fluke	Water contamination Food contamination	Toilets and latrines Excreta treatment Health education Food hygiene Control of host animal
Excreta-related vector-borne	Filariasis	Insects breed in faecally contaminated site	Elimination of breeding site Use of net

Adapted from: Cairncross & Feachem, 1993 (see Table 1.1)

It must be remembered that the improvement of drinking water supply will not achieve the anticipated benefit without the proper disposal of excreta. Moreover, without the proper disposal of excreta, there will always be a risk of contamination of drinking-water sources. The protection of drinking-water sources is always of particular importance.

1.3 Health Risks Requiring Special Attention

1.3.1 Soil and Groundwater Pollution

Ground water is one of the most precious water resources and must be protected, especially in the arid and sparsely populated areas. The study of the pollution of soil and ground water by excreta also provides useful information for the design of excreta disposal, especially its location with respect to sources of drinking water supplies. After excreta are deposited on the ground or in pits, the bacteria, unable to move much by themselves, may be transported horizontally and downward into the ground by leaching liquids such as urine or rain water. The distance of travel of bacteria in the soil varies with several factors, the most important of which is the porosity of the soil itself. It is reported that, unless "flushed" by a considerable amount of water, bacterial contamination does not travel more than 7.5 m through fine sand.

Depending upon conditions of humidity and temperature, pathogenic bacteria and the ova of parasitic worms will survive varying lengths of time in the ground. Pathogenic bacteria do not usually multiply in the soil, and will die within a few days. On the other hand, hookworm eggs will survive as many as five months in wet, sandy soil, and three months in sewage.

1.3.2 Location of Latrines

In the developing countries, private and small-scale public wells provide drinking water to a large part of the rural population. Many of these wells are contaminated by liquid leaching or leaking from wrongly built and/or located latrines. Regarding the location of latrines, the following points should be taken into consideration:

- There can be no arbitrary rule governing the distance that is necessary for safety between a pit latrine and a well for drawing drinking water. Many factors, such as slope and level of ground water, and soil permeability, affect the removal of micro-organisms from groundwater. However, the typical distance between a pit and a ground-water source should be between 7.5 m to 15 m.

- In homogeneous soils, the chance of groundwater pollution is virtually nil if the bottom of the pit latrine is more than 1.5 m above the groundwater table.

- A careful investigation should be made before building pit latrines in areas containing fissured rocks and limestone formations.

- Pour-flush latrines involve larger amounts of liquid than pit latrines, and this must be taken into account with respect to both the design and the location of the latrines.

1.3.3 River and Coastal Pollution

River and coastal pollution harbor many risks. River water is often used as a source of drinking water without prior purification in the developing countries, both by individuals and small communities, and it serves widely for bathing and laundering. Coastal water is used for recreation and the production of sea food, and presents special risks of pollution. Many people are exposed to polluted surface and coastal water in the developing countries, especially women and children. The following must be taken into account:

- The discharge of sewage and nightsoil without prior treatment is basically undesirable, although it may be practiced temporarily. It must be carefully appraised in light of public health requirements.

- The treatment of sewage prior to disposal should be standard practice, although the degree of treatment should be adapted to the local health and environmental requirements (see Section 8.3.4).

- The disposal of sludge from on-site sanitation (latrines or septic or other tanks) requires special attention. The sludge may be highly infective in terms of both individual and community health, and also harbours occupational risks for those involved in desludging operations. The following must be considered:

  - The safety of the equipment and procedures used in desludging.

  - The type and location of the disposal, taking into account public health and environmental requirements.

  - The special risks and criteria for tipping stations, where applicable.

- Whenever rivers of coastal waters are used for the disposal of sewage and nightsoil, water quality should be monitored.

1.3.4 Re-use of Effluent and Nightsoil

The re-use of nightsoil is basically undesirable. Whenever effluent is re-used, strict public health criteria should be observed both in the planning and operation of the facility.

1.3.5 Open Drains

Open drains for the collection and transportation of sewage are basically undesirable but are in use in many of the developing countries. They harbour many risks, e.g. they are accessible and are a source of personal contact (especially by children), they may provide breeding grounds for insects, rodents and vectors of disease, and they are used for the disposal of garbage are thus often clogged and flooded. The design, and the operation and maintenance of open drains, must take these risks into account.

1.3.6 Criteria and Standards

Annex 2 lists some selected criteria and standards which should be used and/or adapted with a view to protecting health and the environment against the special risks discussed in the preceding paragraphs.

Annex 2[2]

Environment- and Health-related Standards and Criteria

2.1 Introduction

As guidelines to assist Japanese ODA participants in the field of sanitation projects, the following tables and references introduce examples of standards and criteria. Among them, some Japanese standards and criteria are introduced, and these may be helpful for non-Japanese participants or specialist who are not familiar with Japanese conditions. As not all Japanese health- and environment-related standards can always be used in ODA projects, however, most of the tables and references are selected from international standards and criteria. They come from the areas of microbiological standards and characteristics, water consumption, effluent standards, wastewater-treatment options, community participation, and gender issues.

Two tables of nightsoil purification tanks and *Jokaso* are shown as examples of Japanese standards and criteria for appropriate technoligies for rural areas in Japan.

2.2 Japanese Standards and Criteria

2.2.1 Simple *Jokaso*

Table A.2.2.1 Installing Conditions and Performance of *Jokaso*

(footnotes, source, next page)

Installing conditions and performance of *Jokaso*				
Area where *Jokasos* are installed	Capacity[d] (persons)	Performance: Removal ratio of BOD (%)[e]	Performance: BOD of discharge water for individual sewage disposal tank (mg/l)	Remarks
Particular sanitary obstacle[a]	<100	>65	<90	flush toilet waste water only
	100 - 500	>70	<60	
	>500	>85	<30	
Water pollution control law[b]		>90	<20	
No particular obstacle[c]			<120	
Others	<500	>65	<90	flush toilet waste water only
	500 - 2,000	>70	<60	
	>2,000	>85	<30	

[2] Source: International Environmental Planning Center, Tokyo, Japan

a) Area permitted in regulations provided by district government agency because of particular sanitary obstacle
b) Area where Biochemical Oxygen Demand (BOD) of discharged water is determined as less than 20 mg/l by water pollution control law
c) Area permitted in regulations provided by district government agency because of no particular obstacle
d) Capacity measured as equivalent of number of people, according to method established by Ministry of Construction
e) Removal ratio of BOD to be obtained by dividing the given numerical value of BOD by the numerical value of BOD in the water flowing into individual sewage disposal

Source: T. Noike (1995) Night Soil Treatment and Disposal in Japan. In: JICA/Japan Society on Water Environment, Environment. Eng. Course — Water Quality Management, No. 13.

2.2.2 Structural Standards for On-site Systems

Table A2.2.2 Outline of Structural Standards for *Jokaso* Systems

<Table on next two pages>

Source: Ministry of Health and Welfare, Ministerial Notification No. 1292

Table A2.2.2 Outline of Structural Standards for *Jokaso* On-site Systems

(Page 1 of 2 pages in table)

Outline of Structural Standards for *Jokaso* On-site Systems

Classifi-cation		Type of treatment	Treatment method	Capacity (persons) 5-50	51-200	201-500	501-2,000	2,000-5,000	5,0001 -	Treatment BOD removal, %	Performance BOD in effluent	Remarks
#1	1	Flush toilet wastewater treatment	Separation - contact aeration process	■	■	■				>=65	<=90 mg/l	(1)
	2		Separation - aeration process	■	■	■						
	3		Trickling filter process	■	■	■						
	4	Combined domestic wastewater treatment	Separation - contact aeration process	■						>=90	<=20 mg/l	
	5		Anaerobic filter -contact aeration process	■								
#2	1	Combined domestic wastewater treatment	Rotating Biological contact process		■	■	■			>=70	<=60 mg/l	
	2		Contact aeration process		■	■	■					
	3		Trickling filter process		■	■	■					
	4		Extended aeration process		■	■	■					
#3	1		Rotating Biological contact process		■	■	■	■	■	>=85	<=30 mg/l	
	2		Contact aeration process		■	■	■	■	■			
	3		Trickling filter process		■	■	■	■	■			
	4		Extended aeration process			■	■	■	■			
	5		Conventional activated sludge process				■	■	■			
#4		Flush toilet wastewater treatment	Septic tank process	■	■	■				>=55	<=120 mg/l	
#5		Flush toilet wastewater treatment	Land filtration process	■	■	■				>=55	<=250 mg/l	Concerning SS concen-tration
#6	1	Combined domestic wastewater treatment	Rotating Biological contact process		■	■	■	■	■		<=20 mg/l	
	2		Contact aeration process		■	■	■	■	■			
	3		Trickling filter process				■	■	■			
	4		Extended aeration process			■	■	■	■			
	5		Conventional activated sludge process						■			

Table A2.2.2 Outline of Structural Standards for *Jokaso* On-site Systems (continued)

(Page 2 of 2 pages in table)

#7	COD (mg/l)	SS (MG/l)	N-hex. (MG/l)	pH	Total Coliforms (N/ml)	Structure
Emission standard under the Water Pollution Control Law	60	70	20	5.8 - 8.6	<=3,000	#2, #3, #5
	45	60	20	5.8 - 8.6	<=3,000	#3, #6
	30	50	20	5.8 - 8.6	<=3,000	#6
#8	Specially approved process	Qualified to be equivalent or better than processes with structures specified by Notification Nos. 1 through 7 by the Ministry of Construction				
Note: The shadowed parts (on page 1 of table) indicate the range of people and processes applicable to "the districts recognized to have hygienic problems by the competent authorities and specified as such by applicable regulations".						

(1) (see page 1 of table, upper right) Multichamber type and modified multi-chamber type

Source: Ministry of Health and Welfare, Ministerial Notification No. 1292

2.3 International Standards and Criteria

2.3.1 Water Supply

1) Microbiological aspects of drinking water

Table A2.3.1.1 Bacteriological quality of drinking water

Organisms	Guideline value
All water intended for drinking	
E. coli or thermotolerant coliform bacteria	Must not be detected in any 100-ml sample
Treated water entering the distribution system	
E. coli or thermotolerant coliform bacteria	Must not be detected in any 100-ml sample
Total coliform bacteria	Must not be detected in any 100-ml sample
Treated water in the distribution system	
E. coli or thermotolerant coliform bacteria	Must not be detected in any 100-ml sample
Total coliform bacteria	Must not be detected in any 100-ml sample

Source: WHO, Guidelines for drinking-water quality, 2nd ed., Vol.1: Recommendations, Geneva,1993

2) Water consumption

Table A2.3.1.2 Water consumption in some rural areas in four developing countries

Water use (liters per person per day)	Lesotho[a]	Uganda[b]		Pakistan	Mozambique[d]
		Lango	Kigezi	Punjab[c]	
Drinking and Cooking	8.0	5.8	6.4	5.7	2.3
Other domestic use	10.0	11.9	1.6	24.0	10.0
Total	18	18	8	30	12

a: Feachem *et al.*, 1978; b: White *et al.*, 1972; c: Ahmed *et al.*, 1975; d: Cairncross, S., personal communication

Source: WHO, A guide to the development of on-site sanitation, Geneva, 1992

2.3.2 Sanitation

1) Bacteriological aspects of wastewater and nightsoil

Table A2.3.2.1 Occurrence of some pathogens in urine[a], faeces and sullage[b]

Pathogen	Common name for infection caused	Present in: urine	faeces	sullage
Bacteria				
Escherichia coli	diarrhoea	yes	yes	yes
Leptospire interrogans	leptospirosis	yes		
Salmonella typhi	typhoid	yes	yes	yes
Shigella spp	shigellosis		yes	
Vibrio cholerae	cholera		yes	
Viruses				
Poliovirus	poliomyelitis		yes	yes
Rotaviruses	enteritis		yes	
Protozoa - amoeba or cysts				
Ascaris lumbricoides	roundworm		yes	yes
Fasciola hepatica	liver fluke		yes	
Ancylostoma duodenale	hookworm		yes	yes
Necator americanus	hookworm		yes	yes
Schistosoma spp	schistosomiasis	yes	yes	yes
Taenia spp	tapeworm		yes	yes
Trichuris trichiura	whipworm		yes	yes

a: Urine is usually sterile; the presence of pthogens indicates either faecal pollution or host infection, principally with *Salmonella typhi*, *Shistosoma haematobium* or Leptospira

b: From: Cheesebrough (1984), Sridhar *et al.* (1961) and Feachem *et al.* (1983)

Source: WHO, A guide to the development of on-site sanitation, Geneva, 1992

2) *Effluent standards*

Table A2.3.2.2 Effluent standards in five developing countries[5]

Effluent standards in five developing countries					
Country	BOD (mg/l)	NH_4^+ + NH_3	TSS (mg/l)	pH	Temp (°C)
India[1]	30	-	100	5.5 - 9.0	-
Tanzania[2]	30	10	no sludge formation	6.5 - 8.5	-
Brazil[3]	60, or 80% removal	-	settle. sol. <=1 mL/L	5.9	40
Thailand[4]	20[6]	Nkj<=40	30	5 - 9	40
Philippines[5]					
Class AA	30	-	50	6 - 8.5	40
Class D	50	-	75	6 - 8.5	40
Indicated are maximum allowable values					

1 : For domestic and most industrial waste water
2 : Ministry of Health, April 1977
3 : State of São Paulo, May 31, 1976
4 : Drafted standards by National Environmental Board; Nkj stands for Kjedahl-nitrogen, covering also ammoniacal N.
5 : 1982; Class AA: receiving water intended for water supply with minimal treatment; Class D: receiving water suitable for irrigation and industrial purposes
6 : Depends on size of polluting unit

Source: International Institute for Hydraulic and Environmental Engineering, Feasibility of anaerobic sewage treatment in sanitation strategies in developing countries, Delft 1990

3) Choice of sanitation system

Table A2.3.2.3 Choice of sanitation system

Choice of sanitation system								
Sanitation system	Suitable for rural areas?	Pop. density where suitable	Con-struction cost	Opera-tion cost	Ease of con-struction	Water require-ment	Perme-able soil required?	Off-site facilties required
Pit latrine	Yes	L	VL	L	Very easy	None	Yes	None
VIP latrine	Yes	L	L	L	Easy	None	Yes	None
Twin pit latrine	Yes	L / M	M	L	Needs builder	None	Yes	None
Pour-flush toilet	Yes	L / M	L	L	Needs builder	Water nearby	Yes	None
Septic tank and soakaway	Yes	L	H	H	Needs builder	Multiple tap	Yes	Sludge disposal
Small bore sewerage (sewered pour-flush)	No	H	H	M / H	Needs engineer	Yard tap	No	Sludge disposal, sewers, treatment
Sewerage	Yes	H	H	M	Nees engineer	Multiple tap	No	Sewers, treatment
H = high, M = medium, L = low								

Source: London School of Hygiene and Tropical Medicine/Ross Institute, Small Scale Sanitation, London, 1988

4) Comparative analysis of sanitation programmes

Table A2.3.2.4 Comparative analysis of sanitation programmes (on-site, intermediate-scale, off-site) by major selection determinants[5]

Comparative analysis of sanitation programmes (on-site, intermediate-scale, off-site) by major selection determinants					
Wastewater	On-site		Intermediate-scale		Off-site
Determinant (strategy)	black	gray	brace	gray	gray
Technical					
BOD removal (Environmental pollution control)	-	0	0	++	++
Pathogen removal (Public health improvement)	0/ (++)[1]	0/ (++)[1]	0/+	0/+	0/+
Process stability	+	0	+	+	++
Economic and financial	++	0	++	+/++	-
Institutional	0/++	0/+	0	0	-
Community involvement	++	++	++	++	-

The marks indicate suitability (in terms of performance, applicability or cost) of the programme; they have only a relative meaning to allow comparison within one row

[1] Provided percolation of supernatant into soil functions well, and removed sludge is disinfected

Legend:		
	++	high efficiency, easy, very low cost
	+	good efficiency, relatively easy, reasonable cost
	0	fair efficiency, not very easy, higher cost
	-	poor efficiency, relatively difficult, higher cost

Source: International Institute for Hydraulic and Environmental Engineering, Feasibility of anaerobic sewage treatment in sanitation strategies in developing countries, Delft, 1990

5) Landscape and selection of wet on-site and off-site low-cost sanitation and treatment technologies

Table A2.4.2.5 Landscape and selection of wet on-site and off-site low-cost sanitation and treatment technologies in tropical developing countries with special reference to the position of anaerobic treatment

<Table on next two pages>

Source: International Institute for Hydraulic and Environmental Engineering, Feasibility of anaerobic sewage treatment in sanitation strategies in developing countries, Delft, 1990

Table A2.3.2.5 Landscape and selection of wet on-site and off-site low-cost sanitation and treatment technologies in tropical developing countries with special reference to the position of anaerobic treatment

(Page one of two pages in table)

Landscape and selection of wet on-site and off-site low-cost sanitation and treatment technologies in tropical developing countries with special reference to the position of anaerobic treatment							
Site Condition		Planned or unplanned uncongested area (medium to high income)			Unplanned congested area (low to medium income)		
		Sewerage feasible	Low-cost sewerage / drainage feasible		Sewerage not feasible		
		Land price near town			Household income/month		
		<=US$5	>US$5		<=US$35		>US$35
		Estimated size of target population in world (% of total population)				Local institutional framework	
		5-10	15-20	25	25	strong	weak
Strategy							
A.	Environmental protection						
1	BOD eff: 50 mg/l	pond	UASB	communal[1] or township UASB (for preferably greywastewater)	on-site: black wastewater: black wastewater, percolated; and sullage properly drained away in existing drain and treated off-site		
2	BPD eff: <20 mg/l	series of ponds	UASB + post-treatment[2]	communal or township UASB + off-site post-treatment	ditto		
3	BOD eff: <20 mg/l, 75% nitrification	series of ponds	UASB + post-treatment[2] or full anaerobic treatment	communal or township UASB + off-site post-treatment	prohibitively expensive unless subsidized		
4	BOD eff: <20 mg/l, 75% nitrification, eutrophic control	as 3 but with appropriate tertiary treatment		prohibitively expensive	prohibitively expensive unless subsidized		
B.	Public health	series of ponds; or dilution in river		effluent of communal or township UASB conveyed in closed sewer + off-site post-treatment	(double) leaching pit; public[3] toilet	(double) leaching pit or septic tank and trench; cartage	(double) leaching pit

Landscape and selection of wet on-site and off-site low-cost sanitation and treatment technologies in tropical developing countries with special reference to the position of anaerobic treatment

Site Condition				
	Planned or unplanned uncongested area (medium to high income)			Unplanned congested area (low to medium income)[1]
	Sewerage feasible	Low-cost sewerage/drainage feasible		Sewerage not feasible
	Land price near township			Household income/month
	<=US$5	>US$5		<=US$35 … >US$35
	Estimated size of target population in world (% of total population)			Local institutional framework
	5-10	15-20	25	25 … strong … weak
Strategy				
C. Ground water protection	go to A	go to A	go to A	cartage; public toilet near township + sewer, shared[3] UASB with effluent conveyed via open drain
D. Re-use				
1 In irrigation	ponds	UASB	communal or township UASB (+ off-site only sludge can be re-used; toilet near drain pond)	
2 aqua- and pisciculture	series of ponds (HRT = 25d)	UASB + series of ponds	communal or township UASB + off-site series of ponds	ditto
X. Sludge fate	off-site dewatered, possibly after digestion; sludge sold as fertilizer or dumped		tank desludged and sludge locally or centrally dewatered; as fertilizer or dumped	pits emptied and tanks desludged by carts (private or government or city); stabilized and disinfected; dewatered; sold as fertilizer or dumped; shared[3] tanks more easily desludged

1. Congested area means typical population density of >500 cap/ha, without multi-storeyed buildings. Monthly income is here considered to be typically US$35-70
2. Post-treatment may include pond, physical pre-anaerobic treatment depending on land cost
3. "Communal" means for 10-11 households.
"Shared" means for 2-5 households.
"Public" toilet facilities aim typically at 5-50 households, and do not provide for individual house connections.

(Page two of two pages in table)

Table A2.3.2.6 Descriptive comparison of sanitation technologies

Descriptive comparison of sanitation technologies												
Sanitation technology	Rural application	Urban Application	Construction cost	Operating cost	Ease of construction	Self-help potential	Water requirement	Required soil conditions	Complimentary off-site investments	Reuse potential	Health benefits	Institutional requirements
VIP latrines and ROECs[c]	Suitable	Suitable in low/medium-density areas	L	L	Very easy except in wet or rocky ground	H	None	Stable permeable soil; groundwater at least 1 meter below surface[b]	None	L	Good	L
PF toilets[c]	Suitable	Suitable in low/medium-density areas	L	L	Easy	H	Water near toilet	Stable permeable soil; groundwater at least 1 meter below surface[b]	None	L	Very good	L
DVC composting toilets[c]	Suitable	Suitable in very low-density areas	M	L	Requires some skilled labor	H	None	None (can be built above ground)	None	H	Good	L
Self-topping aquaprivy	Suitable	Suitable in low/medium-density areas	M	L	Requires some skilled labor	H	Water near toilet	Permeable soil; groundwater at least 1 meter below surface[b]	Treatment facilities for sludge	M	Very good	L
Septic tanks	Suitable for rural institutions	Suitable in low/medium-density areas	H	H	Requires some skilled labor	L	Water piped to house & toilet	Permeable soil; groundwater at least 1 meter below surface[b]	Off-site treatment facilities for sludge	M	Very good	L
Three stage septic tank	Suitable	Suitable in low/medium-density areas	M	L	Requires some skilled labor	L	Water near toilet	Permeable soil; groundwater at least 1 meter below surface[b]	Treatment facilities for sludge	M	Very good	L
Vault toilets and cartage	Not suitable	Suitable	M	H	Requires some skilled labor	H[d]	Water near toilet	None (can be built above ground)	Treatment facilities for nightsoil	H	Very good	VH
Sewered PF toilets, septic tanks, & aquaprivies[c]	Not suitable	Suitable	H	M	Requires skilled engineer/builder	L	Water piped to house	None	Sewers & treatment facilities	H	Very good	H
Sewerage	Not suitable	Suitable	VH	M	Requires skilled engineer/builder	L	Water piped to house & toilet	None	Sewers & treatment facilities	H	Very good	H

a. On- or off-site sullage disposal facilities are required for non-sewered technologies
b. If goundwater is less than 1 meter below ground, a plinth can be built
c VIP means Ventilated Improved Pit; ROECs means Reed Odorless Earth Closets; PF means Pour-flush; DVC means Double-vault composting
d. for vault construction
L = low, M = medium, H = high, VH = very high

6) Descriptive comparison of sanitation technologies

Table A2.3.2.6 Descriptive comparison of sanitation technologies

<Table on preceding page>

Source: World Bank, Appropriate technology for water supply and sanitation: A planner's guide, 1980

7) Expected removal of excreted bacteria and helminths

Table A2.3.2.7 Expected removal of excreted bacteria and helminths in various wastewater treatment processes

Expected removal of excreted bacteria and helminths in various wastewater treatment processes

Treatment process	Removal (log_{10} units)			
	Bacteria	Helminths	Viruses	Cysts
Primary sedimentation				
Plain	0 - 1	0 - 2	0 - 1	0 - 1
Chemically assisted[a]	1 - 2	1 - 3 (E)	0 - 1	0 - 1
Activated sludge[b]	0 - 2	0 - 2	0 - 1	0 - 1
Biofiltration[b]	0 - 2	0 - 2	0 - 1	0 - 1
Aerated lagoon[c]	1 - 2	1 - 3 (E)	1 - 2	0 - 1
Oxidation ditch[b]	1 - 2	0 - 2	1 - 2	0 - 1
Disinfection[d]	2 - 6 (E)	0 - 1	0 - 4	0 - 3
Waste stabilization ponds[e]	1 - 6 (E)	1 - 3 (E)	1 - 4	1 - 4
Effluent storage reservoirs[f]	1 - 6 (E)	1 - 3 (E)	1 - 4	1 - 4

(E) With good design and proper operation the Engelberg guidelines are achievable
a. Further research is needed to confirm performance
b. Including secondary sedimentation
c. Including settling pond
d. Chlorination, ozonation
e. Performance depends on number of ponds in series
f. Performance depends on retention time, which varies with demand

Source: Feachem *et al.* (1983)

Source: WHO/UNEP, Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture, Geneva, 1989

2.3.3 Wastewater reuse — Recommended microbiological quality guidelines

Table A2.3.3 Recommended microbiological quality guidelines for wastewater use in agriculture

Recommended microbiological quality guidelines for wastewater use in agriculture[a]					
Category	Reuse conditions	Exposed group	Intestinal nematodes[b] (arithmetic mean no. of eggs per litre[c])	Faecal coliforms (geometric mean no. per 100 ml[c])	Wastewater treatment expected to achieve the required micro-biolgoical quality
A	Irrigation of crops likely to be eaten uncooked, sports fields, public parks[d]	Workers, consumers, public	<=1	<=1000[d]	A series of stabilzation ponds designed to achieve the microbiological quality indicated, or equivalent treatment
B	Irrigation of cereal crops, industrial crops, fodder crops, pasture and trees[e]	Workers	<=1	No standard recom-mended	Retention in stabilization ponds for 8-10 days or equivalent helminth and faecal coliform removal
C	Localized irrigation of crops in category B if exposure of workers and the public does not occur	None	Not applicable	Not applicable	Pretreatment as required by the irrigation technology, but not less than primary sedimentation

a In specific cases, local epidemiological, sociocultural and environmental factors should be taken into account, and the guidelines modified accordingly.

b Ascaris and Trichuris species and hookworms.

c During the irrigation period

d A more stringent guideline (<=200 faecal coliforms per 100 ml) is applicable for public lawns, such as hotel lawns, with which the public may come into direct contact.

e In the case of fruit trees, irrigation should cease two weeks before fruit is picked, and no fruit should be picked off the ground. Sprinkler irrigation should not be used.

Source: WHO, Health guideline for the use of wastewater in agriculture and aquaculture, Geneva, 1989

2.4 Others

2.4.1 Community participation

Table A2.4.1 Level of participation related to project stage

Level of participation related to project stage			
Project stage		Level of community participation	
		Water supply	Sanitation
1.	Pre-planning	low	low
2.	Planning		
1)	Data collection, needs assessment	low	low
2)	Identify technical options	low	low
3)	Community organization	medium	low
4)	Select goals, systems, technology	low	low
5)	Decide on timetable	low	low
6)	Determine manposer needs and resources	medium	low
7)	Identify local hygiene education needs and strategies	low	low
3.	Implementation		
1)	Designs	medium	low
2)	Construction	high	medium
3)	Information, education, commuication	low	low
4)	Maintenance	medium	medium
50	Evaluation	low	low

Source: IRC, Community participation and women's involvement in water supply and sanitation projects, The Hague, 1988

2.4.2 Gender issues

Table A2.4.2 Actions to make sanitation programmes more gender specific

Actions to make sanitation programmes more gender specific		
Level	Action	Reason(s)
Programme	Selection of geographic areas	Gender relevance; efficiency: effectiveness
Programme	Setting of gender-specific behavioural objectives	Go beyond physical outputs to adequate maintenance and use by men, women, boys, girls
Programme	Greater and informed user choice to men and women in focus of improvements, type(s) of technology, design and contributions, including division within households	Sustainability of programmes
Programme	Formulate gender-specific strategies to plan and implement sanitation projects. Revise hygiene education and training strategies to include new gender insights	Effectiveness, socio-economic benefits, redressing of gender imbalance
Policy	Make capacity building of men and women a programme aim besides physical outputs and sustained behaviour change	Sustainability of programme
Policy	More gender-specific research and documentation of sanitation programme with emphasis on whether conditions and practices continue to be improved	Insight development
Policy	Support to capacity building of agencies involved in sanitation for gender-specific and sustained programmes which improve community conditions and practices in cooperation with local men and women	Shift from short term "building" to long term "enabling"
Policy	Aim at better gender balances, increased professionalization and inter-disciplinary staff in sanitation	Current sanitation has low status and specialization; staff is mainly male

Source: van Wijk C (Undated) Gender aspects of sanitation, the missing slipper of Cinderella? The Hague, IRC International Water and Sanitation Centre (paper prepared on request of SIDA, Stockholm)

Annex 3[3]

JICA's Development Study

3.1 Development Study

A Development Study is part of the technical cooperation of JICA (See Figure A3.1), defined as "the undertaking of basic surveys for development projects in developing regions of the world". It is one of the main pillars of government-level technical cooperation provided by Japan.

Figure A3.2 shows the implementation structure in a schematic form, centering around official development assistance.

3.2 Significance of the Development Study

The significance of a Development Study is to contribute to concrete plans for national development through formulation of plans for socio-economic development (See Figure A3.3), e.g.:

- Data for judging policy-making decisions;
- Formulation for the extension of financial assistance (loan or grant), to be used by the development organizations, *etc.*; and
- Technology transfer to technical staff (counterparts).

3.3 Areas to be Covered by a Development Study

A Development Study covers all areas relating to national development, e.g.:

- Agriculture, forestry and fisheries;
- Mining, industry and energy;

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[3] Adapted from unpublished JICA document

- Socio-economic infrastructure; and
- Regional development.

3.4 Types of Development Study

JICA's Development Studies are divided as follows (See Figure A3.4):

- Regional development plan;
- Sectoral master plan (M/P);
- Feasibility Study (F/S);
- Resource exploration study;
- Preparation of basic national topographical maps; and
- Detailed design (D/D).

3.5 Process of a Development Study

In the cycle of a Japanese assistance project, the Development Study undertakes the stage of preparation (See Figure A3.5). The implementation process of a Development Study has several stages, as described in Figure A3.6. Necessary actions to be taken in each stage are described in Figure 3.7.

Figure A3.1 — Services and Operations of the JICA

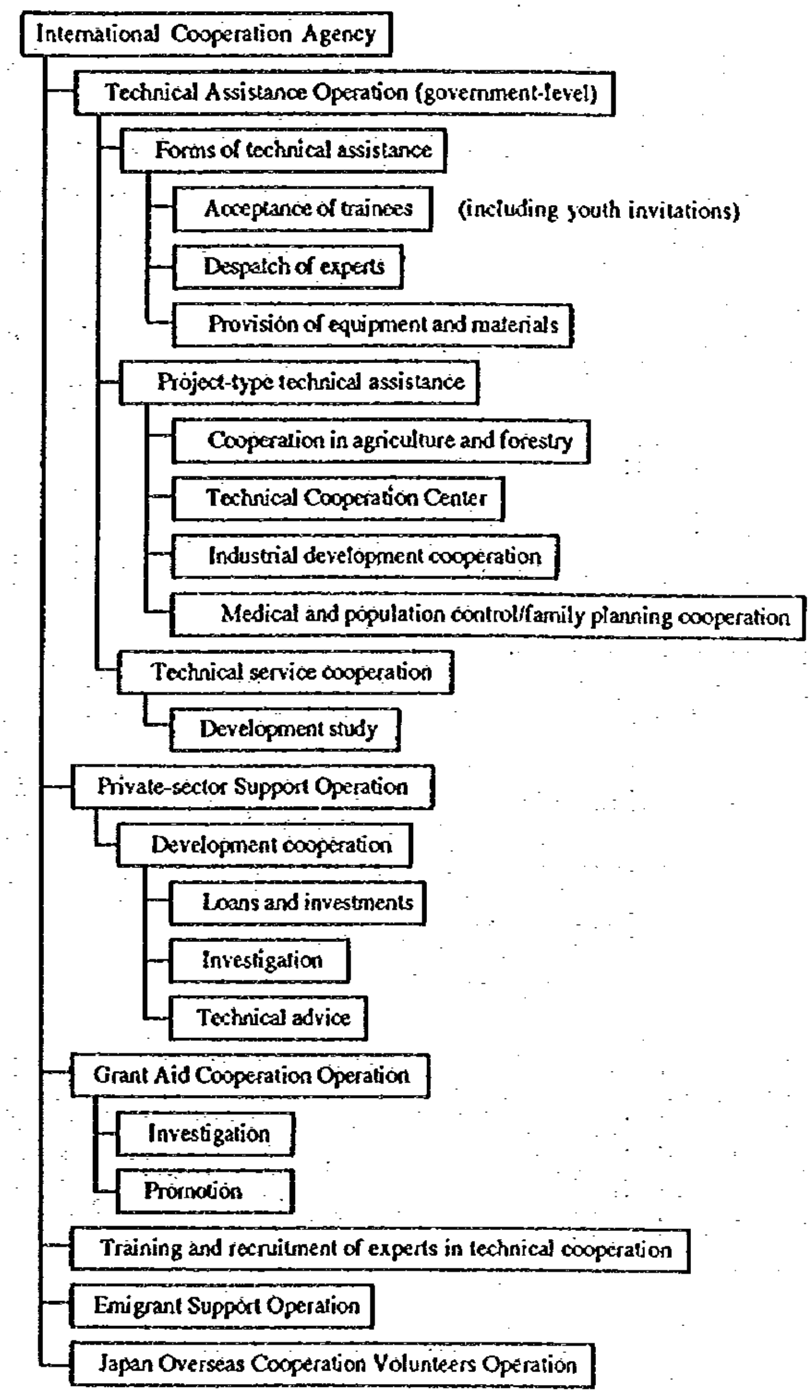
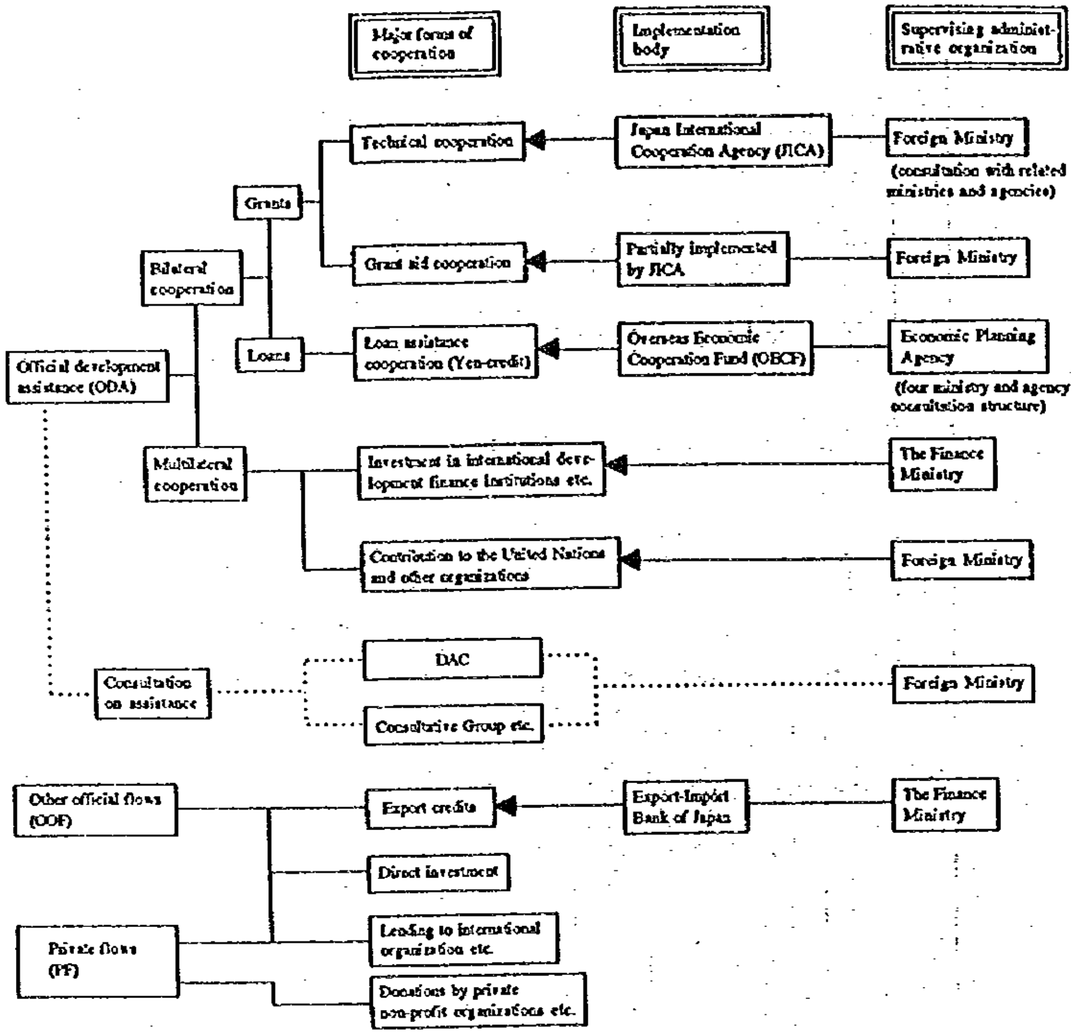


Figure A3.2 — Implementation Structure of Economic Cooperation



Japan International Cooperation Agency: Established on August 1, 1974 through the reorganization of the International Technical Cooperation Agency (established in 1962 to provide government-level technical assistance services) and the Overseas Emigration Agency (established in 1963), by taking over the services provided by these two organizations.

Overseas Economic Cooperation Fund: Established on March 16, 1976. Funds: ¥352.8 billion (as of the end of March 1976). Main services: Extending loans to governments of developing countries etc. as well as investing in and extending loans to development projects

Export-Import Bank of Japan: Established on December 28, 1Dh09 Funds: ¥761.3 billion (as of the end of March 1976). Main services: Export financing for ships, plants, etc., overseas investment financing, import financing, and lending to foreign governments.

Figure A3.3 — Function and Role of the Development Study

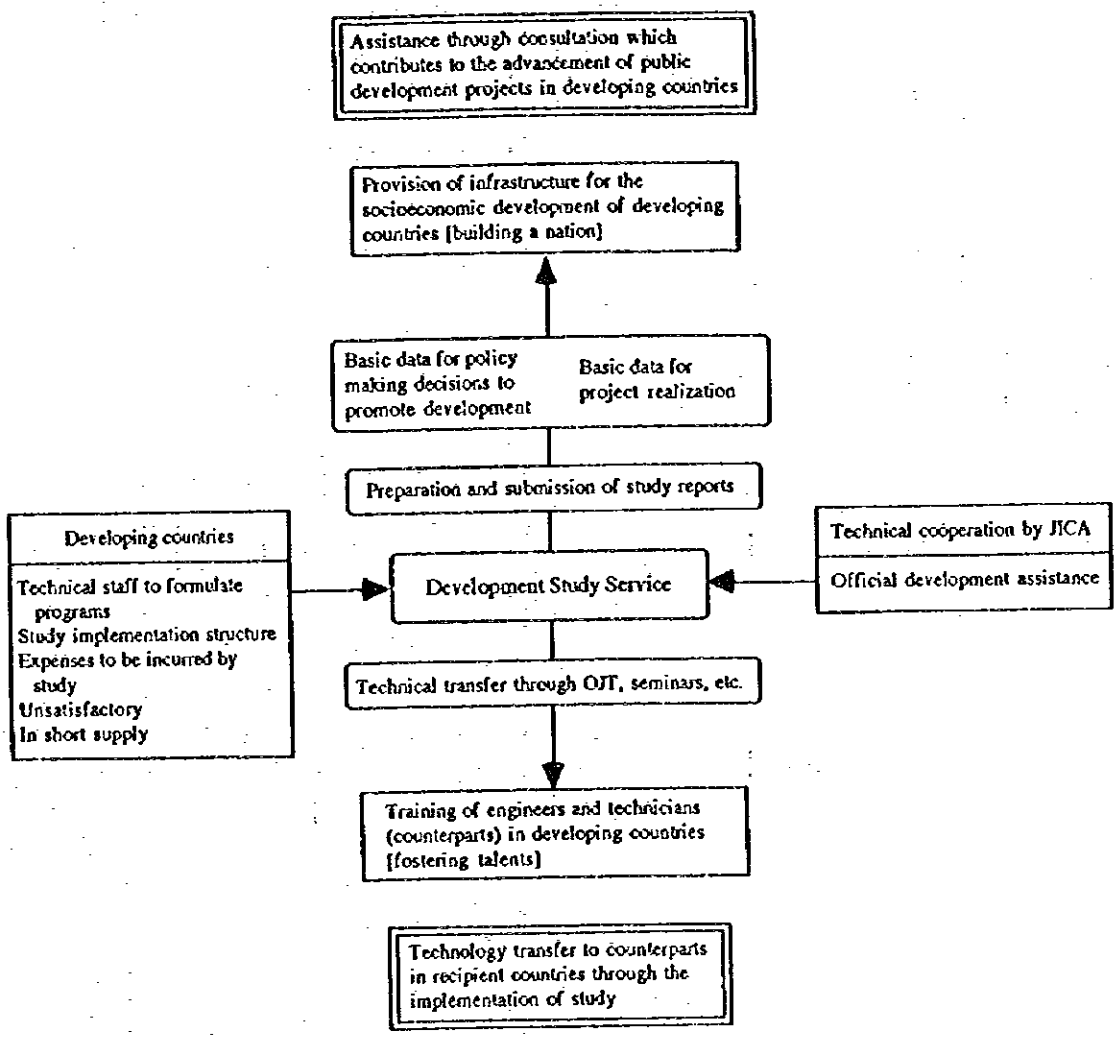


Figure A3.4 — Types of Development Study

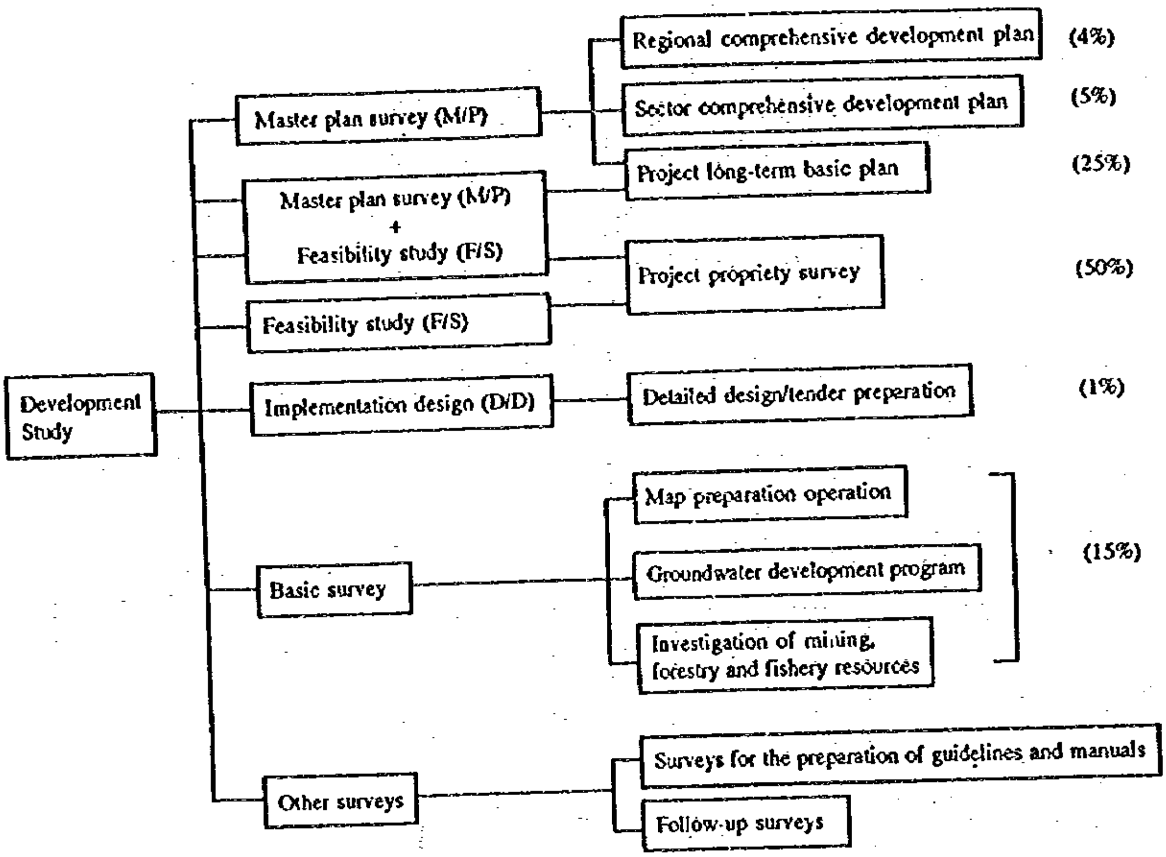


Figure A3.5 — Cycle of Japanese Assistance Project

Stages		Implementation step		Related organizations
Finding	1st Stage (finding)	• Collection of information relating to economic and social infrastructure	....	Government of prospective recipient country ⇄ Local embassy
	↓	• Understanding of development needs		
		• Formation of project idea		
	2nd Stage (formation period)	• Preparation of T/R for project		
	↓	• Request for assistance	....	Government of prospective recipient country → Local embassy
Selection	3rd Stage (selection stage)	• Evaluation of practicability and propriety of assistance and adoption of scheme	....	Foreign Ministry/JICA
	↓			
	4th stage (confirmation stage)	• Implementation of preliminary study and agreement on S/W for full-scale study	....	JICA
	↓			
Preparation (study)	5th Stage	• Implementation of full-scale study	....	JICA (consultants)
		• Preparation of a study report		
	↓	• Decision making on whether to recommend project implementation	....	Recipient country
	6th Stage	(Grant aid)		
		• Request for grant	....	Prospective recipient country government → Local embassy
	↓	• Evaluation of practicability and propriety of assistance and adoption of scheme	....	Foreign Ministry/JICA
			....	JICA (consultants)
		• Implementation of basic design survey	....	Cabinet meeting
			....	Cabinet meeting
		• Evaluation on whether to provide grant aid	....	Both governments
		• Decision to provide grant aid		
		• Signing of exchange of notes	....	Recipient country → Local embassy
		(Loan assistance)	....	Foreign Ministry, Finance Ministry, Economic Planning Agency and Ministry of International Trade and Industry
		• Request for loan		
		• Evaluation of request		
			....	Cabinet meeting
			....	Both governments
		• Decision to provide loan		
		• Signing of exchange of notes		
Evaluation	7th Stage	• Negotiation of loan contract with	....	OECF/Recipient country
	↓	• Investigation by lending organization	....	OECF
			....	OECF/Recipient country
		• Conclusion of loan contract		
Design	8th Stage	• Selection of consultant	....	Recipient country (OECF)
		• Implementation design	....	Consultant
	↓			
Survey and construction	9th Stage	• Procurement of equipment and services (erection work)	....	Recipient country government
	↓	• Execution of erection work	....	Contractor
		• Implementation of loan	....	OECF
		• Construction management	....	Consultant
Commissioning	10th Stage	• Commissioning of facilities	....	Recipient country government
	↓			
Assessment	11th Stage	• Confirmation of the effectiveness of assistance (follow-up assessment)	....	JICA, OECF, etc.

Figure A3.6 — Implementation Process of Development Study

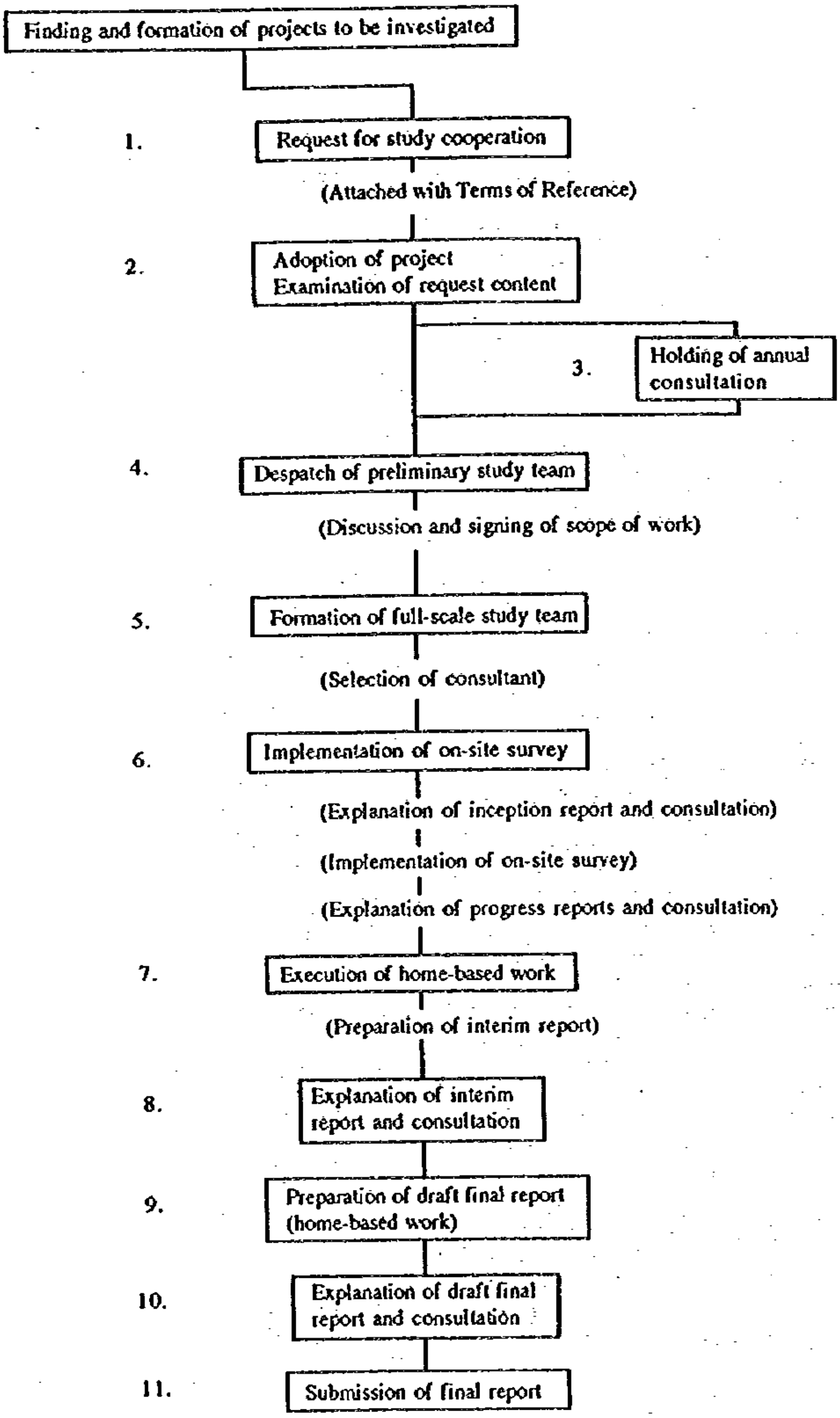


Figure A3.7 — Necessary Action in Each Stage of Development Study

No.	Item	Implementation body	Explanation	Remarks
1	Request for study cooperation	Requesting country → Local Japanese embassy	(1) Request is to be made with a verbal note (Note Verbal) (a document containing a statement to the effect that a request is being made for the implementation of a study) attached with a survey request (Terms of Reference)	(1) The issuer of the verbal note should be the representative of the organization which coordinates economic cooperation projects in the recipient country. (2) Content of TOR 1) The project name and objectives, study area, stage (M/P, F/S etc.) and content, prospective project implementation body, facilities to be provided by the requesting country, the study implementation schedule, etc. for the project being proposed should be described and included. 2) As the background to the requested study, its position in the overall national development plan, priority, and the necessity of the study (e.g. the state of damage) should also be included. It is also desirable that the prospective source of funds for the implementation of the project after the completion of the study, as well as maps, data, the existence of reference materials, etc. related to the study be described and included for reference.
2	Examination of the content of the request and the adoption of the proposed scheme	Foreign Ministry, JICA	(1) Evaluation is to be made of all proposed schemes from various countries as to the necessity and propriety of conducting a study as well as Japan's capability of accommodating them, with consultation taking place on successful schemes for which a study will be conducted. (2) Views are sought on technical matters from ministries and agencies supervising the area involved in the proposed scheme as necessary.	(1) Criteria for evaluation of proposed schemes: 1) Present state, problems, the propriety of the development method in the proposed scheme and its urgency 2) Prospect of developmental effectiveness (economy, society and politics) 3) Compatibility with programs of higher precedence 4) Present state of the prospective project implementation body (e.g. financial state, technical capabilities and staff structure) as well as the prospective source of funds for project implementation 5) Its position with regard to Japan's past cooperation (technical and financial cooperation) 6) Trends in other aid organizations' operations to provide assistance (e.g. collaboration and emphasis) 7) Availability of basic data (data on natural conditions as well as hydrological and statistical data)

				8) Existence of environmental problems (natural as well as social environments) 9) Conditions of public peace and order
3	Despatch of a study team for annual consultation (project confirmation)	Foreign Ministry, JICA	Based on the evaluation results in "2" above, a decision is made on whether to adopt the proposed project after consultation with the requesting country. Depending on the consultation results, an order may be issued to JICA to implement a study.	Countries under an annual consultation arrangement with Japan are informed of the results in "2" above through the local Japanese embassy.
4	Despatch of a preliminary study team	JICA	Prior to the implementation of a full-scale study, a preliminary study is conducted to undertake the following tasks: (1) Prior investigation of the content of the request and the setting of a basic work direction (2) Site surveillance (3) Preparation of a work direction outline (Scope of Work) and consultation (including the requesting country's share of burden and provision of facilities) (4) Preparation and submission of a report incorporating suggestions and recommendations regarding the implementation of a full-scale study.	The preliminary study team is despatched after the embassy obtains confirmation of its acceptance from the requesting country.
5	Composition of the full-scale study team	JICA	(1) For the implementation of a full-scale study, a private-sector consultant is chosen and appointed to undertake the study work under contract. (2) An advisory committee is established as necessary in order to give technical advice to private-sector consultants.	
6	Implementation of full-scale study/on-site survey	JICA (consultant)	(1) The study team (consultant) prepares an inception report through home-based work, incorporating concrete study items, methods and schedule as major components, based on the agreed S/W, etc.	Prior to the implementation of a full-scale study, the local Japanese embassy issues a verbal note to the representative of the requesting body informing him/her of the commencement of the survey, and receives a verbal note from the other party in reply. With this, an international obligation for the implementation of the survey is considered to be established.
			(2) On-site investigations are basically conducted on the following items: 1) Explanation of the inception report and consultation 2) Collection of study-related data and information 3) Detailed survey of the area to be covered by the study 4) Examination of natural conditions necessary for technical investigations such as surveying and boring 5) Preparation and explanation of a progress report and consultation.	Implemented through joint work with counterparts appointed by the requesting country

7	Home-based work	Same as above	A report is prepared on the on-site investigation results, and submitted and explained to the competent authority of the requesting country. For some schemes, such as large-scale projects or those covering a large area, an interim report is usually prepared incorporating the work results up to the establishment of the basic direction of project formulation (e.g. establishment of alternative plans and the selection of an optimum one)	Depending on the project, an interim report is sometimes prepared during the on-site survey.
8	Submission and explanation of an interim report and consultation	Same as above	(1) An interim report is submitted to the competent authorities of the requesting country with consideration made to avoid impediments to the implementation of future work by holding consultation and explaining the results of home-based work. (2) Additional on-site investigations are undertaken as necessary.	
9	Preparation of a draft final report	Same as above	The survey results from each of the above stages are compiled as a draft final report. This report should have accuracy and content suitable to become a final report, without change, if no comment has been made by the requesting country.	
10	Submission and explanation of a draft final report and consultation	Same as above	A draft final report is submitted and explained, while consultation is held asking for any comments from the requesting country.	
11	Submission of a final report	Same as above	A final report is prepared and submitted to the requesting country after any modifications have been made based on the above comments.	

Annex 4[4]

Choice of Technology

- The number of technology options available for selection is very large
- The status of drinking water supply has always been and will continue to be the primary criterion in the choice of technology for environmental sanitation.
- Today, it is accepted practice, however, that many other technical and non-technical factors are considered in choosing technology for environmental sanitation in developing countries.
- The step-wise upgrading of technology is the most realistic approach in the preparation of long-term development plans for sanitation in the developing countries.

4.1 Technology Options

The technology options for environmental sanitation cover a very wide range — from rudimentary open pit latrines, on the one hand, to, on the other hand, water-borne sewerage systems with high-tech technology for the treatment of waste water, followed by the safe disposal or re-use of effluent. Their unit, or *per capita,* initial and recurrent costs, and their managerial, operational and financial requirements, also cover a wide range; a full-scale and high-tech sewerage system may cost as much as 2000 US Dollars *per capita* and more, and will call for a sophisticated organization to operate and maintain it. In contrast, a rudimentary open latrine may cost very little but certainly does not meet most criteria of public health and convenience.

Much research has been undertaken and many books and reports have been published on the technology options for environmental sanitation in the developing countries. One of the first publications of international relevance was the WHO Monograph No. 39, on "Excreta Disposal in Rural Areas and Small Communities", 1958. Many others followed, based on

[4] Source: International Environmental Planning Center, Tokyo, Japan

research by such organizations as the IRC–Water and Sanitation Centre, the London School of Hygiene and Tropical Medicine, the Water Engineering and Development Centre, the World Bank, various bilateral aid organizations, e.g. IDRC, SIDA and the SDC, and a number of research establishments. The WHO updated its early Monograph No. 39 in 1992 and issued additional information recently.

Today, off-site and on-site sanitation stand side by side as the two principle options ready for application. This has not always been the case. Off-site sanitation, of course, is commonly used in the developed part of the world but its cost and other requirements have proven prohibitive in very many cases in the developing countries — even though lending for such system by the international and bilateral funding organizations can be relatively easy. In such cases, the challenge for the planner is to choose from among the options of on-site sanitation with due consideration of the imperatives posed by implementation, operation and maintenance, and funding.

This is not the place to review the literature regarding the technology options for environmental sanitation. Selected references are shown in the "Notes", and additional information is contained in Annex 2.

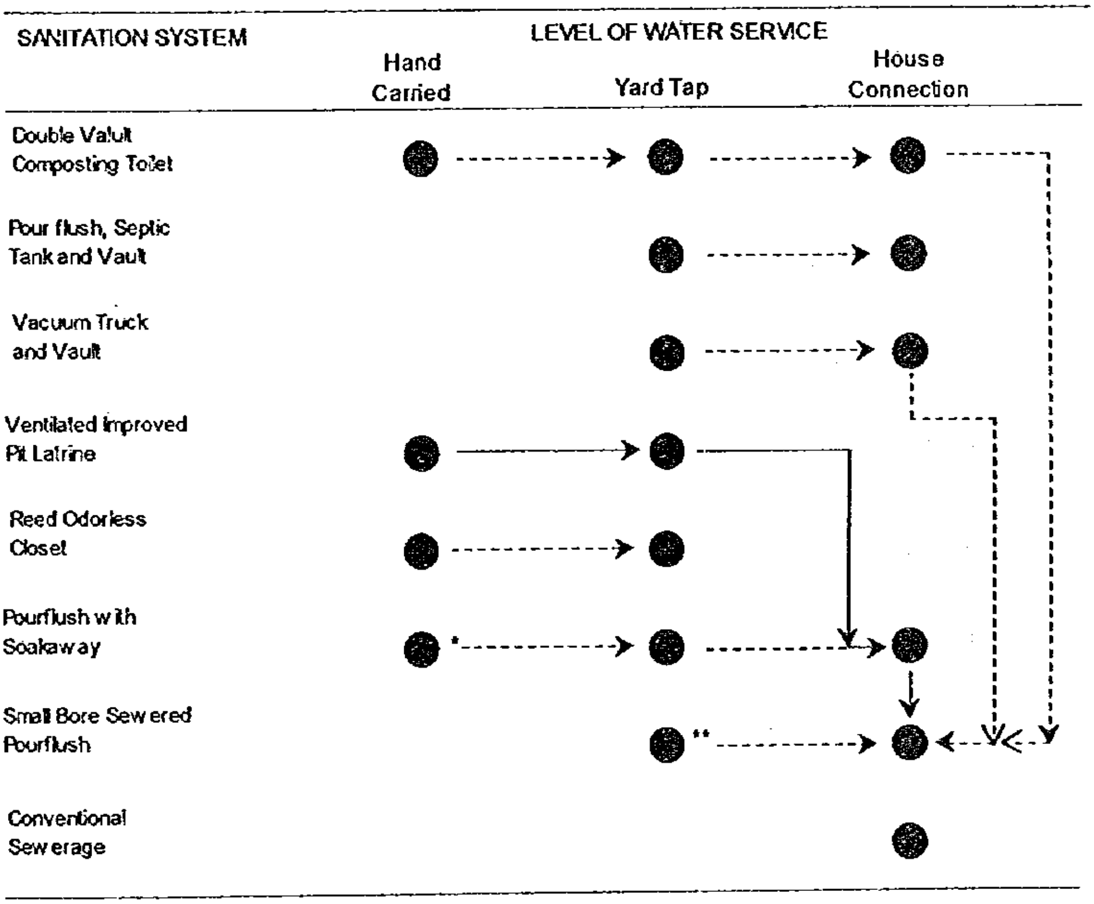
4.2 Conventional Approach

It is compelling logic that the capacity and the technology of environmental sanitation must be commensurate with the amount of waste water to be handled. Yet, this logic is too simplistic for two reasons, i.e. (i) the system must not only handle waste water (gray water) but, in the first place, human excreta, and (ii) the system must always meet public health criteria in addition to merely handling a certain quantity of water. Thus, it has already pointed out that even if only very small amounts of drinking and household water are available, rudimentary open latrines are undesirable and should be replaced by more sanitary technologies, such as double vaulted composting toilets, Ventilated Improved Pit Latrines, or pour flush latrines with soakaway.

On the other hand, it goes without question that the planning of environmental sanitation should be based on the level of water service, as has been the conventional approach for many decades. It is important to anticipate the future levels of water service rather than accept an existing situation as a design criteria. It should always be assumed that the water services will be improved, even if only gradually. For instance, if the distance for hand-carrying water is reduced by the introduction of a piped supply with public outlets spaced, say, at 200 m, the amount of hand-carried water will thereafter be substantially greater than that in situations where water must be fetched from natural sources over long distances — perhaps miles. Similarly, if taps are installed at or in the yard of dwellings, the amount of water drawn will increase again. Ultimately, if house connections are available, more and more waste water will be produced.

Some criteria for the choice of technology options have been exhibited in Annex 2. More details are discussed in Figure A4.1, which relates sanitation technology to the level of water service to be anticipated in a project area. The Figure demonstrates that several technology options are available whenever water is supplied through yard taps, according to the circumstances. The number of options decreases when house connections are introduced and ultimately, only two broad categories of options remain, i.e. small-bore sewered pour-flush latrines and, finally, a conventional sewerage system.

Figure A4.1 — Technically Feasible Sanitation Sequences



* Feasible if sufficient pourflush water will be hand carried
** Feasible if toilet wastewater flow exceeds 50 liters per capita daily
Source: Economic Development Institute, The World Bank, Low Cost Sanitation

4.3 Factors Considered Today

In Table A4.1, some of the most common factors are listed that should be considered nowadays when the technology for environmental sanitation is chosen. Obviously, the Table is a general guideline only, since for each project the planner must decide which of the factors are relevant in the specific case.

Table A.4.1 Factors Commonly Considered

Factors Commonly Considered	
Type	**Factors**
Physical	Aridity Frequency of floods Availability or lack of land Type and design of housing Squatter areas and slums Population density
Environmental	Environmental absorptive capacity Water quality protection
Public health	Contamination of drinking water Endemic diseases Vectors of disease Re-use of waste water Occupational risks associated with nightsoil
Engineering	Status of water supply and its likely future development Water resources Availability of construction material Constraints imposed on construction methods Availability of equipment, pipes and other supplies Availability of labor for construction
Management and finance	Availability, or lack of it, and source of funding Willingness of the beneficiaries to pay Capacity of the management organization Participation of the beneficiaries O&M requirements Degree of sustainability Private sector participation
Sociocultural	Perception and response of the beneficiaries Insufficient appreciation by government and foreign Consultants of cultural factors Participation and community action for O&M

4.4 Step-wise Upgrading of Technology

4.4.1 Need for Step-wise Improvement

Appropriate sanitation systems shown in conventional guidelines do not normally reflect the time required to develop water supply and sanitation in a developing country to the "desirable" level — which often is more than 10 years, or even a couple of decades, because of tight financial situations and other constraints. It is important, therefore, to pay attention not only to the final goal but also to the intervening process and necessary steps to arrive at that goal.

In the development of appropriate sanitation, there are always two major alternatives, i.e. off-site sanitation and on-site sanitation. (Each offers several options within itself.) The selection among these two basic categories is always controversial because, on the one hand, the people and the recipient usually prefer the installation of an off-site system; whereas, on the other hand, the lack of money, the operational and maintenance implications of technology, and the lack of cost-sharing render such systems infeasible in many situations prevailing in developing countries. Even if the users can afford to pay for off-site sanitation, it may be many years before tertiary sewers reach the beneficiaries. Thus, a "second best" solution may be required for the intervening period of time..

Three terms are used in the following paragraphs:

- Should-be picture — This would be the "desired" solution. For example, in densely populated area, the should-be picture would be a conventional system of off-site sanitation or, perhaps, low-cost sewerage. In rural areas, it would be VIP-latrines or other on-site systems. But in both cases, the should-be picture is the "ideal" solution chosen without due consideration of the time it may take to achieve this goal.

- On-the-way picture — This would be the practical and appropriate intermediate solution. For example, wherever the should-be picture is an off-site system, the on-the-way picture may involve some temporary use of on-site technologies, during a period of time, while the off-site system is gradually introduced.

- Step-wise improvement — This concept, introduced by the International Environmental Planning Center of the University of Tokyo, implies that the development plan (i) responds to the most pressing needs and (ii) makes the best use of available resources by defining the most feasible on-the-way technologies or improvements which will finally lead to the should-be picture. This implies:

  1) Step-wise improvement must address the health implications of intermediate solutions in the light of current health states, especially the degree to which they are determined by the current state of environmental sanitation. Health indicies must be used to evaluate these implications in the first instance rather than environmental ones, i.e. the fecal coliform contamination should be considered rather than the biochemical oxygen demand (BOD).

  2) Step-wise improvement is different from part-by-part improvement, since its steps imply the gradual upgrading of technology --- as is implied in the example used in the explanations for "Should-be picture" above, i.e. the gradual change-over from one technology to another in keeping with resources available, rather than the introduction of the "final" technology according to a phased construction schedule. Obviously, therefore, step-wise improvement requires careful attention to avoiding "double or repeated investment" and also to the economics of deferred investment.

4.4.2 Identification of the Should-be Picture in Japanese Experience

An important step in the definition of the should-be picture is the "demarcation" of, respectively, the off-site part and the on-site part of the project area. After the demarcation, specific technologies would be reviewed for both parts and the most appropriate chosen.

In Japan's domestic programme for environmental sanitation, off-site technologies are usually applied in urban areas. However, in peri-and suburban areas, the difference in cost-effectiveness between off-site and on-site sanitation must be studied. Planning methodology for the demarcation has been established by the Ministry of Construction.

Each prefectural government, together with the municipalities, makes area maps on which on-site and off-site areas are demarcated for each inhabited sector, including small communities. On-site sanitation is usually by combined *Jokasos* (in-site treatment of nightsoil and gray water) whereas off-site sanitation normally implies the use of a conventional sewerage system. The methodology rests on cost comparison over 30 year of the initial investment cost and the cost of operation and maintenance of the two technologies. In this context, it is assumed that the lifespan of on-site sanitation is 15 years and of off-site sanitation 30 years. In the case of off-site sanitation, construction costs include both the sewer network and the sewage treatment plant. After the cost comparison, the most economical alternative overall is chosen as the should-be picture.

4.4.3 On-the-way Picture

According to the concept of "Some for All rather than More for Some", the should-be picture may need to be scaled down and temporary systems introduced for the time being. This is the essential concept of "step-wise improvement". Figure A4.2 exhibits this approach, which may imply the following steps:

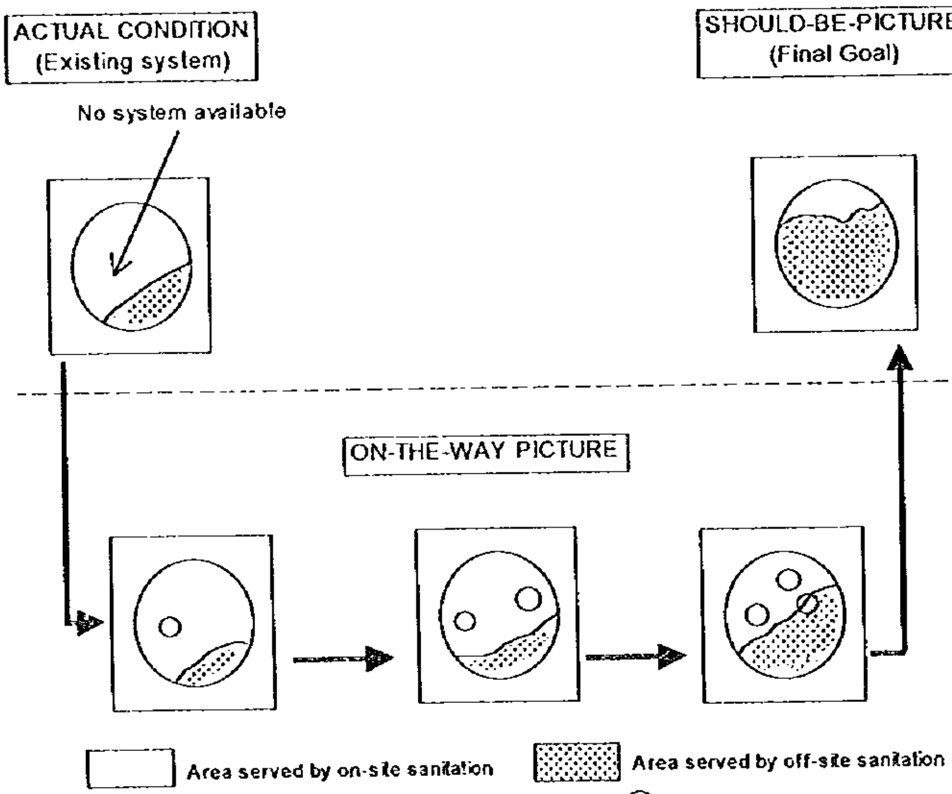
- Prevention of the discharge of human excreta into the environment by prohibiting open defecation or the use of "over-hung latrines".
- Installation of public toilets or individual on-site sanitation (e.g. pour-flush toilets with septic tank or leaching pit if no appropriate system for the treatment of sludge is available).
- Investment in desludging equipment and facilities for servicing individual on-site sanitation.
- Gradual development of the total area, and construction of temporary small-scale treatment facilities.
- Connecting temporary treatment facilities to the final off-site system.

In Figure A4.2, the temporary small-scale treatment facilities are shown as small circles and identified as "Modular systems" in the legend. The purpose of step-wise improvement is to maximize the benefits by the best spatial and time-wise allocation of available resources, and with due regard to the specific circumstances of the project, especially the health implications. This approach is not without risks, however, and requires careful planning of investment and the avoidance of "double or repeated investment". Planning will be facilitated by a choice of technology based on the following considerations:

- The choice of technology must also include respectful consideration of locally existing technologies, and should not be a total "transfer" by the external aid organization.
- Maximum use of locally available materials and labour is desirable.

- Technology and methods should encourage participation and self-help.
- Past performance should be looked at, of similar projects under similar conditions in that country.
- Capacity for O&M could be a limiting factor.
- Willingness and ability of the beneficiaries to pay and participate in cost-sharing affects the pace of transition.

Figure A4.2 — Concept of On-the-Way Picture



Source: INTEP

Annex 5

Social Studies

In Sections 4 to 8, a case was made for the study of the societal aspects of every project for environmental sanitation. The purpose of such studies is:

- to obtain basic information for the preparation of the project;
- to identify questions requiring answers during the preparation of the project;
- to identify, plan and implement project support measures;
- to enable post-evaluation; and
- to identify research and information activities to be carried out in conjunction with the project.

> Social studies cannot be planned and carried out in the consultants' home office. They involve local investigation and consultation with the people in accordance with local traditions.
>
> The subjects investigated will normally encompass the beneficiaries, the best form of their participation, the choice of technology, cost recovery, empowerment, integration with other measures, and the social factors contributing to the risks of the project.

Basically, social studies deal with people — population groups and the way they are organized, act and interact. Thus, social studies are only one aspect of project planning and design. The others are the technical, economic and financial, and managerial studies undertaken in the course of the development of a project for environmental sanitation.

5.1 The Planning and Implementation of Social Studies

No single model is available for the planning and implementation of social studies. But there are universal requirements, e.g.:

- The studies cannot be planned and implemented in a vacuum. Planning must involve the target population itself and the implementation must be on-site.

- The method of the study must be culture-specific, especially as concerns the process of interaction with the target group, and not forgetting the women. Gender bias can doom sustainability. Consultation with all concerned should therefore be the key operational approach.

- The degree of government participation must be determined by country-specific factors.

- Social studies cannot be successful unless they are conducted with the full and active participation of local, and — in many cases — non-governmental and female investigators; you need the informal leaders on your side, not in opposition.

- Every social study, in addition to yielding information, should be designed to be a means to motivate participation.

5.2 Subjects for Study

What follows is a listing of subjects that often require social studies, although others may be added to the list in accordance with the needs of each specific project. Eight subjects have been derived from the points made in relation to social matters in Sections 7 and 8. For each subject, a few items are listed to which the studies might give particular attention. The lists are "by way of examples" and cannot be more than general suggestions for the planning of the studies. In any case, it should be borne in mind that each study must be planned in light of the local conditions it will address, so that its outcome will allow the design of tailor-made project-support measures and/or serve as genuine guidelines for the planning and design of the project as a whole. Many of the items relate to several of the subjects listed.

Many, if not most of the subjects listed below, relate to the beneficiaries and how they can be motivated to take an active part in the preparation, implementation and subsequent O&M of the project that is being elaborated. As has been pointed out in Chapter 8.3.5, their sufficient level of awareness of the problems, benefits, and solutions regarding environmental sanitation is an important prerequisite in motivating them. Health education is considered the essential instrument for motivation. Therefore, health education may in itself be a subject for study — in which case, items listed below under numbers 5.2.1 through 5.2.7 would be studied in addition to health statistics and population data related to the communicable diseases originating from the environment.

5.2.1 Beneficiaries (Target Group)

Projects cannot be planned without a wide gamut of information on the beneficiaries, both as individuals and as part the community. The items for study include:

- Demography.
- The distribution of health states.
- Literacy.
- The awareness, understanding and perceptions of the beneficiaries with respect to hygiene and health, their preferences and felt needs, and the priorities they give to environmental sanitation *vis-à-vis* other needs, and why.
- Misconceptions.
- If there is a lack of understanding, the reasons for it.
- The sanitary behaviour at the level of the individual and the family.
- The attitudes towards ownership and participation.
- Gender roles.
- Income levels and other socio-economic factors, and their distribution.

5.2.2 Form of Participation

Participation may "make or break the project". A great deal of specific, localized information is needed for promoting and achieving it, e.g. what is:

- The understanding of participation on the part of the individual and the community and of what may be involved, e.g.: decision-making, cost sharing, contractual obligations, labor.
- The degree of social readiness to accept responsibility for communal affairs.
- The underlying social structures, and the implications of the country's legal and political system.
- The tradition with respect to ownership.
- Other facilitating factors and constraints.

5.2.3 Choice of Technology

The planner must choose technology against the background of people's perceptions. To make a judgement, information must be available on, e.g.:

- The people's perceptions and expectations with respect to the range of possible technologies *per se,* their optional service levels and of their costs and methods of funding.
- Past experience with sanitation technology.
- The implications of alternative technologies with respect to the readiness for cost sharing.
- The variations between high-income *versus* low-income groups.
- The implications of O&M requirements.

5.2.4 Cost Recovery

Cost recovery is the acid test for the quality of the project and its preparation. It takes into account, *inter alia*:

- The beneficiaries' awareness of the risks of bad environmental sanitation, and of the benefits that can be accrued with good environmental sanitation.
- The value of privacy.
- Understanding of the technical options, their respective costs, and available funding.
- Acceptance of the need for cost sharing and financial participation.
- The history of cost sharing in other fields.
- The beneficiaries' income and income distribution.
- Affordability and the people's willingness to pay, and cost distribution within the community.
- Incentives required, e.g. credits for latrine components or house connections.

5.2.5 Empowerment

The factors facilitating or constraining community management of environmental sanitation must be very well understood by the planner, e.g.:

- The existing social organization, its strength and weaknesses.
- The influence of the country's legal and political structure.
- The degree of readiness and the capacity of the community and local organizations.
- Government structures in the sector and related sectors.
- Miscellaneous facilitating factors and constraints.
- Synergistic effects of linkages with other developmental measures planned or under way.
- The presence of the private sector.

5.2.6 Integration

Integration with other developmental measures to improve health and hygiene, especially water supply, food, solid waste, environmental pollution, and water resources protection.

Benefits may be offered by linking environmental sanitation with other development measures, although, without a full understanding of the situation by the beneficiaries, no effective linkages can be proposed. Points to be explored include:

- General hygiene practices at the levels of the family and the community and their respective impact on health.
- Health implications of prevailing conditions.
- Perceptions and preferences of the beneficiaries as to the priorities among the above.
- Opportunities offered by other development measures in the project area.
- The role of schools.
- Synergistic effects.

5.2.7 Risks

Prior risk assessment is an imperative for the sustainability of sanitation projects but cannot be undertaken without information regarding the beneficiaries and the community. This may involve:

- Their general literacy and especially health literacy.
- Their sanitary behavior and perception of cleanliness.
- The existing conditions regarding the up-keep of present sanitary facilities by the beneficiaries.
- The degree of motivation of the beneficiaries.
- The effectiveness of community structures.

5.2.8 Research and Information Activities

For monitoring and follow-up, research and information programmes may be needed if so indicated. The following social factors may be included:

- Health states and their stage of evolution.
- Sanitary behavior and changes occurring in it.

Annex 6[5]

Financial Analysis and Cost Recovery

Financial analysis is undertaken to determine the financial features of projects, including how revenues are created to meet the annual cost.

> Financial analysis is essential to projects whether funded through loans or Grant Aid. It will provide the information for establishing the total financial and economic costs of the project. It should also be used in selecting the best project alternatives.
>
> Financial analysis includes selection of the best method of raising revenues to cover all or part of the costs of the project.
>
> The funding agencies require that effective financial management be developed during the preparation of projects for subsequent funding.
>
> The method described hereafter represents good management but must be scaled down in the case of on-site sanitation.

6.1 General

The overall objective in financial management is to maintain cash liquidity. However, in real life, this objective is often not achieved when dealing with environmental sanitation, and it is for that reason that international and bilateral funding institutions hesitate to make loans. They fear that the projects, once built, may fail to perform because revenues are below expected levels. Some of the common errors found in the financial management of environmental sanitation and their effects on the performance of projects are exhibited in Tables A6.1,A6.4 and A6.5.

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[5] The permission of WHO to make extensive use of "Financial Management of Water Supply and Sanitation" (Geneva, World Health Organization, 1995) is kindly acknowledged.

The International Drinking Water Supply and Sanitation Decade provided ample proof that sharing costs between government and beneficiaries is not only essential but also feasible. Financial analysis, both of project alternatives and of the proposed project, is the tool necessary for arriving at a practical arrangement under which the beneficiaries will be able to financially participate. The operating organization or the involved government agency, for their part, must focus on cost containment on the investment side and on consultation with the beneficiaries to determine their willingness to pay. A rate or tariff structure should assure that expenses are covered.

6.2 Financial Analysis

Financial analysis should start when the alternatives for achieving the project's objectives are investigated. The analysis should cover construction, O&M, and calculation of the total annual cost. Of course, at this stage, only rough and preliminary estimates are available since implementation design has not yet started. Construction costs would be divided into foreign and local cost, and the local cost should be divided into cost covered both by cash and in kind, i.e. divided into capital, material, and labor cost, including labor provided by the beneficiaries. The latter must also be considered when the beneficiaries assume part of the cost of operation and maintenance.

On the basis of the above information, the total annual financial cost can be estimated. The cash expenditure must include interest payments on foreign and local loans. The estimate of the total annual cost, in local currency, will then allow calculation of the amount to be recovered from the community. Should this show that full recovery will not be possible, changes in the scheme must be made, including a reduction in cost and/or shifting capital cost from loans to Grant Aid.

After the best technical solution for achieving the project's objective has been selected, full and precise financial analysis can begin, using the format presented in Table A6.2. The analysis will be based on (i) financial data derived from preliminary engineering designs rather than being preliminary estimates only, and (ii) revenues which can be realistically expected. In this context, the total financial costs are made up of three components, i.e.:

- Capital cost, which is the sum of interest, repayment and depreciation;
- Costs of running the system and producing its output, including the cost of materials, consumables, spare parts and miscellaneous services and contracts; and
- Personnel expenditure and general overhead.

As part of a full analysis, the economic costs of the project are also of interest, especially if the project competes for national and/or external resources, either with other projects for environmental sanitation or with projects in other sectors. The economic cost is different from the financial cost because it measures the cost to the country of making available environmental sanitation. In other words, the financial cost of the project is made up of the three components listed above, whereas the economic costs contain only those elements that could have been otherwise utilized if the project had not taken place, such as:

- Cost of capital — at the rate of return at which the money could be invested in other projects for environmental sanitation or in other sectors;
- Cost of construction, O&M, equipment, personnel, goods and services, evaluated in economio terms and reflecting the actual use of resources; and
- Value of time if expenditure had been postponed.

The average incremental cost (AIC) is a useful indicator for tariff setting, in the case of off-site environmental sanitation. Similarly, the internal rate of return (IRR) of the project is an indicator for comparing the proposed programme with a number alternatives. The IRR is the discount rate which the sum of discounted cost increases and discounted service increases so that the present cash flow is zero. A format for the calculation of the AIC is contained in Table 3.

6.3 The Creation of Revenues

The raising of revenues is a matter requiring consultation with the beneficiaries so as to determine the best method or mix of methods, e.g.:

- Community fund raising: beneficiaries finance or partly finance the project by contributions to various community funds or payment of taxes, especially for projects where all households are provided more or less identical environmental sanitation (where a mix of on-site and off-site sanitation and/or a variety of service levels are proposed, user charges to reflect these differences in service will be usually more appropriate).

  For community fund raising, a number of options exist, e.g.:

  - ad-hoc contributions
  - revolving funds;
  - communal revenue levies; and/or
  - cooperative unions.

- Indirect taxes: this method is not advisable for communities without an adequate taxation base and effective tax collection. Where indirect taxes are used, it must be assured that the funds collected for the project will unfailingly be transferred from the taxation agency to the operating agency (this is often not the case).

- User charges: they are made after the system has been built and put in operation. They can be:
  - connection charges in the case of off-site environmental sanitation, and for on-site systems which receive a loan or grant and/or which are serviced regularly by the operating agency;
  - fixed charges levied on households depending on the number of people in the household and/or the drinking water consumed. They may be applied in the case of both off-site and on-site systems.
- Contributions in kind, e.g. latrine construction and/or maintenance.

Consultation with beneficiaries must include a study of their willingness to pay. The study of the willingness to pay for environmental sanitation is inextricably linked with the beneficiaries' perception the benefits which can be accrued from improvements in individual and public health and the quality of life. In most cases, therefore, research for the study of willingness to pay will involve a number of project-support measures of the kind discussed in Chapter 8.3.4.

6.4 Ensuring Effective Financial Management

The project proposal submitted for appraisal by the prospective funding agency or agencies will exhibit institutional and managerial arrangements made for the financial management of the system. This will include:

- Arrangements for the mobilization of the financial, physical and human resources required during construction and operation.
- Systems for recording, accounting and monitoring of the project's financial management, and for assessing its efficiency in the use of resources.

This implies that:

- Appropriate institutional development has taken place during the preparation and/or implementation of the project, including human-resources development;
- Accounting systems are in place to:
  - enable financial decisions;
  - indicate the level of efficiency in use of resources;

- determine to which extent the needs of the community have been met; and
- to keep account of cost recovery.

The choice of accounting system must be made dependent on the circumstances and the capacity of the institution. A minimum system may simply be a cash book in which all financial transactions related to the running of the system are recorded, together with a simple log of payments and receipts. A full system may be much more detailed and record investments and show how they have been financed, i.e. allowing the preparation of standard financial statements as they may be required. Ultimately, electronic data processing may be chosen. In each case, however, a procedures handbook must be established before the project is submitted for appraisal, containing instruction on standard practices and being suitable for training the staff of the operating agency.

All this will culminate in the preparation of annual financial statements made in accordance with legal and audit requirements, and will provide information for the planning and operation of the facility and its future expansion. The accounting system should comprise:

- balance sheets;
- income and expenditure statements;
- statements of sources and application of funds;
- cash flow analysis;
- details on debtors and creditors; and
- other management information reports as required.

It should be borne in mind that the information contained in the above reports will also be needed to inform the community and the beneficiaries on a regular basis. Typical formats for a balance sheet, a statement of income and expenditure and on the sources and the application of funds are each contained in Tables A6.4, A6.5, and A6.6.

6.5 Scaling Down the Analysis in the Case of On-site Environmental Sanitation

The difficulties associated with the funding, operation and maintenance, and timely replacement of on-site sanitation must not be considered sufficient reason for foregoing a financial analysis of such projects. Financial analysis should always be obligatory. But the analysis can be scaled down in the case of on-site sanitation by taking into account:

- the small investment usually needed for on-site sanitation as compared with off-site projects;

- the high ratio of funds needed for, respectively, software components *versus* hardware components;

- the high proportion of funding by the beneficiaries themselves in many cases, both with respect to initial investment and to operation and maintenance;

- the need for simple and community-based management which often must "learn by doing" in a cultural environment where people may look at government as being the sole provider of sanitation and which, thus, is not conducive to the application of strict financial and lending practices.

In light of the above, scaling down the financial analysis is necessary. This implies that the analysis is carried out in considerably less detail and on the basis of rather rudimentary data only — without, however, sacrificing the principles of financial analysis. Primary consideration should be given in that context to the following, at least:

- Repayment of financing that the beneficiaries obtained for construction of the on-site facilities, even if Grant Aid is involved;

- Payment for any services provided by the local or other organization, or from the private sector, e.g. during construction, and for operation and maintenance, including the relocation of latrines after they are full, the desludging of septic tanks, or the regular servicing of the on-site facilities; and

- Creation of programme/project reserves for extensions, replacements and technological up-grading.

Consequently, the minimal analysis would focus on:

- the annual income, expenditure and cash flow of the organization (Table A6.2);

- a statement on the sources and application of funds of the organization (Table A6.6); and

- the preparation of balance sheets.

Accordingly, the analysis will not include calculation of the AIC and the IRR, nor the economic costs of the project.

Table A6.1 Common Errors in Financial Management and their Effects

Errors	Effects
A. Financial & management accounting	
No clear accounting policies in place Backlog of accounts and regular reports allowed to build up Poor budgeting and budgetary control Lack of qualified staff Poor communication within the organization	Consolidation of information from different regions/offices is impossible Information available to managers is too little, inaccurate or late, so that they are unable to make soundly based decisions The effectiveness of the use of resources cannot be assessed.
B. Cash management	
Inadequate management information or financial planning leading to inadequate information on short- and long-term cash needs Inadequate links between cash-flow systems and budgeting systems means that cash requirements cannot be anticipated and provided for	*Either* Shortage of funds to make scheduled payments, e.g. to suppliers or repayments of debt Need to recover short-term deficits through expensive short-term borrowing *Or* Excessive surplus cash holdings, suggesting inadequate investment procedures and absence of financial planning
C. Tariff and charging policies	
Failure to understand the cost structure of the service provided Failure to understand the different types of consumers and their service requirements Failure to understand the behaviour of consumers in response to changes in prices Failure to undertake financial planning	Revenues do not cover costs, leading to liquidity problems — operating costs, debt service payments or working capital requirement cannot be covered The social objectives of the service may not be achieved
D. Billing and collection	
Inflexible and inappropriate payment arrangements for customers Inadequate management information does not identify debtor accounts Failure to take account of customer complaints Failure to take action on overdue accounts Late billing because of ineffective arrangements for revenue collection Inadequate accounting for bad debts	Poor and ineffective billing and collection leads to high levels of accounts receivable, and the expenditure of too much money on the procedures themselves, thus using up scarce resources and threatening the liquidity of the service

(continued on next page)

Common Errors in Financial Management and their Effects

Errors	Effects
(continued)	
E. Asset management	
Inadequate or inappropriate records of assets Failure to ensure efficient use of assets Failure to optimize life of assets through consideration of costs of maintenance and replacement Failure to adequately maintain assets	Financial statement may not reflect the true value of the assets to the service Wrong decisions may be made concerning the need to replace assets The depreciation allowance may be wrong, leading to longer-term problems of adequacy of revenues to cover costs and provide for service extension
F. Information technology (IT)	
Failure to address the proper role of IT Failure to include it in IT budgets, and inadequate allocation for support and training	Overinvestment or underinvestment in an IT system, its support and training requirement Selection of an IT system that does not improve customer service in a cost-effective manner
G. Procurement and inventory management	
Lack of clear strategy for procurement Inadequate storage capacity Opportunities for economics of scale in procurement are not used Purchase lead times not taken into account Inappropriate stores-valuation procedures followed	Inappropriate levels of stock: levels that are too high lead to wastage of money, in particular scarce foreign exchange, and perhaps to pilferage and wastage of stock; those that are too low hamper other parts of the operation of the service, e.g. maintenance
H. Capital structure	
Failure to determine all sources of finance and their terms Failure to take a long-term view of the implications of different types of financing Failure to address the appropriate mix of debt and equity	Failure to meet debt service payments, or to be able to sustain working capital requirements Failure to ensure sufficient return on capital
I. Organization of the finance function	
Failure to ensure that the organizational structure of the finance section is compatible with the aims of the finance function, e.g. with regard to reporting arrangements, information flow, manpower and skill levels	All other areas of financial management are hindered by inappropriate organization, as a result of inadequate information, reporting, manpower and skills, or possibly excessive costs incurred by the finance section

Source: WHO (1995). Financial Management of Water Supply and Sanitation. Geneva, World Health Organization. 101 pp.

Table A6.2 Calculation of Project Cash Flow

Calculation of Project Cash Flow				
Item	**Year 1**	**Year 2**	**Year 3**	**Year 4**
Construction cost:				
Foreign exchange				
Local component				
Total construction cost				
Replacement costs				
Financing:				
Foreign loan				
Local loan (from government)				
Government grant				
In-kind contribution = community fund				
Total financing				
Foreign loan:				
interest				
repayments				
Local loan:				
interest				
repayments				
Debt service and replacement				
Wages:				
skilled labour				
unskilled labour				
Wastewater treatment				
Other				
Operation and maintenance				
Total cash requirement				

Source: ibid.

Table A6.3 Calculation of Average Incremental Cost

Calculation of Average Incremental Cost				
Item	Year 1	Year 2	Year 3	Year 4
Construction costs (financial)				
Foreign currency				
Foreign cost (adjusted)				
Local cost				
Total construction cost (economic)				
Replacement costs (financial)				
Foreign currency				
Foreign cost (adjusted)				
Local cost				
Total replacement costs (economic)				
O&M cost (financial)				
Skilled labour at market cost				
Unskilled labour at market cost				
Skilled labour at economic cost				
Unskilled labour at economic cost				
Water treatment				
Other				
Total O&M costs (economic)				
Total undiscounted costs				
Discount factor				
Discounted capital costs				
Discounted replacement costs				
Discounted O&M costs				
Total discounted costs				
Production				
Discounted production				
Sales				
Discounted sales				
Sum of discounted costs				
Sum of discounted production				
Sum of discounted sales				
AIC				

Source: ibid.

Table A6.4 Balance Sheet

Balance Sheet				
Item	Year 1	Year 2	Year 3	Year 4
Assets				
Gross book value				
Less cumulative depreciation				
Net fixed assets				
Work in progress				
Cash and bank deposits				
Accounts receivable				
Inventories				
Other (prepayments)				
Total current assets				
Total assets				
Liabilities+ equity				
Retained earnings				
Government equity				
Community funds				
Total equity				
Foreign loans				
Local loans				
Total long-term liabilities				
Accounts payable				
Deferred taxes				
Overdraft				
Debt-service arrears				
Total current liabilities				
Total liabilities + equity				

Source: ibid.

Table A6.5 Income and Expenditure Statement

Income and Expenditure Statement				
Item	Year 1	Year 2	Year 3	Year 4
Income				
From desludging				
From flat rates				
From connections				
Total sales				
Interest received				
Total income				
Expenditure				
Wastewater treatment				
Labour				
Other				
Total				
Operating surplus				
Depreciation allowance				
Profit before interest and tax				
Interest				
Net profit before tax				
Tax				
Net profit				

Source: ibid

Table A6.6 Statement on the Sources and Application of Funds

Statement on the Sources and Application of Funds				
Item	Year 1	Year 2	Year 3	Year 4
Sources				
Profit before interest and tax				
Depreciation allowance				
Internally generated funds				
Foreign loans				
Local loans				
Overdraft increases				
Government grants				
Community funds				
Total external funds				
Total sources of funds				
Applications				
Construction or replacement				
Interest				
Repayments				
Arrears				
Tax				
Increase in cash				
Increase in noncash working capital				
Total application of funds				

Source: ibid.

Annex 7

Selected Parameters for the Appraisal and Evaluation of Projects for Environmental Sanitation

The appraisal and evaluation of a proposal to undertake and finance a Project is the acid test in the life of that Project. It clears the way for approval by the funding agency, and for subsequent negotiations with the recipient. Many different sets of parameters have been included in the guidance issued by some of the aid organizations for the preparation of the appraisal reports, which most of the organizations require before they decide to support a Project.

The appraisal report is normally prepared by the technical staff and economists of the organizations to whom the Project is submitted for funding. Sometimes, representatives of other disciplines may also be involved, e.g. sociologists, social anthropologists, and/or political scientists. The important point to note is that the appraisal and evaluation are in-house matters and are never passed on to others.

Some of the organizations have chosen to issue guidance for project appraisal and evaluation in a generic form, others opt to cover very specific parts of the appraisal, e.g. financial, economic, institutional and gender-specific appraisal, or with respect to sustainability or operation and maintenance, e.g. the World Bank. In a number of other cases, checklists or screening formats exist for pre-appraisal and appraisal, e.g. in GTZ and DGIS. The OECD has issued DAC Principles for Effective Aid which include the essential points of project appraisal, e.g. technical, financial, economic and institutional, and the identification of the target groups, social and distributional analysis, and environmental impact.

Of greatest interest are the few guidelines which have been established specifically for the appraisal of projects for environmental sanitation, e.g. those published by the KfW and the European Union, and, to some degree, by the BID.

The guidance issued for project evaluation is also of interest. WHO issued Minimum Evaluation Procedures during the International Decade, giving emphasis to assuring the appropriate use and social impact of systems for water supply and environmental sanitation. A general evaluation handbook and a guide to performance measurement have been published by US/AID, and a handbook on social development by ODA. SIDA has made available an evaluation manual, and in the Swiss Policy Paper for Water Supply and Sanitation (SDC) some checklists and indicators are listed.

By implication, all of the above are also guidelines for the preparation of projects for environmental sanitation in the developing countries. Though they have been issued as guidance for use during subsequent stages of the project cycle, i.e. appraisal and evaluation, they also indicate the information already considered essential at the stage of project formation, especially for the preparation of master plans or feasibility studies.

In the following pages, the parameters for appraisal and evaluation are exhibited in some detail, serving as a demonstration of the types of methods used by six rather different organizations. They vary greatly in scope and detail. For full detail, the individual references should be consulted.

Table A7.1 Japan Overseas Economic Cooperation Fund (OECF)[6]

OECF	
1. National economy and national development plan	
Geographic natural environment	Historical social environment
Present situation of the national economy and problems	Development policy and plan
2. Background and necessity of the Project	
Background	Necessity
Present situation of demand and supply	Demand and supply forecast
3. The Project	
3.1 Basic plan	
Location requirements of the Project	Scale and timing of implementation
Style of Project	Plan of main facilities
Basic design	
3.2 Project cost and financial plan	
Coverage of Project cost	Standard of cost estimation
Domestic and foreign money	Points of evaluation of Project costs
Finance method	Financial plan
3.3 Implementation and management plan of the Project	
Operational institution and staff	Contractor and Consultant
Supply of machinery and materials	Construction plan and work schedule
Operation and management plan	Institution of operation and management
4. Evaluation	
4.1 Financial evaluation	
Profit analysis	Scope and calculation of cost and profit
Evaluation of the internal rate of return	Payment plan
4.2 Socioeconomic evaluation	
Evaluation of national economy	Quantitative and qualitative analysis
Economic evaluation	Social evaluation
4.3 Environmental evaluation	
4.4 WID	
5. Management of the proposed Project	

[6] Extracted from: Operational Guidance on OECF Loans, OECF, Tokyo

Table A7.2 Directorate-General for International Cooperation (DGIS), The Netherlands[7]

DGIS	
1. Overall Policy Check	
Project contributes to priority goals of recipient country	Project fits into the Netherlands' Country Policy Plan
Project complies with the Netherlands' Sector Policy (see 4., below)	Target groups and beneficiaries identified
Data available on poverty, WID, environment and indicators established	Target group has participated in preparing the Project
Project complies with DAC-WID principles	
2.. Assessment of effects on poverty, WID and environment	
3. Assessment of feasibility and sustainability, e.g.:	
Technical feasibility	Financial cost-benefit analysis
Economic cost-benefit analysis	Institutional feasibility
Socio-cultural feasibility	Sustainability analysis
4. Principles of the Netherlands' sector policy	
Coordination with other sectors and water users	Strong institutions
Cost recovery for autonomous operations	Community participation and management
Integration of water supply with sanitation, hygiene education and environmental protection	Use of an appropriate technology
Coordination between donors and multilateral organizations	

[7] Extracted from: Development Screening, Three Parts, DGIS

Table A7.3 ODA[8]

ODA	
1. Overall: all submissions for approval must address:	
Benefits for the poor Population component, whenever practical	The role of women
2. For investment projects:	
Conditions essential for the Project's success (must be monitorable and enforceable)	The main components of the Project and the allocation of aid between them
Background of the Project, e.g.: Compatibility with aid policy Pre-investment work to date	Compatibility with country's development policies/programmes
Technical appraisal Proposed design and standards Cost effectiveness of proposed solution Difficulties encountered in the design Reliability of cost estimates Risks associated with implementation	Economic justification, e.g.: Cost benefit and cost-effectiveness in social-opportunity-cost terms Least-cost means to achieving stated objectives? Net present value
Environmental appraisal	Labor inputs and services required
Financial appraisal, e.g.: Financial flows arising from the Project, including O&M Reasonableness of financial policy Operating enterprise's financial sustainability Financial viability of the Project Financial management of operating enterprise	Social and institutional appraisal, e.g.: Impact on poverty Impact on participation Will Project disadvantage any section of population? Impact on gender roles and needs of the beneficiaries Formal and non/formal institutions with the Project, with justification of the chosen approach Institutional effectiveness and efficiency
Arrangements for the operation of the completed Project, e.g.: Obligations of recipient and responsible agency Arrangements of management and training Arrangements for maintenance and sustainability Supporting technical cooperation	Finance for capital and technical cooperation costs Arrangements for implementation
Arrangements for the operation of the completed Project, e.g.: Obligations of recipient and responsible agency Arrangements of management and training Arrangements for maintenance and sustainability Supporting Technical Cooperation	
3. Performance criteria for evaluation	
Vis-à-vis ODA's priority objectives Economic liberalization Enhancing productive capacity Good governance Poverty impact Human resources: education Human resources: health Human resources: children by choice Environmental impact Impact on women	Project effectiveness Social impact Institutional Impact Technical success Time management within schedule Cost management within budget Adherence to Project conditions Financial rate of return Economic rate of return Financial sustainability Institutional sustainability Overall sustainability

[8] Extracted from: Guide to Aid Procedures, Section G, and Guide to ODA Evaluation Studies, ODA, London, respectively June and August 1994

Table A7.4 Kreditanstalt für Wiederaufbau (KfW)[9]

KFW	
1. Problem analysis	
General framework and developments in the sector	Regional and local background of the Project
Justification	
2. Problems to be addressed through the Project	
Technical scope	Planned developmental impact
Expected demand and proposed levels of service	Compatibility with sector policy
3. Objectives, target groups and developmental framework	
Achievement of overall goals	Demand and feasible objectives, and indicators for measurement
Target group	Compatibility with sector and general policy
4. The planned intervention	
Previous KfW supported measures	Relation to measures supported by other organizations
Intervention and result Targets and time horizons Possible alternatives Rationale of the selected alternative Software components Choice of the technology Risks	Implementation, e g.: Capacity for subsequent O&M Participation in O&M Risks
7. Borrower and executing agency	
The borrower	The executing agency Legal status, functions and programmes Relations to target groups Economic and financial capacity Capacity to sustain the system
6. Costs and financing	
Total costs, e g.: Investment costs, per-capita costs and costs of software components Basis for estimation	Financing, e.g.: Appropriateness, distribution and budgeting Participation of target group
7. Effectiveness and overall risks	
Impact on the local economy, e g : The effective costs of the Project Cost recovery Economic and financial feasibility	Impact on the national economy The Project in the national resources context National water resources context Urban and regional development context
Socio-economic impact, e.g.: For target groups Low-income groups Replicability WID	Socio-cultural impact, e.g.: Changes in perceptions Participation
Ecological impact, e.g.: Environmental impact assessment Risks	

[9] Extracted from: Appraisal Guidelines for Waste Water Projects, KfW, Frankfurt, 1995

5. The World Bank[10]

The World Bank	
Operational Manual State No. 2.20	
1. General	
Basis for decision	Consistency of components
Facilitates evaluation	
2. Economic aspects	
Appropriate use of countries' resources	Fits sectoral plans, not just for "viability" and "optimality"
When inappreciable, anticipated Project revenues may serve as proxy	Reduction of income disparity and poverty alleviation
3. Technical aspects	
Sound engineering	Estimates of investment and operating costs
Minimum needs: good feasibility study and preliminary design	If necessary, additional studies
4. Institutional aspects	
Management methods	Organizational arrangements
Staffing and training	Financial management system and performance
Operation and maintenance system	Inter-agency coordination
Sectoral policies	Institutional aspects must be part of Project design
5. Financial aspects	
Reliability of Project's financing plan	Financial performance
Accounting and auditing arrangements	Reasonableness of financial forecasts
Appropriateness of pricing	Possibilities for reducing costs
For non-revenue-earning projects, focus on recurrent financial cost of O&M	Impact on financial beneficiaries and incentives for their participation
Financial Analysis in light of financial forecasts	
6. Social aspects	
Sociocultural characteristics	Acceptability
Social strategy for Project implementation and operation	Willingness to contribute
People linked to Project	Special case of women

(continued on next page)

[10] Extracted from: Operational Manual Statement No. 2.20, and OP 10.40, The World Bank, Washington, D.C., respectively January and September 1994

The World Bank	
(continued from last page)	
New Operational Policies, NO. OP.10.40	
1. Criteria for acceptability	
Discounted expected present value of Project's benefits, net of costs: Must not be negative Must be higher than or equal to expected net present value of mutually exclusive project alternatives	Alternative Project designs Throughout Project cycle Mutually exclusive designs
2. Nonmonetary benefits	
Must ensure broader sectoral or economy-wide programmes	Project must represent least-cost way of attaining the stated objectives
3. Sustainability	
Project will be sustained during its life	Therefore: assess robustness with respect to economic, financial, institutional and environmental risks
Legal and institutional framework must be in place or will be developed	Critical private and institutional stakeholders have or will have incentives to implement the Project
Financial impact on implementing/sponsoring institution	Must estimate the direct effect on public finances of the Project's capital outlays and recurrent cost
4. Risk	
Source, magnitude and effects of risks	Consider possible range in the values of the Project's variables and assess robustness of Project's outcome with respect to changes in these values
5. Poverty	
Meets Bank's poverty-reduction strategy	
6. Externalities	

Table A7.6 European Union[11]

European Union	
The information requirements with respect to the most important subjects include:	
1. Background information	
1.1 Main features of the sector	
The broader policy context	Health and sanitation
Water resources	Development policy for the region
Institutional resources	Role of the private sector
Existing credit system	National financial resources available
1.2 Problems	
Poor water quality	Wastage
Inadequate sanitation	Estimating the effective demand for water
Promoting the level of sanitation	The location
Appropriate technology	The weakness of institutions
Problems of O&M	Inadequate education
Limited access to facilities	
1.3 Beneficiaries and parties involved	
2. Intervention	
Overall objectives	Project purpose
Results	Activities
3. Assumptions	
Assumptions at different levels	Risks and flexibility
4. Implementation	
Physical and nonphysical means	Organization and implementation procedures
Timetable	Cost estimate and financing plan
Special conditions	
5. Factors ensuring sustainability	
Policy-support measures	Appropriate technology
Environment-protection measures	Institutional and management-capacity building
Sociocultural and legal aspects	Economic and financial analysis
Community participation	Cost/benefit analysis
Proper maintenance	Cost effectiveness analysis
Women	Special issues
Legal issues	
6. Monitoring and evaluation (annexes)	
Evaluation & Bibliography	Environmental Checklist
Assumptions in the Logical Framework (plus an example)	Logframe Matrix: Sewerage in Jamaica
WID Questionnaire	

[11] Extracted from: Guidelines for the Preparation, Management and Evaluation of Projects/Programme in the Rural Water supply and Sanitation Sub-sectors, CEC, Brussels, 1993

Table A7.7 Organization for European Cooperation and Development (OECD)[12]

OECD	
1. The central notion of sustainability	
Policy or policy changes to create a conducive environment	Clear and realistic goals
Project design corresponding to the capacity of the recipient	Economic soundness
Affordability of initial costs and O&M	Involvement of local authorities and target groups
Choice of technology according to economic and social conditions	Realistic time frames
Adequate maintenance and support systems once external assistance is terminated	Compatibility with sociocultural conditions
Environmental sustainability	
2. Technical appraisal	
Technology and standards	Technical implications of factors listed under item 1
3. Financial appraisal	
Financial analysis, e.g: Expected income and expenditure on capital and recurrent outlays Repercussion of the Project on public finances Financial viability of Project & operating entity Financial sustainability Cost recovery Repercussions for vulnerable groups Ability of recipient to provide adequate financing	Appropriate terms, e.g.: Concessional terms of financial assistance Concessionality in terms for end-users
3. Economic appraisal	
Cost-benefit analysis	Shadow prices or the effects method
Economic returns analysis whenever possible, or else alternative methods of demonstrating the standard and quality of service and benefits rendered to as many beneficiaries as possible	
4. Institutional assessment	
Capacity of implementing agency to execute Project	Management framework of the agency
Financial management by the implementing agency	Extent and duration of technical assistance required by the agency
5. Provision for effective maintenance	
Human resources available	Delineation of responsibilities
6. Target groups and social and distributional analysis	
Distribution of costs and benefits	Socio-cultural analysis
Role of women in development	Demographic analysis
Involvement of local institutions and target groups	
7. Environmental assessment	
8. Provision for monitoring and evaluation	

[12] Extracted from: DAC Principles for Project Appraisal, In: DAC Principles for Effective Aid, in Development Assistance Manual, OECD, Paris, 1992