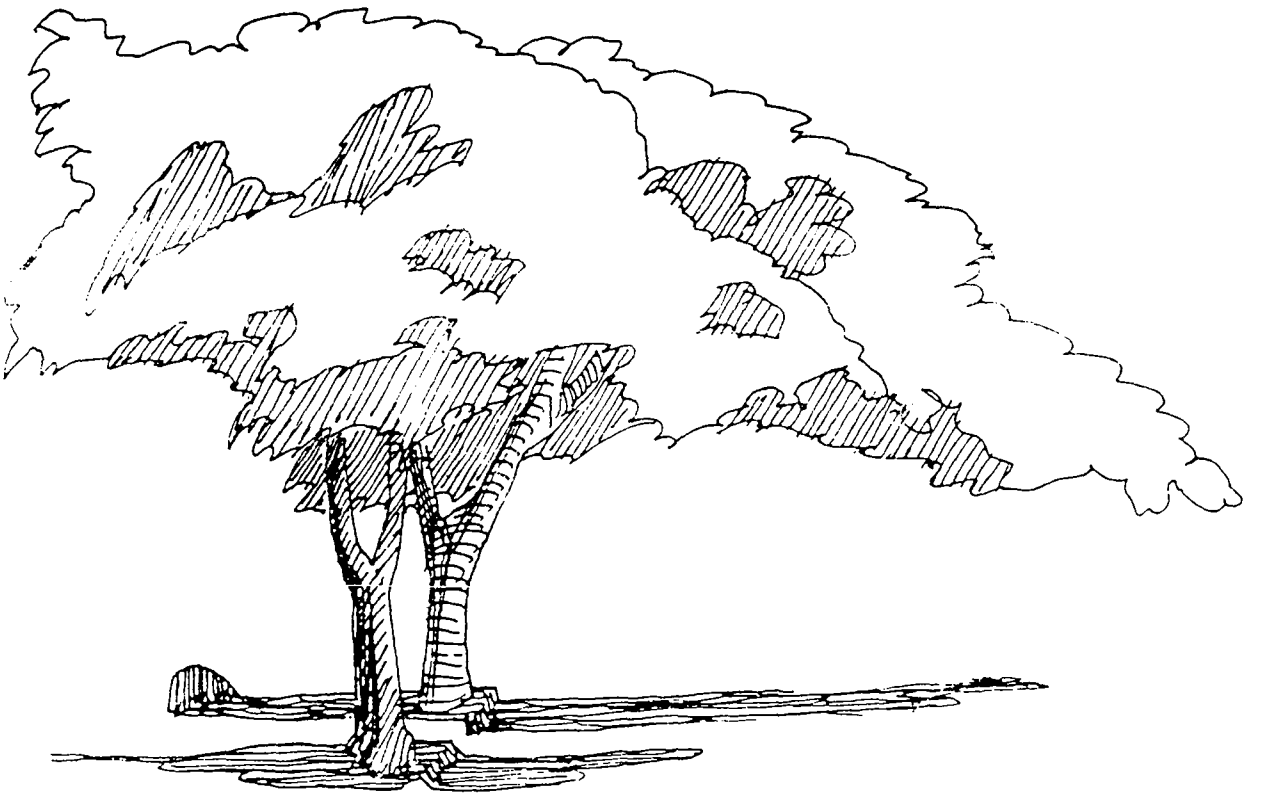
Evaluation of Sanitation Programme Planning



University of Technology
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"EVALUATION of SANITATION PROGRAMME PLANNING"

MSc thesis
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Dept. of Civil Engineering - Division of Sanitary Engineering

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October 1983

Foreword

The principle purpose of improving water supply and waste disposal is to help overcome the problem of debilitating and killing diseases that afflict developing countries.
More generally can be stated that improving water supply and waste disposal is a precondition for a healthy and man worthy living condition and an indispensable component in the process of development. The ultimate goal is the well-being of the millions involved lacking basic needs.
The impact of improved health and food conditions should be carefully analyzed. An explosive increase of world population, wich can be expected as a consequence, would mean an unwarrented assesment on world recources as food, energy, forests, water etc.. Careful planning on world and national level by international institutions and governments, achieving an integrated programme in the field of population controll, health, food, education, economics, etc. is a necessative to avoid squandering of recources in non integrated, isolated programmes.
This report deals only with one aspect, important to development: Sanitation.
Provision of merely excreta disposal systems is useless. The benefits of improved sanitation will be evinced most profitable when the sanitation programme is integrated in a complete, all-embracing development programme.
A general solution in sanitation is not realistic. Differences in culture, religion, environment (physical), economy require different solutions. This report is objected to rural and suburban areas in developing countries where conventional sanitation systems are not applicable and "low cost sanitation" is the only alternative left.

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- Sanitation and water supply, a problem?

A convenient supply of safe water and sanitary disposal of human wastes are essential ingredients of a healthy, productive life. Water that is not safe for human consumption can spread disease; water that is not conveniently located results in the loss of productive time and energy of the water carrier; and inadequate facilities for excreta disposal reduce the potential benefits of a safe water supply by transmitting pathogens from infected to healthy persons. Over fifty infections can be transferred from a diseased person to a healthy one by various direct or indirect routes involving excreta.

UNICEF estimates that about 15 million children below the age of 5 die in the developing countries every year. The absence of safe water and sanitation plays a major part in this tragedy. If everyone had access to safe drinking water and sanitation, infant mortality could be cut by much as 50 per cent world wide.
According to the World Health Organization (WHO, 1977/1978), approximately 80 per cent of all sickness and disease can be attributed to inadequate water or sanitation. For example:

- Diarrhoea kills six million children in developing countries every year, and contributes to the death of up to 18 million people.
- Trachoma affects some 500 million people at any given time, often causing blindness.
- Parasitic worms infect nearly one half of the entire population of the developing countries, often with serious consequenses. For example, 200 million people in 70 countries suffer the debilitating effects of schistosomiasis.
- Malaria yearly kills one million children below the age of two in Africa, South of the Sahara, alone.

The need for sanitation programmes

To understand the magnitude of the problem, one only needs to consult the data collected by the WHO in preparation for the United Nations Water Conference (Mar del Plata, Argentina, Spring 1977). These rough estimates show that only about one third of the population in developing countries have adequate sanitation services; that is, about 630 million out of 1.7 billion (exc. P.R. of China). Population growth will add to this figure in the 1980s, another 700 million who will have to be provided with some means of sanitation if the goal of the International Drinking Water Supply and Sanitation Decade--adequate water supply and sanitation for all people--is to be achieved.

At the present time, the first priority of excreta disposal programmes in developing countries must be human health; that is, the reduction and eventual elimination of the transmission of excreta-related diseases. This health objective can be fully achieved by non-conventional sanitation technologies that are much cheaper than sewerage.

	Infection	Infections thousands /year	Deaths thousands /year	Average no. of days lost per case	Relative disability *
WATER-BORNE DISEASES	Amebiasis	400,000	30	7-10	3
	Diarrhoeas	3-5,000,000	5-10,000	3-5	2
	Polio	80,000	10-20	3,000+	2
	Typhoid	1,000	25	14-28	2
WATER-WASHED DISEASES	Ascariasis (roundworm)	800,000-1,000,000	20	7-10	3
	Leprosy	12,000	Very low	500-3,000	2-3
	Trichuriasis (whipworm)	500,000	Low	7-10	3
WATER-BASED DISEASES	Schistosomiasis (bilharzia)	200,000	500-1000	600-1000	3-4
DISEASES WITH WATER-RELATED VECTORS	African trypanosomiasis (sleeping sickness)	1,000	5	150	1
	Malaria	800,000	1,200	3-5	2
	Onchocerciasis (river blindness)	30,000	20-50	3,000	1-2
FECAL DISPOSAL DISEASES	Hookworm	7-9,000,000	50-60	100	4

Source: after Julia A. Walsh and Kenneth S. Warren, Selective Primary Health Care: An Interim Strategy for Disease Control in Developing Countries, The New England Journal of Medicine, vol 301, no 18, November 1, 1979, p 967.

*1 means the sufferer is bedridden; 2 able to function to some extent; 3 able to work; 4 experiences minor effects.

Table:1 Incidence and impact of diseases related to water supply and sanitation

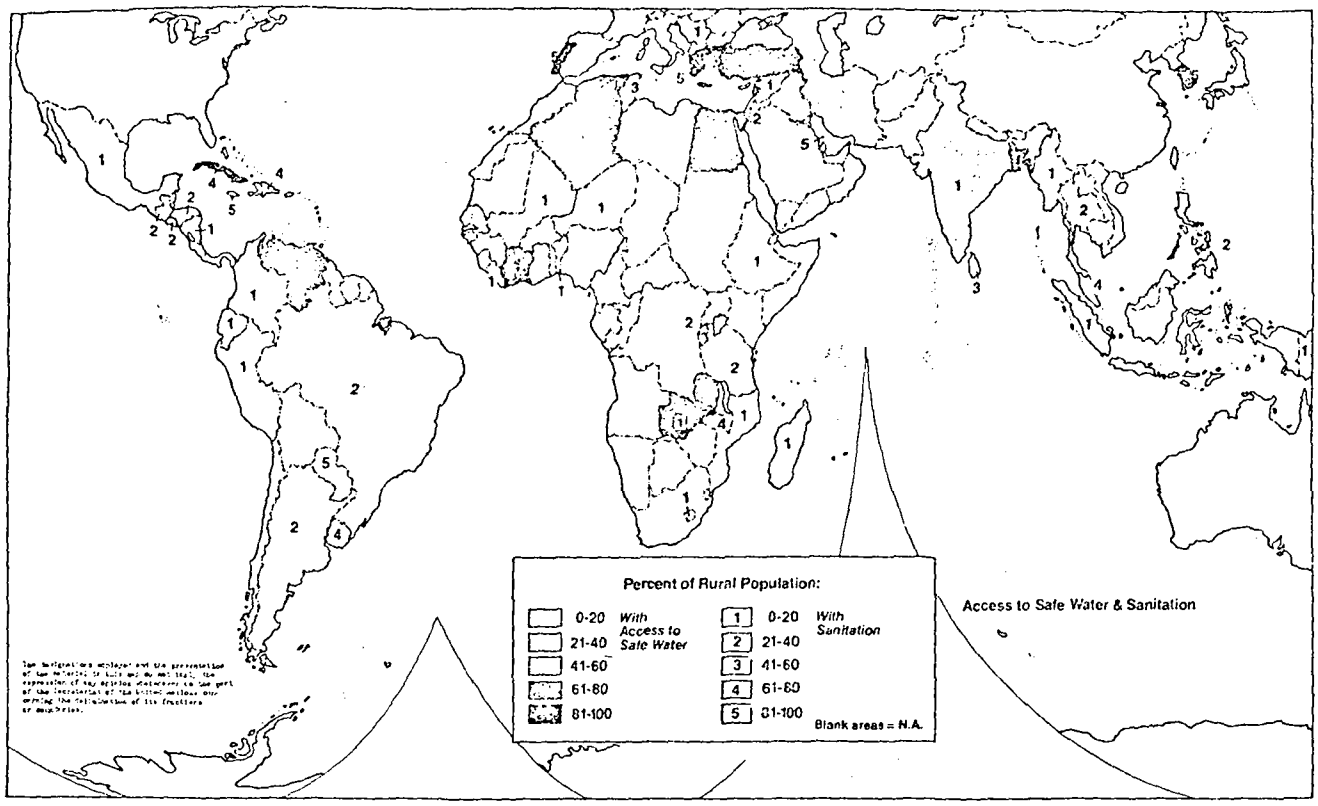


Fig. 1: Access to safe water and sanitation.

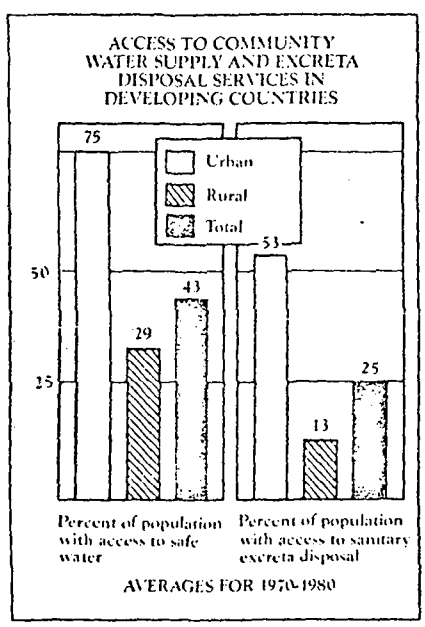


Fig. 2: Access to community water supply and excreta disposal services in developing countries.

Source: WHO Rapid Assessment Report, 1980 (United Nations, Report of the Secretary-General, *International Drinking Water Supply and Sanitation Decade: Present Situation and Prospects*, United Nations document A/35367, July 1980.)

Notes: (1) Figures should be regarded as rough approximations, giving orders of magnitude only. The number of public and private water and sanitation facilities which have fallen into disuse or disrepair is grossly underestimated. (2) Figures exclude People's Republic of China, for which statistics are unavailable.

Note: Figures 1 and 2 are both published in
DECADE DOSSIER
International Drinking Water Supply
and Sanitation Decade 1981 - 1990

Low cost sanitation

The principle constraints to the successful provision of sanitation facilities in developing countries are lack of funds, lack of knowledge about non-conventional sanitation technologies, weak institutions with few trained personnel, and additionally in rural areas weak social structures. There is no forseable way that waterborne waste disposal, with an average investment cost of around U.S. $ 300 per person, can be made affordable in countries in wich annual per capita income averages less than that amount. In addition, and implicit in the decission to provide sewerage, is a decission to provide a water connection to each house.

Given the continued increase in poverty of developing countries, where financial recorces are limited, massive investments in water born sewerage are impossible. Other factors which militate against the use of conventional sewerage systems in developing countries are: relatively complex skills are required for both the design and installation of the pipe network; blockage due to 'unconventinal' anal cleaning materials and other household waste objects is a frequent occurrence.

Low cost sanitation, in fact a range of different sanitation technologies, is an answer on the need of sanitation facilities.

Table 2:

Alternative Sanitation Technologies:
Financial Requirements for Investment and Recurrent Cost per Household
(1978 U.S. dollars)

Technology	Total investment cost[a] (1)	Monthly investment cost[b] (2)	Monthly recurrent cost (3)	Monthly water cost (4)	Hypothetical total monthly cost[b] (5)	Percent of income of average low-income household[c] (6)
Low-cost						
Pour-flush toilet	70	1.5	0.2	0.3	2.0	2
Pit latrine	125	2.6	–	–	2.6	3
Communal toilet[d]	355	7.4	0.3	0.6	8.3	9
Vacuum-truck cartage	105	2.2	1.6	–	3.8	4
Low-cost septic tanks	205	4.3	0.4	0.5	5.2	6
Composting toilet	400	8.3	0.4	–	8.7	10
Bucket cartage[d]	190	4.0	2.3	–	6.3	7
Medium-cost						
Sewered aquaprivy	570	7.1	2.0	0.9	10.0	11
Aquaprivy	1,100	13.7	0.3	0.2	14.2	16
Japanese vacuum-truck cartage	710	8.8	5.0	–	13.8	15
High-cost						
Septic tanks	1,645	14.0	5.9	5.9	25.8	29
Sewerage	1,480	12.6	5.1	5.7	23.4	26

[a] *Including household plumbing as well as all other on-site and off site system costs.*
[b] *Assuming that investment cost is financed by loans at 8 percent over 5 years for the low-cost systems, 10 years for the medium-cost systems, and 20 years for the high-cost systems.*
[c] *Assuming average annual income per capita of $180 and 6 persons per household.*
[d] *Based on costs per capita scaled up to household costs to account for multiple-household use in some of the case studies.*

(Source: ref. 01)

Chapter 1 Medical and Social perspective

1.1 Sanitation and Health

The hygienic disposal of human excreta is of the utmost importance to the wellbeing of all communities. It is necessary for the preservation of health, and indeed the correct disposal of excreta is one of the most effective measures which any community can undertake to improve its health. The sanitary disposal of human wastes will help to control all those infectious diseases which are caused by pathogens excreted by people in their faeces or urine. Table 1.1 provides a list of some of the more important infections transmitted in the faeces.

Table 3: Some important infectious diseases related to the unhygienic disposal of human faeces.

Bacterial Infections
Typhoid, cholera, bacillary dysentery, miscellaneous diarrhoeas and gastro-enteritus.
Viral Infections
Infectious hepatitus, poliomyelitis, miscellaneous diarrhoeas
Protozoal Infections
Amoebic dysentery (amoebiasis)
Helminthic (worm) Infections
Roundworm (ascariasis), hookworm, bilharzia (schistosomiasis)

The sanitary disposal of human wastes is perhaps of grater importance than the provision of a safe water supply because, if the disposal of human excreta is correctly managed, there will be little risk of human feacal contamination of domestic water sources. It is better to protect the environment from feacal pollution than to undertake expensive measures to reduce the pollution when it has already taken place.

1.2 Social dimensions

Excreta disposal, then, is important. But it is extremely difficult to achieve changes in excreta disposal practices. They are part of the basic behavioural pattern of a community and are not readily modified. Many Europians have difficulty in adopting a squatting position for defeacation and are reluctant to use water and hand for anal cleansing. Similarly, many villagers in developing countries, used to defaecation in the bush around the village, are reluctant to adopt the use of a latrine.
Positive results, reduction in excreta related diseases, by sanitation programmes can only be expected, when everyone will make use of latrines. There is absolutely no sense in building latrines if they will not be used, and an appreciation of the acceptability of a particular form of sanitation to the community is an essential first step in any programme.
It is necessary to understand existing defaecation practices and beliefs. It is necessary to develop any sanitation programme in close cooperation with community leaders. It is essential to provide the training and extension work necessary to acquaint the community fully with the method of using and maintaining the particular type of latrine. It is always necessary to take account of community feelings concerning the sanitation programme.

Excreta disposal in rural areas is far more complex socially than it is technically and it is not appropriate to assign total responsibility for rural sanitation programmes to engineers. It is essential to realize that the improvement of sanitation is not completely achieved by the construction of a latrine.
Follow-up visits to the home are needed to check whether the latrine is being used, whether it is kept clean, whether a real improvement in domestic hygiene has been achieved, and whether any maintenance problems are emerging.

All these follow-up activities require a substantial commitment in manpower and funds, but a sanitation programme has little change of success without them. It is essential to resist the temptation to go on building new latrines beyond the capability to supervise and service them.

Chapter 2 Feasible Sanitation Systems

2.1 General approach

2.1.1 Criteria

It is of considerable value to have a checklist of criteria, based on which sanitation systems can be evaluated. It will however be found that many items in that list have to be interpreted in the light of what people want.
Choices about technology cannot therefore be made in general terms for all developing countries, but must be made seperately and locally by each community or nation.
A list of criteria, based on purely technical considerations, is published in "Excreta disposal for rural areas and small communities" (Wagner and Lanoix, World Health Organization (WHO), 1958).
These criteria are:

1. The surface soil should not be contaminated.
2. There should be no contamination of groundwater that may enter springs or wells.
3. There should be no contamination of surface water.
4. Excreta should not be accessible to flies or animals.
5. There should be no handling of fresh excreta, or when this is indispensable, it should be kept to a strict minimum.
6. There should be freedom of odours or unsightly conditions.
7. The method used should be simple and inexpensive in construction and operation.

It is evident that, in planning a permanent solution to an excreta disposal problem, apart from the mentioned technical criteria, many inter-related factors must be considered. Among these factors are: cultural patterns, religious customs, climatological and geological conditions, economic standards, political and social organization of communities, general and health education, skills of local populations, and the availability of construction materials and personnel for technical supervision.

2.1.2 Communal versus individual

The installation of communal facilities will require less initial costs than individual household systems, however this advantage is of minor interest compared to the following disadvantages:

- the lack of cleanliness and maintenance, as it appears to belong to no one individually and so there is very little commitment by individual users to keep it clean and operating properly.
- the lack of privacy.
- the distance from the individual households, a problem for children and for users at night during wet or cold weather and illness.

With regard to above mentioned disadvantages, individual household systems should be preferred.

2.1.3 Classification of existing systems

Two key distinctions can be identified:

I Dry systems versus Wet systems.
An example of a dry system is the composting latrine.
In a wet system water is mixed with excreta, usually by a flushing mechanism.

II On-site disposal versus systems in which excreta is carried off by cartage or by water flow in sewers.

Given the four possibilities mentioned above, the existing systems are categorized subsequently:

1. Wet systems, off-site treatment and disposal:
   -conventional sewerage
2. Wet systems, on-site treatment:
   -aqua privies, septic tanks, wet pit latrines, most biogas plants
3. Dry systems, off-site treatment and disposal:
   -bucket latrines with cartage
4. Dry systems, on-site treatment:
   -composting latrines, dry pit latrines

2.2 Three feasible systems

2.2.1 Introduction

Three systems will be offered here, based on financial, environmental, sociological, and cultural grounds, as feasible sanitation options for rural and suburban areas:

I Ventilated Improved Pit (VIP) latrine
II Pour-flush latrine
III Composting latrine

The three, here above mentioned, sanitation systems have the following items in common:

- on-site disposal
- low cost
- suitable in rural areas and in low density urban areas
- relatively simple to construct
- high potential for self help programmes
- no need of complementary off-site investments
- good health benefits
- institutional requirements can be limited to a minimum

In the series "Appropriate Technology for Water Supply and Sanitation" (World Bank, 1980) volume 11 (page 31 to 60), "a Sanitation Field Manual", the three sanitation options VIP latrines
Pour Flush latrines
Composting latrines
are described and discussed in detail.
The information in this report on these excreta disposal systems will be limited to just the principle differences.

2.2.2 The Ventilated Improved Pit (VIP) latrine

The VIP latrine differs from the conventional pit latrine in being equiped with a ventilation pipe and a more solid construction of pit, squatting slab and superstructure.
The most striking detail of the VIP latrine is the vent-pipe, which generates a strong updraft and so maintains a flow of air down through the squatting plate. The effect of this air current is to minimize odours and to discourage fly breeding within the pit; moreover, if the exit of the vent-pipe is covered with a mesh and the latrine superstructure is kept relatively dark compared to the pit (or the squatting plate covered) any flies which do hatch out in the pit will be attracted to the daylight at the top of the vent-pipe, where they will be trapped by the mesh and eventually die.
Conventional pit latrines are the commonest, in many parts of Africa, and most simple sanitation system. The VIP latrine stands from a culturally point of view very close to the conventional pit latrine. Its simplicity increases the changes of acceptability.
The VIP latrine is most appropriate for self help programmes in which individual householders are responsible for their own sanitation.

The major technical obstacles to on-site pit latrines are: population density, high water table, rock, sand, and water contamination.

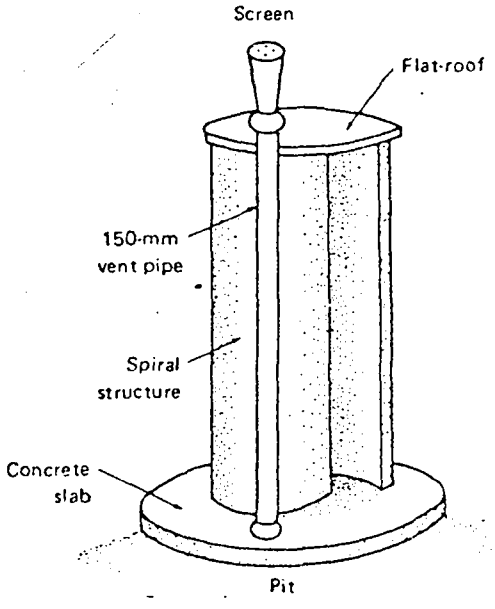


Fig. 3: VIP latrine, built in Zimbabwe.

The VIP latrines shown on the figures 3 and 4 are recently built, on a small scale, in Zimbabwe and Tanzania.
Emptying the filled up pits of these "direct" pit latrines can be done either by hand or by vacuum truck. Handling "fresh" excreta encounters the danger of infection while the main disadvantages of vacuum trucks, in urban areas, are the need of institutional requirements and the significant increase in operational costs.

Fig. 4: VIP latrine, UNICEF-Rural Sanitation Project, Iringa/Tanzania.

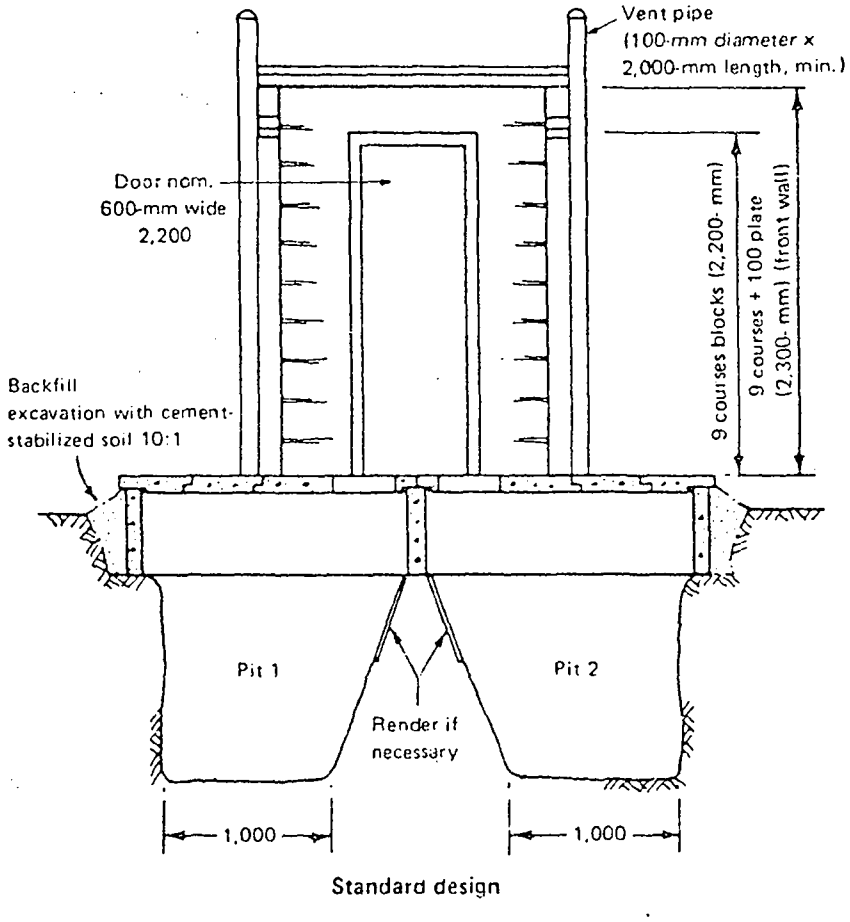


Fig. 5: Ventilated Improved Double (VIDP) Pit latrine. (measurements in millimeters)

These problems are avoided in the Ventilated Improved Double Pit (VIDP) latrine. The life-time of one pit will exceed at least one year, so once a pit is filled up and closed and while the second pit is in use, the excreta in the first pit will transform into a relative harmless material. Construction costs of the VIDP latrine are logically higher.

2.2.3 The Pour-Flush (PF) Latrine

The pour flush latrine has a water seal unit incorporated into the squatting plate. The advantage of this type of latrine is that the water seal prevents the development of odours and the breeding of insects and therefore no venting system is required.
Approximately three litres of awter or sullage are manually poured in to flush the excreta into the pit after each usage. Because of the odour elemination, this type of latrine can be located inside the house, if desired.
The PF latrine is an appropriate sanitation technology if sufficient water is available for flushing and the people commonly use water for anal cleansing.
Two basic types are shown on the figures 2.4 and 2.5. The first type is a modification of the pit latrine in which the squatting plate is provided with a simple water seal. The second type of PF toilet, which is widely used in India, south-east Asia, and some parts of Latin America, is used in combination with a completely offset pit. The PF bowl is connected to a short length (8 meters maximum) of 100-millimeter diameter pipe that discharges into an adjacent pit.
PF toilets can be easily upgraded to a low cost sewerage system that also accepts sullage.

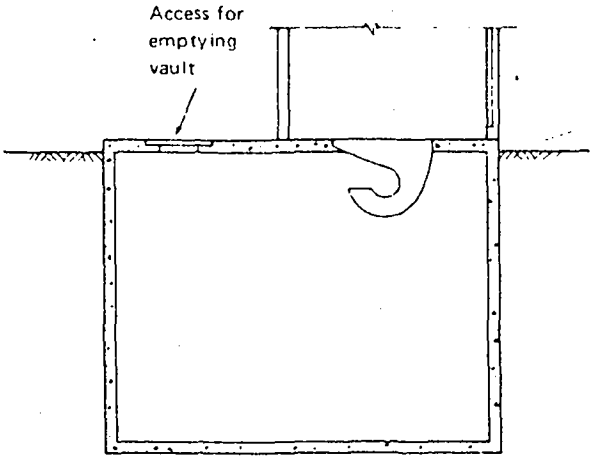


Fig. 6: Pour Flush (PF) latrine, direct discharge design.

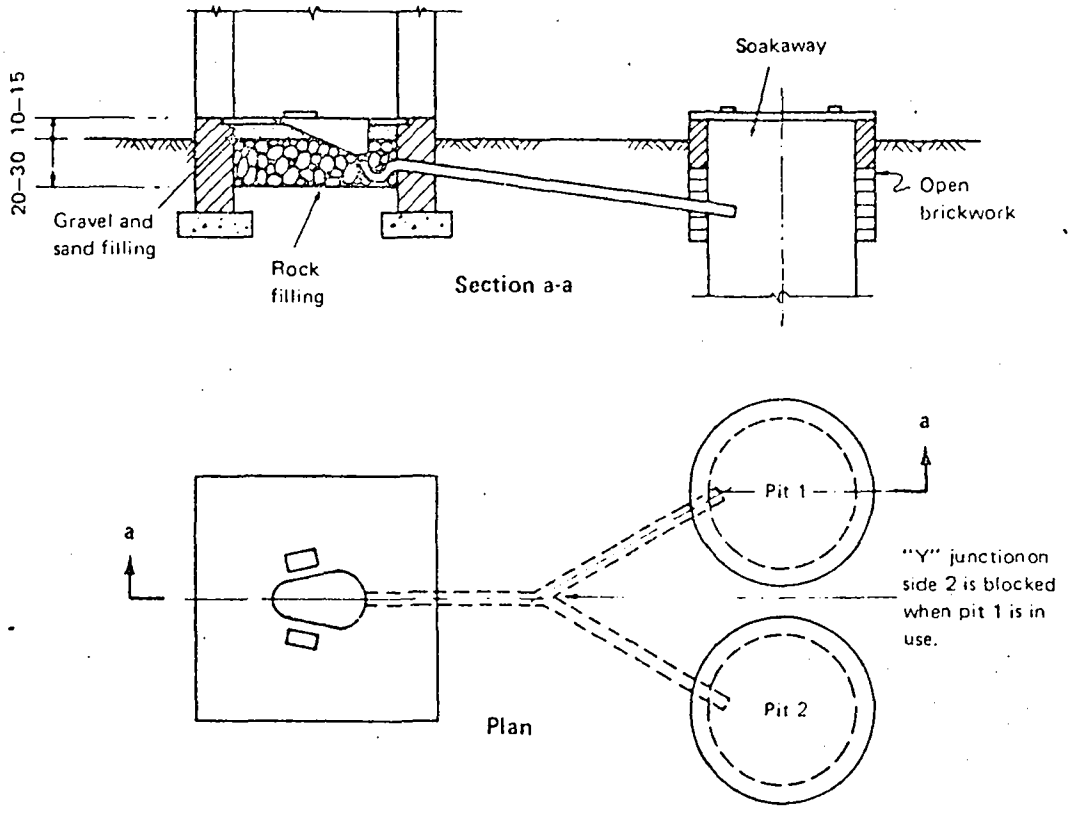


Fig. 7: Pour Flush latrine, offset pit design.

2.2.4 Double Vault Composting (DVC) latrine

Composting is a biological process in which various types of organisms under controlled conditions break down organic substances to a humus kind of end product.
Apart from excreta, ash and easily biodegradable organic wastes such as sawdust, grass, and vegetable wastes must regularly be added in correct quantities to the composting latrine to maintain a suitable carbon-nitrogen ratio. The preferable moisture content is low, therefore only the absolute minimum of water should be added to composting latrines.
The main advantage, over other types of latrines, is the possibility of resource recovery, however in societies where compost is not used in agriculture this advantage will not be evinced.

Two types of composting latrines exist: 1. continuous type
2. batch type

Continuous composting latrines are developments of a Swedish design known as "multrum". Trials with this type (ref.05) in Tanzania and Botswana indicate that continuous composters were found to be extremely sensitive to the degree of user care; even with the required sophisticated level of user care, the composting process seemed difficult to controll. Ref. 05 (World Bank 1980) concludes that this type of composting latrine is not suitable for use in developing countries.

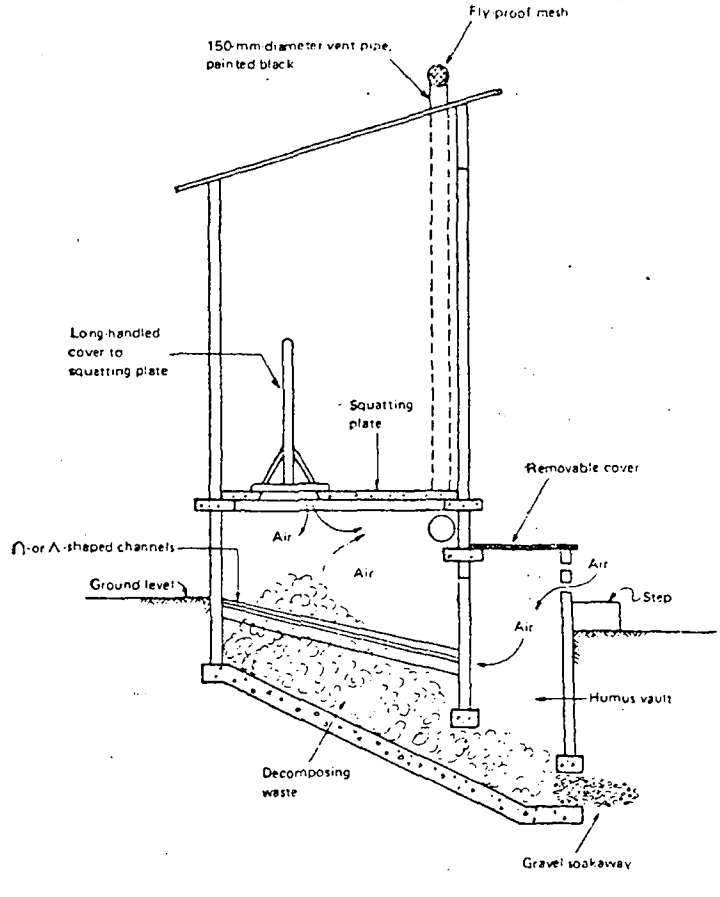
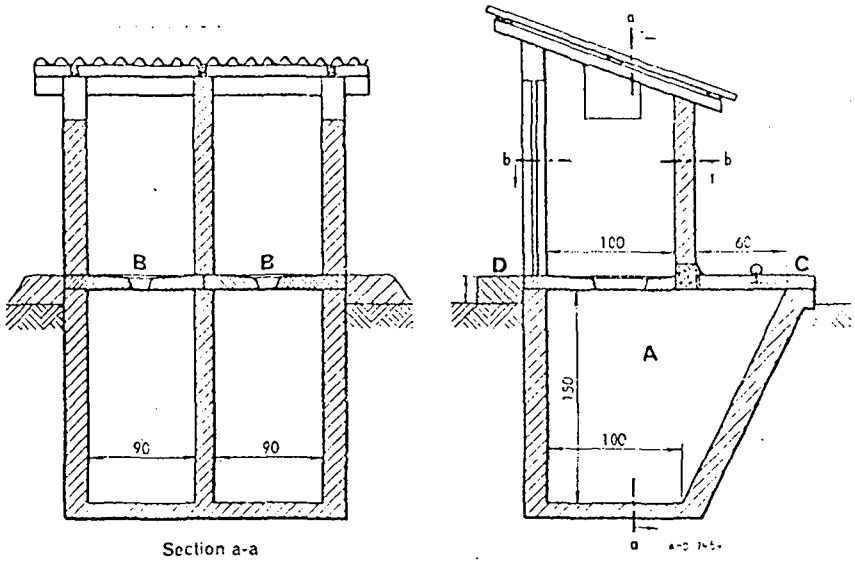


Fig. 8: "multrum" Continuous-composting latrine

The Double Vault Composting (DVC) latrine is a batch type of composting latrine. It is the most common type of this art. It has two adjacent vaults, one which is used until it is about three-fourths full, then covered with grass, filled with earth and sealed. The other vault is then used.

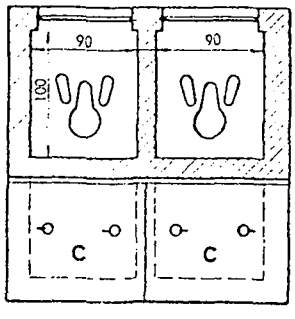
The produced humus kind of end product can be used as an agricultural fertilizer and soil conditioner or to enrich fish and algae ponds (widely used in Indonesia). The DVC latrine requires less maintenance and users care than the "multrum" and is therefore a better alternative for developing countries.

DVC latrines are relatively easy build on a self help basis. A continuing long-term and vigorous programme of user education, however, will normally be necessary in order to ensure that DVC latrines are used correctly.



Section a-a

Measurements shown are in centimetres



Section b-b

A = Two vaults
B = Squatting slabs
C = Removable covers
D = Step and earth mound

Fig. 9:
Double Vault Composting latrine

(Source: 'Excreta Disposal for Rural areas and small communities', Wagner and Lanoix, WHO,1958)

New types of DVC latrines have been developed, based on this principle.

2.2.5 Descriptive comparison of Sanitation Technologies

Sanitation technology	Rural application	Urban application	Constr. cost	Operating cost	Ease of constr.	Self-hel potentia
VIP latrine	Suitable	Suitable in low/medium density areas	L	L	Very easy except in wet or rocky ground	H
Pour-flush (PF)latrine	Suitable	Suitable in low/medium density areas	L	L	Easy	H
Double vault composting (DVC) latr.	Suitable	Suitable in very low density areas	M	L	Requires some skilled labour	H

Sanitation technology	Water requirement	Required soil cond.	Reuse potent.	Health benefits	Institutional requirements
VIP latrine	None	Stable permeable soil. GWT at least 1 m. below surface	L	Good	L
Pour-flush (PF)latrine	Water near latrine	As VIP latr.	L	Very good	L
Double vault composting (DVC) latr.	None	None (can be built above ground)	H	Good	L

VIP Ventilated Improved Pit latrine
PF Pour-Flush latrine
DVC Double Vault Composting latrine
GWT Groundwater Table

Chapter 3 Sanitation and Planning

3.1 Priority setting

Goal formulation is the part of planning process which should reflect the overall demand and desire of the community at large, taking in consideration the political temperature, and expressing the criteria by which the plan might ultimately be assessed.
Values in a community can be seen as:

Healthy condition of both environment and individuals.
Safety of the individuals.
Wealth i.e. the income, services and goods accruing to individuals in the community.
Beauty of the area.
Enlightment i.e. knowledge, education, cultural relations.
Efficiency i.e. in transport, communication and in provision of goods and services.

From these values, goals can be formulated. The goals are likely to range from provision of good health in the area, provision of efficient and safe means of transport and communication to, provision of safety and security in the area.
Sanitation is one goal in the variety of goals.
It is clear that achieving these goals demands accurate planning, time, funds and commitment. Therefore priorities should be set.

To avoid wasting of time, money, energy etc., it is obvious that merely providing a community with sanitation facilities is useless. As long as other goals are felt to be a greater need to the community, a sanitation programme is doomed to fail.
Introduction of sanitation systems can only be useful when the community feels that sanitation facilities are necessary and that it will give benefits to their community.

3.2 Minimum standards of Water Supply and Sanitation

Setting a minimum standard of infrastructure is a political issue depending on social politics and economy. If no such policy or scheme exists, only urban rich people will be able to solve their infrastructure problems in an acceptable way.

Here, the following minimum standards, only for water supply and sanitation, are suggested for a community.

Water Supply

Water must be available within a maximum walking distance of 200 m. from any plot. The supply system must prevent people from getting in direct contact with the source entailing the risk of contaminating the water. Water must be treated if the source is polluted or contaminated in order to remove any substance constituting a health risk to the population. A disease (like cholera) can easily be transmitted through the water supply if the pathogens are not destroyed in a treatment process. The supply must also be sufficient in quantity, wich means 20-40 litres/capita/day.
Furthermore it must be reliable to prevent people from using unsafe water collected outside the supply system. Fire hydrants should be considered in high-density areas.

Sanitation

The sanitation system must prevent direct contact with fresh excreta. The handling of excreta must prevent the transmission of excreta related diseases. This applies both when excreta are deposited on site or when conveyed to a central place for treatment. To make sure that people use the sanitation facilities, these must be convenient, easy to keep clean, easy and safe to use, free from odour and insects, and must secure privacy.

3.3 Community participation

3.3.1 Forms of community participation

Community participation has until now been limited in most cases to: passive acceptance of services

transfer of information in household surveys

provision of money, f.i. for a pump

labour, f.i. digging a well for a water supply or laying bricks for a health centre or a school

The dynamics of a changing society, however, demand more than mere acceptance, allegiance, and unpaid labour. Community participation, focussed on one purpose, namely socio-economic development, should mean involvement in thinking, planning, deciding, acting and evaluating.

The forms of community participation, which are listed hereunder, are described and discussed in ref.14 'Community Participation in Water and Sanitation' (WHO International Reference Centre for Community Water Supply, The Hague, 1981)

Forms of Community Participation:

1. Consultation
2. A financial contribution by the community
3. Self-help projects by groups of beneficiaries
4. Self-help projects involving the whole community
5. Community specialised workers
6. Mass action
7. Collective commitment to behaviour change
8. Endogenous development
9. Autonomous community projects
10. Approaches to self-sufficiency

3.3.2 The benefits of community participation

The reasons why community participation should play an important role in programme planning are more and more discussed. The community is the group of people who has to make use of the facility provided, clean, maintain, and if necessary improve it.
The provision of a water supply- or sanitation system means a step in development, it is obvious that the community should take a step accordingly.
The lack of community participation can sometimes be seen as an important reason behind failure in water supply projects in developing countries. "There should be more emphasis on developing appropriate technology with the poor, instead of developing appr. technology for the poor". (ref. 15)

Ref.14, 'Community Participation in Water and Sanitation', lists ten reasons for community participation:

1. With participation, more will be accomplished
2. With participation, services can be provided more cheaply
3. Participation has an intrinsic valu for participants
4. Participation is a catalyst for further development
5. Participation encourages a sense of responsibility
6. Participation guarentees that a felt need is involved
7. Participation ensures things are done the right way
8. Participation uses valuable indigenous knowledge
9. Participation frees people from dependence on others'skills
10. Participation makes people more conscious of the causes of their poverty and what they can do about it.

Incorporation of community participation in projects is not simple. Several projects in e.g. Tanzania with community participation have failed. The main reasons for these failures were:

- the people were not motivated to cooperate. The decissions were already taken and the reasons why they should help were not clear.
- the people were not used to self-help. They expected the government to implement the projects.
- communities seemed not be able to organize themself sufficiently.

Chapter 4 Sanitation Programme Planning

4.1 Introduction

Sanitation programme planning is the process of identification and structural improvement of sanitary technologies in a given community. The objectives of a sanitation programme are:

- identification, design, and implementation of the most appropriate sanitation technology.
- achieving such level of community involvement that the sanitation systems will be operated and maintained by the community.

The most appropriate technology is defined as that which provides the most socially and environmentally acceptable level of service at the least economic cost. The long-range objective of community participation in sanitation programme planning is to ensure that the technology selected matches the preferences and resource constraints of the beneficiaries.

4.2 Phases in Sanitation Programme Planning

4.2.1 Introduction

Sanitation programme planning can be broken up in four phases:

1. Feasibility Study
2. Sanitation Technology Identification
3. Implementation
4. Operation and Maintenence

A description of above four mentioned phases is given in the following chapters.

4.2.2 Feasibility Study —Phase 1—

The need for sanitation programmes is high. Not all communities who should improve their sanitation system can be supported by sanitation experts at once, therefore a selection of communities is necessary. The feasibility study is a method for the selection of communities. which should get priority in improving their sanitation system. A technical and a social feasibility study have to be performed.

A technical feasibility study should reveal whether the three sanitation options, suggested in chapter 2, are applicable.
Technical information is required on:

1. Existing sanitation system (including incidence of excreta related diseases).
2. Housing Density; In very densely populated urban areas, VIP latrines are infeasible, and PF latrines with soakaways are feasible only under favourable conditions.
3. Water Supply Service. Level; The VIP and DVC latrine are possible choices when water is to be carried by hand since they require no water for flushing. PF latrines are feasible when there are yard taps or a sufficient quantity of water can be carried to the household.
4. Ground Condition; On-site disposal systems are infeasible on impermeable ground or rock.

In a social feasibility study information is collected on the community. The purpose of a social feasibility study is to recognize the "human" risks of a community towards a sanitation programme.
Central questions to be solved are:

Do the intended beneficiaries want improved sanitation?
Previous projects, have there been any? Failure/Success? Why?

Failure of the "first" sanitation programmes would not only mean a loss of money, time etc. but will have also a negative impact on future sanitation programmes in other areas.

4.2.3. Sanitation Technology Identification —Phase 2—

In this phase, the sanitation system to be implemted is identified.

Community participation alone is not sufficient for the successful design (and implementation) of a sanitation programme. Institutional support by government —national, state, and local— is needed to supply technical expertise and support services not available in the community.
The final choice of sanitation system should be the result of a dialogue of the community with the field team of experts.
This field team consists of a Public Health Engineer (Sanitary Eng.), Economist, and a Behavioural Scientist.

This phase: Technology Identification, can be divided into 4 stages

Stage 1:
In stage 1 unstructured interviews are conducted with a few local leaders (such as political officials, religious, and school teachers) and a small number of housholds. The purpose of these interviews is to identify user attitudes and other factors that are likely to determine the engineering design and acceptance criteria. In this stage is determined which type of sanitation system (chapter 2; VIP, PF, or DVC latrine) will be implemented.

Stage 2:
In stage 2, a questionnaire is developed, based on the information from stage 1. The types of information that this questionnaire should elicit include:

1. The desire of the community for sanitation improvements, and then expressed in terms of willingness to contribute to the costs through cash contributions and/or labour and materials.
2. Health, sickness, and nuisance as they are perceived to be affected by sanitation practices and water supply, in detail.

3. Attitude toward convenience, privacy provided by improved sanitation.
4. Aesthetic features of sanitation alternatives such as superstructure colour and materials or squatting plate design.
5. Attitudes toward handling and reuse of stabilized human waste.
6. Confidence in local or visiting political and technical authorities.

Other factors about which information is essential for design or implementatio include land tenure and the customary manner in which local committees are formed.

Stage 3:

In stage 3, structured interviews are conducted using the questionnaire from stage 2. The households selected for this survey should be representative for the social and income groups of the community.
Special attention should be paid to women, since they are mostly the key-person in the household and they are responsible for training children in personal hygiene.
Based on this questionnaire and additional technical information, as e.g. a permeability test, the sanitary engineer has to develop low-cost designs which should, as far as possible:

1. use local materials and local expertise;
2. depend upon cooperation from community leaders;
3. fit in with traditional patterns of water use and excreta disposal and associated practices or beliefs.

Stage 4:

In stage 4, the field team presents its proposals for sanitation alternatives to the community or its representatives. If necessary, limited demonstration latrines may be built and operated, e.g. near the school, dispensary, community leader etc..
At a follow up meeting, (one) alternative(s) has/have to be selected after discussions and with full support of the community.

As a warning should be stated here that it will be much more easy to change design of a sanitation option than to alter behavioural patterns.

However, if a significant proportion of the community population (say, 50 percent) is not interested in cooperating in a sanitation project by the end of this phase, it will ordinarely be better to shift the project and resources to another community.

4.2.4 Implementation —Phase 3—

If phase 2, sanitation technology identification, was successful, than there are already ideas on the implementation phase. The initiative will be now on the side of the community, which will have to organize the implementation and subsequent operation and maintenance of the facilities to be constructed. If there is no formal organizational structure in the community, it may be used to organize project implementation. If no structure exists, or the existing structure is too weak, special arrangements will have to be made for the project.

During the implementation phase, it would be ideal if there is some kind of 'sanitation centre' stationed in the project area.
The functions of this 'sanitation centre' are:

1. Information centre; technical information on construction materials, building technology etc., information on personel hygiene, diseases, nutrition etc..
2. Distribution centre; materials which are normally not available in the community can be purchased here. 'Difficult' parts as e.g. a squatting slab or a bowl can be constructed, for the whole project area, at the sanitation centre.
3. Administration centre; records on the progress in the implementation phase are kept at the centre, but also records on time, cash, or materials provided by community members.

4.2.5 Operation and Maintenance —Phase 4—

Phase 4 is the operation and maintenance of the sanitation facilities. Proper use and regular maintenance should be checked through regular visits by community health workers. Problems experienced by the users should be noticed and, if possible, be solved quickly. Provisions should be made for rapid contact in cases of emergency (pit collapse, brake down of squatting plate).

Problems evinced in existing programmes should be avoided in future programmes, therefore also visits are necessary after one or more years after completion of a sanitation project.

4.3 Sanitation technology comparisons

In this chapter a number of factors will be discussed which influence the selection of sanitation systems from a technical point of view.

4.3.1 Water Supply Service Level

Three levels of water supply are identified:

I Hand-carried supplies
II Yard taps
III House connections

With regard to the three sanitation options, discussed in chapter 2, the following can be remarked:
The VIP latrine and the DVC latrine do not require yard taps or house connections for water supply. The PF latrine is feasible when sufficient water is available. That means that a yard tap is to be preferred above hand carried supplies.
Combinations of on-site disposal systems as VIP, PF and DVC latrines are not likely. An important matter however is th with increasing water supply level the amount of water, and hence the amount of waste-water, per capita increases accordingly. Waste-water collection systems become necessary when yard taps and house connections are used.

4.3.2 Soil conditions

Soil conditions are important for all sanitation technologies.
Soil stability is important for VIP and PF latrines. In unstable soils pits must be lined, often to their basis. DVC latrines can, if necessary be built completely above ground level.
Permeability; Liquids in VIP and PF pits soak away, however the soil should be enough permeable. In impermeable soils, or rock, VIP and PF latrines are not feasible.
If the groundwater table is within 1 meter of the ground surface, VIP and PF latrines are only then feasible if the soil is sufficiently permeable. The liquid level in the pit should not be less than 0.5 meter below ground level.

4.3.3 Housing Density

On-site sanitation systems are not feasible in very densily populated urban areas. The main point is to determine, in any given situation, whether or not there is sufficient space on the plot to provide two alternating pit sites that have a minimum lifetime of two years. Two years is the absolute minimum lifetime, but the minimum desirable lifetime is five years, with ten years being preferred for VIP latrines. The maximum figure for on-site sanitation systems as e.g. VIP latrines is around 250 to 300 persons per hectare.

4.3.4 Other factors

Complementary investments

The advantage of 'simple' systems as the VIP, DVC and PF latrine is that no complementary investments such as sewerage or treatment works are required.

Reuse potential

DVC latrines should be provided only there where there is a demand to reuse excreta. Material from latrines can be applied as fertilizer if the pits from which it was removed were not used for 12 months or more. Sludge from PF and VIP latrines can also be used as fertilizer, but only after composting or treatment.

Self-help potential

The unskilled labour and some (but not all) of the skilled labour required for VIP, DVC and PF latrines can be provided by the users. Self-help labour, however, requires organization and supervision by e.g. local authority.

Anal cleansing material

PF latrines can not easily cope with anal cleansing materials such as maize cobs, stones, and cement-bag paper because of the clogging of the water seal. The practice of using water for anal cleansing presents problems only to DVC latrines, which may become too wet for efficient composting.

4.4 Economic analysis of sanitation technologies

Economic costing

In economic costing, the opportunity costs to the national economy are calculated.

Ranking different sanitation technologies on costs will give policy-makers a basis to decide.

In preparing estimates, three principles must be followed:

1. all relevant costs must be included.
2. each cost must be properly evaluated.
3. the assumptions used for costing different technologies must be mutually consistent.

In an economic analysis, for the determination of the least-cost technology with respect to the national economy, it is necessary to include all costs attributable to a given alternative irrespective of whether they are born by the household, the administrative authority, the national government, or whomever.

In quite a few countries, market prices do not reflect the "real" costs to the economy due to socio-political reasons. The adjustment of market prices to reflect opportunity costs is known as "shadow pricing".

The calculation of shadow rates is a difficult task that requires intimate knowledge of a countries economy. In the economic costing of sanitation technologies there are four shadow rates that normally need to be incorporated into the analysis.

These are:

1. the unskilled labour wage shadow factor
2. the foreign exchange shadow factor
3. the opportunity cost of capital
4. the shadow price of water, land and other direct inputs

1. Unskilled labour. Many governments enact minimum wage legislation. In combination with high rate of unemployment, this means that unskilled labour will be overvalued. Generally the shadow factor for unskilled labour in developing countries is in the range of 0.5 to 1.0 .

2. Foreign exchange. The foreign exchange shadow factor is the ratio of the shadow exchange rate (what the currency would be worth in a freely trading international market) to the official exchange rate fixed by the government. The shadow factor is thus greater than 1 whenever the local currency is overvalued or import restrictions are high.

3. Opportunity cost of capital. In many developing countries, capital is a scarce commodity and therefore has a high opportunity cost. The decission to finance e.g. the provision of VIP latrines means that investments in e.g. industry can not be made. The economic cost of this decission is the yield that the government would have received had it invested its capital in the best alternative way.

4. Water, land, and other inputs. Low-cost sanitation alternatives as the VIP, DVC, and PF latrine do not require much land for installation, or water for maintenance. However, in urban areas where it seems necessary to use waste stabilization ponds shadow rating might be inevitable.

The installation of VIP latrines in a small town will take several years. The number of households provided by a VIP latrine will increase during these years. One of the best methods to overcome this problem of differing capacity utilization rates of different systems (especially for sewerage systems and treatment plants) is the Average Incremental Cost (AIC) approach.(ref.09)

$$(AIC)_t = \frac{\sum_{t=1}^{t=T} (C_t + O_t)/(1 + r)^{t-1}}{\sum_{t=1}^{t=T} N_t/(1 + r)^{t-1}}$$

where: t time in years

T design lifetime in years (measured from start of project at t=0)

C_t construction costs incurred in year t

N_t additional people or households (from year t=0) served in year t

r opportunity cost of capital in percent times 10^{-2}

It is essential that all costs used in the equation have been appropriately shadow priced.
Note, that for a system that is fully utilized upon construction, the equation reduces to merely the sum of the annuitized capital costs and annual operating and maintenance costs divided by the design population.

Financial costs

The user/owner is interested in financial costs, i.e. what he will be asked to pay for the system and how payment will be spread over time. Financial costs are entirely subject to interest rate policy, loan maturities, central government subsidies, and the like.
For example, the financial cost of a sanitation system can be zero if the central government has a policy of paying for them out of the general tax fund.

For an on-site system with a very short construction period and little requirement for municipal maintenance, the construction costs can simply be annuitized over the life of the facility at the prevailing (market) interest rate. To this annual capital cost must be added operation and maintenance cost that will be required.
Decreasing costs (financially) to the user/owner can be achieved by:
- increased self-help input
- loans
- construction grants

Chapter 5 The ability to pay for sanitation

5.1 Introduction

A discussion on the subject if public facilities should be given free or that the user should pay for the service, mostly ends with a conclusion which favours the second idea.
Arguments for paying a certain percentage of the project costs are:

- -it stimulates the feeling of responsibility and involvement
- -the creation of a maintenance fund

On the other hand: Sanitation is a basic need, and can you ask from people in the margin of society a financial contribution?
The answer is: yes.
Experience shows that a project stands a better chance of being realized if a community is financially self-reliant, in the sense that revenues collected on a project cover debt service, operation and maintenance.
The percentage of project costs to be covered by the users depends on: -policy government

- -finance, consisting of
  - ability and willingness of users to contribute
  - financial support international agency
  - governmental contribution

5.2 Theoretical ability to pay for sanitation

The income proportion which could be spent on sanitation by the households will depend on their income levels.
The World Bank (ref.09) divides a community into four income groups:

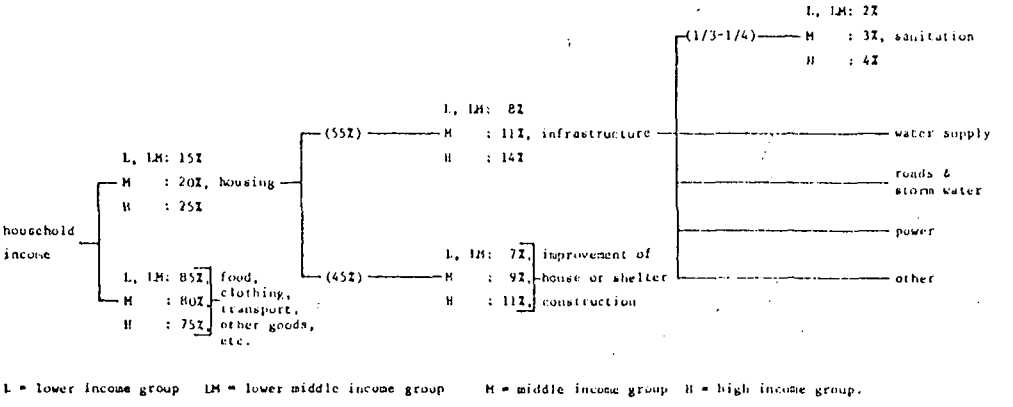
- lower income group
- lower middle income group
- middle income group
- high income group

Whether a household belongs to a lower or a high income group depends on the country to which it belongs. Thus a household from among the lower income group in a relatively high-income developing country could eas ly belong to the middle income group in a poor developing country. Generally per capita incomes below $180 per year is rated as low income (ref.05).

Table 4 gives household expenditure for different income levels based on World Bank publications and figures given by ministries and organizations in several African countries (ref.09)

Table 4:

Household expenditures for different income levels.



Thus the household income proportion which each income group can afford to spent on sanitation will be as follows:

- lower and lower middle income groups 2%
- middle income group 3%
- high income group 4%

5.3 Cost recovery systems

Cost recovery means that a certain percentage of the project costs will be covered by the users of the sanitation facilities. The problem is how cost recovery can be achieved.
Two systems will be discussed here:

I a monthly fee has to be paid as sanitation tax
II a once for all fee

ad I.
Sanitation tax can be added to f.i. the bill for water or electricity. The advantage is that if someone refuses to pay, water or electricity can be cut off. The collector can use his influence. In urban areas where households are supplied with electricity and/or a house connection for water, this system can function but unfortunately many households have to lack both facilities.
The possibility of subsidation of f.i. individual households or enforcement of a sanitation programme, when an extra tax for sanitation is collected, is likely.

ad II.
The advantage for the collector: quick recovery of money
no expensive recovery system
Operation and maintenance costs have to be met by the community.
For low income groups it will take a long time to save enough to raise the amount of money required, therefore loan systems have to be developed and be made available by local banks.

Chapter 6 Evaluation

6.1 Purpose and objectives

The two main purposes of project evaluation are:

1. To provide feedback to the project itself. This enables an assesment of project performance to be made -has it been a success or not? The criteria for this judgement are primarily the comparison between initial objectives, predicted performance, and actual achievement of objectives and performance.
2. To provide feedback to the planning process. This comes from the lessons gained from project experience and comparison of project achievements with the goals of current policy.

Information, required for evaluation; to maintain or improve project performance, should be obtained through regular monitoring of project performance. Monitoring should be a routine activity of the project management system.
Evaluation should not only be performed after a project is completed; (ex-post evaluation). Evaluation has to be a contineous process of collecting information and comparing this with the original planning. This approach adds two advantages to standard ex-post evaluation:

1. The identification of problems in a primary phase, and
2. Controll and,if necessary, apposition of the project itself in time.

An evaluation may take many forms. It may concentrate upon different types of problems, as e.g. the planning process; project organization; policy issues (preventive health measures, tariff policy) etc.
It is important to be clear about objectives from the start.

The major potential objectives of an evaluation of a sanitation programme are as follows:

1. to asses users degree in operation and maintenance
2. to find out how to increase users degree in operation and maintenance
3. to provide feedback on the apprpriateness of the current strategy for the sanitation programme in terms of village selection, choice of technology, implementation system etc.
4. to justify the efforts being made, with a view to attracting further resources
5. to indicate areas where complementary inputs, such as health education/reuse of excreta for agri- and aquacultural purposes could improve the positive effect of sanitation programmes

Chapter 1 to chapter 5 have dealt with technical, organizational, economical and social aspects of both sanitation systems and sanitation programme planning. These chapters give the information required on which a proper evaluation can be based.

6.2 Social benefit-cost analysis

The main objective of improving sanitation conditions, as stated in the introduction of this report, is the reduction in incidence of excreta-related diseases.
Table 6.1 shows that in reduction the incidence of excreta-related diseases not only the provision of toilets is an important instrument, but also other controll measures as e.g. improving water supply, health education, improved housing etc.

Table: 5
Environmental classification of excreted infections (ref.03)

Category	Epidemiological feature	Infection	Dominant transmission focus	Major control measure
I	Nonlatent, low infective dose	Enteropiasis Enteroviral infections Hymenolepiasis Amoebiasis Giardiasis Balantidiasis	Personal Domestic	Domestic water supply Health education Improved housing Provision of toilets
II	Non-latent medium or high infective dose, moderately persistent and able to multiply	Typhoid Salmonellosis Shigellosis Cholera Path Escherichia coli Yersiniosis Campylobacter infection	Personal Domestic Water Crop	Domestic water supply Health education Improved housing Provision of toilets Treatment prior to discharge or reuse
III	Latent and persistent with no intermediate host	Ascariasis Trichuriasis Hookworm	Yard Field Crop	Provision of toilets Treatment of excreta prior to land application
IV	Latent and persistent with cow or pig intermediate host	Taeniasis	Yard Field Fodder	Provision of toilets Treatment of excreta prior to land application Cooking, meat inspection
V	Latent and persistent with aquatic intermediate host (s)	Clonorchiasis Diphyllobothriasis Fasciolasis Fasciolopsiasis Gastrodiscoidiasis Heterophyiasis Metagonimiasis Paragonimiasis Schistosomiasis	Water	Provision of toilets Treatment of excreta prior to discharge Control of animal reservoirs Cooking
VI	Excreta-related insect vectors	Bancroftian filariasis (transmitted by Culex pipiens), and all the infections listed in I–V for which flies and cockroaches can be vectors	Various fecally contaminated sites in which insects breed	Identification and elimination of suitable breeding sites

Cooperation and coordination in these fields will certainly increase the chance on achieving above mentioned health objective.

Economical benefits of improved sanitation can be found in the reduction of foreign currency required for medicine and insecticides (used for spraying in urban areas); and even perhaps, when agricultural productivity increases, in a reduction in imports of food. Export of food or industry related products might increase.
If operated properly, the Double Vault Composting latrine has economical benefits over the Ventilated Improved Pit latrine and the Pour-Flush latrine. The production of compost, which can be used as fertilizer, is an economical benefit for the user directly, as well as for a country when imports of fertilizer diminishes.

A successful completion of a sanitation programme will have strengthened the organizational structure and self confidence of a community. Initiatives for further development will stand now a better chance to be realized.

The installation of latrines will have a positive impact on the physical environment, through the prevention of faecal pollution. However, a disadvantage of pit latrines is the possible pollution of groundwater.

The costs of improving sanitation depend, apart from the costs of materials and labour, very much on the type of sanitation system to be implemented, method of implementation, additional organizational and institutional activities etc., which will differ from one country to another.
An indication of costs for several sanitation systems is given on page 4 , table 2 .
Sanitation programme planning with an emphasis on community participation/self-help will possibly reduce the financial costs, compared to other implementation systems. However, this approach, as suggested in this report, can be a time consuming, tiring, and energy demanding processs. Most participants in this process have to contribute time (time after their work is finished), sometimes money, and should have the intention/willingness and motivation to improve their existing situation.
These constraints are most likely the most important, not to be underestimated "costs" in sanitation programme pl nning, and should accordingly be properly monitored and evaluated.

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