Feasibility communal sewerage and treatment in urban Botabek (W-Java)

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FEASIBILITY COMMUNAL SEWERAGE AND TREATMENT IN URBAN BOTABEK (W-JAVA)

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FINAL REPORT

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ABBREVIATIONS AND TERMS

Babakan Ujung	Low/middle income area in the city of Tangerang, where a rudimentary sewerage system has been implemented (by Botabek Project)
Botabek	Bogor, Tangerang and Bekasi
Botabek Project	Botabek Sewerage and Drainage Project
Conventional sewerage	A sewerage system by which waste water is collected via yard and house connections
CSD	Connection Sewer to Drainage
Desa	Village (Lowest level of formal government administration)
Drainage	A system of channels to carry away rainwater. Also used in Indonesia for wastewater disposal)
HH	Household
House connection	All the in-house plumbing and on the plot piping from the inspection box to the various waste water discharge points such as toilet, kitchen and floordrain(s). Part of the conventional sewerage system.
i.e.	Inhabitant equivalent
Kecamatan	Sub-district (third level of formal government administration)
Kelurahan	Lowest formal Administrative Division. Village/Desa
m	metre or month
Local sewerage	A sewerage system without trunk sewers
Low cost sewerage system	A sewerage system by which wastewater is collected via CSD's and drainage system
O&M	Operation and maintenance
On-Site Sanitation system	System which disposes of the wastewater on-site ,the kind of on-site sanitation systems applied in Indonesia are the pit and septic tank
no Sew	Without house connection (to sewer)

not Sewrd	Not sewered district
PDAM	Perusahaan Daerah Air Minum : Local Water Enterprise
Perumnas	National Housing Board
Perumnas area	New development area in Tangerang, where conventional sewerage facilities have been implemented
Pit	A pit receiving toilet wastes in which the solid accumulate and the liquid leaches into the surroundig soil
Pour flush toilet	A toilet from which excreta is flushed from the basin by pouring a small quantity of water
Rudimentary sewerage system	see Low cost sewerage system
Rupiah (Rp)	Indonesian currency (1 NLG ≈ Rp. 850, in December 1988)
Septic tank	A sealed tank receiving (usually only) toilet wastes in which the solid matter precipitates and decomposes and the liquid overflows
Sewerage	A system of underground pipes to carry away waste waters
Sukasari	A desa in Tangerang where a conventional sewerage system has been implemented (by Botabek Project)
Sullage	All domestic waste water other than toilet-water/Waste water from kitchen and bathroom
With Sew	House connection (to communal sewerage)
Yard Connection	Section from the sewer pipes in the street to the inspection box on the plot boundary. Part of the conventional sewerage system.
ϕ	Diameter

PREFACE

Safe drinking water and sanitary disposal of wastes have long been recognized as basic needs of society, helping to safeguard human health and to make possible a more productive life. Health and environmental problems caused by inadequate water supply and waste disposal are made more serious by the growth of population and its concentration in urban areas. Most of the people in developing countries do not have facilities that meet the minimum standards. The importance of the improvement of drinking water supply and sanitation has long been recognized by the United Nations. Therefore, this organization declared the period 1981-1990 to be the International Water Supply and Sanitation Decade. In 1990 75 % of the urban population should be provided with proper water supply facilities and 60 % with proper sanitation facilities. The Indonesian Government adopted the goals of the UN Decade.

The Indonesian Government started pilot projects to develop possible approaches for improvement of urban sanitation. One of these projects is the Botabek Sewerage and Drainage Project in Tangerang (West Java). In 1980 the Indonesian and Dutch Government agreed upon financing this project. The objective of the project is to develop a generally applicabe approach and solution for the rainwater and wastewater disposal in urban Botabek. Botabek is a fast urbanizing area, 5700 km^2, surrounding the metropolitian Jakarta. The Dutch consultants DHV and the Indonesian counterpart Deserco were commissioned to start the project. As a pilot project improved sanitation facilities have been implemented in Tangerang. As implemented facilities are rather new technologies in Indonesia, it was decided to execute a comprehensive programme on monitoring and evaluation of the project. For this DHV and Deserco were commissioned.
The implementation of sewerage facilities in Indonesia was with great difficulty; the evaluation programme of the Botabek Project did not start until 1988. It also became clear that the goals of the Indonesian Government with respect to sanitation improvement were too optimistic.

In 1986 I started studying Technology Development Sciences at the Faculty of Philosophy and Social Sciences of the Eindhoven University of Technology (EUT) in the Netherlands. This study is finished with a M.Sc. Research in a developing country.
In 1987 I inquired at DHV for possibilities to do my M.Sc. Research. They could offer me an interesting opportunity at the evaluation programme of the Botabek Project. A research proposal for assignment in the Botabek Project was made in April 1988.
As a Research assistent I worked with DHV consultants in the period May 1988 to April 1989 on the Botabek Project, with residence in Jakarta. I participated in the socio-economic evaluation on the implemented sewerage and treatment facilities in Tangerang. My research has a double purpose; firstly it has to

meet the requirements of the EUT and secondly it intents to contribute to the consultants'work.
This report presents the results of the M.Sc. Research.

At this point I would like to thank the persons who assisted me in the research and made it possible. With appreciation for all the others I will restrict myself to :
DHV Consultants, especially Kees Bilijam, who gave me the opportunity to work on the Botabek Sewerage and Drainage Project. Kees Bilijam also gave useful criticism on the text of this report with great persistence.
The employees of DHV for their time and cooperation, especially , Leonard Bijlsma, the team leader of the project, who guided me in my work and who made useful comments regarding my reports, Jan Kraay and Frits Jakma, who guided me during my first weeks in Indonesia, Hugo de Groote who supervised me during the survey and Ron Eveleens who made the data processing programme for the survey.
Penny Marson and my supervisors at the University, Chris Bertholet, Herman Gaillard and Simon Ottengraf, who read and reviewed this text with much persistence. Pa Sugeng of PDAM Tangerang who assisted me at the many field visits in Tangerang.
The interviewers of the faculty of Economy at the National University in Jakarta - Vriema Chempaka, Agung, Adriani Azis, Rudi Supriyadi and Zaal Mahdi - their trainer Pa Isprowono and field supervisor, Pa Hari Zamharir of Deserco, who carried out their work with great enthusiasm and perseverance.

SUMMARY

At present about half of the living accomodation in the densely populated urban area of Botabek, a rim area just outside the Indonesian capital - Jakarta, has access to a private on-site sanitation system, whereas the other half has no sanitation system at all.

The aim of the Botabek Sewerage and Drainage project is to develop an approach to improve the environmental and health conditions in urban Botabek. Two types of sewerage systems (a rudimentary and conventional sewerage system) and a treatment plant have been implemented in the town of Tangerang as a pilot project.

In this study, the feasibility for further implementation of the two types of sewerage systems, combined with the treatment plant, has been evaluated for urban Botabek. The feasibility was based on assessment of the pilot project from several points of view: technical, financial-economic, social and institutional. This has also been compared with the sanitation systems in use.

The information required for the feasibility was gathered by :
- an extensive desk study of Botabek project contracts, price lists, documents etc..,
- a community survey, covering both sewered and non sewered areas
- interviews with key informants
- field observations

The major constraints of this research were :
- a lack of available health data, which was necessary to formulate control measures with respect to sanitation
- an incomplete implementation of the agreed facilities in the pilot project area

In general it can be concluded that both system propositions are not feasible, even though the amount of waste water generated is sufficient to ensure proper operation of the chosen technologies. The reasons for this being :

1) the households which are at present using an on-site system have limited felt need for improvement, in general, and are unwilling to pay a high price for it;

   This statement is supported by the results of the survey which indicate that households are satisfied with their existing on-site sanitation, which is cheap (only costing 0.7% of their income). They consider these systems healthy and convenient. The households are also satisfied with the functioning of the drainage system, although waste water is discharged into it.

There is only a limited feeling that a new improved system is necessary and consequently the people are unwilling to pay high for it.
This is supported by the survey results; households which are connected to the conventional sewerage system are only willing to contribute 1,500-2,000 Rp/month (0.8-1.1 % of their income) for waste water disposal. This amount is limited to the coverage of the operation and maintenance costs of the systems.
This limited willingness to pay must also be seen in the context of the tendency for buying consumer goods (e.g. it was found that 85-90 % of the surveyed households own a radio and television set).

- inability of the households to pay for the sanitation improvements;

Even if the households were willing to pay for the improvements, they are considered incapable of paying for this. 8-9 % of households income would be required for recovery of both investment and operation and maintenance costs of the improved systems. Guidelines for urban sanitation, based upon experience in Asian developing countries, assume that households can spend a maximum of 3 % of their income on sanitation (The survey results in Tangerang even argue for a lower maximum, toward 1.5 %, as expenditures for urban services tot up to 10 % of the household income).
Together with this fact it is also considered that the government has insufficient means to pay if these facilities were applied on a large scale. For this 25 % of the government development budget would be required, while 3 % is supposed to be the limit.
There is at present no foreseeable way to make these facilities affordable for application on a large scale ; possibilities for further reduction of presented costs are limited, while government and households expenditures for sanitation are not expected to increase radically in the coming years.

The research indicates that only limited implementation of the improved systems is feasible with government subsidies. Here the best opportunities for implementation have been identified. The overriding recommendations for a successful selective implementation of the improved facilities are:
- to set up and strengthen the organisations, especially on the financial side, which should guarantee the continued functioning of the improved systems
- besides special attention should be given to community education; if there is a ascribed need for implementation of the improved systems, the community should be made aware of this. They must be convinced about the need for connection to the system(s) and finally to pay for the operation and maintenance of it.

Public health improvements (in Botabek) might still be realised to a lower extent in other areas where sewerage and treatment facilities are not planned on the short term by :
- 100 % coverage of on-site sanitation systems (for excreta disposal), so that one of the most important transmision routes of infections is cut. These systems are assumed to be affordable (1-2% of income).
- a better, more regular maintenance of the drains, so that stagnant wastewater problems might be reduced. Costs of this improvement are estimated on 300 Rp per household per month (or 0.2 % of income)

To reach these goals information campaigns will also play an important role.

With respect to environmental improvement there is at this moment no real alternative and the quality of surface and ground waters will deterioriate if nothing is done. This might interfere in future with the use of these waters for other purposes such as drinking water preparation.

1 INTRODUCTION

1.1 Botabek Sewerage and Drainage Project

In 1980, 40 percent of Indonesia's urban population, of which the largest part live in highly densely populated areas, had facilities for sanitary disposal of wastes. However, only 16 percent had proper facilities for sanitary disposal of wastes [12]. This bad situation made the Indonesian government start pilot projects to develop possible approaches for improvement of urban sanitation.

One of these pilot projects is the Botabek Sewerage and Drainage Project (or Botabek Project). In 1980 the Indonesian and Dutch Governments agreed upon financing the project of which the objective is to develop a generally applicable approach and solution for water disposal (i.e. stormwater and wastewater) in the urban areas of Botabek (Botabek consists of the kotamadya* Bogor and the three kabupaten** Bogor, Tangerang and Bekasi which surround Jakarta). This approach has to be feasible from different point of views. In 1980 the Dutch Consultant DHV and its Indonesian Counterpart Deserco were commissioned to start the project.

The town of Tangerang, with a population of 142,000 (1987) and situated 20 km West of Jakarta, was selected for executing the project. The geological and demographic situation in Tangerang can be considered as more or less representative for the urban areas in Botabek. The location of Tangerang is shown on figure 1.1, where the broken line (---) shows the boundaries of the Botabek area.

The project started in 1980 with the preparation of a masterplan for sewerage and drainage for an area of about 1,000 ha. As a pilot project two types of sewerage systems (a conventional sewerage system as applied in most Western countries and a low cost sewerage system), a waste water treatment plant and drainage provisions were implemented in Tangerang.

---

* kotamadya = municipality, city with a governmental status comparable to a district

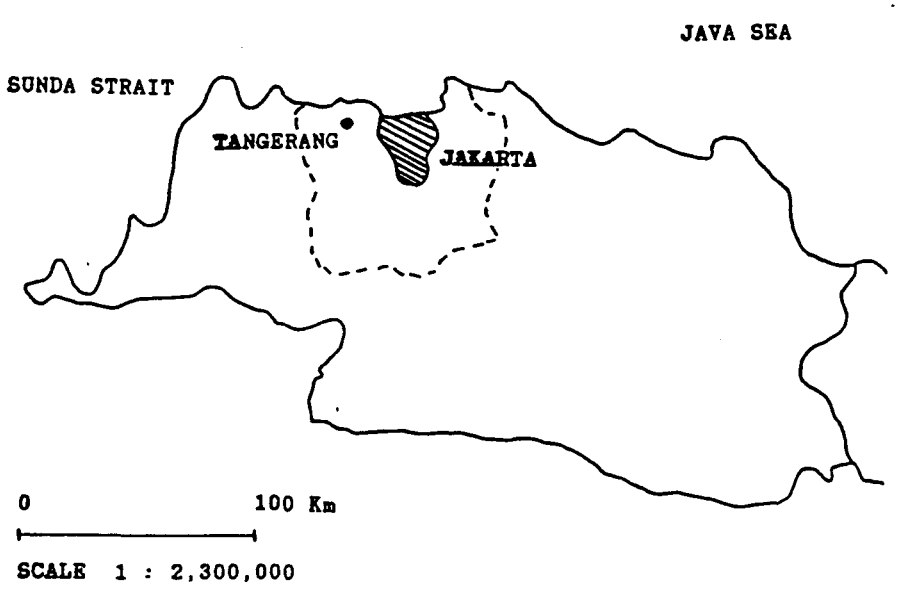
** kabupaten = district (second level of government administration)

The wastewater collection systems and, especially, the wastewater treatment plant are rather new technologies in Indonesia. To evaluate these technologies in Indonesia, gain experience and collect data for a review of design and suitability of the systems it was decided to execute a comprehensive programme on monitoring and evaluation of the project. DHV and Deserco were commissioned for this. Since the implementation of sewerage facilities was very difficult (§ 2.5.5), the programme did not start until August 1988. The objectives of the programme are to evaluate :

- whether the functioning and utilization of the implemented facilities are in accordance with its design; and if not, to formulate solutions needed for this
- the socio-economic as well as the technical feasibility for further implementation of the chosen technologies at other locations

In field visits in September 1988 it was observed that utilization of the systems was limited; only a part of the domestic wastewater was discharged to the sewerage systems and to the treatment plant. Consequently the facilities still don't function properly and the households still don't experience the full benefits. This situation cannot be changed in a short time. Hence an "evaluation phase" with respect to the original project objectives and implementation results is premature from a technical and social point of view.

FIG 1.1 : LOCATION OF TANGERANG (ON MAP WEST JAVA)



1.2 M.Sc. Research

The M.Sc. research took place in the framework of the consultants' monitoring and evaluation programme.

1.2.1 Problem Definition

The problem definition of the M.Sc. research is as follows :

> Are the chosen technologies feasible for (further) implementation in Tangerang and other places in urban Botabek ? and if 'yes' under which conditions ?
>
> Are other solutions for sanitation improvement in urban Botabek, especially in Tangerang, possible ?
>
> Which of the possible solutions is the most attractive ?

In the M.Sc. Research main attention is given to the chosen technologies in the Botabek Project. These technologies are only compared with the private sanitation facilities in use (i.e. on-site sanitation systems).

1.2.2 Problem Elaboration

The chosen technologies are rather new types of infrastructure in Indonesia. The communal character of the facilities has several implications :
- an institution is required for continued functioning of these facilities
- for succesful implementation of communal facilities households must be willing to participate
- a way to finance the communal facilities must be found

For further implementation in other places the proposition for Tangerang has to be feasible from a technical, economical, financial, social and institutional point of view. The last four points are considered in the socio-economic feasibility analysis. For assessing the feasibility of the chosen technology the following main issues, stated in the elaborated problem definition, have to be determined (see next page) :

Technical feasibility

Is the potential amount of wastewater sufficient to operate the systems ? *

As the potential amount of wastewater is related to the used amount of water by the households, this item will be discussed in the social analysis.

Socio-economic feasibility

Economic feasibility

Depends on the benefits and costs of the chosen technology.

As the health and environmental benefits of chosen technology are difficult to quantify in money, it was originally the purpose to use the cost-effectiviness criterium : how can the intended benefits be realized as cheaply as possible ? [17]. For this the technology should be compared with its alternatives. However, intended benefits are not clearly defined by the policians (§ 1.2.5). Therefore main emphasis is given to the cost aspects of sanitation technologies, while benefits (in qualitative terms) remain in the background. How far adaptation of the chosen technology can reduce the costs, will also be determined.

Financial feasibility

Can a proper solution to finance the technology be found ?

For this the government's and households' affordability to pay for the costs of the chosen technology are assessed.

Is Indonesia able to finance the foreign currency component of the cost ?

* Originally, it was the purpose to assess also the viability of the technical components under prevailing conditions. This criteria was dropped, as a technical evaluation in this stage was not worthwhile (p.2)

Social feasibility

Are the households willing to cooperate in communal sanitation projects ?

Do the users accept and properly use the facilities ?

Are the households willing to pay for improved sanitation?

At least the first two issues have to be fulfilled for succesful implementation and continuation of communal sanitation facilities.

Institutional feasibility

Deals with Indonesia's ability in continued functioning of implemented facilities. It is investigated if an organization can be set up and staffed (with personel and management), which will be capable of running the implemented facilities properly ?

1.2.3 Scope of the Research

A one year period is too short to make a profound study of the sanitation sector in urban Indonesia. Therefore the M.Sc. research is limited to :

1. waste water disposal

The Botabek project is set up to improve waste water and stormwater disposal in order to improve the health and environmental conditions (by waste water disposal) and to contol floodings (to prevent or reduce damages to material possessions, houses, infrastructure and so on).

In the monitoring and evaluation phase of the project, the emphasis is on improvement of waste water disposal. Therefore, the M.Sc. research will be limited to this.

2. Urban Botabek

The Botabek area is characterised by specific geological conditions for wastewater disposal (§ 2.5.2). As these conditions affect the choice and costs of the sanitation technology, the research is limited to the Botabek area.

3. Residential Areas

The type of area affects the financial and social feasibility of the chosen technology. The target group in residential areas are the households. In commercial and industrial areas the target group(s) may be different.

4. The chosen technology and facilities in use

In table 1.1 the technologies considered in the analyses are summarized.

TABLE 1.1 : TECHNOLOGIES CONSIDERED IN THE M.SC. RESEARCH

Techonology	Financial-Economic Analysis	Institutional Analysis	Social Analysis
On-site sanitation systems	X		X
Low Cost Sewerage System	X	X	
Conventional Sewerage	X	X	X
Communal Treatment (Carrousel)	X	X	

In the institutional analysis the facilities in use (on-site sanitation systems) are not considered; operation and maintenance of these private facilities is arranged by the households. The low cost sewerage system is not incorporated in the survey (social analysis) as no differences between the past and actual situation should be observed regarding sanitation (§ 2.5.5). The communal treatment is also not incorporated in the survey as it is a great distance away from the residential quarters and so not noticed by the households.

In the M.Sc. Research both new development areas and existing housing estates are considered. This differentiation is only made for the sewerage facilities. As the Botabek Project deals with existing housing estates, results of the Perumnas Sewerage Project, a pilot project in a new development area in Tangerang, are also evaluated.

The research is mainly limited to the micro level (Botabek area). At macro level (implications of implementation on national level)

only foreign exchange effects are discussed, evaluation of other macro effects is considered less relevant at this stage.

As an extensive institutional study would be performed by other members of the consultancy team, it was agreed that in the M.Sc. research emphasis would be given to the financial-economical and social analysis. However the M.Sc. research also includes a short institutional analysis to complete the socio-economic evaluation.

1.2.4 Research Relevance

The consultants DHV and Deserco can use the M.Sc. research results in their final evaluation of the project. The consultants' findings indicate in which way the sanitary and environmental conditions in the urban areas of Indonesia can be improved. Besides they assess the feasibility of the possible solutions and give the consequences if nothing is done. The authorities in Indonesia can use the evaluation results on the Botabek Project in their policy towards the sanitation sector and the linked water supply sector.

1.2.5 Research Constraints

The present situation in the project areas (see p.2) may affect people's satisfaction with the implemented facilities and their willingness to pay for it. Therefore, some care is commanded in generalization of the M.Sc. Research Results.

Another principal constraint is the lack of health data (frequency of excreta related diseases) and health objectives, which are necessary to formulate the required control measures.

1.2.6 Data collection method

In table 1.2 the global data collection method for the different analysis are summarized. A more specific description is presented at the beginning of each of the economical, financial, social and institutional analyses.

Data for calculation of costs (i.e. unit prices and quantities) of the sanitation technologies have been principally gathered by a desk study of reports, documents, price lists of producers and Public Works, contracts etc..
In some cases (components of sewerage facilities) the quantities accounted for in the contracts appeared to be rather high.

Therefore, interviews with experts have been held in addition to achieve a realistic bill of quantities.

In the social feasibility analysis the project was analysed from the demand side. A survey approach has been chosen since the aim of the M.Sc. Research is to describe certain magnitudes. In addition, some short interviews with local neighbourhood officials (local government) have been held and field observations used.
Data for financial analysis (i.e. government expenditures, household income) have been collected by desk study of reports.

For institutional analysis data have principally been gathered by desk study, as the responsibility for management of the systems is still not transfered from Central to the Local Government (PDAM Tangerang will be trusted with this responsibility). In addition some field observations at the PDAM Tangerang and results of some interviews with local governemnt officials have been used.

TABLE 1.2 : GLOBAL DATA COLLECTION METHOD

Kind of Analysis	Data Collection Method				
	Desk study of reports, documents etc.	Field visits (observations)	Interviews with key informants		Community survey
			DHV	Local Government	
Economical	X		X		
Financial	X				
Social		X		X	X
Institutional	X	X		X	

1.3 Reporting

The report first provides some background information on the Botabek Area, on sanitation and water supply, on the sanitation facilities in use in urban Indonesia on the Botabek Project and on the Perumnas Sewerage Project at Tangerang.

The main part of this report describes the M.Sc. Research Results, in which the chosen technology is evaluated from different point of views :
- Chapter 3 : Economical Analysis
- Chapter 4 : Financial Analysis
- Chapter 5 : Social Analysis
- Chapter 6 : Institutional Analysis

In the economical analysis the costs of sewerage and treatment facilities are presented for different type of areas. Special attention is given to the costs of sewerage, the largest part of the costs of communal sanitation facilities. The calculated costs of the chosen technology are compared with the real costs of implemented works in Tangerang and with costs of facilities in use. Further it is analysed how far adaptation of chosen technology can reduce these costs.

In the financial analysis the government's and households' ability to pay for the costs (as calculated in chapter 3) are assessed.

In the social analysis the present situation with respect to water supply and waste water disposal in Tangerang is analysed. The water supply situation is incorporated in the social survey as water use is very important factor in the choice of the sanitation system, as will be explained in paragraph 2.2 and 2.5.2. The social survey covers sewered and non sewered districts in the city of Tangerang. In these areas the utilization and appreciation of used water supply and sanitation facilities are analysed. In the sewered district also the willingness to pay for sewerage and the willingness to cooperate in sewerage projects are analysed.

In the institutional analysis the institutional development options and possible problems for them are analysed.

The method used in the socio-economic evaluation is presented at the beginning of each chapter (3-6), while the main findings and recommendations of each analysis is presented at the end of these chapters.

The main results and recommendations are brought together and put in perspective in chapter 7.

2. RESEARCH BACKGROUND

This chapter first provides some background information on the urban areas in Botabek and on the impacts of water supply and sanitation on health and environment. After that the sanitation facilities in use are described and the present situation with respect to urban sanitation is analysed. Next, some information is provided on the Botabek Project. The choice of the technologies is explained (under prevailing conditions in Tangerang). Further the benefits of chosen technologies, required coverage and implementation results are discussed. Finally some information is provided on the Perumnas Sewerage Project at Tangerang (of which results are also evaluated, § 1.2.3)

2.1 The Botabek Area (Bogor, Tangerang and Bekasi)

Botabek consists of the three kabupaten Bogor, Tangerang and Bekasi (which surround Jakarta) and the kotamadya Bogor.* Botabek's area, accomodating 6.4 million people (1985), totals 5709 km^2 or 13 % of the total area of the province West-Java.

The present situation in the Botabek area must be seen in the context of Jakarta, the centre of Indonesia, especially as Jakarta has grown atronomically both in population (the 1985 population was ca. 8 million people) and economic importance for the country as a whole since 1973 (the first oil boom). Government is very much concentrated in Jakarta. Many large-scale industries sought location in Jakarta in order to be near to markets, money and capital and, to be in the neighbourhood of politically influential people. Since space in Jakarta is limited industrial growth soon started to spill over to nearby regions. Botabek, with good transport connections was the first region to benefit from the spill-over of new investments and economic activities from congested Jakarta. During the period 1969-1987 Botabek accounted for 16.5 % of the total national amount of domestic investment approvals and 13.4 % of the national amount of foreign investment approvals. These shares for Jakarta are 16.0 % and 23.4 % respectively [14, vol.C, p.i-ii].

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* Indonesia is organized into five formal levels :national, 27 provinces, districts ('kabupaten'/'kotamadya') and 2 lower levels).

The economical growth in Botabek led to high immigration figures. The great attraction of Botabek for migrants is born out by the average annual income of this region. This economical growth caused high population growth in the fast growing industrial and urban centres of Botabek, which involve about 20 % of the Botabek population. In these fast growing centres (e.g. Bekasi, Bogor and Ciputat) the population growth was 5 - 7 % over the period 1980-1986. According to the Dutch Consultant Haskoning [14, vol.C, p.21] this fast growth in economic as well as demographic terms, appear to have been at the costs of some aspects of social welfare; the infant mortality rate of infants less than one year of age, an important indicator of public health, was in 1985 111 per 1000 in the Botabek area. This rate is 21 % higher than the provincial average and is principally the result of diarrhoeal diseases, which have their origin in a lack of proper* sanitation and drink water facilities [16,p1]

2.2 Impact of Water Supply and Waste Water Disposal on Health [9]

Human excreta contains millions of bacteria, of which a few are potentially disease-causing. Sanitation is largely concerned about these organisms carried in human waste; but in a broad consideration of sanitation programmes for improvement of health also disease causing organisms that are transmitted by skin to skin contact or by insects and animals are included. There are a number of pathways of transmission of the diseases concerned, and the aim of sanitation and water supply programmes is to cut the pathway and thereby prevent the spread of the disease.

The diarrhoeal diseases are, when combined with malnutrition, a large cause, or indeed the major cause, of childhood disease and death throughout the world [9,p.35]. They are the most important group of water-and excreta related infections.
Main transmission routes of diarrhoeal diseases are illustrated in figure 2.1; A susceptible person may be infected by excreta of an infected person (transmission route 3) in the following ways:
directly by excreta (transmsission route 2) or indirectly via water or food polluted by excreta (transmission routes 3-4-1 and 3-2-5). In this figure the control measures (five types) to cut the pathways are also given.

* the definition of proper depends on the local conditions.

To prevent the spread of diarrhoeal diseases disposal of excreta* (route 3) only is not sufficient; After defecation people may come in contact with fecal material during clean up (In Indonesia people directly come in contact with fecal material during anal cleansing). Infection via this route (route 2) can be prevented via increased availability of water and the use for hygienic purposes of increased volumes of water. Transmission of diarrhoeal diseases may also be via infected water which people use for consumption (and in less extent when they use this water for bathing and washing).** Transmission via this route can be prevented by improving the quality of used water (route 1) and/or by preventing too much pollution of water ((in)directly) used for drinking water purposes. The last one is realised by treating excreta before its disposal (route 4).

The infections related to water supply and sanitation are numereous. In table 2.1 part of Water Supply and Sanitation Decade related infections are classified in groups having similar epidemiological features. They are tabulated in a way that highlights their amenability to prevention through interventions in water supply, excreta disposal and hygienic behaviour.

One of the control measures mentioned in table 2.1 is sullage and drainage disposal. Sullage is defined as all domestic wastewater other than toiletwastes; it includes laundry and kitchen wastes as well as bathwater. In volume this form the largest part of the wastewater. Sullage contains some excreted pathogens, but of course condiderably fewer than toiletwastes. The characteristics of sullage and toiletwater are presented in table 2.2.

A large group of infections (e.g. malaria), several of them of major international public health importance, are transmitted by flies or mosquitoes. Mosquitoes are a major nuisance in many tropical cities and can breed in stagnant wastewater, which is created by sullage (that is usually discharged on the surface in contrast with toiletwater). Infections like malaria can be prevented by improvement of sullage and drainage disposal.

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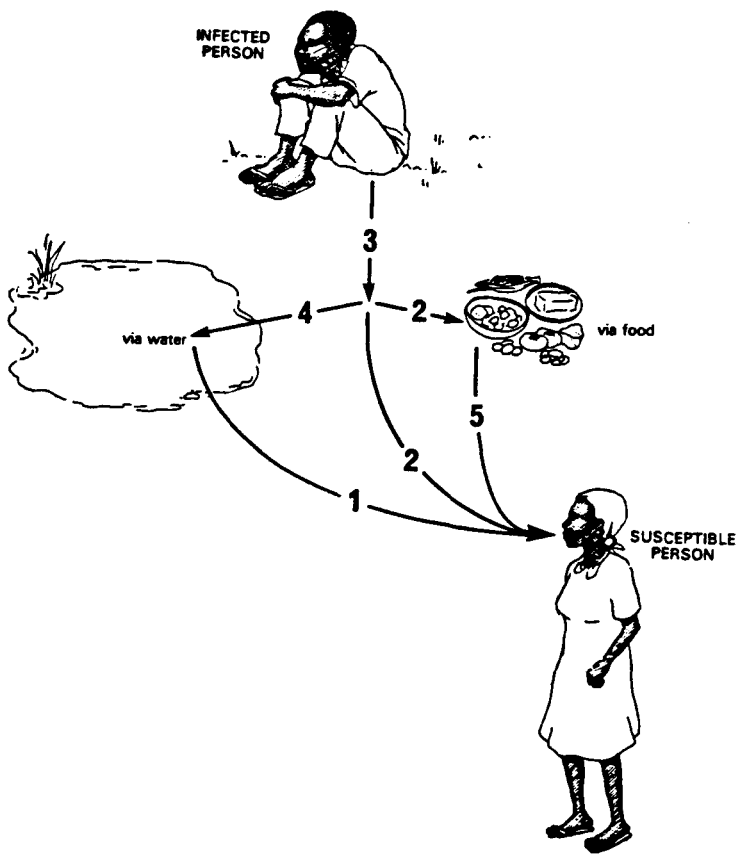
* In Indonesia people use water for anal cleansing and for flushing their toilets. Disposal of toiletwater is equivalent to excreta disposal.

** Well known are the epidemics of cholera and typhoid (both belonging to the group "Diarrheal diseases and enteric fevers") which occured in some European towns in the past and were caused by urban water supplies with inadequate treatment facilities.

FIG 2.1 : MAIN TRANSMISSION ROUTES OF DIARRHOEAL DISEASES AND CONTROL MEASURES



Main Transmission Routes

_____ Human feces

Control Measures

1 Water Quality (Safe Water)
2 Water Availability plus personal and domestic Cleanliness
3 Excreta Disposal
4 Excreta Treatment
5 Food Hygiene

Source : P.G. Bourne, Water and Sanitation, Economical and Sociological Perspectives, p. 37, Academic Press (1984)

TABLE 2.1 : SOME DECADE-RELATED INFECTIONS AND THEIR CONTROL

Infections	Importance of alternative Control Measures						Public Health Importance
	Water Quality	Water Availa-bility	Excreta Dis-posal	Excreta Treat-ment	Drain-age and Sullage Disposal	Food Hygiene	
Diarrhoeal Diseases and Enteric Fevers							
Viral Agents	2	2	1	1	0	1	3
Bacterial Agents	3	3	2	1	0	3	3
Protozoal Agents	1	3	2	1	0	2	2
Poliomyelitis and Hepatitis A	1	3	2	1	0	1	3
Worms with no intermediatie host							
Ascaris+Trichuris	0	1	3	2	1	2	2
Hookworms	0	1	3	2	0	1	3
Infections spread by water-related Insects							
Malaria	0	0	0	0	1	0	3
Banc.Filariasis*	0	0	0	0	3	0	3

Note : 0 = no importance; 1 = little importance; 2 = moderate importance ; 3 = great importance
* = Bancroftian Filariasis
Source : P.G. Bourne, Water and Sanitation, Economical and Sociological Perspectives, p. 35, Academic Press (1984)

Water supply programmes are aimed at improvement of water quality and/or water availability. Sanitation programmes are aimed at at least one of the following components : improvement of excreta disposal, improvement of excreta treatment, improvement of sullage disposal and prevention of pollution of water used for consumption. Though a necessary prerequisite in most sanitation programmes is adequate, clean water, the health impact of the UN Decade will not be achieved by a simplistic policy of supplying clean water (see table 2.1). In developing a sucessful programme one also has to anticipate the possible effects of control measures; for example when the flow of piped water into a town or

city increases many stagnant and polluted bodies of water are created in the case of absence of adequate waste water disposal systems. In this case the beneficial aspects of improved and extended water supply may then be nullified by an insufficient functioning of the waste water disposal system. The effect of the measure may then merely be a shifting of diseases. Only carefully designed programs that integrate water quality improvement with improvements in water availability, sanitation, and hygiene education will achieve substantial reductions in the transmission of water- and excreta-related infections.

TABLE 2.2 : DOMESTIC WASTE WATER (in developing countries)

Item	Domestic waste water	
	Toilet water	Sullage
Source	Toilet	Kitchen, bathroom
Created by (purpose of wateruse)	Anal cleansing and toilet flushing	Cooking, bathing, washing
Volume (% of total wastewater)	5-10	90-95
Pollution		
Pathogenic Organims	Much	Little
Organic (%) [a]	≈ 50	≈ 50

Note : a) See paragraph 2.3, figures depend on the water consumption

2.3 Impact of Waste Water Disposal on the Environment [15]

Besides its impacts on public health, as explained in the preceding paragraph, waste water disposal also affect the environment.

Concerning domestic waste water three kinds of pollution can be distinguished :

- pollution by pathogenic organisms (§ 2.2)
- organical pollution; Waste water is principally organic. It contains lots of organic compounds. About 50 % of the organic pollution comes from the sullage and 50 % from the toilet water (the exact figure depend on the water consumption). For converting these compounds oxygen is required. If wastewater is discharged untreated to the surface water (e.g. rivers, lakes etc.), it exerts a demand on the oxygen resources of the surface water for the conversion process of the waste water. If too much waste water is discharged (such as is usually the

case in high densely populated areas), the oxygen concentration in surface waters may become too low.
- anorganic pollution*, for example phosphates from detergents which cause eutrophication of surface waters

So, wastewater should be treated before its ultimate disposal in a receiving watercourse in order to :
- reduce the spread of communicable diseases caused by pathogenic organisms in the wastewater (§ 2.2)
- prevent the pollution of surface and ground waters. The pollution of these water is especially undesirable as it interferes with aquatic life or with the use of the drinking water preparation and other domestic,industrial or agricultural purposes. If these waters become too polluted, they become unsuitable for these purposes.

2.4 Types of Waste Water Disposal Systems in Urban Indonesia

In 1985, 45 percent of Indonesia's urban population did not have facilities for sanitary disposal of wastes [11,p.196 + 12] (in 1980, this percentage was 60 [11,p.196]). A large proportion of this percentage still defecate indifferently in open channels of the drainage systems and rivers or even on occasion in the open space adjacent to their houses. This water from rivers, drains etc. is used by some people for bathing and washing (see photo 2.1 and 2.2). As explained in paragraph 2.1, this involves large health risks, especially in densely populated areas where people live crowded together and so may be easily infected.

55 percent of Indonesia's urban population have facilities for sanitary disposal of wastes. The type of toilet which people usually have in urban Indonesia is the pour flush toilet (see fig. 2.4). A pour flush toilet is a toilet from which excreta are flushed from the basin by pouring a small quantity of water (water use is about 10 liter per capita per day).
Various technologies exist for waste water disposal. Especially the pit and septic tank are used for disposal of toiletwater in urban Indonesia as people use water for anal cleansing and flushing their toilets; Other simple type of excreta disposal systems are not practiced in this case. At present, in Indonesia, the largest part of domestic wastewater (i.e. the sullage) is discharged to the drainage system. In this paragraph the facilities in use are described.

* At present eutrophication in the Netherlands is problematic. In Indonesia anorganic pollution is less relevant than the other two types.

2.4.1 Pit

In a pit (figure 2.2) excreta (toiletwater) are collected and biologically digested. Wastewater and soluble compounds of digested excreta leach into the soil surroundig the pit, while the faecal material is collected. Application of a pit and the use of sufficient water for hygienic purposes prevents people from coming directly in contact with the septic excreta (control of infection via route 3-2, figure 2.1). However, not all the transmission routes of infections have been cut; the space to construct pits or sub-surface disposal systems of septic tanks at a sufficient distance from shallow wells (> 10-15 m) is not available in high densely populated areas, so that these wells may easily be contaminated by leaching water. Groundwater pollution must be prevented, particulary in areas where drinking water is obtained from shallow wells, as polluted drinking water affects the health of the people (infection via route 3-4-1, figure 2.1).

Pits gradually are filled. At a certain sludge level problems arise with the discharge of the waste water. Therefore the pit should be emptied or another one should be constructed.

2.4.2 Septic tank

A septic tank (figure 2.2) is a watertight box in which the solid matter precipitates and decomposes and the liquid overflows. The effluent from a septic tank still contains a high content of pathogenic bacteria and direct discharging of it into a public water course or on land is not recommended. Further treatment of the effluent of the septic tank is required. This may be done on-site by means of sub-surface disposal systems such as soil absorption systems. Via these systems the water is discharged into the ground. Just as in the case of a pit, water in the shallow well can be contaminated if sub-surface disposal systems are located near a shallow well (infection via route 3-4-1, figure 2.1). In many cases no sub-surface disposal system is used and the high polluted effluent of the septic tank is discharged to the road-side drains.

Just like the pits septic tanks gradually fill. Septic tanks should be desludged if the sludge level exceeds 50 % of the tank depth. Above this level problems arise with discharging the waste water and the treatment of the toilet water detoriates.

Both the septic tank and the pit are called on-site sanitation systems, as the waste water is disposed of on-site.

PHOTO 2.1 : "TOILET" ABOVE THE CISADANE RIVER

Note : See in the photo that children swim near the "toilet"

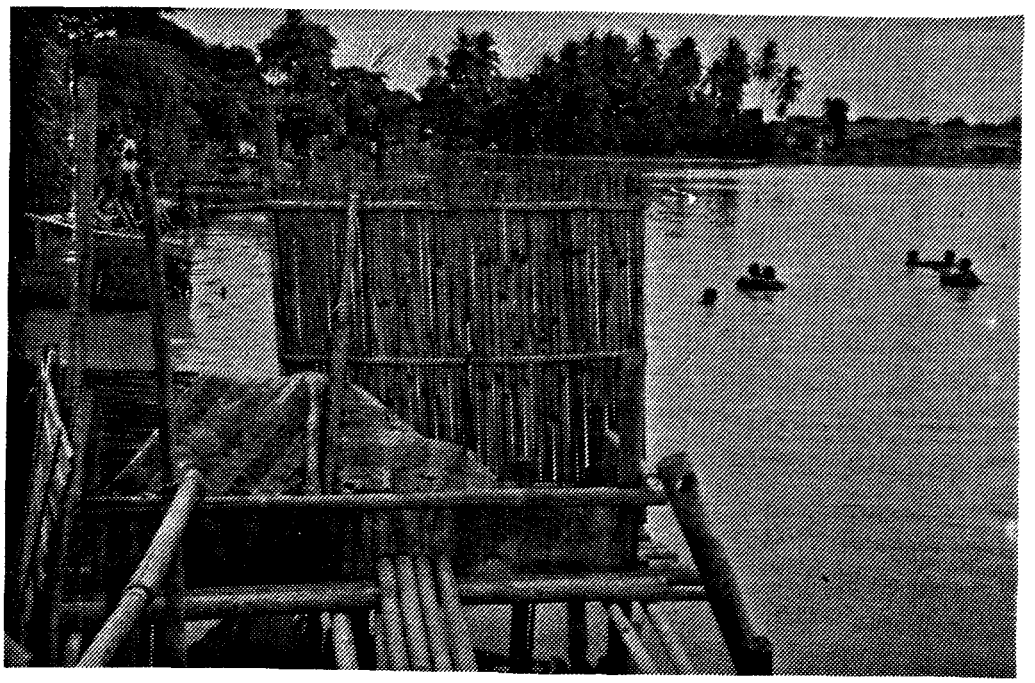
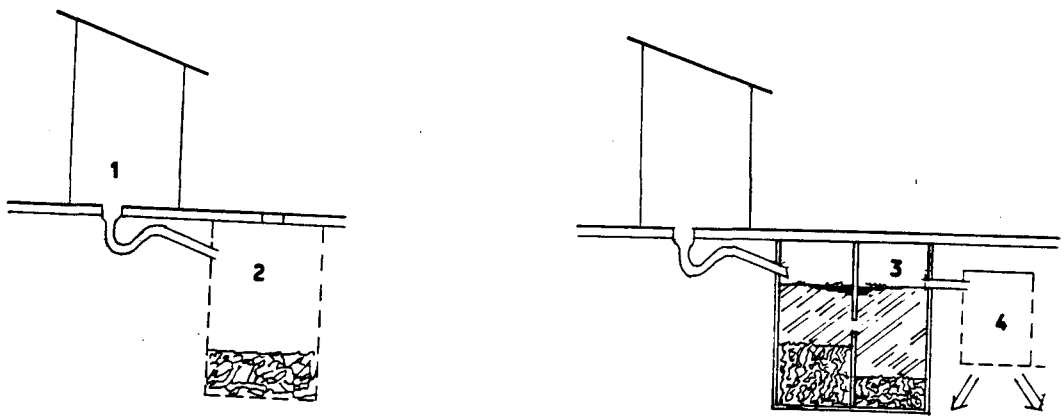


PHOTO 2.2 : PEOPLE WASHING IN THE CISADANE RIVER

FIG. 2.2 : PIT AND SEPTIC TANK



1 : Pour Flush WC, 2 : Pit, 3 : Septic Tank, 4 : Sub-Surface Disposal System

2.4.3 Drainage system

In urban Botabek/Indonesia, the roadside drains (see fig. 2.4) are not only used for the discharge of stormwater (where they should be used for), but also for the discharge of wastewater (sullage and effluent of septic tanks). Drains are presently continuously used for discharge of wastewater, because people cannot discharge it into the ground via their existing disposal systems. Sullage may be disposed to the drains in case of a good natural drainage, because it is less septic. However, the general condition of drains is rather poor (see photo 2.3) and stagnancy of wastewater flows in drains is observed regularly, especially in flat areas.
Stagnating wastewater in drains is undesirable since it
- gives bad smells
- attracts mosquitos which can transmit diseases
- creates breeding places for germs,insects, bacteria. Playing children can come direct into contact with this water and may be infected (transmission route 3-4-1, figure 2.1) (see photo 2.4)

Besides wastewater discharge to drains is undesirable as the drained off wastewater will affect the surface water quality.

PHOTO 2.3 : SOLID WASTE IN DRAIN (CAUSING STAGNANT WASTE WATER)

PHOTO 2.4 : CHILDREN PLAYING NEAR (STAGNANT) WASTE WATER IN DRAIN

2.4.4 Evaluation of Present Situation

Some important pathways of transmission are cut by present sanitation systems. However, these systems don't effectively cut all the pathways of transmission of infections; especially in densely populated areas, where people live crowded together, one still may be easily infected by the following routes :
- via drinking water obtained from shallow wells
- via stagnant waste water (by direct contact or by mosquitos breeding in the waters)

Further a large proportion of the urban people still have no sanitation system at all and defecate in open waters which they sometimes also use for washing and bathing.

Finally the environmental pollution in these densely populated areas is also serious. The degradation of pollution by facilities in use is poor, while the whole of the sullage is drained off to the surface waters without treatment. As a result of the increased pollution, the quality of many surface waters deteriorated, as no adequate measures to prevent this are taken. Further pollution of these waters is undesirable as it may in future interfere with aquatic life and with other purposes (for example in Tangerang water from the Cisadane river is the major source for drinking water preparation not only for Tangerang, but also for a part of Jakarta).

2.5 Botabek Sewerage and Drainage Project (at Tangerang)

The Botabek Sewerage and Drainage project at Tangerang aims at developing an approach for improvement of environmental and health conditions for urban Botatabek.
Being one of the first towns in Indonesia where introduction of sewerage facilities in combination with the construction of a waste water treatment plant was planned and executed, the project was declared as a pilot project.
The project started in 1980 with the preparation of a masterplan for sewerage and drainage for an area of about 1,000 ha. Ultimately, detailed sewerage and drainage plans have been worked out for two areas in Tangerang : the Sukasari and Babakan Ujung area.

Sukasari area

Both middle/high income and low/middle income groups are living in the Sukasari area, covering an area of about 70 ha. The population density in the sewered areas is about 200 inhabitants/ha. A conventional seperate sewerage system has been designed for this area. The collected waste water flows to the Sukasari pumping station from where it is pumped to

the treatment plant, Carrousel type, which has a capacity to treat all waste water originating from the 15,000 people, who live in the Sukasari area with sewerage services.

Babakan Ujung area

Mainly low/middle income groups reside in this densely populated area (375 inhabitants/ha). A low cost sewerage (rudimentary) system has been designed and constructed for the Babakan Ujung area, covering a surface of about 12 ha. For the time being the collected waste water in Babakan Ujung is discharged to the Cisadane River by means of a small pumping station.

2.5.1 Description of Chosen Technology

The Carrousel in which the collected water is treated (biological and bacteriological) is decribed in annex 1. Hereafter the two types of sewerage systems are decribed. The systems differ in the way upon which the wastewater of the households is collected.

2.5.1.1 Sewerage Systems in General [4]

The collection and transport of wastewater by means of sewers is a well known method, which is widely applied all over the world.

The system consist of network of underground pipes which are laid in the streets. These pipes are constructed under a slope (which has to meet minimum requirements), so that the collected wastewater can be transported out of the living area by gravity. This way of discharging prevents contact with humans and groundwater.

In contrast to the on-site sanitation systems, all wastewater (both toiletwater and sullage) should be discharged to the sewerage system in order to experience the full benefits of it and to allow a proper functioning of the system (§ 2.5.4)
Besides amounts of waste water discharged to the systems should be sufficient (in urban areas ≥ 100 l/cap.day for conventional sewerage and ≥ 40 l/cap.day for rudimentary sewerage) to take place the self cleaning phenomenon in the sewer pipes. In this case the solid parts can be transported by the water, preventing operation problems like cloggings and difficulties with discharging wastewater.

The sewerage system is provided with manholes, which have the following important functions :
- inspection of the system for blockages
- accessibility to the system for maintenance works

2.5.1.2 Conventional Sewerage System - seperate sewerage system

For a conventional sewerage system as applied in Sukasari all wastewater should be discharged to the sewerage system as all stormwater should be discharged to surface drains.* All streets need a sewerage facility in this case. If all plots are properly connected to the sewerage, no wastewater is seen anymore in the roadside drains.

The connection of the dwellings to the sewerage in the street is split up into two parts (see fig.2.4) :

- yard connection : this is the section from the sewer pipe in the street to the inspection box ('bak control') on the plot boundary. The end of the yard connection is a junction point, to which the house connection can be connected and which also functions as a inspection box for necessary clearing. Preferably a yard connection is provided to each plot at the time the sewerage system is implemented.

- house connection : the house connection includes all the in-house plumbing and on the plot piping from the inspection box to the various waste water discharge points as toilet, kitchen and floor drain(s).

The construction of conventional sewerage facilities include the following successive activities :
- demolition of road and footways on house plots/floors in the houses if necessary
- excavation of ground
- laying of pipes and joining of component parts
- reinstatement of demolished items

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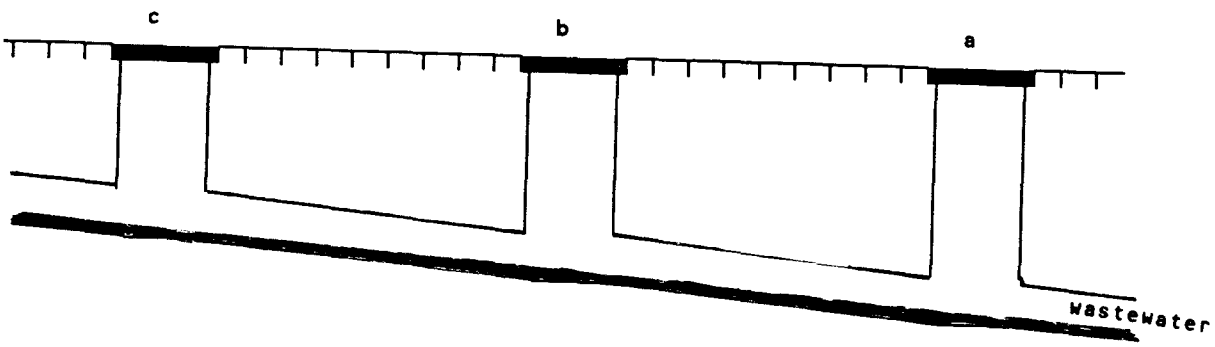
* In general two types of sewer systems are known : combined and separate sewer systems. Combined sewer systems transport both waste water and stormwater (applied in the Netherlands). In case of a separate sewer system the discharge of waste water and stormwater is accomplished by means of different systems. In tropical countries like Indonesia, with high amounts of stormwater and high rainfalll intensities combined sewer systems are less attractive from an economical point of view (discharge of rainwater by means of sewers would lead to very high capital investments due to much larger diameters of the sewers). Therefore, the Consultants proposed the discharge of stormwater in the common way by means of open drains and to construct a system of pipes for the discharge of waste water [4].

FIGURE 2.3 : MANHOLE

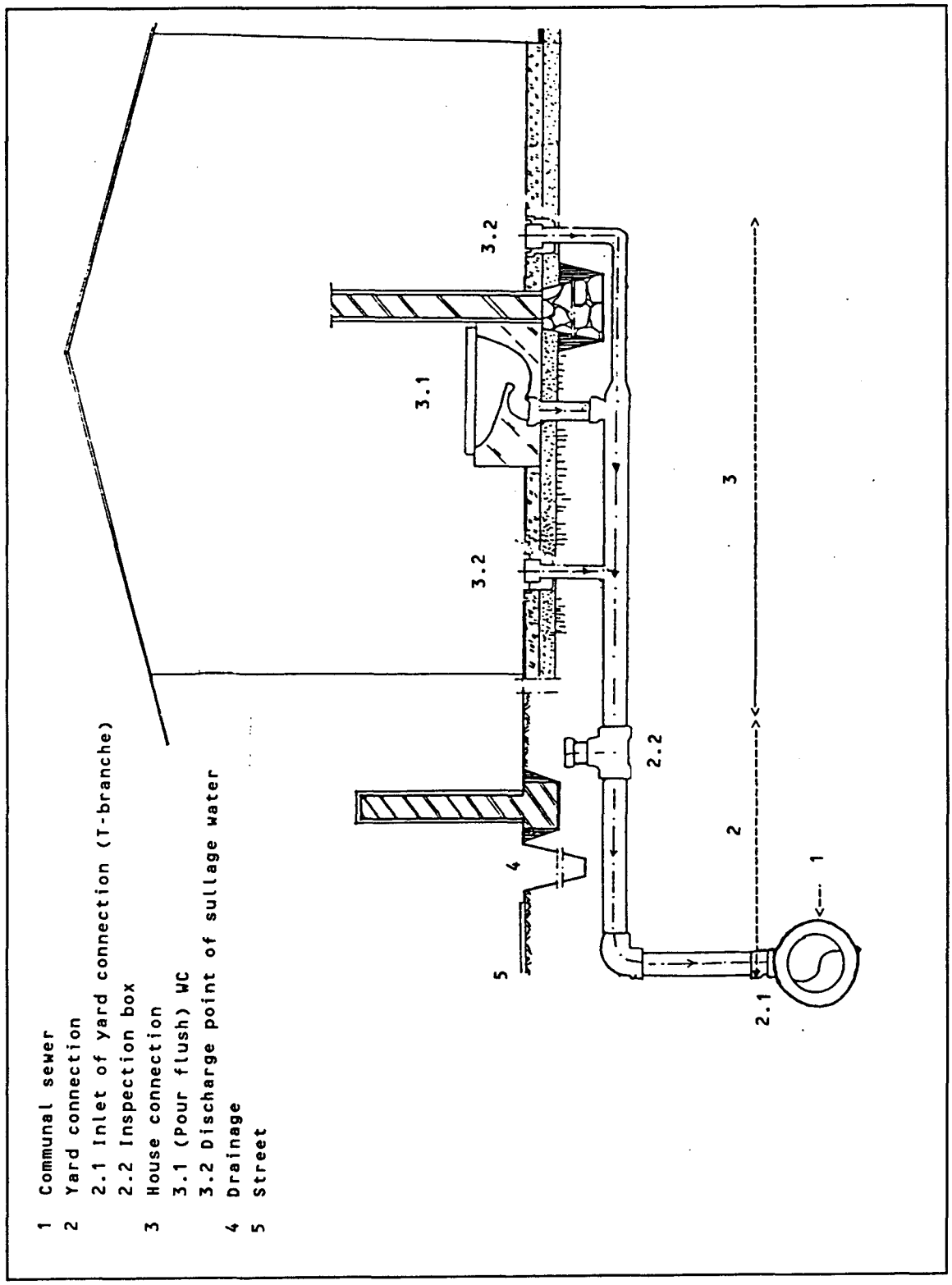


Note : The water level in the higher situated manholes will rise in the case of a blockage at A

PHOTO 2.5 : SEWERED AREA

Note : No wastewater is seen in the road-side drains

FIG. 2.4 : CONNECTION OF A DWELLING TO THE CONVENTIONAL SEWERAGE SYSTEM



2.5.1.3 Low Cost (Rudimentary) Sewerage System - semi combined sewerage system

As mentioned under paragraph 2.4.3, in Indonesia, waste water (sullage and effluent of septic tanks) and stormwater are usually discharged to the drainage system.
When applying a rudimentary sewerage system not all streets are provided with sewerage and at a limited number of locations (every 200 meter), a connection is made (CSD = Connection between Sewerage and Drainage) between the drainage and the sewerage system.*

The advantage of the rudimentary piped sewer system is that at relatively low construction costs the waste water is collected and brought outside the densily populated area. Construction costs for a rudimentary system are considerably less since not all streets are provided with sewerage and expensive house connections and yard connections are not required. Apart from the advantage of low construction costs, the rudimentary sewerage system has the disadventage that waste water is always experienced in the drains; by a lack of maintenance of this system (no regular clearing of CSD's and drains resulting in blockages of CSD's) waste water can't flow into sewerage system so that waste water may become easily stagnant (as a result the benefits of the system are nullified). Another disadvantage may be that groundwater is still polluted when pits are used or when the septic tank effluent is not discharged into the drains, but seeps into the subsoil.

Rudimentary sewerage systems may be preferable when a conventional sewerage system is not affordable or when the water use is low. Then the amounts of waste water would result in a too low flow velocity in the (conventional) sewer pipes.

The implementation of additional sewers is very easily possible, so that a completed (conventional) sewerage system may be developed gradually.

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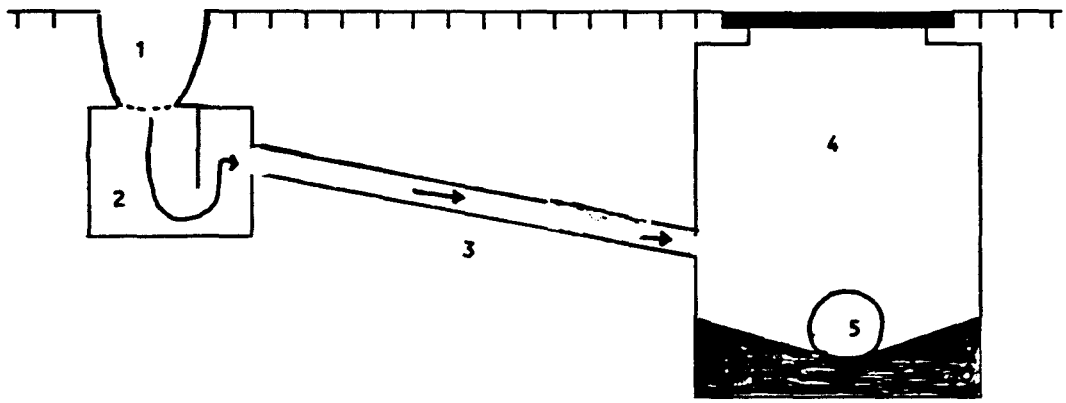
* Under dry weather conditions the waste water flows via the existing drains and CSD's to the sewerage system. Under rainy weather conditions the quantity of waste and storm water, which can not be discharged by the sewerage system, flows via the drainage system to the surface waters.

FIG. 2.5 : CONNECTION BETWEEN SEWERAGE AND DRAINAGE (CSD)



Note : 1=Drain, 2=CSD, 3=Coupling sewer, 4=Manhole, 5=Sewer of sewerage system

2.5.2 Argument for Choice [4]

The conditions in Tangerang, which affect the choice of the waste water disposal system, can be considered to be more or less representative for the Botabek area. These conditions together support the implementation of communal sewerage and treatment facilities.
These conditions are :

1) increased amounts of waste water by the extension of piped water supply
- improper conditions for disposal of waste water via pits/septic tanks or drainage system :
    2) poor infiltration capacity of the subsoil, which means that waste water hardly can be discharged through the subsoil
    3) high ground water tables sometimes, hindering wastewater discharge through the subsoil
    4) rather flat areas
5) high population density (150-200 people/ha)

The infiltration capacity of the subsoil in Tangerang is very low, so that only toilet water from pour flush toilets can be discharged into the subsoil (given standard sizes of the on-site sanitation systems).* Therefore, the sullage is discharged into the road-side drains. Even the discharge of toilet water into the subsoil, may give many problems due to high groundwater tables.

The government of Indonesia wants to extend piped water supply throughout the country. Targets of Repelita IV piped watersupply programmes for cities of 100,000 to 500,000 inhabitants are a coverage of 75 % and daily allowances of 90 liter per capita per day. As discussed in paragraph 2.2, the benefits of an extended water supply system may be nullified if the increased amounts of waste water are not properly brought outside the living area; the increased amounts of wastewater (sullage), have been enhancing the stagnant waste water problems, especially in flat areas (like Tangerang) where maintenance of the drains is poor.

Besides these increased amounts of waste water are required to operate a (conventional) sewerage system.
As already discussed in paragraph 2.4.4. stagnant waste water problems, contamination of well water and environmental pollution are made more serious by the concentration of people in densely populated areas.

2.5.3 Impact of Sanitation Technologies on Public Health and Environment

Public health and environmental data are required to formulate (minimum) control measures regarding sanitation. Without these data the conditions mentioned in the preceding paragraph may be used.

* Standard pits (and sub surface disposal systems of septic tanks) have a leaching area of 5 to 10 m^2. The infiltration capacity of the subsoil in Tangerang is 10 liter per m^2 per day [3], so that only 50 to 100 liter (or about 10 to 20 liter/capita) may be discharged into the ground by the facilities in use.

The impact of the sanitation technologies on the improvement of public health and environment, as discussed in the preceding paragraphs, is summarized in table 2.3 and 2.4. In the first table detailed benefits of the control measures are presented. In the second table 2.4 the effect of the sanitation technologies on control measures, as distinguished by Bourne (cf. Table 2.1) are given. This table also includes the impact of piped water supply on the control measures.
It is obvious that the effects are moderated by the coverage (see § 2.5.4).

It is seen that the improvement to both public health and environment is maximal if piped water supply with conventional sewerage and treatment are applied; sewerage and treatment facilities are superior to the on-site sanitation systems.

Whether the required improvements can be realised by the alternatives depends on the type of problem. It is also seen in table 2.4 that there might be (less superior) alternatives for sewerage and treatment regarding publich health control measures. With respect to the environment the situation is more serious; a real improvement in the environment can only be attained by sewerage and treatment.

The ultimate choice of the system will depend on the technical feasibility of the systems (dependent on the conditions for waste water disposal, see § 2.5.2) and the benefits and costs of the technologies.

2.5.4 Planning Criteria Coverage

In the " Practical Guidance for Waste Water Treatment + Disposal in Integrated Urban Development Project (IUDP)" criteria to establish the methods of sanitary facilities and the number of people served are given. For zone's with density > 200 cap/ha (Sukasari as well as Perumnas area) fully on-site sanitary discharge or discharge into the adjacent drains is considered undesirable with a view to public health. In effect a piped discharge of the area is the only responsible solution. The IUDP Consultants consider 100 % of urban population access to sanitary facilities a criterion for the quantity for these zone's. Further, all waste water (toilet water as well as waste water from kitchen and bathroom) has to be discharged to these sewerage systems.

As long as considerable quantities of waste water continue to be discharged to the drains instead of the sewers, a real improvement of living conditions is not achieved.

TABLE 2.3 : BENEFITS OF CONTROL MEASURES IN SANITATION PROGRAMMES

Control measure	Benefit	
	Kind	Description
Excreta disposal	Public health	Cutting the direct transmission route of infection via excreta
Prevention ground-water pollution	Public health*	Cutting the transmission route of infections via (shallow) well water, used for consumption
	Environmental	Safeguard groundwater for the use of purposes such as drinking water preparation
No (stagnant) wastewater in drains anymore**	Aesthatic/Human	No wastewater seen in drains anymore
	Human	No odour anymore from drains
	Public health	Cutting the transmission routes of infections via insects breeding in stagnant wastewater
	Public health	Cutting the transmission routes of infections when playing children come in contact with wastewater from drains
Prevention of surface water***	Public health	Cutting the transmission route of infec- when people come in contact with polluted surface water
	Environmental	Safeguard aquatic life and safeguard these waters for the use of purposes such as drinking water preparation

Notes : * = equivalent to water quality (cf. Table 2.1). This also may be obtained by piped water supply
** = equivalent to sullage disposal (cf. Table 2.1)
*** = includes excreta treatment (cf. Table 2.1) and treatment of organic pollution

TABLE 2.4 : EFFECT OF SANITATION TECHNOLOGIES ON CONTROL MEASURES

Sanitation system	Type of control measure					
	Public health					Environmental
	Water Quality	Water Availability	Excreta Disposal	Excreta Treatment	Drainage and Sullage Disposal	Protection of environment
Piped water supply	3	3	0	0	0*	0
Pit	0	0	3	0	0	0
Septic tank	1***	0	3	1	0	0
Better maintenance of drains	0	0	0	0	2	0
Rudimentary sewerage (+pit) + treatment**	0	0	3	0	2	2
Rudimentary sewerage (incl. sept. tank) + treatment	3***	0	3	3	2	3
Conventional sewerage + treatment	3***	0	3	3	3	3

Notes : 0 = no importance; 1 = little importance; 2 = moderate importance ; 3 = great importance
: * piped water might increase the stagnant wastewater problems
: ** toiletwater leaches into the ground, instead that it is discharged to the sewerage system, so that ground waters are still polluted
: *** by prevention of pollution of groundwater used for consumption
Based on : Judgement by the author

2.5.5 Implementation Results

Sukasari Area

The construction of sewerage facilities in Sukasari started in 1981/1982. At this time an area of 30 ha was covered by sewers. About 750 plots were provided with a yard connection at the same time. It was expected that the people should make the house connections by themselves (at their own costs). In 1985 (3 years later) less than 10 % of the households had been connected to the sewerage system, so that only a small amount of waste water could be discharged to the treatment plant. To increase the waste water flow to the treatment plant, project funds were made available to construct toilet connections on the house plot. The users only had to pay for reinstatement of in-house damages. In 1987/1988 the second phase implementation took place (sewered area 30 ha); at the same time about 500 - 600 yard-connections and 300-400 toilet connections were constructed in this area. In this phase toilet connections were again offered to beneficiares free of costs.

Construction of the sewerage provisions in Sukasari is still ongoing; in 1989 about 60 ha of the communal system has been constructed. About 1300 out of 1800 dwellings within the area serviced by sewers have been connected to the sewer, so that still 30 % of the households don't discharge any (part of their) waste water to the sewerage system.

Although 1200-1300 house connections have been made, the waste water flow to the treatment plant is still low since only toilets are connected (in volume the waste water from the toilets is small, about 5-10 %). The lack of waste water discharge to the sewerage system do not allow a proper functioning of the waste water treatment plant and of the sewerage system itself. On the long term the sewerage system in Sukasari can only function properly if all waste water (also from bathrooms and kitchens) is discharged to the sewerage system (Then the self-cleaning phenomenon in the sewer pipes takes place).

Babakan Ujung Area

In Babakan Ujung the present condition is also very unfavourable; Up to July 1988 the sewerage system in this area has not functioned at all and in December 1988 to the largest part (80-90 %) of the system no waste water could be discharged as drains were completely filled with sand, garbage, leaves etc., causing blockages of the CSD's). Consequently no differences regarding sanitation have been observed between the past and actual situation.

2.6 Perumnas Sewerage Project (at Tangerang)

In Tangerang communal sewerage and treatment facilities have been implemented by Perumnas in new development areas. In these areas the starting point to meet the planning criteria with respect to coverage are more favourable than in existing areas; sewerage facilities (including house connections) can easily be included in the construction of the dwellings, while in an existing area people must be willing to cooperate for construction of house connections.*

In the Perumnas area originally 7000 out of 7300 dwellings (96%) have been connected to the sewerage system. All toilets and about 95 % of the kitchens and bathrooms have been connected to the sewerage. 300 (far-off) dwellings in this area have been provided with on-site sanitation systems for economical reasons.

* The ongoing sewerage projects in Indonesia can be characterised by the low percentage of sewer connections.

3 ECONOMICAL ANALYSIS

3.1 Introduction

Benefits (health improvement, environmental protection) of chosen technology are difficult to quantify in money; they are therefore not considered. In this analysis only costs of implementation and exploitation of the technologies are considered (excluded are medical costs etc.). ,

This analysis gives cost calculations of the kind of facilities as implemented in the pilot areas in Tangerang and of on-site sanitation systems.
Special attention is given to the breakdown of the investment/construction costs of sewerage. Reasons for this are :
- investment costs for sewerage facilities form the largest part of the costs of communal sanitation facilities
- quantities for construction of sewerage facilities are more affected by type of area than those of treatment facilities

The methodology of cost calculation has been described in paragraph 3.2, while results are presented in the following paragraphs. First the factors affecting the costs of sewerage, the largest part of costs of communal sanitation facilities, are identified. Costs for different type of areas and average costs for urban Botabek are calculated by assessing the values of these factors. The calculated costs of chosen technology are compared with the real costs of implemented works in Tangerang and with costs of facilities in use. Further it is analysed whether costs of sewerage facilities can be reduced by adaptation of the technology or by community participation.

The figures presented of both investment and O&M costs are based upon complete implementation of the project in the pilot areas; it is assumed that the other waste water discharge points besides the toilet connection are also connected.

The calculated costs are presented per average household of 5 persons living in urban Botabek or are presented per dwelling. Costs are expressed in local currency at price level of December 1988 (1 NLG ≈ Rp. 850) and include Value Added Tax, financial costs and the on costs given hereafter. They don't include price and physical contingencies.

In appendix 2 some tables (3.13 - 3.23) are presented and more detailed explanation of cost calculation is given.

3.2 Methodology of Cost Calculation

3.2.1 Investment Costs of Chosen Technology

3.2.1.1 Costs of Local Sewerage Facilities

Since the pilot areas of Sukasari and Babakan Ujung are relatively small, no trunk sewers were required (in this case the sewerage system is being considered as "local") and the pipes could be laid at shallow depths (less than 2.5 metre deep),

Detailed cost calculations are given for:
- house connection
- yard connection
- communal sewerage system in the street
- pumping station (methodology of calculation, see par 3.2.1.2)

Investment costs of sewerage facilities (house connection, yard connection, communal sewerage in the street) are based upon price list for PVC pipes and components of local suppliers [24,25] and upon unit rates of public works in the Botabek area [20,21,22]. These price lists and rates don't include 10 % profit for contractor, generally applicable in Indonesia. Some costs (for example for a manhole) have been collected from the recently constructed works in Tangerang after careful checking with data from the Ministry of Public Works [29].

Quantities for different components have mainly been derived from recently executed works [29,30] (except for the sullage connections, where no information is available). In some cases the accounted quantities appeared to be rather high. To come to realistic bill of quantities, interviews with experts have been held in addition.

The quality of the applied materials is conform the specifications of the tender documents.

In the case of the rudimentary sewerage system any expenses for upgrading of the drainage system are not accounted.

3.2.1.2 Costs of Pumping Station and Treatment Plant

Construction of the Sukasari pumping station and treatment plant took place in the period 1982-1984. Mechanical and electrical equipment was procured from the Netherlands at that time. Expenses, made within that period have been brought to level December 1988 and the Rupiah rate of (1 NLG = Rp 850). The inflation in the Netherlands over the past 5-6 years was about

10 %. The following correction factors have been used to bring local costs to price level December 1988 [37] :

year	inflation correction factor
1982	1.64
1983	1.47
1984	1.35
1985	1.30
1986	1.19
1987	1.09

3.2.1.3 Total Investment Costs Local Sewerage and Treatment

As a guideline for accounting of total investment costs the Unido manuals [40,41] have been used (as a checklist for the accounting of the cost components).

To come to the total investment costs of the local sewerage and treatment 10 % Value Added Tax and some general on costs of investment are accounted. The following on costs are taking into account :

- costs for contractor (2.5 % general costs + 10 % profit); general costs are accounted for providing of drawings (as facilities are constructed), testing of materials and the administration building used during construction
- fees of local consultants (2.5 %); fees are accounted for survey, design and supervision during construction
- financial costs (interest on loan during construction, 10 %); the sewerage (excluding the house connections) and treatment (excluding land) facilities are assumed to be full financed by loans (interest rate = 10 % [36]). The construction time of these facilities is assumed to be 1 year

As example, detailed breakdowns of total investment costs of conventional and rudimentary sewerage and of the treatment plant are calculated and presented. It is supposed that the facilities are constructed in an area with an existing infrastructure of low/middle income nature with a population density of 250 inhabitants/ha (area type 4, see hereafter). This area type is quite common in urban Indonesia and Botabek.

The costs of the pumping station are included in the total investment costs of communal sewerage.

3.2.1.4 Parameters Affecting Total Investment Costs of Local Sewerage

Subsequently a variation analysis has been carried out to get an insight in the factors affecting the costs of house connection, yard connection and communal sewerage. For this a software programme has been developed in LOTUS 1-2-3. The considered factors can be classified in two groups :
- design parameters
- area, housing parameters

As the design parameters of conventional sewerage are more or less standarised, the analysis is split up into two parts:
- variation analysis of design parameters, in which it is analysed how far adaptation of the technology can reduce the costs (paragraph 3.3.4)
- variation analysis of area, housing parameters; in this analysis values of area, housing parameters have been carefully estimated for different areas in order to calculate the costs of conventional sewerage facilities of various areas. The considered areas are given in table 3.1.

TABLE 3.1 : CHARACTERISATION OF URBAN AREAS

Type	Description residential area
1	Existing high/middle income area
2	Newly built high/middle income area
3	Newly built low/middle income area
4	Existing low/middle income area with aspalt roads
5	Existing low income area with unimproved roads

About 70 % of Indonesia's urban population is accomodated in area type 4 and 5 [8].

3.2.1.5 Full City Sewerage and Treatment for Tangerang

On the basis of the data in the general plan [1] (covered area : 860 ha, accomodating about 175,000 people) of sewerage in Tangerang an rough estimation is made of total investment cost of full city sewerage and treatment.
In this plan the main lines and the treatment locations are given (3 treatment locations with a capacity of about 60,000 i.e. have

been proposed). Collected wastewater in the covered area is discharged to these plants.

Costs for full city sewerage and treatment are estimated on the basis of costs of the pilot project. For covering the planned area (860 ha), the treatment costs per capita will decrease as the capacity of the plants increase while the costs for sewerage per capita increase as trunk sewers are required. The investment costs per capita I_x of the Carrousel with a capacity C_x is assumed to follow the relationship given by Arceivala [33] :

$$I_x = I_{15,000} \cdot (C_{15,000}/C_x)^{0.2}$$

where $I_{15,000}$ is the investment costs for the Carrousel with a capacity of 15,000 i.e.
To calculate investment costs of full city sewerage the following assumptions have been made :
- 60 % of the households are resident in area type 4, and 40 % in area type 1
- main lines/sewers (diameters 200-800 mm) are constructed at 3.0 m depth, other sewers at 1.5 m depth

3.2.2 Total Investment Costs On-Site Sanitation

Calculation of the costs of on-site sanitation systems (pits, septic tanks) are based on the bill of quantities of the Department of Public Works, prepared by the Dutch consultant Haskoning [14]. Unit prices of Public Works in the Botabek area [20,21,22] and of pricelists of PVC-materials are used [25,26].

To come to the total investment costs of on-site sanitation 10 % V.A.T. and 10 % profit for contractor are accounted. Only in the case of new development areas interest on loan during construction is accounted. In that case it is assumed that construction takes place one year before use and that facilities are fully financed by loans (interest rate 10 %).

For cost comparison with sewerage facilities the connection from toilet to the pit/septic tank is included in the bill of quantities.

3.2.3 Operation and Maintenance Costs

3.2.3.1 Communal Sanitation Facilities

Maintenance costs include the costs of repairs and major overhauls of equipment and those of materials and equipment used in the maintenance. The maintenance is assumed to be executed by the PDAM Tangerang. The labour costs of day-to-day routine maintenance are included in personel costs. Data about maintenance costs of sewerage and treatment are not available for Indonesia. Clearly it is difficult to estimate precisely such maintenance costs and the normal way of allowing for these costs is as a percentage of capital costs (excluding on costs and financial costs). The following rates have been applied (which are based upon experiences in other countries) for calculating the annual maintenance costs :

civil works	: 0.4 % of investment cost
transmission mains	: 0.8 % of investment cost
Mechanical and electrical equipment	: 2.0 % of investment cost
Manhole covers	: 5.0 % of investment cost

Maintenance costs for the house connection are excluded in the operation and maintenance costs of sewerage.

Data about manpower, equipment and energy requirements for operation and maintenance of communal conventional sewerage systems and treatment facilities are collected from projects and studies executed in other tropical countries [2,33,35]. Unit prices in Indonesia have been used.

Amount of overhead required is estimated on the basis of the number of direct labourers, the households served and the kind of activities of direct labour.
Unit prices of labour is assumed to be 1.2 million Rp/year.

Electricity costs are calculated using the tariff of PLN Tangerang [23].

Administration cost expenses are assumed to be 30 % of the personel costs. For the communal sewerage facilities, billing and collection costs are added to the administration costs. Billing and collection costs are 100 Rp per served household per month.

3.2.3.2 On-Site Sanitation

Only costs of emptying are included in the O&M costs of on-site sanitation systems. For a proper functioning the frequency of emptying is one time per 2.5 year. Cost of emptying is 15,000 Rp/time (see paragraph 5.6.3.2).

3.2.4 Discounting of Costs

In the economical comparison investment as well as operation and maintenance costs have to be taken into account. Since it is preferable to incur costs later rather than earlier (or to gain benefits earlier rather than later) , the costs in time have to be made comparable. This is done by discounting them at the opportunity cost of capital (= interest).

For cost comparison the Net Present Value (NPV) of the costs at year 0 will be used. The expression for the NPV is presented in formula 1.

$$NPV = \sum_{t=0}^{n} C_t / (1 + i)^t \qquad (1)$$

where

$\sum_{t=0}^{n}$ = a sum total for the whole lifetime of the project from year 0 to year n

C_t = costs in the year t

i = interest rate (expressed as a fraction, so if rate 10 %, 0.1 should be filled in)

t = year t

The calculated period is equal to the lifetime of the on-site sanitation systems (i.e. 25 years). The incompletely depreciated investments (residual value of investment, R) of the sewerage and treatment facilities remain after 25 years , decreasing the costs of it. This is expressed in formula 2.

$$NPV = \left(\sum_{t=0}^{25} C_t / (1 + i)^t \right) - R_{t=25}/\{(1+i)^{25}\} \qquad (2)$$

Depreciation is assumed to be linear.

The interest rate used for project evaluations in Indonesia is 10 % , on the assumption that prices remain constant [36].

The operation of the sanitation systems is assumed to start at the beginning of year 1. The construction time of sewerage (yard connection and communal sewerage) and treatment plant is assumed to be at year 0. The construction of the house connection and of on-site sanitation systems in existing areas is assumed at year 1, just before the operation of the systems.

3.3 Results of Cost Calculations

3.3.1 Total Investment Costs Chosen Technology

3.3.1.1 Total Investment Costs of Local Conventional Sewerage for Different Areas

Table 3.2 shows investment costs of local sewerage per dwelling for an existing low/middle income area. A detailed breakdown of the costs is given in table 3.18 (annex 2).

TABLE 3.2 :INVESTMENT COSTS OF LOCAL SEWERAGE FOR AN EXISTING LOW/MIDDLE INCOME AREA

Item	Costs (1000 Rp/dwelling)	Percentage of total
Communal sewerage	535	57
Yard connection	130	14
House connection	265	29
Total	930	100

Note : Depth of street sewers = 1.5 m

Costs of a house connection form a considerable part of the investment costs of sewerage. About 70 % of the costs of a house connection is for materials and special components, while 30 % is for labour.

In table 3.3 - 3.5 the parameters affecting the costs of communal sewerage (including pumping station), yard connection and house connection are presented.

TABLE 3.3 : FACTORS AFFECTING COSTS OF COMMUNAL CONVENTIONAL SEWERAGE (1000 Rp/dwelling)

		no reinstatement road	reinstatement road
depth = 1.5 m	5 m sewer/dwelling	450	535
	7.5 m sewer/dwelling	645	775
depth = 3.0 m	5 m sewer/dwelling	660	745
	7.5 m sewer/dwelling	960	1090

TABLE 3.4 : FACTORS AFFECTING COSTS OF A YARD CONNECTION (1000 Rp)

	no reinstatement road	reinstatement road
separate connection	120	130
shared connection	95	100

TABLE 3.5 : FACTORS AFFECTING COSTS OF A HOUSE CONNECTION (1000 Rp)

		Length of pipe (ϕ 100 mm) to toilet			
		5 m	7.5 m	10 m	15 m
no reinstatement works	1 add. conn	110	130	150	190
	2 add. conn	150	170	190	230
	3 add. conn	190	210	230	270
reinstatement works	1 add. conn	160	180	205	245
	2 add. conn	225	245	265	310
	3 add. conn	285	310	330	375

In table 3.3 , it is seen that construction costs of sewerage depend very strongly on the depth of implementation of the sewers; construction at 3.0 m depth is about 40-50 % more expensive than construction at 1.5 m depth.

In figure 3.1 a sewer network in a flat residential area (which can be considered to be more or less representative for Tangerang) is shown. The size of the area is 18 ha. At certain points along the leading path the implementation depth of the sewers have been calculated by assumption of the slopes.

A minimum depth of street sewers of 0.8 m is required to avoid damages by vehicular loadings. Further, it is seen (on fig. 3.1) that the (average) depth increases as the catchment area and the applied slopes increase.
In the pilot areas slopes have been applied which meet the minimum requirements.* These slopes are based upon a long period of practice in the Netherlands (a flat area). In the pilot areas sewers could be constructed at shallow depth (average 1.5 m) as these areas are relatively small.**
Hereafter a depth of street sewers is assumed to be 1.5 m.

In table 3.4, it is seen that savings in case of a sharing of a yard connection are very limited. Hereafter a seperate connection is assumed.

Table 3.5 gives an indication of costs when apart from the toilet connection, also other (1 to 3 more) waste water discharge points are connected. It is assumed that 4 m PVC pipe (ϕ 50 mm) is required for every additional connection.
Hereafter, it is assumed that every dwelling has apart from the toilet connection, two other wastewater discharge points (one in kitchen and one in bathroom).

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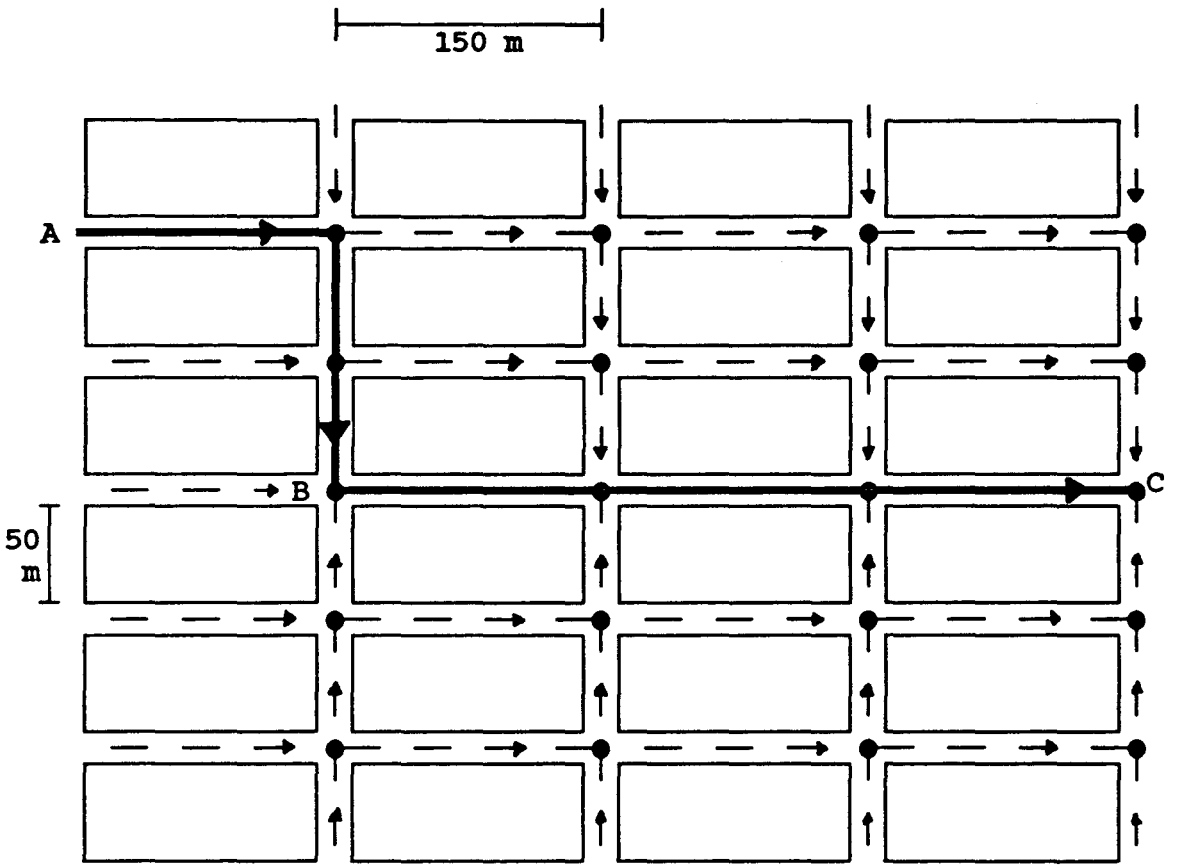
* The minimum slope of sewers (ϕ 200 - 500 mm) for separate sewerage systems is 1 : 1000

** As the catchment area increases, (some) sewers along the leading path may be constructed too deep. In this case construction of a pumping station may be desirable for economical reasons. Down street the pumping station sewer construction of leading path(s) can start again with minimum depth of excavation. By application of pumping stations costs for sewerage facilities may be kept low (see for example table 3.18, only 3-4 % for sewerage facilities is contributed by the pumping station)

FIG. 3.1 : DEPTH OF SEWER NETWORK



= leading path, -- -- = street sewer
Slope leading path is 1 : 1000 :
Depths : at A : 1.00 m, at B : 1.25 m, at C : 1.70 m
Slope leading path is 1 : 500 :
Depths : at A : 1.00 m, at B : 1.50 m, at C : 2.40 m

Assuming the depth of street sewer and number of waste water discharge points, costs of local conventional sewerage facilities will be determined by the following parameters :

- length of communal (street) sewer per dwelling, which is about half of the plot width, since most streets have plots at both sides of the streets. The length will increase for a less densely populated area
- location of sanitation facilities within a house (at back side or front side)
- necessary reinstatement works

These parameters are typically determined by type of area. The starting points which have been applied for the different areas are summarized in table 3.6. The relationship between required length of communal sewerage per dwelling and population density have been estimated on the basis of demographic data (population densities of different sub-areas) and design data (length of street sewers in these sub-areas).
In table 3.6 also the investment costs for these areas are summarized (which can easily be derived from the preceding tables.

TABLE 3.6 : INVESTMENT COSTS OF LOCAL CONVENTIONAL SEWERAGE FOR DIFFERENT AREAS

	Area			Starting points		Investment (1000 Rp/ dwelling)
No	Income	Density	Status	Length pipe to WC (m)	Metre sewer per dwelling	
1	mid/high	100-150	existing	15	7.5	1215
2	mid/high	100-150	new	7.5	7.5	935
3	low/mid	250-500	new	5	5	720
4	low/mid	250-500	existing	10	5	930
5	low/mid *	250-500	existing	10	5	800

Notes : * no asphalt roads. Investment costs are lower than for area type 4 as no road reinstatement is required and a lower class of pipes may be applied by absence of heavy traffic

It is seen that total investment costs of local conventional sewerage facilities differ considerable for the areas; for area type 1 costs are 1.7 times as high than for area type 3. The table shows that in new development areas investment costs are significantly lower than in existing housing estates with similar income and population density. For example investment costs of sanitation facilities in a new development low/middle income are about 25 % less than in an existing low/middle income. The difference is for 60 % caused by reduction of costs of a house connection as sanitation facilites can be located at the front side of a house in stead of at the back side (in existing areas these toilet, kitchen and bathroom are usually constructed at the backside of the dwelling near the shallow well) and reinstatement of floors - due to inhouse plumbing adjustments-

is not required. 35 % of the difference is caused by reduction of cost of sewerage in the street as reinstament of roads is not required in new development areas.

3.3.1.2 Total Investment Costs of Local Rudimentary Sewerage

Investment costs of a rudimentary sewerage system within an existing low/middle income area are 345,000 Rp/dwelling. These costs are significantly lower than costs of conventional sewerage (about 2.5 times) as no costs will be made for yard and house connections and not all streets will be provided with sewerage facilities. It is assumed that that total sewerage length will be about 60 % of the total sewerage length in case of a conventional system. Therefore, the running metre sewer per dwelling will be 3 m. A detailed breakdown of the costs is given in annex 2.

The survey results indicate that the majority of households in an existing housing estate use a pit via which the toilet water leach into the ground (paragraph 5.6.3.1). In this case construction of extra provisions (i.e. septic tank + pipe to the drainage) may be necessary to collect all waste water effectively by the rudimentary sewerage system (It is assumed that discharge of toiletwater directly to the drainage system will refuse socially acceptance). If a rudimentary sewerage system will be applied in a new development area, the costs of the construction of the septic tank also have to be taken into account.

Accounting for costs of septic tanks strongly increase costs of rudimentary sewerage, as shown in table 3.7.

Assuming that in existing low/middle income areas 30 % of the households have a septic tank, investment costs of rudimentary sewerage are about 600,000 Rp/dwelling (if all waste water is collected). This is still 35 % less than costs of conventional sewerage.

In a new development (low/middle income) area investment costs of rudimentary sewerage (incl. septic tanks) are only 10 % less than investment costs of conventional sewerage. Taking the disadvantages of rudimentary sewerage (cf. Table 2.4) into account, conventional sewerage is preferable in these areas.

TABLE 3.7 : INVESTMENT COSTS OF A RUDIMENTARY SEWERAGE SYSTEM FOR AN EXISTING LOW/MIDDLE INCOME AREA

	Area			Investment costs (1000 Rp/dwelling)		
No	Income	Density	Status	Rudimentary sewerage	Septic tank	Total
3	low/mid	250-500	new	295	355	650
4	low/mid	250-500	existing	345	365	710

Note : Investment costs are lower in a new development areas as no road reinstatement is required

3.3.1.3 Total Investment Costs of the Treatment

Taking into account the methodology as described in paragraph 3.2 the costs for the treatment plant amount to Rp 405,000 per dwelling. This involves that about 25-30 % of total investment costs for local sanitation facilities (house connections, yard connections, street sewers, pumping station and treatment plant) is contributed by the treatment plant.

A detailed breakdown of the investment costs of the treatment plant is given in annex 2.

3.3.1.4 Total Investment Costs of Full City Sewerage and Treatment for Tangerang

Table 3.8 shows rough estimations of the investment costs of full city sewerage and treatment based on the methodology described in the preceding paragraph. It is seen that costs for full city sewerage and treatment are not significantly higher than the cost of local sewerage and treatment; higher unit costs of sewerage are offset by lower unit costs of treatment (due to economics of scale).
As the catchment area increases :
- the wastewater to be transported out of the area increases, so that relatively more larger pipes are required
- relatively more sewers have to be constructed deeper

Costs of full city sewerage are slightly higher than those for local sewerage due to these two effects.

TABLE 3.8 : INVESTMENT COSTS OF LOCAL AND FULL CITY AND TREATMENT FOR TANGERANG

Item	Investment Costs (1000 Rp/dwelling)	
	Sukasari pilot area	General Plan
Sewerage	1050	1150[a]
Treatment	400	300
Total	1450	1450

Notes : a) main lines with diameter ≤ 400 mm are supposed to be laid in the streets and connected to the dwellings
b) it is assumed that 60 % of the households are resident in an existing low/middle income area and 40 % in an existing middle/high income area

3.3.2 Total Investment Costs of On-Site Sanitation

The investment costs of (improved) on-site sanistion systems are as follows:
- pit : Rp. 195,000
- septic tank (incl. sub surface disposal system or pipe to gutter) : Rp. 365,000

These costs are almost independent of the type of area (as distinguished in table 3.1).

It is seen that investment costs of local conventional sewerage and treatment are considerably higher (3-7 times) higher than those of on-site sanitation systems. This difference may limit the government's and households' interest for sewerage and treatment facilities.

A detailed breakdown of the costs of on-site sanitation is given in table 3.13 - 3.15 (annex 2).

3.3.3 O&M Costs and NPV of Sanitation Technologies

The main findings regarding investment costs, O&M costs and NPV of the costs (at year 0) are summarized in table 3.9.

It can be seen that the investment costs account for 80-90 % of the total costs (during 25 years) for all sanitation technologies. Further, it is seen that costs of sewerage and treatment facilities are considerably higher than costs of on-site sanitation systems.

TABLE 3.9 : NPV COSTS OF SANITATION SYSTEMS

Type of system		Lifetime (years)	Costs (1000 Rp/HH)		
Nr.	Description		Investment	O&M (per year)	NPV [a]
1	Pit	25	195	6	232
2	Septic tank [b]				
2a	In existing area	25	365	6	386
2b	In new development area	25	355	6	409
3	Local conv.sewerage in exist. area (excl. houseconnection) [c]	50	765	11	830
4	House connection in existing area [c]	50	280	0	242
5	Local sewerage in exist area (3+4) [c]	50	1,045	11	1,072
6	Local sewerage in new development areas (incl. houseconnection) [c]	50	805	11	868
7a	Rudimentary sewerage [d]	50	345	17	483
7b	Rudimentary sewerage + septic tank [d]		710	23	869
8	Treatment (capacity 15,000 i.e)	30	405	9	480
9	Local sewerage + treatment in existing area (5 + 8) [c]		1,450	20	1,552
10	Local sewerage + treatment in new development area (6 + 8) [c]		1,210	20	1,348

Notes : a) Interest rate = 10 %, NPV calculated over 25 years (year 0 to 25)
b) Although septic tanks can be located closer to the drains in new development areas investment costs are about the same as in existing areas, as in new development areas interest on loan is accounted. NPV in new development areas is slightly higher because construction takes place one year before use.
c) It is assumed that 60 % of the households is resident in a low/middle income area and 40 % in middle/high income area
d) It is assumed that the rudimentary sewerage system is implemented in a low/middle income area

3.3.4 Possibilities for Reduction of Costs of Conventional Sewerage

As it was seen in the preceding paragraph, investment costs form 80-90 % of the costs of sewerage facilities.
To reduce costs of sewerage facilities, it is most efficient to reduce investment costs. Reduction of costs is desirable to make implementation of these facilities more attractive from an economical point of view.

In this paragraph it is analysed how far investment costs of sewerage facilites can be reduced by community participation and/or by adaptation of the design.

3.3.4.1 Community Participation

Costs of sewerage facilities may be reduced by providing of labour through the community. As construction of street sewers and yard connections (laying of pipes under required slope, testing of materials etc.) require skilled labour, community participation is only feasible for construction of house connections.
If this is done costs of house connection in an existing low/middle area may be reduced from 265,000 to 180,000 Rp/dwelling. The effect of this on the total investment costs of local conventional sewerage (pumping station, street sewers, yard and house connections) is limited (8-9 %).

3.3.4.2 Adaptation of Design

One form of adaptation of technology, viz. rudimentary sewerage by which the domestic wastwater is collected via the drains, and its costs effects already have been discussed. Here the possibilities for adaptation of the separate sewerage system (see paragraph 2.5.1) will be analysed.

The design parameters (not determined by type of area) of a separate sewerage system and some conventional principles are given in table 3.10.

TABLE 3.10 : CONVENTIONAL PRINCIPLES FOR THE DESIGN OF SEWERAGE SYSTEMS

Design parameter	Conventional principles	
	Value	Explanation
Number of manholes per length of street sewer	≈ 1 per 40 m	For accessibility of system for O&M
Diameter street sewer	≥ 200 mm	The diameter is determined by the discharge capacity. As sewers also have to transport excreta etc., the diameter should not be smaller than 200 mm to prevent blocking. In practice about 80 -85 % of the length of the pipe system for a local seperate system consist of 200 mm sewers.
Depth street sewer	≥ 0.8 m	A minimum depth of 0.8 m should be applied to prevent damages due to (vehicular) loadings. Further depth is determined by slope and size of catchment area.
Diameter yard connection	100 mm	To prevent frequent blocking
Diameter house connection		
- toilet connection	100 mm	To prevent frequent blocking
- sullage connections	50 mm	To prevent frequent blocking
Class pipes and special components		Determined by (vehicular) loadings

As already mentioned before, the design parameters of the seperated sewerage system are more or less determined by these conventional principles. Following these principles, the possibilities for further reduction of costs seems limited.

Quite different principles for application of separate sewerage systems in squatter settlements have been developed by the UN Centre of Human Settlements (Habitat). Systems designed according to these principles are called "Shallow sewerage systems". The shallow sewerage concept has emerged through a 5 year research period by Habitat and it has been succesfully applied in squatter settlements in Brazil and Pakistan. However, one has to realize

that the domestic consumption in these areas does not exceed an average of 27 liter per capita per day [39].

The total investment cost of shallow sewer for Indonesia has been estimated for an existing low/middle income area (type 4) on basis of the quantities and design specification of the implemented works in Brazil and Pakistan [39] and unit prices of components of Indonesia [20,21,22,25,26,29]. In table 3.11 results of calculations are shown.

TABLE 3.11 : INVESTMENT COSTS OF A SHALLOW SEWERAGE SYSTEM

Item	Costs local sewerage (1000 Rp/dwelling)	
	Conventional	Shallow
Communal sewerage	535	250
Yard connection	130	55
House connection	265	195
Total	930	500

It is seen that investment costs of shallow sewerage are about 50 % less than costs of conventional sewerage. The difference can be due (for the most part) to :

- an quite other location of the communal sewerage system; the majority (80 %) of the communal sewers are located at the backside of the houses (where waste water discharge points are usually located) instead of in the streets (as is the case for conventional sewerage). As a result the length of the house connection is shorter and road reinstatement is not required. Besides sewers may be constructed at shallow depth and a lower class of sewers may be applied by absence of vehicular loadings.
- smaller diameters of the communal sewers (ca. 80 % 100 mm sewers and 20 % 150 mm sewers), which can be used according to Habitat [39] in squatter areas because of a low water use.

Despite its cost attractiviness this concept seems not feasible in Indonesia for application on a large scale. Reasons for this are :

- the bad accessibility of the system for operation and maintenance (equipment); in middle and high income areas houses are usually surrounded by walls. In this case construction is not proposed
- the present and planned wateruse in urban areas in Indonesia; in the social survey (see paragraph 5.4.4), it is found that even by low income groups water use is considerable. Further, in existing water supply programmes in Indonesia for cities as Tangerang daily allowances for water are 90 liter per capita per day. To discharge present and planned quantities the capacity of 100 mm pipes are too small (as all waste water, i.e. sullage and toilet water, should be discharged to the system, see § 2.5.4 + § 2.5.1.2).

As yet, it must be concluded that possibilities for adaptation (and consequently of cost reduction) of the conventional sewerage system are limited.
Implementation of shallow sewer systems only may be considered in (low-income) areas where water use is low (use of shallow wells) and in which piped water supply is not planned in the short-mid term.

3.3.5 Comparison Calculated and Real Investment Costs of Conventional Sewerage for Tangerang

Real costs of sewerage have been mainly derived from the works executed in 1988 in Tangerang. All figures have been brought to the price level December 1988. In table 3.12 real and calculated costs for area type 4 are presented. Costs have been split up for communal sewerage, yard and house connections.

It is known that there is limited experience in Indonesia regarding sewerage construction. Considering the difference between calculated costs and costs as per tender, it is hoped to involve an increasing number of contractors in sewerage implementation to create more competition for work tenders.

Apart from the above mentioned reason the differences presented are greatly caused by following factors.

1. During tender preparation relatively high costs are taken into account for shoring (≥ Rp 10,000 per m communal sewer) of the sewer trenches over the full length (depth > 1.5 m). However, shoring is not always be required and applied and therefore it is advised to modify the tender specifications; for shoring the contractor should only be paid if these are

really necessary and applied during construction. Furthermore, it is not realistic to pay for these facilities over the full length of the trench as shoring facilities can be easily re-used several times.

2. In the tender documents and Bill of Quantities some rather expensive items for yard and house connection have been calculated. Instead of these items much cheaper items can be used [6].

If these recommendations are adopted, sewerage construction may be more efficient, so that more people may be provided with these facilities.

TABLE 3.12 : REAL AND CALCULATED COSTS OF SEWERAGE FOR AN EXISTING LOW/MIDDLE INCOME AREA

Item	Investment Costs (1000 Rp/dwelling) [a]	
	Calculated	As per tender
Communal sewerage (5 m sewer ϕ 200 mm) [b]	369	494
Yard connection	112	220
House connection [c]	112	198
Total	593	912

Notes : a) Presented costs exclude overhead costs of contractor, consultancy fees and financial costs (interest on loan during construction) and profit contractor

b) In this case all street sewers are supposed to have a diameter of 200 mm. Costs for pumping station, office and O&M equipment (see annex 2) are excluded

c) House connection is to be considered as the connection between toilet and inspection box at the plot boundary. (Data about real costs of sullage connections are not available). Only costs for demolition of existing floors/footways are included since households were supposed to pay for the reinstatement of floors and footways.

3.3.6 Summary Main Findings

To implement sewerage and treatment provisions in Tangerang huge investment costs are required (290,000 Rp/capita).Investment costs of sewerage form the largest part of the costs (ca. 70 % for local sewerage and treatment). These costs are kept minimal by application of mimimum slopes of sewers. These slopes are based upon a long experience in the Netherlands (a flat area).

The investment costs for sewerage facilities depend on the type of area. In new development areas investment costs are especially attractive (about 25 % less than in existing areas).

The investment costs of communal sewerage and treatment facilities are considerably higher than costs of (improved) on-site sanitation technology (Rp. 195,000 for a pit and Rp 365,000 for a septic tank). This large difference may limit households' and government's interest in sewerage and treatment facilities.

The investment cost account for 80 to 90 % of the total costs of sanitation technologies.
Implementation of seperate sewerage (§ 2.5.1.2) and treatment can be made more attractive from an economical point of view, by reduction of investment costs. However, the possibilities for reduction of the (calculated) costs by adaptation of the seperate design or by providing labour through the community are limited; adaptation of design might only be possible in case of very low water use.

Investment costs of sewerage facilities may be reduced by application of rudimentary sewerage (within a low/middle income area costs of rudimentary sewerage are 60 % less than costs of conventional sewerage). However, extra provisions may be necessary to collect all wastewater effectively. In this case investment is less attractive (25-35 % less than costs of conventional sewerage). In new development areas the investment costs of rudimentary sewerage (inclusive septic tanks) are only 10 % less than those of conventional sewerage. Taken the disadvantages of rudimentary sewerage into account (compared with conventional sewerage), conventional sewerage is preferable in these areas.

3.3.7 Recommendations

Real investment costs of conventional sewerage have shown to be considerably higher (50-60 %) than calculated costs. Possible cost savings can be reached by :
- involving an increasing number of contractors in sewerage implementation
- modifying tender documents (reduce accounted costs for shoring)
- limitating the use of expensive items in construction of yard and house connnection

Implementation of shallow sewer systems may be considered in (low-income) areas where water use is low (use of shallow wells) and in which piped water supply is not planned on the short-mid term.

4 FINANCIAL ANALYSIS

4.1 Introduction

Foreign assistance only act as a catalyst for financing the Water Supply and Sanitation Decade in Indonesia; it is estimated that more than 80 % of funds for water supply and sanitation come from internal sources*.

In this chapter it is analysed whether sufficient funds are available to implement chosen technology on a large scale in residential areas in urban Botabek. The capability of both the government and the households to pay the costs of the chosen technologies and its alternatives, as calculated in chapter 3, is examined. Analysis is also made whether Indonesia will be able to finance the foreign currency component of the costs.

A problem in assessing households' and government's ability to pay in developing countries is determining the criterium to be used. Therefore, firstly some information is provided on the selection of these criteria (§ 4.2).
The methodology has been described in paragraph 4.3, while results are presented in paragraph 4.4.

4.2 Criteria for Ability to Pay for Sanitation

Households

If (part of) the cost of a sanitation project is to be recovered from the beneficiaries, then these people must be both able and willing to meet these costs. In this analysis the ability to pay is considered, which is determined by the current expenditures and the income (see § 5.2.3).

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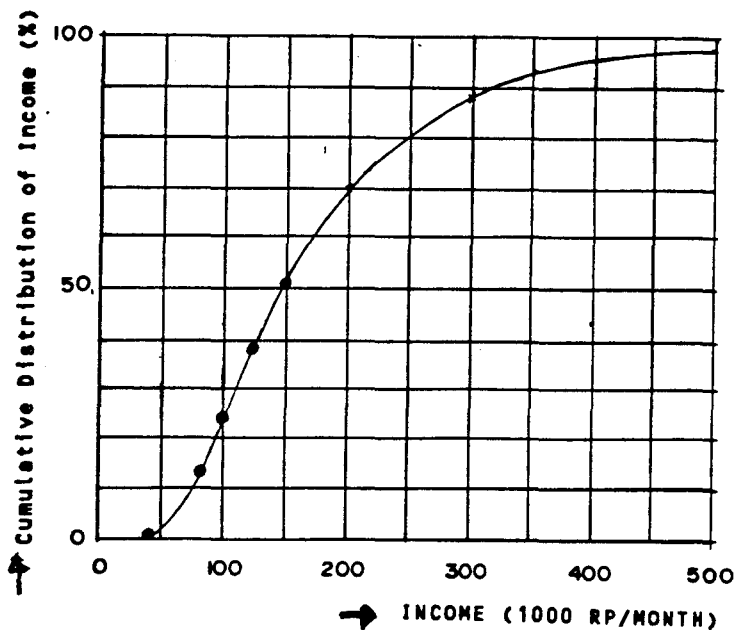
* The Official development aid to Indonesia in 1986 was 667 million U$ or about 1,000 billion Rp/year [49,p.119]. In the past only 5-10% of the total aid to developing countries went toward providing drinking water and sanitation [9,p.136]. So, the estimated contribution to the water and sanitation sector of Indonesia is 50-100 billion Rp/year or 10-20 % of the development budget for this sector (cf. Table 4.4).

Data about present household income distribution in Tangerang (urban areas Botabek) are not available. Therefore an estimation is made (see appendix 3). The estimated income distribution is shown in figure 4.1. The calculated average household income in the urban areas of Botabek is 180,000 Rp/month. It is seen that 70 % of the people in the urban areas have at present a household income < 200,000 Rp/month.

FIGURE 4.1: HH-INCOME DISTRIBUTION IN URBAN BOTABEK (DEC.1988):



The current expenditures of urban households are summarized in table 4.1 and shown in figure 4.2 (Engel's diagram). It is seen that the largest proportion of money is spend on food. About 20 % is spend on housing, fuel, electricity* and water. As household income rises the pattern of expenditures shift (this was already observed one century ago by Engel, a German statistican).

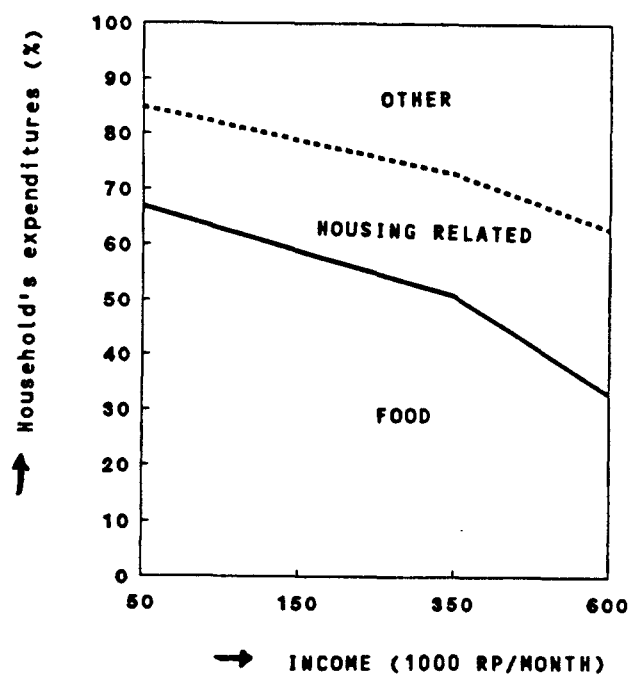
* Results of the socio-economic survey indicate that households in the survey area already spend about 10 % of their income on urban services (of which 6 % for electricity) (see paragraph 5.3.5).

TABLE 4.1 : EXPENDITURES IN URBAN AREAS BY ITEMS OF CONSUMPTION AND INCOME CLASSES

Income Class (1000 Rp/ month.HH)	Expenditure items (% of total expenditures)							
	food	housing fuel, elect, water	misc. goods and services	cloth-ing	durable goods	consum taxes + insur-ance	parties and cere-monies	total
< 100	67	18	7	5	1	1	1	100
100-200	59	20	11	5	2	1	2	100
200-500	51	22	16	4	3	2	2	100
>500	33	30	20	3	8	3	3	100
total	54	22	14	4	3	1	2	100

Note : Income data of BPS have been brought to price level December 1988
Source : BPS, Statistical Yearbook of Indonesia 1985, p.579 (1986)

FIG. 4.2 : ENGEL'S DIAGRAM



The questions of what level of cost recovery is "affordable" is hotly debated. A problem in assessing the ability to pay is to determine the criterium to be used. In the selection of the criterium consideration should be given to the income and costs of other essential items.
Usually, it is supposed that people can afford the facility if the costs to be meet don't exceed a percentage of the income which is derived from a percentage of the housing related expenditures for sanitation.

Literature about percentage figure to be used is scarce. Some data are given in table 4.2. In some sources a percentage is mentioned for water supply and sanitation systems together.

As a test guide in urban areas in Asian developing countries, especially in Indonesia, households are usually expected to be able to spend 1.5-3.0 % of their income on sanitation (or 7.5-15% of the housing-related expenditures, cf. Table 4.1). This criterium seems justifiable taking the other current housing related expenditures into account (i.e. for electricity, water supply, dwelling costs : rent or instalment and housing improvement).
One should be aware that this criterium (1.5 to 3.0%) is arbitrary. In the financial analysis an optimistic criterium (3 %) will be used.

TABLE 4.2 : CRITERIUM FOR ABILITY TO PAY FOR SANITATION

Ability to pay (% of HH-Income)			Source
Sanitation only	Drinkwater	Sanitation and drinkwater	
3 - 5	6 - 10		43
1,5 - 2			48
	3 - 5		44
		< 5 - 7	45
1,5			46

government

Most developing countries appear to have devoted some 4 to 6 percent of public investment to water supply and sanitation in recent years [52, p.306]. It is assumed in the financial analysis that the government can afford to spend 3 % of the development budget on sanitation (and 3 % on water supply).

4.3 Methodology

4.3.1 Assessment of Households' Ability to Pay for Sanitation Technologies

The investment costs together with O&M costs are supposed to be recovered within 20 years by equal yearly payments. Recovery will start when the systems become operational (from year 1 on). The total yearly payments by households are calculated by adding annuity of total investment with the yearly operation and maintenance costs. These yearly payments are divided by 12 in order to get the monthly payments. The required percentage of household income for recovery of all costs is found by dividing these monthly payments by the average households income (Rp 180,000 per month). In low/middle income areas where rudimentary sewerage is implemented the average income is assumed to be Rp 125,000 per month.

The annuity of investment, A, can be calculated with the following formulas :

$$A = I \cdot i \cdot (1 + i)^n / \{ (1+i)^n - 1 \} \quad (3)$$

$$A = I \cdot i \cdot (1 + i)^{n-1} / \{ (1+i)^n - 1 \} \quad (4)$$

where
i = interest rate (expressed as a fraction)
I = investment
n = financing period (from year 1 to n) = 20 years

If construction is in year 0 (and takes 1 year) formula (3) should be applied. If construction is in the beginning of year 1 (just before the systems become operational) formula (4) should be applied.
The interest rate used in the financial evaluation of projects in Indonesia is 10 % on the assumption that prices remain constant [36].

4.3.2 Assessment of Government's Ability to Pay for Chosen Technology

It is assumed that it is government's policy that at least O&M costs and investment costs of the house connection are to be recovered from the beneficiaries.
It is calculated how many urban people in Indonesia can be served with communal sewerage and treatment per year by a given budget for urban sanitation. (It is assumed that the whole budget is used for implementation of chosen technology). The calculated figure is compared with the number of people in urban areas and the growth of these areas, in order to assess government's ability to pay for chosen technology (given current expenditures).

4.4 Results

4.4.1 Households' Ability to Pay for Sanitation Technologies

Table 4.3 shows the monthly payments for different sanitation technologies which are required for recovery of all costs.

It is seen that households have to spend about 8-9 % of their income on sanitation if all costs of conventional sewerage and treatment facilities have to be recovered from beneficiaries.* Given current expenditures, households are considered to be unable to pay this (even if the optimistic 3 % criterium is used). However, households are supposed to be able to pay for O&M costs of the chosen technology. This is required for a succesful continuation of implemented works**. Using the optimistic 3 % criterium, households are also assumed to be able to pay for the construction of house connections (provided that proper credit facilities are given : financing of facilities in at least 5 years).** For recovery of all costs additional sources must be found. This has to be taken into account in the planning of new projects.

It is seen in table 4.3 that a rudimentary sewerage system (without treatment of waste water) is inaffordable for low/middle income classes. If extra provisions (septic tanks) are necessary, costs increase to 6.8 % of the income.

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* In the Netherlands households (2.5 people) pay monthly about the same for wastewater disposal purposes. These contributions are sufficient for recovery of investment and O&M costs. However, in the Netherlands this amount is only a small percentage of the HH-income (< 0.5 %). Calculated costs for Indonesia are not much lower than costs in the Netherlands as :
- equipment (largest part of investment for treatment) for the treatment is imported from the Netherlands
- PVC prices, the principal construction material of sewerage facilities, are not much lower in Indonesia; costs for the raw materials form the largest part of the PVC costs (50 % in the Netherlands, 70 % in Indonesia). This raw material (produced out of oil) follow the world market price.

** It is anticipated that it is the government's policy (also for selective implementation) that at least O&M costs and investment costs of the house connection (on the plot) are to be recovered from the beneficiaries
Reasons for this being :
- the sanitation organization should not be dependent of the Central Government to execute operation and maintenance of the facilities
- construction of on plot works is assumed to be a private matter by the Indonesian Government

If rudimentary sewerage and treatment is implemented in other areas as well as those of low-income, households should have to spend monthly 10,460 Rp/month on sanitation * or about 6 % of their income. This percentage increases to 8 % if extra provisions are necessary. Households are also considered to be unable to pay for this.

Further, it is seen that improved (i.e. better location, better construction materials) on-site facilities are affordable (using the optimistic 3 % criterium).

TABLE 4.3 :HOUSEHOLDS' ABILITY TO PAY FOR SANITATION SYSTEMS

Type of system		Payments for cost recovery per HH			
Nr.	Description	O& M		Total	
		Rp/month	% of income	Rp/month	% of income
1	Pit	500		2,200	1.2
2	Septic tank				
2a	In existing area	500		3,700	2.1
2b	In new development area	500		3,975	2.2
3	Local conv. sewerage in exist areas (excl. houseconnection) [b]	900	0.5	8,400	4.7
4	House connection in existing areas [b]	0		2,500	1.4
5	Local sewerage in exist area (3+4) [b]	900	0.5	10,900	6.1
6	Local sewerage in new develop area [b]	900		8,800	4.9
7a	Rudimentary sewerage [a]	1,400	1.1	4,800	3.8
7b	Rudimentary sewerage + septic tank [a]	1,900	1.5	8,500	7.5
8	Treatment (Capacity 15,000 i.e)	750	0.4	4,700	2.6
9	Local sewerage + treatment in existing area (5+8) [b]	1,650	0.9	15,600	8.7
10	Local sewerage + treatment in new development area (6+8) [b]	1,650	0.9	13,500	6.8

Notes : a) It is assumed that the rudimentary sewerage system is implemented in a low/middle income area, where the average income is Rp. 125,000 per month.

b) It is assumed that 60 % of the households is resident in a low/middle income area and 40 % in middle/high income area. Average income of these households is Rp. 180,000 per month

* In this case costs for rudimentary sewerage are 20 % higher than values in table 4.3, as the sewer requirements per dwelling increase due to incorporation of less densely populated areas.

4.4.2 Government's Ability to Pay for Chosen Technology

Before the government's ability to pay is assessed, its expenditures are analysed, especially those for urban development.

In table 4.4 the planned urban development expenditures are summarized. The largest part of the urban development budget comes from government funds [46]. About 7-10 % of the government's development budget is for urban development.

TABLE 4.4 : RANGE OF PLANNED URBAN SECTOR DEVELOPMENT BUDGET FOR REPELITA V (1989-1994) AT DECEMBER 1988 PRICES

Item	Expenditure range Repelita V (1989-1994)		Expenditures Repelita IV (1984-1989, % of urb.sec dev. budget)
	Rp. billion	% of urban sector development budget	
Water supply	1,424 - 2,171	31 - 38	46.1
Sanitation	230 - 349	5 - 6	3.4
Drainage and flood	598 - 857	13 - 15	16.6
Solid waste	322 - 514	7 - 9	2.6
Kampung improvement *	322 - 514	7 - 9	2.6
Urban roads	1,240 - 1,885	27 - 33	24.5
Total	4,136 - 6,290	90 - 110	100.0

Notes : Including all sources for urban development (central, provincial, local allocations, foreign and domestic loans, grants, local revenue, including taxes and user charges)
: Repelita = Five year development plan
: * includes a small sanitation component (5 %)
Source : Coordination Team for Urban Development in Indonesia [9]

The fast growing urban areas require a great deal of funds for providing and/or improvement of urban services. As funds for development expenditures are scarce, expenditures for sanitation have to compete with other pressing areas of public expenditures. It is seen that priority is given by the Indonesian Government to implementation of piped water supply (of which investment costs per capita are less than half of the investment costs for sewerage and treatment facilities), urban roads and drainage. As a result little money is left for urban sanitation.

It is estimated that 4-5 % of the public investments in Indonesia is devoted to water supply (3.4-4.1%) and sanitation (0.6-0.7%)*. The total percentage is about the same as in other developing countries (§ 4.2). However, as already mentioned, the percentage for sanitation is low.

In table 4.5 government development expenditures over the past years are shown.

TABLE 4.5 : ACTUAL DEVELOPMENT EXPENDITURES BY INDONESIAN GOVERNMENT

Fiscal year	Development budget	
	Billion Rp.	% of total government budget
78/79	2,556	48
79/80	4,014	50
80/81	5,916	50
81/82	6,940	50
82/83	7,360	51
83/84	9,899	54
84/85	9,952	51
85/86	10,873	48
86/87	8,332	38

Source : BPS Statistical Yearbook 1985, 1987 [11,12]

During the period 1973-1983 revenues from oil and gas increased rapidly, leading to increasing government budgets for development. In 1983 the budget had to be readjusted due to lowering oil and gas prices. Although, Indonesia's oil and gas revenues declined strongly, government budget remained nearly constant. This is due to two factors :
- the devaluation in 1983, raising Rp earnings
- efforts of the governments to broaden the revenue basis of the government budget.

* The expenditures for water supply and sanitation in rural development are not known.

It is assumed that funds for urban sanitation will not increase strongly (2 or 3 times as high, at price level December 1988) in the coming 10 years due to the expected pattern of development expenditures and competition with other urban expenditures.

The total budget in Repelita V for urban sanitation is about Rp 300 billion or Rp 60 billion per year.
Investment cost of communal sewerage and treatment (excluding house connections in existing areas) is Rp 1.17 million Rp/dwelling. So, with the budget per year about 50,000 dwellings or 250,000 people can be served. Taking into account Indonesia's present urban population (ca. 35 million) and its yearly growth (770,000 people per year), the present budget is insufficient to implement conventional sewerage and treatment facilities on a large scale; government funds are only sufficient to implement some pilot projects.

To serve 70 % of Indonesia's urban population in the year 2010 (70 % of 54 million) with conventional sewerage and treatment, Rp 2,200 billion or about 25 % of the Development Budget would be necessary yearly. This is far more than 3 % which the Government can afford to spend on sanitation (see par. 4.2). To reach above mentioned goal, the present urban sanitation budget should be increased radically (35 times as much). This is assumed to be unfeasible given the government's current expenditures.

The same conclusions can be drawn for application of rudimentary sewerage with treatment of the collected wastewater*.

4.4.3 Indonesia's Ability to Pay for Foreign Costs

(Nearly) all costs for the on-site sanitation systems are local costs. This is also the case for sewerage systems. The principal construction material of sewerage systems is PVC. The raw material for the production of PVC is produced out of oil, which is locally available. Part of the PVC production equipment is imported. But the contribution of this equipment in the price of PVC is limited (ca. 2 %) [51].

For the treatment aspect the situation is different. In the Botabek Project all the equipment was imported. The foreign costs accounted for about 50 % of the total investment costs (see table 3.20). However, if treatment facilities were applied on a large scale, it might be assumed that the foreign currency component in

* Investment costs for rudimentary sewerage and treatment (exclusive septic tanks) is 0.95 million Rp/dwelling

the costs might be reduced to ca. 25 % of the investment costs of the treatment plant* [50]. This is about 7 % of the total investment costs for treatment and sewerage facilities. These foreign costs may be avoided by choosing another type of communal treatment plant**.

At present the yearly imports of capital goods in Indonesia of the public and private sector together amount to 3,240 billion Rp [14, vol C, p.112].
To serve 70 % of the population in the year 2010 with sewerage (either rudimentary or conventional) and treatment (Carrousel) 188 billion Rp would be required yearly. This should be equal about to 6 % of the imports of capital goods. This is very much. As has been noted, these costs might be avoided by selection of antoher type of treatment.

---

* The (steel) construction of the equipment for the settling tank, sludge thickener, sludge return unit and the piping works may be done in Indonesia. The pumps, electric equipment and the rotors (aeration basin) should be imported for the time being. This assessment is based on field visits of local producents in 1982 by Heymans [50].

** Stabilization ponds might be used for treatment of waste water instead of the Carrousel. Investment costs for this type of treatment are the same as those for the Carrousel. Stabilization ponds are characterized by large ground and little equipment requirements (Land costs account for ca. 70 % of the investment costs).

4.4.4 Summary Main Findings

As yet, it must be concluded that implementation of both system propositions (rudimentary or conventional sewerage with treatment) on a large scale is not feasible as both government funds and household incomes are insufficient to cover the costs. 7-9% of household's income would be required for recovery of both investment and operation and maintenance costs. Guidelines for urban sanitation, based upon experience in developing countries, assume that households can at most spend 3 % of their income on sanitation. Besides the government is supposed to be unable to pay if these facilities were applied on a large scale. For this 25 % of the government's development budget would be required, while 3 % is supposed to be the limit. There is at present no foreseeable way that these facilities can be made affordable for application on a large scale; possibilities for further reduction are limited, while government's and households' expenditures for sanitation are not expected to increase radically in the coming years.

At present the foreign exchange effects also should be considerable if the selected treatment method (Carrousel) were applied on a large scale. However, the foreign costs might be avoided by selection of another type of treatment.

The current expenditures for sanitation by the Indonesian Government indicate that this sector gets a low priority. It is estimated that 0.7 % of the development budget is devoted to sanitation, while government is supposed to be able to spend 3 % of the development budget on this.

Government susidies for the present for selective implementation (as government funds are limited) of sewerage and treatment facilities are required, as households are unable to pay all costs.

It is anticipated that it is the government's policy that at least O&M costs and the investment costs for the house connection are to be recovered from the beneficiaries. 3 % of the household income is necessary to meet these costs. Using the optimistic 3 % criterium, households are supposed to be able to pay for these costs.

5 SOCIAL ANALYSIS

5.1 Introduction

In this chapter the condition of water supply and waste water disposal as perceived by the end users is described and analysed. The research covers three areas in the city of Tangerang (which is assumed to be more or less representative for urban Botabek):
- the sewered Sukasari area (existing housing estate)
- the sewered Perumnas area (new development area)
- a non sewered district

As the research is aimed to describe certain magnitudes a survey approach is chosen.

Water supply is incorporated in this analysis as the water use is a very important factor in the choice of the sanitation system (§ 2.2). The Babakan Ujung area, where a rudimentary sewerage system has been constructed, is not incorporated in the survey as no differences between the past and the actual situation have been observed regarding sanitation (§ 2.5.5). Also questions with respect to the treatment plant in Sukasari are not included in the survey as explained in paragraph 1.2.3.

As pointed out before, the present situation in Sukasari (i.e. no proper functioning, benefits not full experienced) may affect the satisfaction with the sewerage systems (§ 2.5.1.1 + § 2.5.5).

In paragraph 5.2 the methodology of the survey has been described.
The main part of this analysis describes the results of the survey; the report contents follow the various modules which constitute the survey questionaire :
- paragraph 5.3 : socio-economic characteristics of survey area
- paragraph 5.4 : water supply
- paragraph 5.5 : drainage (this part is included as waste water is usually discharged to the drainage)
- paragraph 5.6 : sanitary facilities

Many of the tables, presented in paragraphs 5.3 - 5.6, are print-outs from the data processing programme developed. In these tables the second coulumn "Nr in Sample" presents the total number of households surveyed in that particular desa. The third column "Nr in Selection" indicates the number of households selected for that particular subject as referred to in the table heading. Part of tables are included in the main text. The other (tables 5.25 -5.64) are presented in annex 6.

Detailed analyses of the survey results per survey group are not always worthwile or possible: sometimes relevant numbers are too small; this depends on the kind of variable and the numbers of values of each variable.

5.2 Socio-Economic Survey

5.2.1 Objectives and Relevance

The objectives of the survey are to evaluate the following issues, mentioned in the eloborated problem definition :

- Is the potential amount of waste water sufficient to operate the communal sewerage system ?
- Are the households willing to cooperate in sewerage projects ?
- Do the users accept and properly use the sewerage facilities ?
- Are the households willing to pay for sewerage ?

The results of the survey can be used in the project :
- to formulate solutions to get the functioning and utilization of implemented pilot facilities according to its design
- to find possible constraints which can prevent problems in a later stage of the project (e.g. recovery of operation and maintenance costs)

The results of the survey can also be used :
- in developing a methodology for introduction of this technology in other places
- to assess the social feasibility for further implementation of the chosen technology in other places

5.2.2 Survey Groups and Survey Area

The socio-economic survey covers the following groups :
1 households in the areas sewered by the Botabek Project (in Sukasari) with a house connection (toilet connection) to the sewerage system
2 households in the sewered area of Sukasari which have not been connected to the sewerage system
3 households in the areas sewered by the Perumnas Project (new development area) with a house connection to the sewerage system
4 households in the non sewered desa Sukarasa

Households of survey groups 1 + 3 use at present sewerage facilities, while households in survey groups 2 + 4 use on-site sanitation facilities.

If an area will be sewered, 100 % coverage is required from the point of view of public health (§ 2.5.4). Survey group 2 is incorporated in the survey to find out why these respondents have not been connected to the sewerage system. This information can be used to formulate interventions.

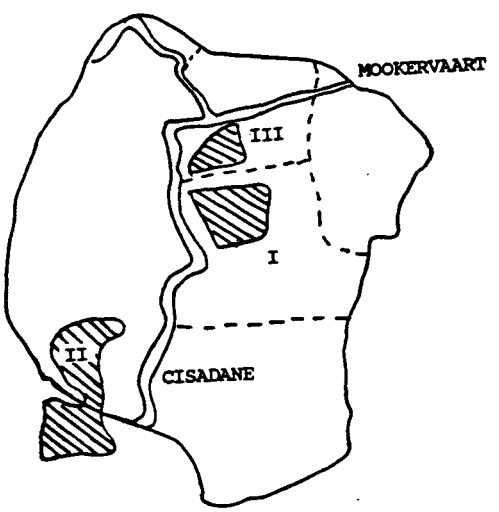
Survey group 3 is incorporated in the survey to evaluate the impact of the starting point of sewerage projects on utilization and functioning; in the Perumnas project sewerage and piped water have been included in the construction of the dwellings, while in Sukasari sewers are constructed in an existing area. Another difference is that in the (largest part of) Perumnas area no wastewater is seen in the road-side drains as nearly all households have been connected.

Survey group 4 is incorporated in the survey as reference area for the sewered areas in Sukasari; the situation in the non sewered area Sukarasa is assumed to represent the situation in Sukasari before the project. In the survey of this group special attention is given to satisfaction with on-site sanitation and felt need for improvement of sanitation.
The applied procedure to select the non sewered area is described in annex 4.

The survey area covers the total of sewered areas in Tangerang (220 ha, 160 ha in the Perumnas area and 60 ha in the desa Sukasari) and a non sewered area of 25 ha in the desa Sukarasa (in Tangerang).

In fig. 5.1 the survey area is shown. In fig. 5.2 the data on survey area, survey groups and objectives are summarized.

FIG 5.1 : CITY OF TANGERANG, SURVEY AREAS



Note : I = Sukasari, II = PERUMNAS area, III= Sukarasa, --- = Boundaries desa

FIG 5.2 : SURVEY AREA, SURVEY GROUPS AND OBJECTIVES

Item	Survey Area (in Tangerang)			
Sanitary conditions	Sewered			Not sewered
Desa/Area	Sukasari		Perumnas	Sukarasa
No location on figure 5.2	I		II	III
Status area	Existing		New	Existing
Survey group	1 Sewer conn	2 On site san/ No sewer conn	3 Sewer conn	4 On site san/ No sewer con
Objectives	Present functioning, utilization, appreciation sewerage and willingness to pay for it	Reasons not connected to the sewer + (see 4)	(see 1)	Present functioning, appreciation on site san + interest in sewerage conn

The survey area covers parts of the desa Sukasari and the nearest desa Sukarasa and the total (of the urbanized part) of Karawaci baru and Cibodas Sari (both in Perumnas project area). All these desa's are located in the town of Tangerang, except the desa Cibodas Sari which is just outside the city of Tangerang.

Table 5.1 includes population data about the desa's in which the survey have been carried out. In table 5.2 the survey groups, the size of the survey areas, the survey population and the households surveyed are presented.

TABLE 5.1 : CHARACTERISTICS OF DESA'S

Desa	Area (ha)	People (1987)
Sukasari	285	31,165
Karawaci Baru	105	14,865
Cibodas Sari *	97	30,007
Sukarasa	144	12,359
City (Kecamatan) Tangerang	3,250	142,407

Note : The data of Kantor Statistik Tangerang also include the unurbanized areas.
Sources : Kantor Statistik Tangerang, Kelurahan Cibodas Sari (*)

TABLE 5.2 : SURVEY GROUPS, SIZE OF SURVEY AREA, SURVEY POPULATION AND HOUSEHOLDS SURVEYED

Survey group	Survey area (ha)	Survey population			Sample size	
		DWU	HH	People	HH	percentage
1 : Sukasari with SEW		1,300	1,508	9,651	88	6
2 : Sukasari no SEW		500	585	3,861	35	6
1+2: (see above)	60	1,800	2,093	13,512		
3 : Perumnas with SEW	160	7,000	7,000	41,300	77	1
4 : Sukarasa/ not SEWRD	25	600	636	4,325	52	9
Total	245	9,400	9,729	59,137	252	3

Note : HH=Households, DWU = Dwelling Unit, SEW = Houseconnection with Sewerage, not SEWRD = not Sewered
Based on: Contractor's registration, Perumnas statistik and survey data

5.2.3 Methodology

The questionnaire has been designed on the basis of theoretical models which are the result of a literature study [52] and field observations. These models describe possible relations between the variable to be investigated. In fig. 5.3 the model for sewerage facilities is presented*. The principal variables in this model are the appreciation of sewerage facilities and the willingness and ability to pay for it. Appreciation (acceptance) may be the result of the functioning of the system, its costs, the perceived benefits and the technological (dis)likes (for example convenience, status etc..). High appreciation is expected in case of a proper functioning of the system (no operating problems experienced), low costs (to be paid), awareness of benefits and many technological likes.
The ability to pay is determined by current expenditures and household income (see § 4.2).
The willingness to pay is mainly determined by the ability to pay as well as by the individual priority setting on expenditures. This priority setting again depends on the perception of needs for improvement. Appreciation of the facilities is also required for willingness to pay.
The willingness to pay may further be influenced by the the costs of alternatives (on-site sanitation systems), financing arrangements and expectations and beliefs (for example the government should pay).

Basically the survey was intented to find answers to a number of questions regarding the functioning, appreciation and costs of / or willingness to pay for water sources and sanitation facilities.
Besides it had to find relations between these variables (possible relations are described in the theoretical models), so that results can be comprehended. For this reason also the current expenditures for urban services, the income and felt needs for improvement of urban services were analysed.
In annex 4 a detailed description of the design of the questionnaire is presented. A sample questionnaire for the community survey is included in annex 5 of this report.

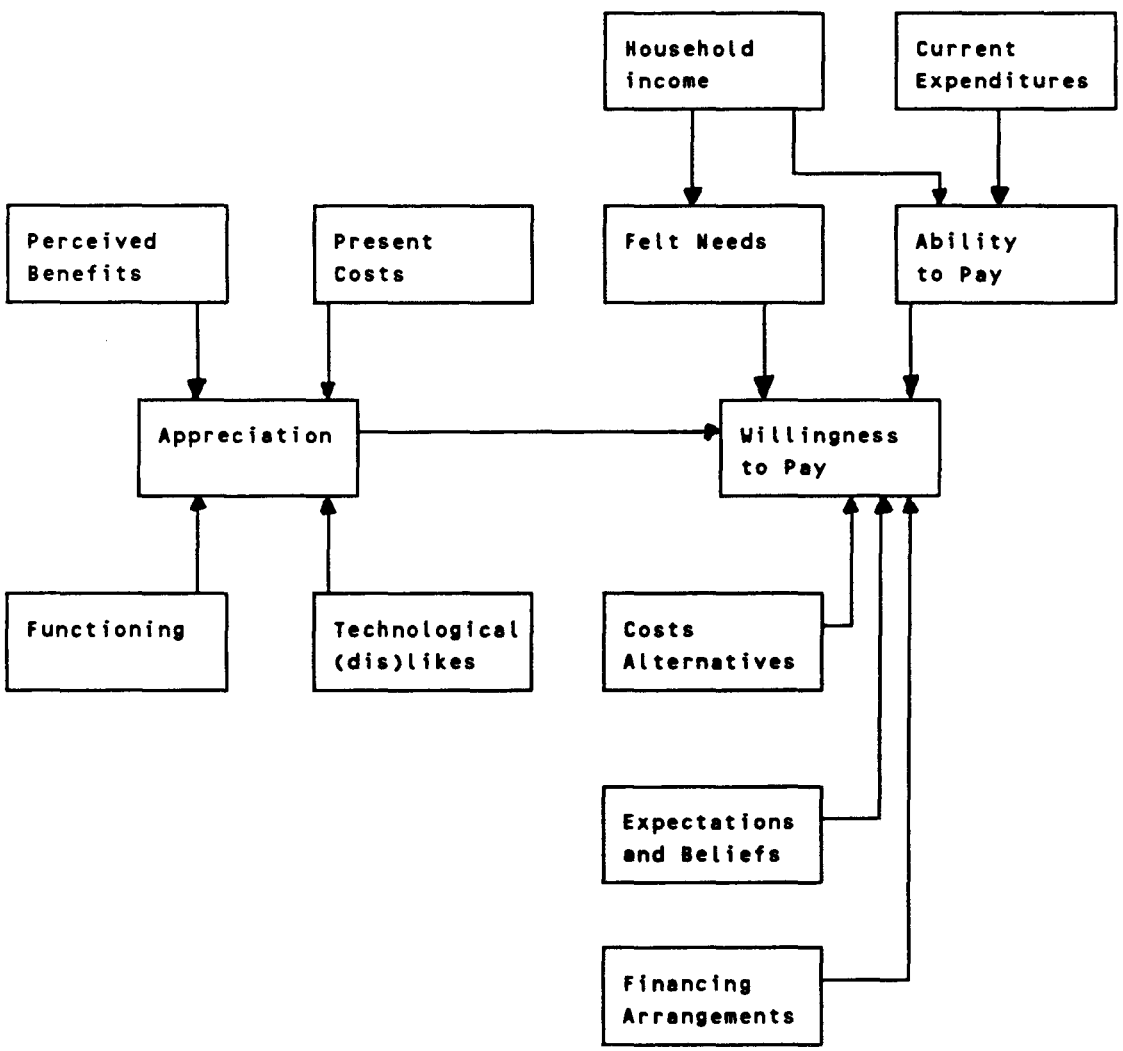
In the community survey data were gathered by personal interviews of randomly selected households by surveyors on the basis of the questionnaire. 252 households were interviewed. In table 5.2 the sample size per survey group is presented.
The selection of the sample size and the procedure to select the households are described in annex 4.

* A similar model has been used for piped water facilities and on-site sanitation systems.

In addition to the community survey some short interviews with local neighbourhood officials (of the kelurahans Sukasari, Karawaci Baru and Cibodas Sari) on the basis of parts of the questionnaire have been held.

Full support was received from the local government, the PDAM, the kelurahans, and also the selected households were in general very cooperative. This contributes considerably to the results of the survey.

FIGURE 5.3 : THEORETICAL MODEL OF FACTORS AFFECTING WILLINGNESS TO PAY



5.3 Socio-Economic Characteristics of the Survey Area

Reporting of survey results of this module concentrate on selected items:

- household composition & housing
- economic activities
- household income
- total expenditures on urban services
- ownership of modern appliances
- felt needs by households

5.3.1 Household Characteristics and Housing

Like in many other urban areas in Indonesia, there is sometimes more than one household living in one house. The survey reveals an average of 1.1 households per dwelling unit in the survey area. The situation is slightly different per survey area; The Perumnas area has only one family per house (cf. Table 5.25).

The average household size in the survey-area is 6.4 persons. the situation is not very different per survey-area (cf. Table 5.25).

Most households outside the Perumnas area report that they have been living more than 20 years in their house. The Perumnas project was completed end 1981; on the average, households report living there 7.2 years.

The median size of the dwelling in the survey area is 84 m^2. The situation is slightly different per survey-area :
- Sukasari : 84 m^2
- Sukarasa : 110 m^2
- Perumnas area : 73 m^2

5.3.2 Occupations

The structure of occupations of the family heads is as follows:

- total sample: (heads of) households: 252 100 %
- economically employed: 200 80 %
- unemployed: 21 8 %
- pensioned: 31 12 %

According to the survey results, none of the family heads in the Perumnas project area seems to be unemployed.

The economic activities (ISIC-code) of the family heads are shown in Table 5.3. Economic sectors with relatively high shares of employment are:

- industry: 15 %
- trade: 38 %
- public administration, defence: 27 %
- private services: 12 %

Important differences in the average composition are found in the Perumnas area: 44 % of the head of households work in the government sector (often government officials have a first claim to obtain Perumnas dwellings). On the other hand, people residing in the Sukasari area find their employment relatively more (50 to 54 %) in trade activities (the commercial centers of the city of Tangerang are located in Sukasari and Sukarasa).

The survey reveals an average of 1.3 employed per household.

TABLE 5.3 : ECONOMIC ACTIVITY HEAD OF THE HOUSEHOLD (ISIC-CLASS.)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PRESENT OCCUPATION HEAD OF FAMILY AGRI-CULTURE	MINING / EXCAV.	INDUSTRY	CON-STRUCT.	TRADE	TRANSP./ COMM.	GOVM'T/ DEFENCE	SERVICES
SUKASARI WITH SEW	88	61 69 %	0 0 %	1 2 %	11 18 %	3 5 %	33 54 %	1 2 %	9 15 %	3 5 %
SUKASARI NO SEW.	35	30 86 %	0 0 %	0 0 %	2 7 %	1 3 %	15 50 %	1 3 %	8 27 %	3 10 %
PERUMNAS WITH SEW	77	72 94 %	1 1 %	0 0 %	10 14 %	3 4 %	9 13 %	5 7 %	32 44 %	12 17 %
SUKARASA/ NOT SEWRD	52	37 71 %	0 0 %	0 0 %	6 16 %	2 5 %	18 49 %	1 3 %	5 14 %	5 14 %
TOTAL HOUSEHOLDS	252	200 79 %	1 1 %	1 1 %	29 15 %	9 5 %	75 38 %	8 4 %	54 27 %	23 12 %

5.3.3 Household Income

In the survey separate data were collected on income of the head of the family and on income of the other household members. The data processing programme allows for calculations of the total monthly household income (cf. Table 5.4). Figure 5.4 shows the total household income distribution of the different survey groups.

The average monthly total household income (mean) of the survey-area is Rp. 213,000- , the median about Rp.176,000-. Main characteristics of the income distribution are:

- 25 % of HH have monthly incomes lower than Rp.95,000-,
- 50 % of HH earn monthly incomes between Rp.95,000 and Rp.350,000-,
- 25 % of HH earn monthly incomes higher than Rp. 350,000-,

There are relatively important differences in total household monthly income level per survey-group (cf. Table 5.4 or fig.5.4).

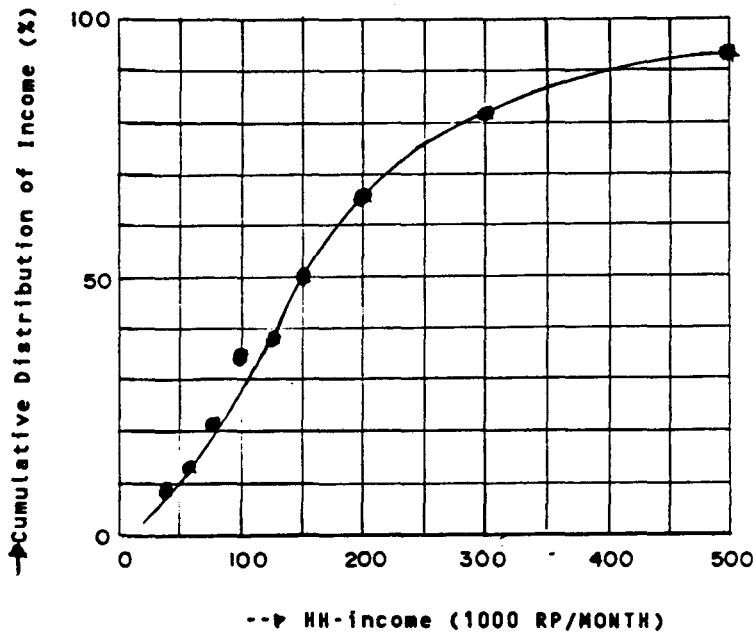
survey group:	median*:	mean:
1 Sukasari with Sew :	Rp. 150,000	Rp. 200,000-
2 Sukasari no Sew :	Rp. 210,000	Rp. 241,000-
3 Perumnas with Sew :	Rp. 150,000	Rp. 171,000-
4 Sukarasa/not Sewrd:	Rp. 240,000	Rp. 277,000-

The average household income of survey group 2 + 4 are significantly higher than those of survey group 1 + 3.
It is seen that in Sukasari households without a sewerage connection tend to have a higher income than households connected to the sewerage system. This might indicate that high income groups are averse to connection. This subject is returned to in paragraph 5.6.2.1.

* The median income can easily be read off the distributions in fig. 5.4 (at f=50 %)

FIGURE 5.4 : HH-INCOME DISTRIBUTION OF SURVEY-GROUPS (FEB. 1989):

SURVEY GROUP 1 :
SUKASARI WITH SEW



SURVEY GROUP 2 :
SUKASARI NO SEW

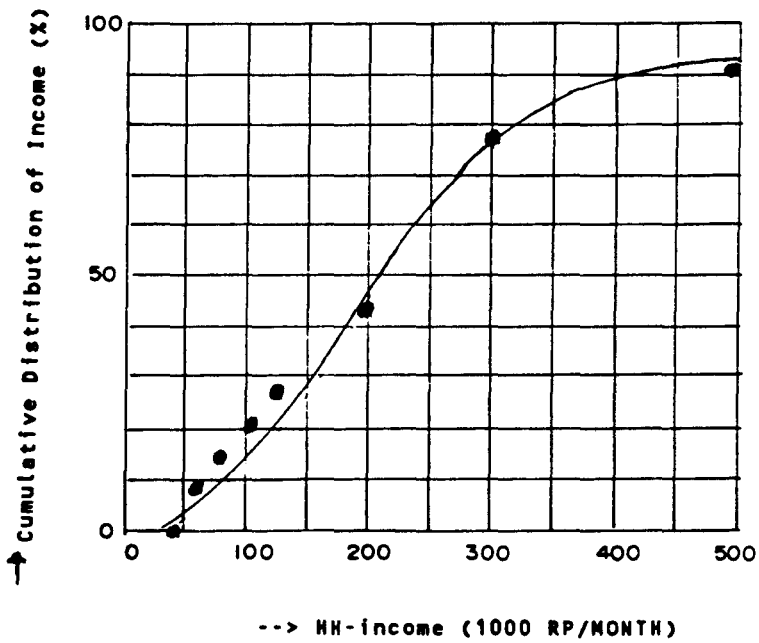
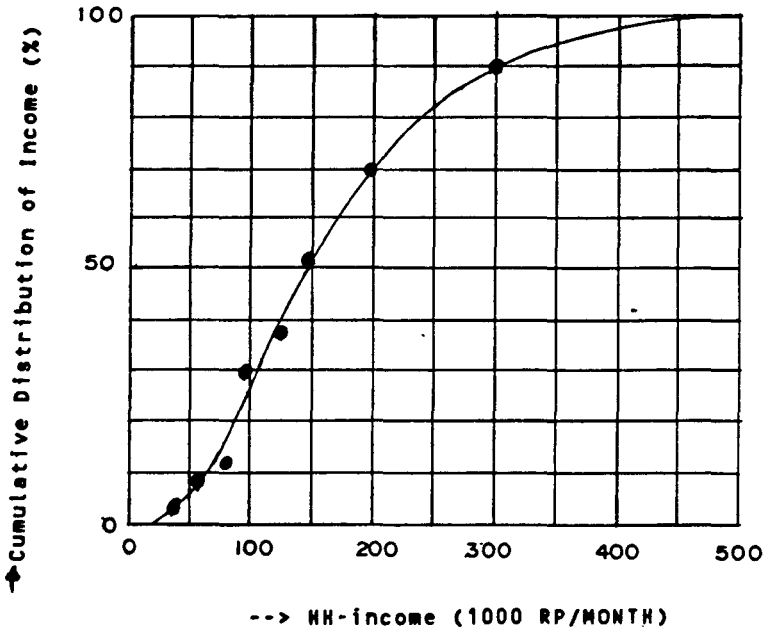


FIGURE 5.4 : (CONTINUED)

SURVEY GROUP 3 :
PERUMNAS WITH SEW



SURVEY GROUP 4 :
SUKARASA/NOT SEWERED

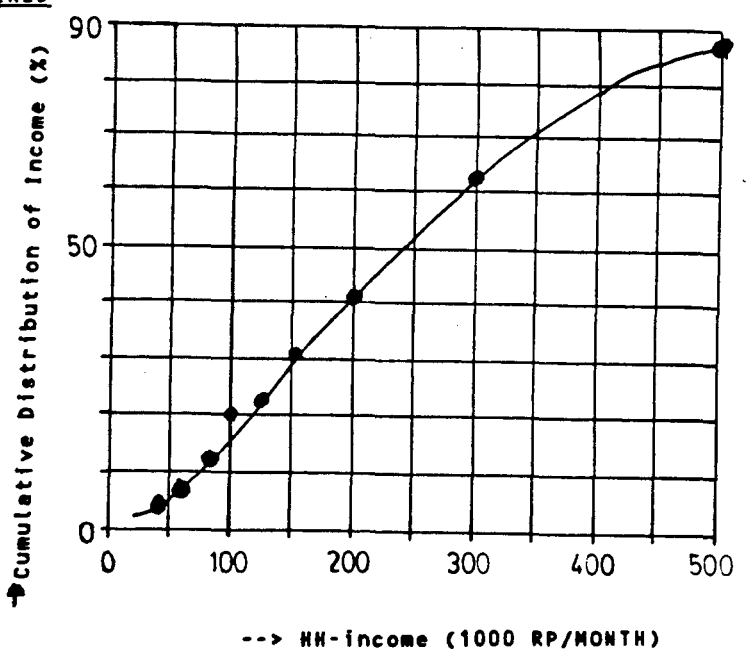


TABLE 5.4 : NUMBER OF HOUSEHOLDS per INCOME CATEGORY and SURVEY GROUP

Survey group	Income Class (Rp.1000/month)									
	Total		≤100		101-200		201-500		>500	
Sukasari with Sew	87	100%	30	34%	24	27%	26	30%	7	8%
Sukasari no Sew	35	100%	7	20%	8	23%	17	49%	3	9%
Perumnas with Sew	77	100%	22	29%	32	42%	23	30%	0	0%
Sukarasa/not Sewrd	52	100%	10	19%	11	21%	24	46%	7	13%
Total households	251	100%	69	27%	75	30%	90	36%	17	7%

5.3.4 Typology of the Survey Area

Some characteristics of the survey area have been compared with other sources to develop a typology of the survey area. The results are shown in table 5.5.

TABLE 5.5 : THE SURVEY AREA COMPARED WITH URBAN INDONESIA

Item	Survey area [a]	Tangerang City [b]	Urban Indonesia [c]
DEMOGRAPHIC :			
Average household size	6.4	5.0	4.8
Employed as % of population	20	23	
Employed per household	1.28	1.14	
HOUSING :			
Median size of dwelling (m^2)	84		50
Water piped into dwelling (% of HH)	73		29
Electricity connection (% of HH)	98		64
INCOME :			
Median HH-income (1000 Rp/month)	176		150

Sources : a) Survey results
b) Kantor Statistik, Provinsi Jawa Barat, Sensus Ekonomi 1986, seri A (1986)
c) The Urban Institute, Housing Policy Studies Project, Final Report (Draft), March 1989

The survey area is distinguished from urban Indonesia by a
- larger household size
- larger size of the dwellings
- larger proportion of households serviced by piped water and electricity

The larger household size in the survey area is likely to be explained by the limited migration; (outside the Perumnas area) respondents in the survey area have been living on the average 21 years in their dwelling.

In the urbanized residential areas of small cities (0.1-0.5 million inhabitants) like Tangerang only 15 % of the population is accomodated in very high densely populated areas (300-500 inhabitants/ha), while in the larger cities (≥ 0.5 million inhabitants) about 55 % of the population is accomodated in these areas [7,p.48]. As a result more space is available for the dwellings in cities like Tangerang, so that the size of the dwellings tend to be higher.

Almost the whole of the survey area is supplied with piped water and electricity since 1980, in contrast to large parts in urban Indonesia which are still not supplied with these services. This may explain a larger proportion of households serviced by these facilities in the survey area.

It is obvious that the large proportion of households serviced with electricity and piped water affect the expenditure pattern.

5.3.5 Total expenditures on urban services

The average (median) monthly expenditures on urban services (including electricity) in the survey-area of Tangerang in 1988 amounts to Rp.20,000,- per household; data on these expenditures per survey-group vary considerably: in the Sukasari area expenditures are the same as the average, while households in the Perumnas area pay much less (Rp. 14,700), and households in the Sukasara area pay much more (Rp. 32,300). In Table 5.6 the expenditures data on urban services are summarized per category, and as a percentage of the monthly household income.

In table 5.7 + 5.8 data on urban services are differentiated into coverage and expenditures per user of these services. Expenditures in table 5.6 are with respect to all households, while figures in table 5.8 are with respect to the households serviced.

TABLE 5.6 : MONTHLY HOUSEHOLD INCOME and EXPENDITURES FOR URBAN SERVICES per SURVEY-GROUP

Items	Survey Groups				
	Total	Sukasari with Sew	Sukasari no Sew	Perumnas with Sew	Sukarasa/ not Sewrd
Total households	252	88	35	77	52
Total monthly income (Rp. 1000)	213	200	241	171	277
Tot. expenditures (Rp.1000)	186	170	205	162	234
as % of total income	87	85	85	95	84
Average Expenditures for Urban Services per Household : (Rp.1000)					
- water supply (PDAM)	3.9	2.7	2.9	4.4	6.1
- electricity	12.4	11.7	14.3	7.0	20.6
- solid waste	0.8	1.2	1.6	0	0.6
- pay to local governm.	1.7	1.8	2.2	0.9	2.2
- pay to RW/RT	1.2	1.2	1.1	1.2	1.6
- Sub-Total	20.0	18.6	22.1	13.5	31.1
% of income	9.4	9.3	9.2	7.9	11.2
Per service (%) :					
- water	1.8	1.4	1.2	2.6	2.2
- electricity	5.8	5.9	5.9	4.1	7.4
- solid waste +local taxes	1.7	1.5	1.4	1.2	1.4

Note : RT is a neigbourhood. Usually comprising 15 to 40 families
RW is an informal administrative division, in between a kelurahan and a RT, comprising up to 10 RT's

TABLE 5.7 : COVERAGE OF URBAN SERVICES PER SURVEY GROUP

Items	Percentage of households serviced (%)				
	Total	Sukasari with Sew	Sukasari no Sew	Perumnas with Sew	Sukarasa/ not Sewrd
Water supply (PDAM)	73	67	63	78	83
Electricity	98	95	100	100	100
Solid waste	85	72	94	95	85
Pay to local governm	94	95	97	90	94
Pay to RW/RT	70	53	54	96	69

TABLE 5.8 : AVERAGE PAYMENTS FOR URBAN SERVICES PER SERVICED HOUSEHOLD

Items	Percentage of households serviced (%)				
	Total	Sukasari with Sew	Sukasari no Sew	Perumnas with Sew	Sukarasa/ not Sewrd
Water supply (PDAM)	5,288	4,100	4,667	5,583	7,308
Electricity	12,649	12,264	14,314	6,959	20,581
Solid waste	1,701	1,767	1,772	864	1,682
Pay to local governm	1,784	1,929	2,287	951	2,357
Pay to RW/RT	1,782	2,284	1,942	1,199	2,239
Solid waste included in Rw/ Rt payments (% of total HH)	39	5	3	86	52

5.3.6 Ownership of Modern Appliances

The survey included a question on the possession of modern appliances and luxury items by households; results are grouped according to household income category and are presented in table 5.9.

Most households own a radio and television set (85 to 90%)*; almost one third of households owns a motorbike and about 20 percent has a car. Car ownership starts with households who have a monthly income as low as Rp. 175,000- (21% of this group); car ownership increases rapidly with incomes above Rp.500,000-: 65% of households within that group. The survey also reports that 22 percent of households are in the possession of a video recorder.

From an economic point of view, these survey results are interesting and intrigueing. One of the questions deals with affordability: how can households with relatively low incomes (Rp. 400,000- is only US$ 235 a month) afford to buy and to maintain such expensive items like a car (even a second hand car)** and a videorecorder ? On the other hand these survey results point to a strong tendency of "material consumerism" in the modern Indonesian urban society. The expenditures incurred for these items compete with necessities of daily life; as a result little or no money is left for other urban amenities like improved sanitation facilities (i.e. sewerage systems).

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* Television is an important medium for community education. Therefore,the extension of the electricity and television network gets a high priority in the Indonesian development plans.

** The annuity of a second hand car (financing period : 5 years, interest rate : 10 %, price : 5 million Rp) = 100,000 Rp/month. Monthly costs of petrol (350-400 Rp/l) are supposed to be 50,000 Rp/month.
Taken this into account, it is probable that many of the car owners with an income < 500,000 Rp/month understate their income. As a result the income distributions shift to higher values

TABLE 5.9 : HOUSEHOLDS and OWNERSHIP OF MODERN APPLIANCES in the SURVEY AREA

Income Class (Rp.1000/month)	Number of HH in income class	Number of households owning following items: TV		Motorbike		Car		Video	
≤ 60	23	19	83%	5	21%	1	4%	1	4%
61- 80	16	10	62%	4	25%	0	0%	0	0%
81-100	30	28	93%	7	23%	1	3%	1	3%
110-140	36	31	86%	9	25%	1	3%	7	19%
151-200	39	35	90%	9	23%	8	21%	14	36%
201-300	54	50	93%	22	44%	13	24%	10	18%
301-500	36	34	94%	13	36%	12	33%	13	36%
>500	17	16	94%	3	18%	11	65%	8	47%
Total households	251	223	89%	72	29%	47	19%	54	22%

Notes : Rough guidelines of some prices (in Jakarta) :
- new TV (20 inch) : Rp. 800,000 - Video (new) : Rp. 700,000
- Car (5 years old) : 5-10 mill Rp - Car (new) : 15-30 mill Rp
- Motorbike (new) : 2 million Rp

: Annuity of new TV (financing perod : 7 years, interest rate : 10 %) is about 12,500 Rp/month ≈ 6 % of average household income in survey area

5.3.7 Felt Needs

The survey includes questions related to priorities households set to improvement of the following urban services :
- water supply
- solid waste
- medical care
- wastewater disposal
- drainage

All these services are more or less related to health. For each of these services households were requested to indicate their first and second priority. The main findings on first services to be improved are summarized in table 5.10.

TABLE 5.10 : FELT NEEDS BY HOUSEHOLDS

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	FIRST PRIORITY IMPROVED SERVICES: WATER SUPPLY	SOLID WASTE	MEDICAL CARE	WATER DISPOSAL	DRAINAGE	DON'T KNOW
SUKASARI WITH SEW	88	88 100%	14 16 %	11 13 %	22 25 %	20 23 %	20 23 %	1 1 %
SUKASARI NO SEW.	35	35 100%	5 14 %	8 23 %	13 37 %	5 14 %	3 9 %	1 3 %
PERUMNAS WITH SEW	77	77 100%	13 17 %	18 23 %	22 29 %	14 18 %	8 10 %	2 3 %
SUKARASA/ NOT SEWRD	52	52 100%	8 15 %	14 27 %	10 19 %	7 13 %	11 21 %	2 4 %
TOTAL HOUSEHOLDS	252	252 100%	40 16 %	51 20 %	67 27 %	46 18 %	42 17 %	6 2 %

The relative priority of improving particular urban services are derived by comparing values of the services with each other. There is no pronounced preference for improvement of a specific service. Improvement of medical care (27 %) and solid waste (20 %) are most desired. Improvement of waste water disposal (i.e. prevention groundwater pollution and no waste water discharge to drains) in the areas Sukasari and Sukarasa is less required by the people relatively speaking.

The situation per survey group is not very different. Differences per income group are also not significant.

The majority (73 %) of households is willing to pay for improvements with first or second priority. This willingness to pay is not very different per income and survey group.

5.4 WATER SUPPLY

The survey module on water supply distinguishes between customers of PDAM and users of other water sources, like private wells. The questions on PDAM water supply concentrate on the following issues/ topics:

- the share of PDAM customers and other water users
- appreciation by customers
- use of water, use of boiled water
- cost of water supplied (PDAM)

and specifically for other water users, but potential PDAM customers:
- interest in becoming a PDAM customer through a house-connection

This chapter summarizes the main findings of the above mentioned questions.

4.1 PDAM-Customers and Other Water Users

The survey area is almost completely provided with the piped PDAM water supply system in the streets (cf. Table 5.11), but not all households have house-connections. An average of 73 percent of households are customers of the PDAM piped water supply system. The percentage is slightly different per survey group (67% to 83%).

The Perumnas area (Perumnas project) used to have a 100% PDAM connection; however, for different reasons (arrears in paying e.g.) 22 % of the households have been cut off during the past few years (Further research to the roots of this problem is proposed in case of a continuing decreasing percentage).

The survey results reveal that the percentage of serviced households is not very different per income group, in contrast to the situation in urban Indonesia (cf. Table 5.12). The difference may be explained by the fact that the survey area is almost completely provided with the piped PDAM water supply in the streets in contrast to large parts of urban Indonesia, where especially in low income areas the supply of piped water is poor (as a result the percentage of serviced households is low).

The total number of house connections in the survey area is estimated on 7,100. PDAM Tangerang supplies the town of Tangerang, Perumnas housing estate to the west and Serpong. According to information from PDAM records (Feb. 1988) it is indicated that the total number of house connections in the area

served is 15,600. So, the survey area covers 45 % of the total number of house connections.

TABLE 5.11 : PERCENTAGE OF PDAM CUSTOMERS IN THE SURVEY AREA

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PDAM CONNECTION / PIPED WATER IN STREET HAVE CONN.	NO CONN./ YES PIPE	NO CONN./ NO PIPE
SUKASARI WITH SEW	88	88 100%	59 67 %	26 30 %	3 3 %
SUKASARI NO SEW.	35	35 100%	22 63 %	12 34 %	1 3 %
PERUMNAS WITH SEW	77	77 100%	60 78 %	17 22 %	0 0 %
SUKARASA/ NOT SEWRD	52	52 100%	43 83 %	9 17 %	0 0 %
TOTAL HOUSEHOLDS	252	252 100%	184 73 %	64 25 %	4 2 %

TABLE 5.12 : PERCENTAGE PDAM CUSTOMERS BY INCOME CLASS IN SURVEY AREA AND URBAN INDONESIA

Household income (1000 Rp/month)	% of households serviced by piped water	
	Survey area	Urban Indonesia
- 100	70	15
101 - 200	75	21
> 200	74	52
Total	73	29

Sources : Survey Results
: The Urban Institute, Housing Policy Studies Project, Final Report (Draft), March 1989

5.4.2 Use of Water Sources

It was identified for PDAM customers what other kinds of water resources they have besides PDAM water supply. In Tangerang the situation is as follows:

- have shallow well with handpump/ bucket:	41 % of HH
- have shallow well with electric pump:	32 % of HH
- supply through water vendor:	0 % of HH
- use of river water:	0 % of HH
total	73 % of HH

The majority (73 % ,135 HH) of PDAM customers have easily access to other water sources of their own. Most PDAM customers (67 %, 123 HH) tend to continue to use these sources daily. The majority (99 HH) of PDAM customers using other water sources do this because these other sources are cheaper.

Usually, customers of PDAM use that water for more than one particular purpose. In the Tangerang survey area the situation is as follows:

- use for drinking:	84 % of households
- use for cooking:	83 % of households
- use for bathing:	63 % of households
- use for washing clothes:	46 % of households

Households seems to be aware of health aspects related to water as all users of wells (100 %) boil well water before use for drinking. This reduces infections via well water. An important fact is that most PDAM users (99%) do the same; They boil PDAM water before they use it for drinking.

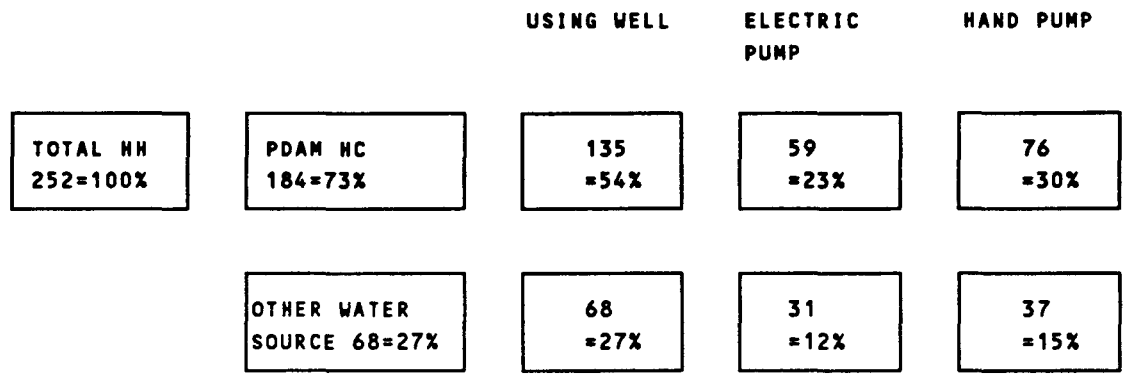
Non-PDAM customers use the following water resources:

- use of shallow well with handpump/ bucket:	51 % of HH
- use of shallow well with electric pump:	46 % of HH
- use of PDAM water through neighbours:	3 % of HH
- use of river water:	0 % of HH

Only 3 % (4 HH) of the Non-PDAM customers share their water source.

The socio-economic characteristics of the Non-PDAM customers are not different from PDAM-customers; The average HH-income of PDAM-customers is 219,000 Rp/month, while that of the Non-PDAM customers is 194,000 Rp/month.

FIGURE 5.5 : USED WATER SOURCES IN THE SURVEY AREA



5.4.3 Appreciation of PDAM Water

The survey also sounded the opinion of households with respect to the quantities and quality of water sources used. It must be realized that many PDAM customers (135 HH in the sample or 73 %) use at the same time other water sources, mainly shallow wells.

The situation in Tangerang reveals that customers of PDAM are, generally satisfied with the quantity and quality of water supplied by the PDAM (cf. Table 5.13).

TABLE 5.13: SUMMARY OF APPRECIATION OF PDAM WATER BY CUSTOMERS

Question	PDAM water/ customers
Water quantity enough ?	99 % of HH
(supply of PDAM customers: 81 % gets water during more than 18 hours per day; only 11 % gets a supply during less than 12 hours/day)	
Water quality good ?	
taste:	93 % of HH
smell:	56 % of HH
colour/clean:	95 % of HH
Main reason for taking PDAM-connection:	
PDAM water is healthier:	61 % of HH
PDAM water more convenient :	19 % of HH
PDAM water has better taste/smell/colour:	19 % of HH

5.4.4 Cost of Water Supplied (PDAM)

The median monthly expenditures for PDAM water (RP/household) are as follows :

- Sukasari with Sew : 4,100 Rp
- Sukasari no Sew : 4,667 Rp
- Perumnas with Sew : 5,583 Rp
- Sukarasa/not Sewrd : 7,308 Rp

- Total 5,288 Rp

The monthly median expenditures are related to the monthly household income; The relation is as follows :

HH-income (1000 Rp/month)	Waterbill (Rp/month)	% of income
- <100	3,700	5.4
- 100-200	6,000	4.1
- >200	6,500	1.8
- total	5,288	2.5

The median water use per capita is calculated on the basis of present PDAM tariff (dated February 1989) and the household size. The results are detailed for the water sources used and summarized in table 5.14.

TABLE 5.14 : USE OF PDAM WATER PER CAPITA IN SURVEY AREA

Watersource(s)	Median Water-bill (Rp/month)	HH-size	Wateruse (l/cap.day)
PDAM water only	6,700	6.0	118
PDAM + Well	4,750	6.5	79
Total HH	5,288	6.3	90

5.4.5 Additional Demand for Piped Water Supply

A minority (27 %, 68 HH) of surveyed households is non PDAM Customer. A minority of these non PDAM customers (3 HH, 1 % of total HH) is interested in becoming a PDAM-customer under present conditions. The interest is not very different for a longer financing period (5 years instead of 5 months) or for a cheaper connection fee (half of the present fee + slightly higher monthly payments). Obviously, the following factors are important to consider this limited interest :

- easily access to competing water sources of their own
- costs PDAM water (connection fee + monthly payments)

Further, it must be realized that PDAM facilities are already 8-10 years in the survey area and that the present coverage (73%) is high.

So, the expected growth of houseconnections in the survey area is small (1-3% of total HH) for the coming years.

5.4.6 Quantity of Waste Water

The waste water production has been estimated on the basis of the water use. The discharge ratio (i.e. water disposal to sewerage system/total amount of supplied water) is assumed to be 0.9 .

The assumed water use per water source is as follows:

- PDAM water (+well)	73 % of HH	120 l/cap.day (cf. Table 5.16)
- Well with elec pump	12 % of HH	120 l/cap.day
- Well with hand pump	15 % of HH	40 l/cap.day
- total		110 l/cap.day

So, the average wastewater production in the survey area is 100 l/cap.day. Future production of wastewater is expected to be slightly more.

The domestic water consumption in the survey area is considerable and equals the consumption in the Netherlands, which is 113 l/cap.day [56]*.

Although, the facilities in Sukasari are designed on a water use of 150 l/cap.day, the water use is in the survey areas would be sufficient (as limit a water use of 100 l/cap.day have been used) to operate sewerage and treatment facilities properly.

* In the Netherlands 25 % of the domestic water consumption is for flushing the toilet. In Indonesia, where pour-flush toilets are in use, this is only 5-10%.

5.5 DRAINAGE

The module on drainage concentrates on maintenance, functioning and appreciation of the drainage system.

This chapter summarizes the main findings of the above mentioned questions which are presented in table 5.15.

TABLE 5.15 : PERCEIVED PROBLEMS OF AND SATISFACTION WITH DRAINAGE

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	REGULAR FLOODS	SOLID WASTE	STAGNANT WASTEW.	REGULAR SMELL	CHILDREN PLAYING	SATISFIED DRAINS
SUKASARI WITH SEW	88	88 100%	13 15 %	16 18 %	29 33 %	15 17 %	5 6 %	76 86 %
SUKASARI NO SEW.	35	35 100%	7 20 %	13 37 %	17 49 %	4 11 %	3 9 %	27 77 %
PERUMNAS WITH SEW	77	77 100%	17 22 %	10 13 %	9 12 %	3 4 %	5 6 %	65 84 %
SUKARASA/ NOT SEWRD	52	52 100%	18 35 %	18 35 %	24 46 %	15 29 %	5 10 %	36 69 %
TOTAL HOUSEHOLDS	252	252 100%	55 22 %	57 23 %	79 31 %	37 15 %	18 7 %	204 81 %

In general people are satisfied with the functioning of the drainage system (81 %). Few problems are perceived; The most perceived problem by respondents is stagnant waste water in the drains (31 %). Other reported problems are : solid waste in drains (23 %), flooding (22 %), bad smell (15 %) and playing children in drains (7 %). Reported problems with regard to solid waste and stagnant waste water agree with the findings of the surveyors. *

* During the survey it was mainly (80-90 % of the time) dry. The weather conditions influence the field observations of the surveyors with respect to stagnant waste water.

It is obvious that these stagnant waste water problems are caused by the increased water use and the lack of maintenance of the drainage system.

There are important differences per sub-area; in the Perumnas area, where mainly all waste water is discharged to the sewerage system, 12 % of the households report stagnant waste water problems, while nearly half of the households (46 %) in the non sewered area Sukarasa report these problems.

The perceived problems partly relate to each other; the stagnant waste water in the drains of the desa's Sukasari and Sukarasa is partly caused by disposal of solid waste into the drains. In field visits of the consultants in these areas it was frequently noticed that drains were often filled with sand, leaves etc. causing stagnant waste water.

An improvement in waste water disposal (reduction of stagnant waste water problems) in non sewered areas in Tangerang, like Sukarasa, on short term, can be realized by a better, more regular (2-3 times/year) maintenance of the drains. Costs of this improvement are estimated on 300 Rp/HH.month (0,2 % of HH-income). At present the local government leaves often this task to people themselves; In the survey area 98 % of the households report that maintenance of the drains is done by the people living in the area.

5.6 SANITARY FACILITIES

The survey module on sanitary facilities distinguishes between users of (communal) sewerage facilities (survey groups 1 + 3) and users of on-site (indvidual) sanitation facilities like pits and septic tanks (survey groups 2 + 4).

The questions on sewerage facilities concentrate on the following issues/topics :
- utilization of facilities
- functioning and appreciation of the sewerage facilities
- construction of house connections (only for the Sukasari area)
- willingness to pay for the facilities

and specificially for households without a connection to the sewerage, but potential users :
- reasons for not having/wanting a house connection
- interest for a house connection to the sewerage

The questions on individual sanitation facilities concentrate on the following issues/topics :
- use of septic tanks/pits (or not ?)
- functioning and appreciation of these facilities
- maintenance aspects of septic tanks/pits, including costs
- construction aspects of septic tanks/pits, including costs

5.6.1 General : Type of Toilet

The results indicate that in the survey area the large majority of households (97 %) have a private WC. Other facilities in use are : shared WC (2%) and use of drains/kali + open fields (1%).

94 % of the households in the survey area use pour flush WC's, while the other 6 % use modern toilets with a rinsing tub above the WC (wateruse = ca. 10 liter per visit).

5.6.2 Sewerage Facilities

5.6.2.1 House Connection Construction in Sukasari

Construction by Households

During first phase implementation (1981/1982, see § 2.5.5) it was initially the intention that the households would construct the house connections by themselves (at their own costs). In 1985 (3 years later) less than 10 % of the households had been connected to the sewerage system.

Asking to the reasons for this was a bit confusing, as the majority (81 %) of households were not informed about the possibility of connection. So, this majority has probably never considered constructing a house connection. A minority (19 %) of the households applied for information about the system to the contractor (CV MURNI) and was in this way informed about the possibility to connect to the sewerage system in the street. Officials of the Kelurahan in Sukasari reported that in the period till 1985 no information was given by the Kelurahan/RW/RT (formal and informal community organizations) about the system itself and the possibility to connect.

It is seen that an important failure of the strategy was a poor information campaign. For communal sewerage projects to succeed in existing areas, information to the target group (about benefits, functioning, payments and costs) and communication with the target group are elements that never can be left out; especially in pilot projects. These elements are of special importance just before and during project implementation.

Construction of Toilet connections by Project

In the period 1985-1988 about 1300 out of 1800 dwellings were provided with a toilet connection to the sewer. The present coverage in the sewered areas is moderate (ca. 70 %), the more so as one take into account that the households in this area obtained the sewerage facilities free of costs; they only had to pay for repare of in-house damages. In the survey it was found out that the coverage is different per street, ranging from 40-95 %. In streets with a high coverage (e.g. Jalan Tegalsari III) advice of RT was an important factor for taking a house connection.

About 30 % of the dwellings have not been connected to the sewerage. In some selected streets the number of dwellings, yard connections and house connections were counted. It was found that in the sample more than 90 % of the households has a yard connection and that 63 % has a toilet connection. Thus, the possible problem to connect a dwelling to the communal sewer is the construction of the house connection (toilet connection).

Households with a yard connection but not connected yet with the sewerage were asked for the reason(s) for this. The reported reasons for not having/taking a toilet connection are as follows :

- already proper on-site sanitation system 17 HH 49 %
- inconvenience of building 16 HH 46 %
- uncertainty payments 10 HH 29 %
- uncertainty functioning 10 HH 29 %
- reparation costs 7 HH 20 %
- no information given 4 HH 11 %
- signed paper, but did not get connection 2 HH 6 %
- other reasons 6 HH 17 %

A small majority (57 %, 20 HH) of these households wants a house connection now. So, the additional demand for sewerage connections in the sewered areas is 285 out of the 500 households not connected yet. A minority (43% or representing 12% of dwellings in sewered areas) of the households wants no connection. Obviously, the principal reason for not wanting is the inconvenience of building and this might explain why especially high income groups, which have already a proper system, are averse to connection (§ 5.3.3).

Although, the starting point in an existing housing estate is not so favourable than in new development areas, 100 % coverage of sewerage provisions in Sukasari seems only feasible if :

- people are convinced of health benefits
- connection has no or little financial implications, but this seems still a long way off

5.6.2.2 Waste Water Disposal to Sewerage

In table 5.16 the main findings with regard to water discharge to the sewerage system are summarised per area. Waste water not discharged to the sewerage system goes directly to the drainage system.

TABLE 5.16 : WASTE WATER DISCHARGED TO SEWERAGE SYSTEMS

	Sukasari	Perumnas area
number of households	88	77
wastewater going to sewer (%) :		
- from toilet	100	100
- from bathing	16	92
- from cooking	16	83
- from washing up	16	87
- from clothes washing	17	87
rainwaterconnections (%)	8	6

In the Perumnas area the percentage of water discharge from kitchen and bathroom used to be 95 %. No disconnections of toilet were reported in this area. Reasons for disconnecting wastewater from bathing,cooking and washing will be discussed later on.

In Sukasari a minority of households (16 %) have also connected bathroom and kitchen with the sewerage system. Part of the households have made these connections with the help of the contractor.

The majority (72 %) of respondents in Sukasari (without connections to bathroom and kitchen at present) were not informed about the possibility to connect sullage water. Also, in this case the majority of households never considered making these connections. 50 % of the respondents had the opinion that this was not allowed/possible.

The sewerage systems in Sukasari and in the Perumnas area are seperate systems (only designed for the transport of waste water) A minority (6-8 %) of the households in the survey area constructed rainwater connections (discharging rainwater from the plot) to the sewerage.*

* In case of many rainwater connections problems like WC overflow arise in rainy situations

5.6.2.3 Functioning

The main findings with regard to functioning are summarized in table 5.17. It is seen that in general the majority of the households are satisfied with the functioning of the sewerage system.

TABLE 5.17 : FUNCTIONING OF SEWERAGE IN SURVEY AREA

ITEM	Sukasari		Perumnas area					
			low situated		high situated		total	
number of households	88	100%	64	100%	13	100%	77	100%
reported problems (%) :								
- overflow WC	3	3%	1	2%	7	54%	8	10%
- blockages/difficulties discharging to sewer	4	5%	4	6%	6	46%	10	13%
- overflow inspection pits	1	1%	6	9%	9	69%	15	19%
households which reported no problems	81	92%	55	86%	1	8%	56	73%
households satisfied with functioning	86	98%					66	86%

Note : if blocakages occur, the waste water will flow out the sewerage system via the inspection pits and find its way into the drainage system.

Although not being properly used (not all waste water discharged to the sewerage system), till date no major problems have been reported in the Sukasari area regarding the functioning of the sewerage. Besides no disconnections are known. People in Sukasari are satisfied with the functioning of the sewerage system, although full benefits are not yet experienced.
As stressed above, in the future all waste water should be discharged to the sewerage system.

In the Perumnas area more problems are reported. It was found that reported problems nearly all came from respondents living in the low situated areas (Jalan Tenggire VII, W.Kusuma I + II, Kentang II) near the treatment facilities (cf. Table 5.17).

In the low situated areas the majority of households reported problems such as overflow of WC and overflow of manholes in the street (86 respectively 67 %). These problems especially occur in rainy situations*. The majority of households (62 %) in these areas reported to have "solved" these problems by disconnecting the sullage water (i.e. discharge of sullage to drainage) and by connecting the manholes in the street with the drainage. In jalan Kentang II households raised up their toilets; no more problems with overflow of WC were experienced, but in its place, overflow of manholes in the street.

As illustrated households "solve" these problems on their own, but their solutions are incomplete. As a result sanitary conditions in these areas detoriate (in and after rainy conditions septic water + excreta flow over into the street).

The problems experienced in rainy conditions are due to a principal mistake in the design (pumping stations were omitted), so that a reverse flow from river (via the treatment facilities) to the sewerage system might occur in rainy situations (as the water level in the river increases). It is obvious that these problems are especially experienced in low situated areas.

Above problems can be prevented by installation of pumping stations between the sewerage systems and the treatment facilities **.

The objectives of operation and maintenance of sewerage systems are parallel to the construction of these systems (see § 6.3). During the first two years (1981-1983) after implementation O&M of the sewerage system in the Perumnas area was done by Perumnas. After that ad hoc maintenance (e.g. replacing manhole when broken, cleaning clogged pipes) was executed by the people themselves or by RT. As illustrated above households can't be trusted with this taks by a lack of knowledge (Besides one has to realize that the objectives of O&M serves public health).

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* In these conditions, wastewater will flow out the sewerage system either via the WC's or via the manholes. The outflow will be in the lowest situated locations.

** For economical reasons pumping stations were omitted in the design and much treatment locations were chosen to keep the sewerage system as shallow as possible. Possibly it was not realized that pumping stations are necessary in the system. By implementation of pumping stations less (than in the Perumnas area) locations of treatment facilities should be applied. Reasons for this are easier management and less investments of communal sanitation facilities.

Concluding, the following improvements are required for a proper functioning of the sewerage facilities :
- Sukasari : - higher coverage (from 70 % to 100 %)
  - connecting bathrooms and kitchens from every dwelling to the sewerage sytem
- Perumnas area:- prevention of reverse flow from river to sewerage system in low situated areas

This is still not enough; organizations have to be setup / strengthened also to continue a proper functioning of the systems in Sukasari and the Perumnas area.

5.6.2.4 Appreciation of Sewerage

One aspect of appreciation (i.e. functioning) has already been discussed in the preceding paragraph. In table 5.18 also the other aspects of appreciation are summarized.

TABLE 5.18 : APPRECIATION OF SEWERAGE FACILITIES

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	MORE CONVEN.	SEWERAGE HEALTHIER	IS MODERN
SUKASARI WITH SEW	88	88 100%	69 78 %	88 100%	87 99 %
SUKASARI NO SEW.	35	35 100%	23 66 %	30 86 %	30 86 %
PERUMNAS WITH SEW	77	77 100%	58 75 %	71 92 %	64 83 %
SUKARASA/ NOT SEWRD	52	24 46 %	18 75 %	22 92 %	23 96 %
TOTAL HOUSEHOLDS	252	224 89 %	168 75 %	211 94 %	204 91 %

The majority of households in the survey area have the opinion that sewerage is more convenient, healthier and modern. The opinions of the households in Sukasari without a house connection are not very different from those with a house connection. In Sukarasa, 46 % of the households know the sewerage system. Their opinions about the system are also not very different from the rest.

The large majority (93%) of households in Sukasari with a house connection to the sewer prefer this system compared with their previous on-site sanitation system. Households were asked to state their most important reason for this. Results are as follows :

- more convenient : 49 % of HH
- healthier : 46 % of HH
- other reason : 5 % of HH

The most important reason to prefer the sewerage system is convenience (49 % of HH)*. In contrast, the large majority (93 %) of households using on-site sanitation facilities indicates their satisfaction with their present system for reasons of convenience (cf. Paragraph 5.6.3.5). These results indicate a weak preference for sewerage systems (see § 5.6.4). In general, improving of sanitary conditions is the most important reason to implement sewerage systems. The households in Sukasari are not fully aware of this. Only 46 % of households indicate that they prefer the sewerage system because it is healthier. It is proposed to stress health benefits in campaigns of planned sewerage projects.

Further, it appeared that the majority of households have no idea at all about investment and operation and maintenance costs of sewerage systems.

5.6.2.5 Willingness to Pay

Willingness to Pay for Investments

After explaining about benefits of connecting the sullage households (in Sukasari with a toilet connection but without connections with bathroom and kitchen) were asked if they would make these connections at their own costs (These additional connections cost about 125,000 Rp/HH).

* In case of a proper functioning (no problems), sewerage systems are more convenient than on-site sanitation systems, which have to be emptied. However, the preference with respect to this item may be low as the practiced frequency of emptying of on-site sanitation systems is very low (see § 5.6.3.2)

At present the willingness to finance the investment of additional connections is insufficient to cover the costs. A minority (7% or 5 HH out of 74 HH) of households is willing to pay for these sullage connections if it cost Rp 100,000, while 27 % is willing to pay for this if this amount can be paid in three yearly instalments of Rp 35,000.

The reported reasons for this limited willingness are :
- cost of connection : 89 % of HH
- already have proper system : 31 % of HH

It is seen that the interest for a connection decrease as households are informed about the real costs of it.

Willingness to Pay for Monthly Contribution

The majority (92%) of households has the opinion that it is reasonable to pay a monthly contribution (among other things for proper operation and maintenance of communal sanitation facilities).

The main findings with respect to willingness to pay monthly for sewerage systems are summarized in table 5.19. In table 5.20 it is seen that the willingness to pay is related to the household income.

TABLE 5.19 : WILLINGNESS TO PAY MONTHLY FOR SEWERAGE

Item	Sukasari	Perumnas Area	Total
number of households	88	77	165
Willing to pay 3000 Rp/month (% of HH)	27	13	21
Willing to pay 1500 Rp/month (% of HH)	67	51	59
Median contribution			
in Rp/month.HH	2,300	1,500	1,800
% of HH-income	1.2	0.9	1.0

TABLE 5.20 : WILLINGNESS TO PAY FOR SEWERAGE RELATED TO HH-INCOME

Item	Income Class (1000 Rp/Month)			
	≤100	101-200	>200	Total
households				
number	52	56	56	164
percentage (%)	32	34	34	100
Willing to pay 3000 Rp/month (% of HH)	12	14	27	21
Willing to pay 1500 Rp/month (% of HH)	47	57	75	59
Median contribution				
in Rp/month.HH	1,400	1,800	2,700	1,800
% of HH-income	2.0	1.2	0.8	1.0

Note : In Sukasari 1,650 Rp/HH.month is required for recovery of O&M costs, while in the Perumnas area about 1,100 Rp/HH.month is required (in the Perumnas area another type of treatment is applied)

Median contributions in Sukasari as well as Perumnas area are sufficient to cover calculated O&M costs (see table 4.3). Thus, recovery of O&M costs, an essential condition for successful continuation of implemented works is feasible in Sukasari as well as the Perumanas area.

At present the willingness to finance investment cost of a house connection is insufficient to cover the costs (cf. Table 4.3). However,besides O&M costs, investments costs of the house connection in existing areas might be recovered via the monthly contribution. For this a monthly contribution of 4,150 Rp/HH.month is required (cf. Table 4.3, recovery in 20 years). The monthly contribution which the people are willing to pay is insufficient to cover also the investment costs of the house connections in existing areas.

Reported reasons why they don't want to pay more are summarized in table 5.21. Main reasons for this are the two linked reasons inaffordability (63 %) and greater concern for other things (90 %) of which last already have been discussed in paragraph 5.3.6.

TABLE 5.24 : REASONS FOR NOT WILLING TO PAY MORE FOR SEWERAGE

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	CAN'T AFFORD	NOT SATISFIED	BUY OTHER THINGS	PIT/TANK CHEAPER	GOVM'T MUST PAY	OTHER REASON
SUKASARI WITH SEW	88	64 73 %	46 72 %	1 2 %	56 88 %	5 8 %	8 13 %	1 2 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	67 87 %	36 54 %	6 9 %	62 93 %	3 4 %	16 24 %	8 12 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	131 52 %	82 63 %	7 5 %	118 90 %	8 6 %	24 18 %	9 7 %

Besides the community survey, officials of the kelurahans in Karawaci Baru + Cibodas Sari (Perumnas project area) and of the kelurahan in Sukasari were interviewed. They also have the opinion that a monthly contribution for O&M of 1,500 - 2,000 Rp is reasonable. (in case that all waste water is discharged to the sewerage system). They assess contributions more than 2,000 Rp/month not feasible for the same reasons as mentioned by the respondents.

5.6.3 On-Site Sanition Systems

In this paragraph the main findings of interviews with households, using on-site sanition systems are summarized.

If not mentioned else, all percentages calculated referring to the number of surveyed households, which use on-site sanitation systems.

5.6.3.1 Type of Systems + Wastewater Disposal

The majority (99%) of the randomly selected households in the surveyed area has access to a (private) on-site sanitation system. This is far more than the average for urban Indonesia (see p. 17). 1 % of the households discharge their toiletwater directly to the drain/kali.

The type of system could be identified with the help of some supporting questions and the presented figures in annex 5.

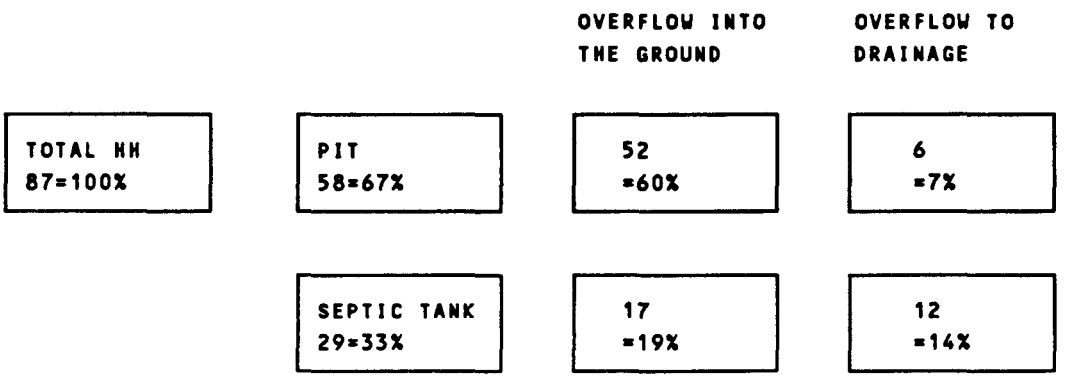
The majority of households, reported that the outflow of their toilets is discharged to a pit (67 %, 58 HH). In 33 % (29 HH) of the cases it is discharged to a septic tank. These figures correspond well with information of households of survey group 1 (with a house connection to the sewerage in Sukasari). The majority (74 %) of these households discharged their toilet water to a pit before they were connected to the sewer, while 24 % discharged it to a septic tank.

The used on-site sanitation system per desa is not very different.

A small majority (17 HH) of households who have septic tanks use a sub-surface disposal system. Via this system the water leaches into the ground. In 14 % (12 HH) of the cases a septic tank with outflow to the drains is used. A small minority (6 HH) of the households which use pits, have constructed an overflow to the drainage system. So, ultimately the majority (79 %) of the households discharge their toilet water into the ground, which causes groundwater pollution.

The majority of households (99 %) discharge their waste water from kitchen and bathroom directly to the drain.

FIGURE 5.6 : TYPE OF ON-SITE SANITATION SYSTEM



5.6.3.2 Maintenance

Septic tanks/pits are usually (98 %) emptied by contractors. The majority of households (96 %) emptied the pit when it was full (instead of constructing a new one). Present costs of emptying for septic tanks/pits range from 5,000 to 30,000 Rp according to the respondents. The average cost of emptying for septic tanks as well pits are 15,000 Rp. The frequency of emptying is summarized in table 5.22.

TABLE 5.22 : FREQUENCY OF EMPTYING PITS AND SEPTIC TANKS

WASTEWATER DISPOSAL SYSTEM	NR. IN SAMPLE	NR. IN SELECTION	HOW FREQUENTLY MUST PIT/TANK BE EMPTIED 1 - 2 YEARS	3 - 4 YEARS	5 - 7 YEARS	8 - 11 YEARS	> 12 YEARS
PIT	58	39 67 %	1 3 %	6 15 %	8 21 %	7 18 %	17 44 %
SEPTIC TANK	29	24 83 %	4 17 %	1 4 %	7 29 %	4 17 %	8 33 %
SEWERAGE	165	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	63 25 %	5 8 %	7 11 %	15 24 %	11 17 %	25 40 %

The median frequency of emptying pits is one time in 9 years and of septic tanks one time in 7 years.

For a proper functiong (i.e. suitable conditions for treatment of toilet water) septic tanks have to be emptied at least one time in 4 years. It is seen in table 5.22 that only a minority (21 %) of housholds using septic tanks do this. In the majority (79 %) of cases septic tanks are used as pits.

The majority of households (76 %) have the opinion that the operation and maintenance of their pits/septic tanks is not expensive.

5.6.3.3 Construction

In the survey area septic tanks/pits are usually (85 %) constructed by contractors. Sometimes these systems are constructed by the households themselves (7 %) or by friends (8 %). It was found out that the construction costs differ per type of system. In table 5.23 the average construction costs according to the respondents are presented. In this table also the costs, as calculated in chapter 3, are given.

TABLE 5.23 : CONSTRUCTION COSTS ON-SITE SANITATION (FEB.1989)

System	Construction costs (1000 Rp) according to	
	respondents	calculations
pit	120	170
septic tank with outflow to drain	145	350
septic tank with sub-surface disposal sytem *	185	350

Note : * Possibly a pit is applied as sub-surface disposal system, while calculations are made for infiltration trenches

It is seen that costs according to the households are less. This difference is likely to be explained by application of materials of lower quality.

Further, it was found out that the costs spent on construction of the on-site sanitation system is related to the household income. These results are presented in table 5.24.

A majority (54 %) of the respondents has the opinion that construction of septic tanks/pits is expensive.

TABLE 5.24 : CONSTRUCTION COSTS ON-SITE SANITATION VS. HOUSEHOLD INCOME

Item	Income Class (1000 Rp/Month)			
	≤100	101-200	>200	Total
Percentage of households (%)	19	22	59	100
On-site sanitation system (% of HH) :				
pit	15	15	37	67
septic tank	4	7	22	33
Construction costs san. system (1000 Rp)	90	127	151	134

5.6.3.4 Income Spent on Sanitation

The average yearly costs of on-site sanitation systems have been calculated by adding the annuity of construction costs with O&M costs (only emptying is considered).

The yearly calculated O&M costs are 2,000 Rp/year.HH. The annuity of average construction costs is about 14,500 Rp/year.HH (financing period = 20 years, interest rate =10 %). Thus, the total yearly costs are 16,500 Rp/year.HH or about 0.7 % of household income.

5.6.3.5 Functioning and Appreciation

The majority (89 % respectively 96 %) of households reported no problems with discharging their toilet water (i.e. overflow from WC or difficulties to discharge) respectively with bad smell. It was expected that more households would experience problems with discharging their toilet water (especially those with a pit) because of the high groundwater table and low permeability of the subsoil in the Tangerang area. However, in general only a limited amount of wastewater is discharged into the ground (about 10 liter per capita per day) because of the use of pour flush toilets and the discharge of the other wastewater to the drain.

The majority (89 % respectively 93 %) of households has the opinion that their sanitation system is healthy and convenient

(one has to take the low frequency of emptying in practice into account).

The situation per desa and per sanitation system (pit or septic tank) is not very different.

So, in general, respondents indicate their satisfion with their on-site sanitation system (cf. Table 5.64, in annex 6). The felt need for improvement is limited.

5.6.3.6 Interest in Sewerage Connection

In Sukarasa, the neighbouring desa of Sukasari, 46 % (24 HH) of the households know of the sewerage system. The large majority of these households (83 %, 20 HH) is interested in a sewerage connection. It is obvious that these households are not aware of the financial implications (cf. paragraph 5.6.2.5).

5.6.4 Review of Results

As stressed frequently, implementation of improved sanitation facilities will benefit public health and the environment.

In the model in fig. 5.3 the situation from the consumer's point of view is presented. As, it was seen no major problems are experienced with both sewerage facilities and on-site sanitation systems. The sewerage systems are more convenient than on-site sanitation systems as it is not necessary to empty them. However, the preference with respect to this item may be weak as the practiced frequency of emptying of on-site sanitation systems is very low. The other likes and dislikes of the sanitation technologies also will not be pronounced, due to the social invisibility of the underground systems. In this situation appreciation of sewerage facilities over on-site sanitation systems is merely the result of the costs and the perceived benefits of the technologies.

The past has shown that the relation between sanitation and health is (often) not seen by the consumers [51]. This being so people do not understand the objective (i.e. health) advantages of communal sewerage over the on-site sanitation systems. This is reinforced by absence of epidemics and frequent diarrhoeal diseases. This being so people are not willing to pay a high price for a thing which is not considered very important by them. This unwillingness is increased by competing claims.

In this situation a high percentage of households willing to

connect to the sewerage system (at their own costs) is not expected.

This context may explain the low success of the ongoing sewerage projects regarding the construction of house connections.

Concluding, a principal problem on introduction of sewerage facilities in existing areas is that there is no felt need for improvement, and this has its origin in a lack of information and problem conciousness.

In new development areas sewerage and treatment facilities can be easily included in the development of the area. This might even be enforced by building regulations (which are to be developed by Central Government). However, one has to realise that this results in considerably higher development costs * or that it is at the cost of other characteristics of the dwellings. The demand for these dwellings may decrease if households find the price of a housing characteristic which they don't consider very important too much. The survey results of the Urban Institute might support this statement** and point also to a lack of information and problem conciousness regarding sanitation.

Concluding, a political decision is required to enforce implementation in new development areas. In this the advantages (benefits) and disadvantages (higher costs) have to be taken into account.

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* The construction costs of Perumnas dwellings in West Java = 6.0 million Rp [11, table 6.4.6]. Perumnas dwellings with sewerage instead of pits in low/middle income areas will cost 6.5 million Rp and 6.9 million Rp if the system is provided with treatment facilities.

** Assuming that construction costs remain constant, implementation of sewerage and treatment facilities is at the cost of other characteristics of the dwelling. In a recent survey of the Urban Institute [18] households were asked to cite the first and second reason of importance for liking their dwelling. The results are as follows (total = 200 %) :
- sufficient space : 60% , - water supply : 48% , - structure quality :39%
- affordable : 20 % , - sanitation facilities : 8 % , - others : 25%
Obviously, sanitation facilities are of relatively low importance in the appreciation of the dwellings.

5.7 Summary Main Findings

PDAM Tangerang got off to a good start in the survey area; Targets of Repelita IV watersupply programmes (i.e. 75 % coverage, daily allowances : 90 l/cap.day) have (nearly) been attained, and also the coverage of low income groups (70 %) is sound, but households tend to use other sources to reduce their costs for water supply.

Many transmission routes of excreta-related infections have been cut in (the surveyed area of) Tangerang :
- by an extension of the piped water system (i.e. water availability and safe water)
- as all households boil water before they use it; they seem to be aware of the health aspects related to water
- as nearly all households have access to on-site sanitation systems for excreta disposal

However, other routes (by stagnant wastwe water) are arisen due to the extension of the piped water supply. In the non sewered surveyed area nearly half of the respondents reported stagnant waste water problems. The felt need to improve this situation is limited.

The increased use of water by the extension of the piped water supply in combination with the demographic and geological conditions in Tangerang argue for introduction of sewerage facilities. The present amount of waste water (which equals that of the Netherlands) would be sufficient for a proper functioning of sewerage system in the survey area and for treatment facilities (as implemented in Sukasari).

Till 1985, less than 10 % of the households in Sukasari connected to the sewerage systems at their own costs.
The households got in a later stage the facilities free of costs.
It was found that the advice of the RT (neigbourhood organization) at this stage was an important reason for taking a house connection.
Still 30 % of the households has not been connected to the system. The survey results indicate that some people, especially the high income groups which already have a proper private sanitation system, might be averse of the construction of the house connection because of the inconvenience of building.
In general, the implementation results in Sukasari point to a lack of problem consciousness and promotion.

In the sewered areas of Perumnas nearly all households have been connected to the sewerage. The difference with Sukasari is explained by more favourable starting points for the construction of the house connection. In the Perumnas area the

house connections were included in the construction of the dwelling.

Although not properly used, no major problems have been reported in the Sukasari area since the sewerage systems became operational.

In the largest part of the Perumnas area also no major problems are reported regarding the functioning of the sewerage systems, except in the low situated areas. In these areas a lot of problems are experienced, especially in rainy conditions. These problems are due to a principal mistake in the design.

Further, it was found that in the Perumnas area (8 years after implementation) no organisation has been set up for operation and maintenance of the sewerage facilities (ad hoc maintenance is done by the households). By absence of proper O&M, the sanitary conditions deteriorate, especially in the low situated areas.

In general one could conclude that households are satisfied with sewerage facilities and are willing to contribute Rp 1,500-2,000 per month for waste water disposal purposes. This amount is limited to coverage of costs for operation and maintenance costs (which is at least required for a successful continuation of implemented works). The willingness to finance investments (i.e. construction of house connection at own costs) is limited (see above).
This limited willingness to pay (for O&M and investment costs) is explained by :

- a lack of felt need for improvement by the households which have already an on-site sanitation system;
  The survey results indicate that households are satisfied with their on-site sanitation system, which is cheap (they spend 0.7 % of their income on these systems) and is perceived as healthy and convenient. The households don't perceive the objective (health) advantages of sewerage over on-site sanitation systems and consequently the felt need for improvement is limited. This being so people are not willing to pay a high price for a thing that they don't consider very important. This unwillingness is increased by competing claims; households appear to give a high priority to expenditures for consumer goods (e.g. it was found that 85-90 % of the surveyed households own a radio and television set).
- a lack of means to pay; in the financial analysis it is assumed that households might spend at most 3 % of their income on sanitation. The current expenditures for urban services total up to 10 % of the household income (6 % for electricity and 2 % for water supply), so that little or no money is left for other urban ameneties. This may argue for application of a lower maximum percentage which households can afford to pay for sanitation.

Regarding the rudimentary sewerage (in combination with treatment) one might draw the same conslusions. The willingness to pay for these facilities will surely not exceed that for conventional sewerage facilities (Rp. 1,500-2,000 per month) as the service level of rudimentary sewerage is less than that of conventional sewerage. This contribution is also insufficient to cover all costs.
And if extra provisions are necessary to collect all waste water effectively, it is also supposed that households are not willing to pay for the construction costs for the same reasons as mentioned above.

5.8 Recommendations

The following improvements are required to allow a proper functioning sewerage facilities in the sewered areas in Tangerang:
- Sukasari : - higher coverage (from 70 % to 100 %)
  - connecting bathrooms and kitchens from every dwelling to the sewerage system
- Perumnas area:- prevent reverse flow from river to sewerage system in low lying areas

Organisations must also be setup / strengthened to continue a proper functioning of the systems and much attention should be paid to community aspects (see below).
If this is not done, disconnections and consequently worsening of sanitary conditions in the living area may happen, so that investments are wasted.

If new sewerage projects are planned, after verification of the objective needs, it must be taken into account that the households which have access to on-site sanitation systems might not feel the need for improvement. Therefore much attention should be given to community participation (by the community organisations RT/RW/Kelurahan) at all stages of the implementation:
- An information campaign should be held to persuade the households to connect to the sewerage system. Possible solid health data (which prove the frequent current diseases by a lack of proper sanitation systems) lend itself admirably to this purpose.
- Besides the households should be assisted at the construction of the house connection.
- Finally information campaigns should be continued during the operation of the systems in order to convince the households to pay for the operation and maintenance of the systems.

6 INSTITUTIONAL ANALYSIS

6.1 Introduction

Since the beginning of the Botabek project Cipta Karya (Directorate of Environmental Sanitation) is acting as executing agency for the preparation and implementation of the Botabek Project. It is a national policy to transfer the responsibility regarding operation and maintenance from Central Government to Local Government at the time the facilities become operational. As the Botabek Project is still ongoing the transfer of responsibility has not taken place up to present. The Local Water Supply Company (PDAM) will be entrusted with this responsibility.

In this chapter institutional development options, possible problems and institutional strenghtening requirements are described and analysed. The methodology has been described first. This analysis is limited to the situation in Tangerang on short and mid term (5-10 years) and is principally based on a desk study of reports.

In Tangerang sewerage and treatment facilities have been implemented by the Botabek Project, but also by the Perumnas in a new development area. In the analysis it is assumed that the responsibility for (to be) implemented sewerage and treatment facilities will be delegated to one organization.

6.2 Methodology

The method, presented in figure 6.1, has been used to carry out the (short) institutional assessment study.
The method can be summarized as follows : First clarity should be obtained on the tasks to be performed by the organisation, selected to assure the continued realisation of certain objectives. Then possible organisations who may be requested to assume these responsibilities should be identified, or : the capacity of a suggested organisation to assume this responsibility should be assessed, or : the basic qualities of an organization to be established for this purpose should be listed.

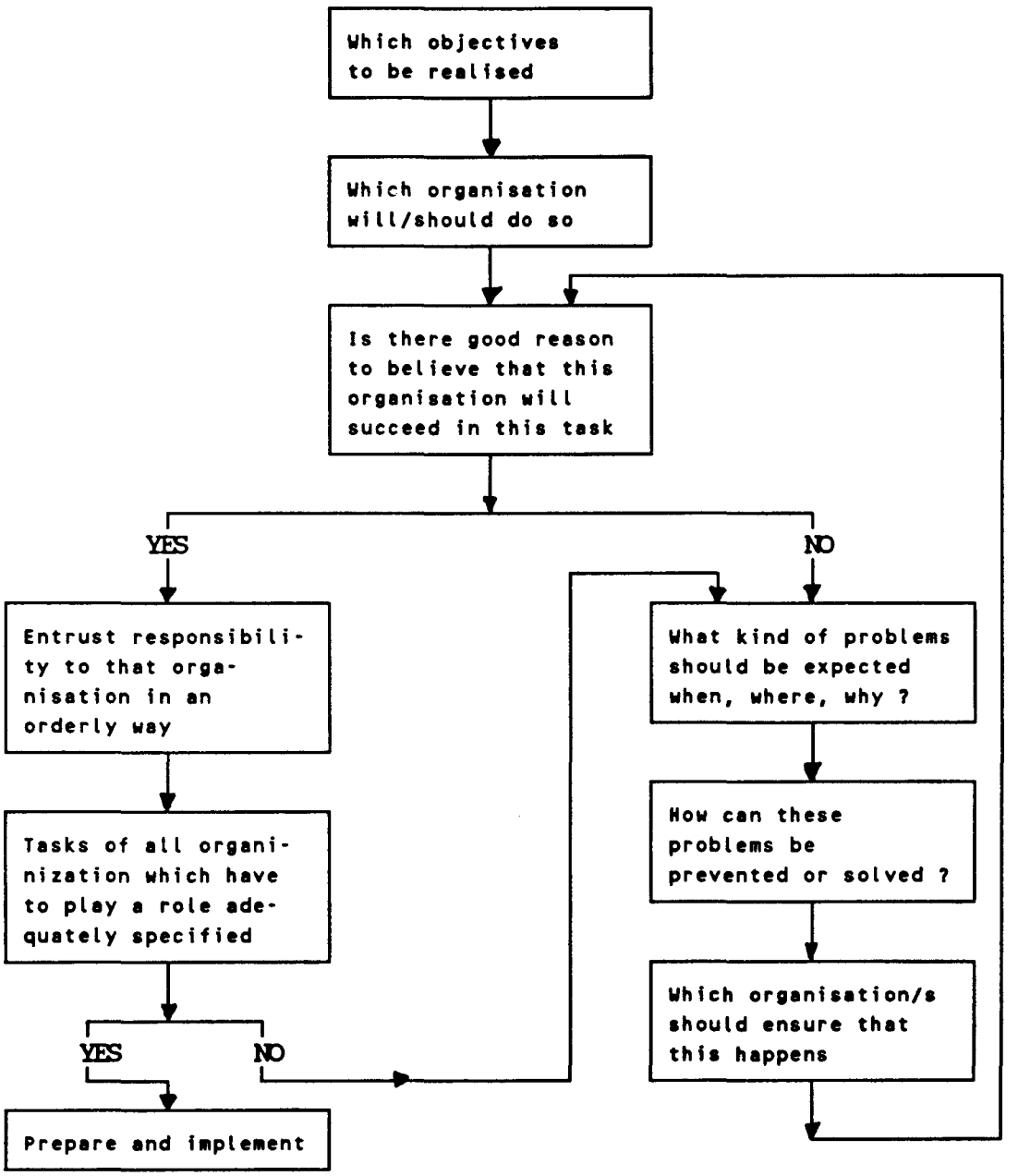
The assessment is done by applying certain criteria (such as technical and organisational ability, autonomy, interest, availability and affinity (e.g. of staff and equipment), past performance in execution of similar tasks, relations with relevant environments). The criteria used for the assessment study are taken from references [58] and [61].

The conclusion may be that the selected organisation is capable of assuming responsibility. However, often it is not so certain that the identified organization will be able to do what is desired. In this case expected problems are elaborated and remedial and/or preventive actions are identified. This process can be continued almost indefinitely in principle, but in practice a moment will come where the analysis is stopped.

The study is principally based on desk study of reports regarding implementation of sewerage and treatment facilities in Indonesia [6, 59] and in other developing countries [63].

Together with this some information has been gathered by field visits to PDAM Tangerang and the Department of Public Works in Tangerang and by a private communication with a government official of Cipta Karya in Bandung.

FIGURE 6.1 : SIMPLIFIED FLOW-CHART FOR APPLICATION OF INSTITUTIONAL DEVELOPMENT ASSESSMENT CRITERIA



Source : van Loo H.L., Institutional development : Recognizing and strengthening organizational capacity, MDF Journal 5 - 1988 (1988)

6.3 Objectives and Tasks to be Performed

In fig. 6.2 the objectives and tasks to be performed by the sanitation organization in Tangerang are presented.

FIG. 6.2 : OBJECTIVES AND MAIN TASKS FOR A SANITATION ORGANIZATION IN TANGERANG

	FOR SEWERED AREAS		FOR NOT SEWERED AREAS
OBJECTIVES	Experience full benefits of implemented sewerage and treatment facilities		(if feasible) Provide sewerage facilities
	100 % coverage	proper O&M	
MAIN TASKS & RESPONSIBILITIES	Construction of house connections	O&M of implemented facilities	Construction of sewerage network

Note : tasks for sanitation organization for small cities are taken from [63]

The importance of 100 % coverage already have been discussed in paragraph 2.5.4.

The following problems might occur when sewerage and treatment facilities are not properly operated and maintained :
- blockages in the sewerage system; if this will occur the waste water might flow out of the sewerage system and find its way to the drainage system.
- people might even disconnect their waste water discharged to the sewerage system when many problems are experienced.
- inadequate conversion of wastes in the treatment plant

So, obviously proper operation and maintenance of implemented sewerage and treatment facilities is necessary to guarantee good functioning of these systems now and in the future and its objectives are parallel to the construction of these systems.

It is assumed that responsibility for possible implementation (design and construction) of new treatment facilities (in the future) will be trusted to a higher level of authority (Cipta Karya in Bandung), while extension of sewerage networks (if feasible) is assumed to be under responsiblity of the sanitation

organization in Tangerang (this is also practice for water supply).

From the main tasks and responsibilities, the following functions are derived for the local sanitation organization in Tangerang :
- technical planning and design : develop and supervise construction activities, up-to date technical drawings of sewerage system and records of sewer connections
- operation and maintenance : maintenance (preventive, curative and emergency) operations of the sewerage system and operation and maintenance of treatment facilities
- finance and administration : overall management, financial control, tariff rating, billing, collection of sewerage fee
- customers relations : inspection and recording of existing and potential customers (inputs for technical section and policy makers), marketing of house connections, assistance to public in making house connections, promotional acitivities

Manpower requirements for the present have been estimated by DHV Consultants [6]. The estimations are as follows :
- technical planning and design : 6 people
- operation and maintenance : 14 people
- finance and administration : 5-10 people
- customer relations : 5 people

So, total about 30-35 employees are necessary to perform the tasks as identified in figure 6.2. This manpower is for O&M of the systems in Sukasari and Perumnas (8,800 potential connections, accomodating 55,000 people, see table 5.2).

6.4 Institutional Development Options

As collection (by sewerage) and treatment of waste water are closely related, it is desirable to place them together in one organization.

A crucial question is whether a new or an existing organization should perform the in the preceding paragraph derived functions.

Until now, there is little experience in Indonesian cities and towns with municipal organizations responsible for sewerage services and wastewater treatment. There is still no "model" organanization, suitable for different situations. In Jakarta and Bandung, the situation is for example as follows : In Jakarta a completely new organization is being established, while in Bandung, a sewerage division is incorporated in the PDAM (Local water supply company).

For Tangerang 3 institutional development options are possible :
- incorporate as a part of the Public Works Department (PU Tangerang)
- incorporate as a part of the Water supply company (PDAM) in Tangerang
- establish a new independent organization

6.4.1 Choice of Institutional Development Option

On the short/mid term incorporation as a part of the PDAM Tangerang is prefered because :
- there is a close relationship between required organization for water supply and for sewerage provisions
- the PDAM has experienced technical and financial/administrative staff
- the PDAM has had a billing and fee collection department for a long time. The same administration tasks are required for fee collection of sewerage facilities
- the PDAM is, in technical matter, more capable to meet with technical more complex aspects as planning, controlling, implementation of water supply systems, the same aspects as for sewerage and treatment
- have experience with customers relations, recording of data

Also some people argue for incorporation as a part of PDAM, as PDAM has the authority to disconnect people from the piped water supply system in case of unwillingness to pay for a public sewerage service. Whether this can be justified by PDAM is considered as doubtful as coverage of piped water is not 100 % and people have alternative water sources of their own. Besides this will conflict with the objectives of the water supply division.

Water supply and waste water disposal are closely linked (see § 2.5.2); if the increased amounts of wastewater are not properly disposed of outside the densely populated living area, the benefits of water supply might be nullified. To prevent this happening, one might argue that water supply and waste water disposal should be placed in one organization.

Establishing an independent enterprise like the PDAM exclusively for sewerage and treatment means that sections within the required organization have to be established which are already existing in the PDAM organization. The same starting problems are expected which can be avoided as much as possible if an integration in the PDAM stucture should take place.
Besides the size of the organization (at this stage) might be too small for cities as Tangerang to carry out the tasks in an efficient manner (in contrast for example for the situation in Jakarta).

In general, accountability for sanitation matters is considered to be a responsibility of the Municipality. This argues for incorporation in the Public Works Department. In a interview with an official of the PU Department in Tangerang, it appeared that PU has no experience with the (similar) tasks to be performed by the sanitation organization. For this reason incorporation in the PU for the time being is not recommended.

6.4.2 Integration of Wastewater Division into the PDAM

PDAM Tangerang is still small in size (15,600 house connections). At present the PDAM employs 240 people, of which 154 are employed in the technical sectors.

An integration of a wastewater division into the PDAM Tangerang requires the following adjustments:

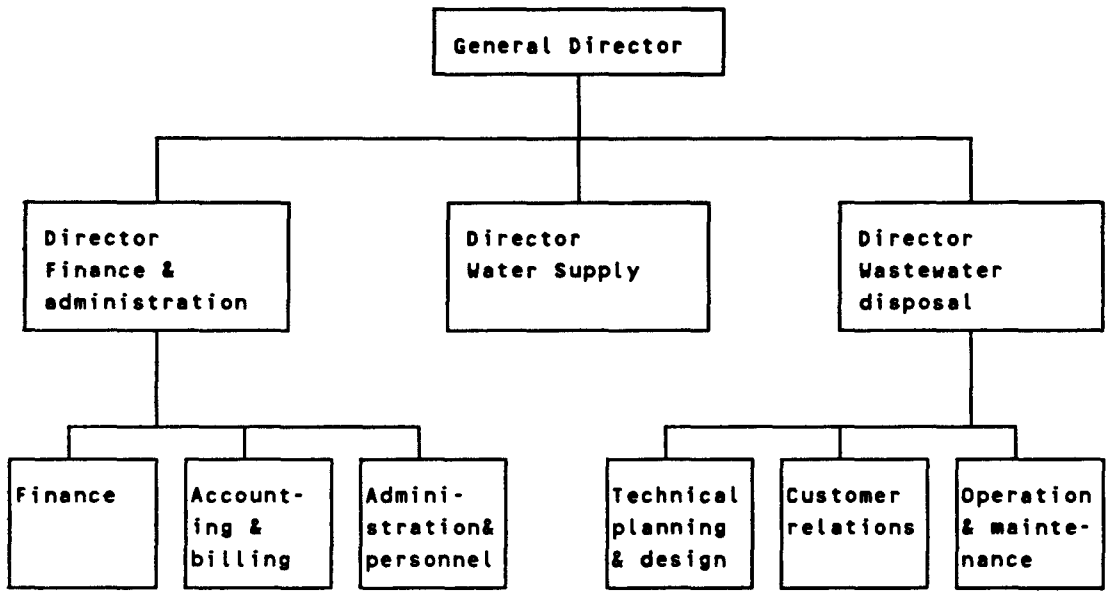
- administration sectors must be fully integrated; an extension of the staff will be required as soon as a fee collection system is operational
- certain autonomy of waste water division; for performing the tasks properly it is required that the waste water divison has a certain autonomy; this indepence must exist to the extent that the division is able to conduct its affairs with minimum interference and controls by other entities and to meet its responsiblity in an effective manner. If this requirement is not met, the risk is large that these tasks get a low priority compared with the more profitable water supply activities (see further § 6.5.1).
  To create this autonomy :
  - the technical sectors (of water supply and waste water) are separated from each other to keep the organization and responsibilities clear and effective.
  - each department has their own financial account, income and expenditure

Eventually, it could be possible to divide this entreprise into two sectors after a period of 5-10 year as knowledge transfer would have already taken place.

The proposed organisation chart of the PDAM for the coming years is presented in fig. 6.3.

The appointment of a Director Wastewater/Sewerage (at the same level as the Director for Water supply) is considered to be crucial, to prevent wastewater getting a lower priority than drinking water.

FIGURE 6.3 : PROPOSED ORGANIZATION CHART FOR THE PDAM



6.5 Anticipated Problems and Institutional Strenghtening Requirements

6.5.1 Anticipated Problems

The following main problems are anticipated for the sewerage and wastewater division :

1. difficulties in achieving the target of 100 % coverage in sewered areas (by a lack of felt need for improvement, funds and/or sanctions)
2. lack of financial self-sufficiency
   a. possible problems to recover O&M costs (by lack of proper sanctions)
   b. financial dependence for extension works
3. lack of skilled and trained staff
4. limited interest of PDAM management for waste water activities as the management is :
   a. not involved in planning & design activities
   b. involved in a large water supply project which is under preparation

1. achieving 100 % coverage

One of the objectives of the waste water disposal division is to attain 100 % coverage in the sewered areas. It might be difficult to attain this objective (in future extension works), as households might be unwilling (due to a lack of felt need for improvement) and/or unable to pay* for construction costs of the house connection. In this case, three possibilities are left :

i) make the households aware of the relation between sanition and health. As a result the felt need for improvement might increase. Since the PDAM will not be able to change the attitude of the people, it will depend on a community development organisation to reach this objective.
ii) payment by government funds; the acceptance of sewerage connection might increase if connection has no or little financial implications.
iii) enforcement; A problem is how can people be forced to connect to the sewerage system. Regulation/legislation with regard to seizure of goods is hardly applicable. Besides one has to realize that the properties of households are minimal and that seizure of goods might be socially unacceptable. Apart from the difficulty to find a proper sanction, enforcement will not be effective if households cannot afford to pay*.

It is of the author's opinion that alternative i is to be prefered.

2. lack of financial self-sufficiency

a. problems to recover O&M costs

For continued functioning of implemented facilities it is necessary that at least O&M costs are recovered. In paragraph 5.6.2.5 it was seen that in general households are willing to pay Rp. 1,500-2,000 per month for wastewater disposal purposes. This amount is sufficient to meet the costs.
However, some people might be unwilling to pay for O&M costs. By absence of proper sanctions and community education, this might be adopted by other households and might become practice (increase in percentage of uncollectable bills).

* In the financial analysis of this report, households are supposed to be able to spend 3 % of their income on sanitation. This should be sufficient to cover both O&M costs of the systems and the construction costs of the house connection. Taking the high current expenditures for urban services into account (i.e. 10 % of the income, cf. table 5.6), the 3 % criterium seems too optimistic - 1.5 % seems more realistic in this case. Then households are not able to pay for the construction of the house connection.

It is difficult to make proper sanctions to enforce households to pay for O&M costs; cut off the sewerage connection (waste water will be discharged to the drainage again) is unacceptable as it conflicts with the objectives of the sewerage division (i.e. 100 % coverage). Regulation/legislation with regard to distrain for payment is not available, while disconnection from the piped water supply system is not always applicable (not all people are connected to the piped water system) and conflicts with the objectives of the water supply division.* Obviously, the best way to prevent that households are unwilling to pay for O&M costs (at this stage) is continued community education. For this the PDAM will also be dependent on a community development organization.

b. financial dependence for extension works

Since the contribution which households are willing to pay for wastewater disposal purposes is limited to O&M costs, cash generation within the sewerage division is limited.
It is assumed that the PDAM will not use the generated cash surpluses in the Water supply Division to invest in unprofitable sewerage works (extension of sewerage network and house connections) as this puts risk on the continuity of the PDAM (the PDAM should be self-financing in extension of piped water in Tangerang). Obviously, the sewerage division will depend on (Central) government funds for the extension of their system. As government funds are scarce, growth of the sewerage division is expected to be limited for the coming years.

3. lack of skilled and trained staff

In the water supply and sanitation sector in Indonesia, there is insufficient trained and experienced managerial, technical and financial manpower available at all levels, but especially in local government and local entreprises (such as the PDAM). A recent estimate indicates that at national level less than half of the 40,000 required persons are available [60].

As sewerage and treatment may be considered as a relatively new phenomenon in Indonesia, it will be difficult to recruit staff with a wastewater background. Training is needed to become familiar with the various aspects of operation and maintenance of the sewerage and treatment facilities.

* In a later stage of development, when all households are connected to the piped water supply system and no longer have other water sources of their own, disconnection from the piped water (as sanction) (or billing for wastewater as a surcharge of drinking water) might be considered, provided that the tariff for wastewater is fair (affordable)

Stable, autonomous institutions offer career opportunities that attract competent staff. However, it might be hard for the waste water division of the PDAM (with its weak financial outlook in case no additional Central government funds are found) to attract and keep (scarce) competent staff.*

4. limited interest of PDAM management for wastewater

Till date PDAM has shown limited interest in the management of waste water disposal activities (this impression was gathered by private communication with the Technical Director of the PDAM). Apart, from the perceived financial risks of incorporation of the sewerage division, this limited interest may (also) be due to :

- a limited involvement in the planning and design of recently implemented sewerage and treatment facilities;
  Instititutions which could design sewerage facilities should therefore in future submit their plans/designs for approval to the PDAM, otherwise PDAM will not feel the responsibility to accept those facilities for O&M.
- involvement in a large water supply project;
  nowadays, PDAM is a rather fast growing institution and an important drinking water supply project is under preparation, which is asking much attention of the present management (at present the total production capacity is 0.66 m^3/s. In the new project a plant with a capacity of 3 m^3/s will be implemented to provide West Jakarta in future with piped water [62])

6.5.2 Institutional Strenghtening Requirements

The essence of the anticipated problems is the weak financial outlook of the waste water division (in the PDAM) which has its origin in households' limited willingness and ability to pay for the services. It is clear that his division needs much strengthening at the financial (i.e. support from Central Government to cover all costs) and at the demand side (convince the households to connect to the sewerage system and to pay for O&M of the system in order to improve the sanitary conditions in the residential areas and to maintain this)

* Higher salaries also may attract capable staff. However, this alternative seems not feasible, as salaries of government (enterprises) are dictated.

At a minimum the following institutional strengthening requirements are necessary for a properly continued functioning of the implemented works (in the sewered areas in Tangerang) :

- Central Government guarantees, covering the costs for operation and maintenance, if the PDAM is not successful in recovering their expenses regarding waste water issues from the households
- Government funds to cover the connection costs of not yet connected dwellings in the sewered areas
- Central or Local Government guarantees to organize community development work in order to convince the households to connect to the sewerage system and to pay for the O&M costs
- Arrange and finance the training of the recruited personnel; * the training should start after it is sure that the personnel is capable for the job and can be kept in it.

Reluctance of the PDAM mangement to incorporate the wastewater division might decrease if these guarantees were given by Central Government.

* Training courses regarding the operation of the treatment plant were already given to a few operators in 1985 and 1988

6.6 Conclusions

Operation and maintenance of sewerage and treatment facilities is necessary to guarantee good functioning and its objectives are parallell to the construction of these systems. At present the right organization for O&M of implemented sewerage and treatment facilities for cities as Tangerang is the PDAM (Local drinking water company), as O&M and institutional requirements for sewerage and treatment adminstration have similarities with those for piped water supplies.

It is anticipated on the following problems for the wastewater division within the PDAM :
- difficulties in achieving the target of 100 % coverage in sewered areas
- lack of financial self-sufficiency in the operation and maintenance and in the extension of the system
- problems in attracting capable staff
- limited interest of PDAM management for wastewater

The difficulties of achieving 100 % coverage and of recovery of O&M costs are anticipated as PDAM will not be able to change attitudes of people and organize community development work.

The essence of these problems is the weak financial outlook of the waste water division and the waste water division needs much strengthening at the financial and demand side.

The following institutional strengthening requirements are necessary at minimum for a properly continued functioning of the implemented works :
- Central Government guarantees, covering the O&M costs if the PDAM is not successful in recovering these costs from the households
- Government funds to cover the connection costs of not yet connected dwellings in the sewered areas
- Central or Local Government guarantees to organise community development work in order to convince the households to connect to the sewerage system and to pay for the O&M costs
- Arrange and finance the training of the recruited personnel

6.7 Recommendations

Recovery of O&M costs is required for continued functioning of implemented works. The best way to prevent households being unwilling to pay for these costs (at this stage) is continued education by the community organisations (as proper sanctions are hard to find). In a later stage of development recovery via the water bill or the sanction of disconnection from piped water might be considered (to assure recovery of O&M costs).

The interest of the local organisation, responsible for O&M of communal sanitation facilities, could be increased by involving them in an earlier stage of project implementation.

7 DISCUSSION OF MAIN RESULTS AND RECOMMENDATIONS

1. Many transmission routes of excreta-related infections have been cut in (the surveyed area of) Tangerang :
   - by an extension of the piped water system (i.e. water availability and safe water). 73 % of the households has access to water supply facilities (p.88)
   - as all households boil water before use; they seem to be aware of the health aspects related to water (p.90)
   - as nearly all households (in non sewered areas) have access to on-site sanitation systems for excreta disposal (p.108)

2. The present conditions in Tangerang, especially the extension of the piped water system, which have been increasing the stagnant waste water problems, argue for implementation of improved sanitation facilities : sewerage and treatment (p.96). The quantity of waste water (ca. 100 liter per capita), which equals that in the Netherlands, is sufficient to operate these facilities properly (p.94).

3. Huge investments are required for large scale implementation of conventional sewerage and treatment facilities in Tangerang (290,000 Rp/capita). The breakdown of these costs is as follows (p.49) :
   - sewerage system : 230,000 Rp/capita (79 % of total) (incl. house connection)
   - treatment plant : 60,000 Rp/capita (21 % of total)

   The investment cost of the house connection is 55,000 Rp/capita (24 % of the costs of the sewerage system or 19 % of the total costs, p.50)

4. In general it can be concluded that implementation of conventional sewerage and treatment, on a large scale, is not feasible. The reasons for this being :

   I) the households which already have an on-site system have limited felt need for improvement, in general, and are unwilling to pay a high price for it;

   This statement is supported by the results of the survey which indicate that households are satisfied with their existing on-site sanitation, which is cheap (only costing 0.7% of their income). The households don't experience problems regarding the functioning (p.111) and consider these systems healthy and convenient (according to the

households, the systems are only emptied one time per 8-9 year, p.109 + p.111).
Besides the households are satisfied with the functioning of the drainage system, although waste water is discharged to it (p.95)
As households don't perceive the objective (health) advantages of the improved systems, there is only a limited feeling that a new improved system is necessary (p.104 + p.112) and consequently the people are unwilling to pay highly for it. This is supported by the survey results; households which are connected to the conventional sewerage system are only willing to contribute 1,500-2,000 Rp/month (0.8-1.1 % of their income) for waste water disposal (p.106). This amount (which is not much more than the expenditures for the on-site sanitation system) is limited to the coverage of the operation and maintenance costs of the sewerage and treatment facilities.
This limited willingness to pay must also be seen in the context of the tendency for buying consumer goods (e.g. it was found that 85-90 % of the surveyed households own a radio and television set, p.86)

II) inability of the households to pay for the sanitation improvements;

Even if the households were willing to pay for the improvements, they are not considered capable of paying for this. 8-9 % of households income would be required for recovery of both investment and operation and maintenance costs of the improved systems (p.62). Guidelines for urban sanitation, based upon experience in Asian developing countries, assume that households can spend a maximum of 3 % of their income on sanitation (p.60).
Together with this fact it is also considered that the government has insufficient means to pay if these facilities were applied on a large scale. For this 25 % of the government development budget would be required, while 3 % is supposed to be the limit (p.66).
There is at present no foreseeable way to make these facilities affordable for application on a large scale ; possibilities for further reduction of presented costs by adaptation of the design or providing of labour through the community are limited (p.51-54), while government and households expenditures for sanitation are not expected to increase radically in the coming years.

5 With regard to the rudimentary sewerage system (in combination with treatment) one might draw the same conclusions, although the costs of rudimentary sewerage and treatment are slightly less (225,000 Rp/capita, if 70 % of

the households need extra provisions to collect wastewater effectively, p.47). This proposition is also too expensive, requiring 7 % of the income (p.63), and the willingness to pay for this proposition will surely not exceed that for conventional sewerage facilities (Rp. 1,500-2,000 per month) as the level of service of rudimentary sewerage is less than that of coventional sewerage.

6 The research indicates that only limited implementation of the conventional sewerage and treatment is feasible with government subsidies (p.66)

The impact of selective implementation in relatively small areas on the environmental conditions will be limited; but selective implementation considerably improve the health conditions in these areas (if 100 % coverage is achieved, p.30)

7. It is anticipated that it is the government's policy (also for selective implementation) that at least O&M costs and investment costs of the house connection (on the plot) are to be recovered from the beneficiaries.
Reasons for this are:
- the sanitation organisation should not be dependent on the Central Government to execute operation and maintenance of the facilities
- construction of on plot works is assumed to be a private matter by the Indonesian Government

Households should spend 3 % of their income to pay for both O&M costs and the house connection. Using optimistic guidelines households are supposed to be able to pay for these costs (p.60).
However, the experiences in the pilot project areas in Tangerang have shown that housholds in existing areas, which have already access to an on-site sanitation system are in general not willing to construct the house connection at their own costs (p.97-98). This is supported by the survey results (p.104-107).
Reasons for this are:
- the limited felt need for improvement (see point 4.I above)
- a lack of means to pay; the current expenditures for urban services total up to 10 % of the household income (6 % for electricity and 2 % for water supply, p.83-84), so that little or no money is left for other urban ameneties. The high percentage of income spent on urban services may be due to the high coverage of it (p.81).

These survey results indicate that the assumption that households can spend at most 3 % of their income is still

too optimistic and may argue for application of a lower percentage. This being so, a review of the government's policy, in case of selective implementation of sewerage and treatment facilities, is required (i.e. payment of the house connection by government funds).

For the rudimentary sewerage system similar conclusions can be drawn, if extra provisons are necessary to collect all waste water effectively.

8. The best opportunities (for selective implementation) seems in :
   - new development areas because of the attractive investment costs in these areas (17 % less than in existing areas, p.50) and the ease to reach the goal of 100 % coverage (p.100)
   - areas where problems regarding public health and environment are most serious; in areas where households have no access to on-site sanitation systems felt need for improvement will surely be higher. However, these areas tend to be of lower income, where households have no means to pay
   - high income areas where households can afford to pay for the house connection. However, one has to realize that these households often already have a proper on-site sanitation system and might be averse of construction to the sewerage system (due to the inconvenience of building, p.99)

9. The PDAM (Local Drinking Water Company) is considered the right organization for operation and maintenance of the implemented facilities in Tangerang (p.122). It is anticipated on many problems for the PDAM such as attainment of 100 % coverage (which is required to reach the full benefits) and recovery of O&M costs (p.125-126). These problems have their origin in a limited willingness and ability to pay by households.

10. The overriding recommendations for a successful selective implementation of the improved facilities are:
    - to set up and strengthen the organisations, especially on the financial side, which should guarantee the continued functioning of the improved systems (p.116 + p.128)
    - special attention should also be given to community education; if there is a ascribed need for implementation of the improved systems, the community should be made aware of this. They must be convinced about the need for connection to the system(s) and finally to pay for the operation and maintenance of it (p.116)

11. The public health improvements in urban Botabek might still be realised to a lower extent in other areas where sewerage and treatment facilities are not planned on the short term by :
    - 100 % coverage of on-site sanitation systems (for excreta disposal); still a large proportion of the urban population in Botabek don't have facilities for sanitary disposal of wastes (p.17). Obviously, this has large risks for public health and at least 100 % coverage of on-site sanitation systems is required to cut one of the most important transmision routes of infections (p.15). These systems are assumed to be affordable (1-2% of income, p.63)
    - a better, more regular maintenance of the drains, so that stagnant wastewater problems might be reduced. Costs of this improvement are estimated on 300 Rp per household per month.(0.2 % of income, p.96)

    To reach these goals information campaigns will also play an important role.

    With respect to environmental improvement there is at this moment no real alternative and the quality of surface and ground waters will deterioriate if nothing is done. This might interfere in future with the use of these waters for other purposes such as drinking water preparation.

12. A real improvement in environmental and health conditions (comparable with that by implementation of communal sewerage and treatment), which is affordable, might be attained by facilities (to be developed) which treat the waste water (toilet and sullage water) effectively on the plot; costs of these facilities might be lower as sewers, the largest part of the costs of communal sanitation facilities (see point 4), are not necessary.
    It is therefore recommended to find out whether application of such kind of facilities is feasible from a technical and socio-economical point of view.

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Annex 1 : DESCRIPTION OF TREATMENT PLANT (Carrousel) [2,15]

In the treatment plant the organic compounds are converted and the amount of pathogenic organisms are reduced. The effluent (treated wastewater) can be disposed of to a water course.

A large variety of bacteria are the primary degraders of organic wastes. These bacteria are adsorbed on flocs of inert material, called sludge. Bacteria break down wastes to provide themselves with the necessary energy to reproduce :

$$\text{Organic waste} + \text{Oxygen} \xrightarrow{\text{sludge}} \text{Oxidized waste} + \text{Energy} \quad (5)$$

This energy is partly used to build new cells :

$$\text{Organic waste} + \text{Energy} \xrightarrow{\text{sludge}} \text{Sludge} \quad (6)$$

The bacteria merely need an adequate amount of oxygen to eliminate the wastes. This is provided in the form of mechanical aeration. The mechnanical aerators (rotors) are placed in the aeration basin. The rotors also perform a second function; they keep the sludge in suspension. This is required to increase the contact between the sludge and the wastewater (and so the conversion rate).

The volume of the aeration basin at Tangerang is 1,560 m^3. The retention time of the wastewater in the basin is 0.7 day at the designed capacity (15,000 i.e.).

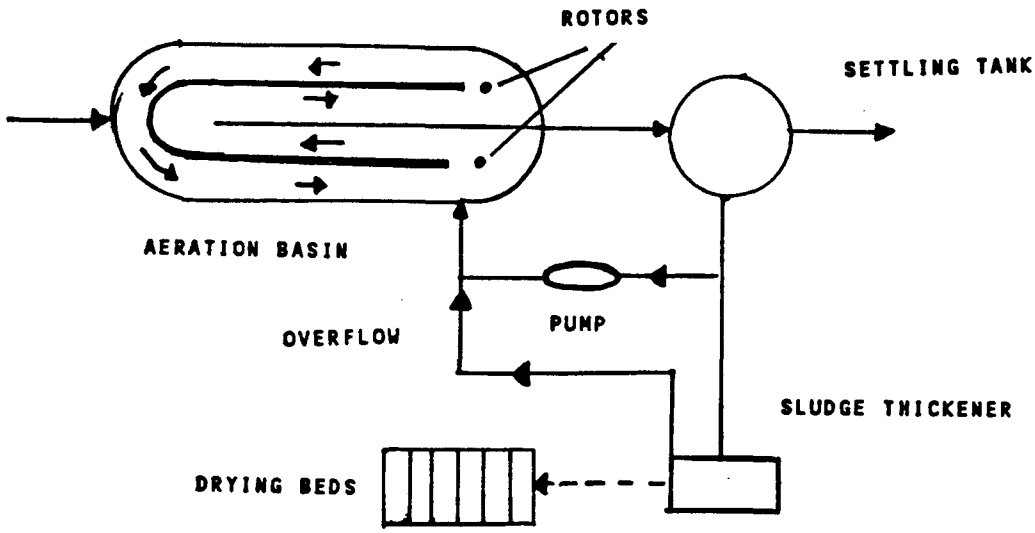
After treatment, the water can be discharged into the surface water. However, the sludge has to remain in the system for the treatment of the wastewater; the heavier flocs (sludge) and treated water are separated in the settling tank by sedimentation. (Part of) the settled sludge is recycled to the aeration basin.

The bacteria flocs grow as a result of the conversion process (equation 6). The sludge concentration in the aeration basin must be hold within certain marges. Therefore the excess of sludge must be removed out of the system. Before removal the sludge is thickened in the sludge thickener. The thickened sludge is removed from time to time to the sludge drying beds. (It is thickened to reduce the required surface for the drying beds). The dried sludge may be used for agricultural purposes (e.g. as fertilizer).

The subsystems of the treatment plant are shown in figure 2.6. The Carrousel is relatively simple in operation and maintenance. Its largest advantage is that it can treat large amounts of

wastewater (for populations up to 1 million) in a relatively less space (ca. 0.3 m^2 per capita for the total system [33, p.539]).

FIG. 2.6 : CARROUSEL



ANNEX 2 : ECONOMICAL ANALYSIS TABLES

TABLE 3.13 : INVESTMENT COSTS OF A PIT (December 1988)

No.	Item	Unit	Quantity	Unit prices (Rp)		Total (Rp)
				Wages	Material	
1	Digging earth	m^3	3.15	2,511		7,910
2	Backfill earth and gravel	m^3	0.85	1,683	7,200	7,551
3	Carry off earth	m^3	2.30	2,000		4,600
4	Honeycomb masonry	m^3	0.54	24,120	22,024	24,918
5	Masonry specie	m^3	0.13	29,968	24,930	7,137
6	Plaster 1:3	m^3	2.17	1,859	890	5,965
7	Concrete plate 1:2:3	m^3	0.13	155,480	202,850	46,583
8	Additional					
a	PVC pipe 100 mm	m	5.00	1,800	4,502	31,510
b	Bend 100 mm	unit	1	1,750	6,329	8,079
c	Reinstatement floor	m	3.30			16,866
9	10 % V.A.T. on items 1-8					16,111
10	10 % profit for contrator on items 1-9					17,722
	TOTAL					194,942

Notes : Connection to the toilet is included for comparison with investment costs of sewerage

Based on : Bill of quantities : [34], Unit prices : [20], [21], [22], [26]

TABLE 3.14 : INVESTMENT COSTS OF A SEPTIC TANK (December 1988)

No.	Item	Unit	Quantity	Unit prices (Rp)		Total (Rp)
				Wages	Material	
1	Digging earth	m^3	5.00	2,511		12,555
2	Backfill earth and gravel	m^3	1.68	855		1,436
3	Carry off earth	m^3	3.32	2,000		6,640
4	Backfill gravel	m^3	0.12	1,070	7,500	1,028
5	Kali stone masonry	m^3	0.36	22,380	43,160	23,594
6	Stone masonry	m^3	0.69	29,968	32,943	43,409
7	Plaster 1:3	m^3	11.50	1,859	890	31,614
8	Concrete plate 1:2:3	m^3	0.22	155,480	202,850	78,833
9	Galvanic pipe 25 mm	unit	1	4,300	6,350	10,650
10	Additional (see table 3.13)					56,455
11	10 % V.A.T. on items 1-10					26,621
12	10 % profit for contrator on items 1-11					29,284
	TOTAL					322,118

Notes : Connection to the toilet is included for comparison with investment costs of sewerage

Based on : Bill of quantities : [34], Unit prices : [20], [21], [22], [26]

TABLE 3.15 : INVESTMENT COSTS OF SUPPLEMENTARY FACILITIES FOR A SEPTIC TANK (December 1988)

No.	Item	Unit	Quantity	Unit Price (Rp)	Total (Rp)
ALTERNATIVE 1 : INFILTRATION TRENCHES					
1	Materials				
	Sand	m^3	0.167	14,000	2,338
	Gravel	m^3	0.333	16,000	5,328
	PVC Pipe 100 mm	m^3	6.556	4,502	29,515
	Cap 100 mm	unit	1	3,881	3,881
2	Digging				
	Digging earth	m^3	0.833	2,511	2,092
	Backfill earth	m^3	0.333	855	285
	Carry off earth	m^3	0.500	2,000	1,000
3	Perforation of pipe	md	0.37	4,000	1,480
4	10 % V.A.T. on items 1-3				4,592
5	10 % profit for contractor on items 1-4				5,051
	Total infiltration trenches				55,562
ALTERNATIVE 2 : PIPE TO THE GUTTER (Area type 4)					
1	PVC pipe 100 mm	m	5	4,502	22,510
2	Digging/laying pipe	m	5	1,800	9,000
3	Reinstatement footways	m	1.1	2,866	3,153
4	10 % V.A.T. on items 1-3				3,465
5	10 % profit for contractor				3,812
	Total pipe to the gutter				41,930

Note : md = manday
Based on : Bill of quantities infiltration trenches : data from IKK Sanitation Project (Indonesia)
Unit prices : [20], [21], [22], [26]

TABLE 3.16 : CONSTRUCTION COSTS OF SEWERS PER METER VS. DIAMETER
(at 1.5 m depth, December 1988)

Diameter sewer (mm)	Costs (Rp/m, exclusive 10 % V.A.T.)					
	Material	Digging	Laying	Reinstate-ment road	Manholes	Total
100	6,891	3,938	4,100	10,000	14,443	39,462
150	14,675	4,243	4,950	11,000	14,443	49,311
200	24,052	4,547	5,800	12,000	14,443	60,841
250	36,788	4,850	6,650	13,000	14,443	75,731
300	58,596	5,154	7,500	14,000	14,443	99,693
400	105,363	5,762	9,200	16,000	14,443	150,768

Notes : see table 3.17, Based on : see table 3.17

TABLE 3.17 : CONSTRUCTION COSTS OF SEWERS PER METER VS. DIAMETER
(at 3.0 m depth, December 1988)

Diameter sewer (mm)	Costs (Rp/m, exclusive 10 % V.A.T.)							
	Material	Digging	Laying	Reinsta-ment road	Manholes	Dewater-ing	Trench shutter-ing	Total
	a	c	c	c,d	b	e	e	
200	24,052	8,806	5,800	12,000	21,768	10,000	6,000	88,425
250	36,788	9,402	6,650	13,000	21,768	14,000	10,000	111,607
300	58,596	9,998	7,500	14,000	21,768	18,000	14,000	143,862
400	105,363	11,191	9,200	16,000	21,768	21,000	17,000	201,521
500	140,917	12,383	10,900	18,000	30,000	24,000	20,000	256,200
600	176,159	13,576	12,600	20,000	30,000	28,000	23,000	303,335
700	222,000	14,769	14,300	22,000	30,000	31,000	26,000	360,069
800	252,000	15,961	16,000	24,000	30,000	35,000	29,000	401,961

Notes : a) Construction material : $\phi \leq 300$ mm : PVC, $400 \leq \phi \leq 600$ mm : Asbest Cement, $\phi \geq 700$ mm : Steel
b) 1 manhole per 40 m sewer, price manhole cover : Rp 275,000
c) Width of sewer trench (mm) = 400 + diameter sewer
d) Reinstatement costs road : 20,000 Rp/m^2
e) Shoring and dewatering of sewer trenches may be necessary if depth $\geq$ 3 m

Based on : PVC +ACP pricelists, Unit prices Public Works [20], [21], [22], [24], [25], [26]
Costs of dewatering and trench shuttering from [38]
Costs of manholes from [29]

TABLE 3.18 : INVESTMENT COSTS OF CONVENTIONAL SEWERAGE PER DWELLING
(existing low/middle income area, December 1988)

No.	Item	Unit	Quantity	Unit Price (Rp)	Total (Rp/dwelling)
I	COMMUNAL SEWERAGE (in street) [a,c]				
	PVC pipe 200 mm	m	4.22	60,841	256,749
	PVC pipe 250 mm	m	0.34	75,731	25,748
	PVC pipe 300 mm	m	0.06	99,693	6,979
	PVC pipe 400 mm	m	0.38	150,768	5,982
			+		+
1	m sewer/dwelling	m	5.00		345,771
2	Pumping station				
a	Mechanical/electrical equipment				23,000
b	Civil works				6,667
3	O&M equipment + Office				8,667
4	10 % V.A.T. (on it 1-3)				38,411
5	15 % on costs (on it 1-4)				63,378
6	10 % interest on loan during constr (on it 1-5)				48,589
					+
	Subtotal I				534,482

TO BE CONTINUED

TABLE 3.18 (CONTINUED)

No.	Item	Unit	Quantity	Unit Price (Rp)	Total (Rp/dwelling)	
II	YARD - CONNECTION					
A	PVC-materials					
	T-Branch	unit	1	17,920	17,920	
	PVC pipe 100 mm [e]	m	5	6,891	34,454	
	Bend 100 mm	unit	1	6,329	6,329	
	T-piece 100 mm	unit	1	7,461	7,461	
	Cap 100 mm	unit	1	3,881	3,881	
						+
	Subtotal II A				70,046	
B	Other					
	Digging and laying pipe [c,e]	m	4	1,800	7,200	
	Joining PVC parts	unit	3	1,750	5,250	
	Construction inspection box	unit	1	2,300	2,300	
						+
	Subtotal II B				14,750	
C	Reinstatement works [c,d]					
	Road	m	0.8	10,000	8,000	
						+
1	Subtotal II A - II C				92,796	
2	10 % V.A.T. (on it 1)				9,280	
3	15 % on costs (on it 1-2)				15,311	
4	10 % interest on loan during constr (on it 1-3)				11,739	
						+
	Subtotal II				129,126	

TO BE CONTINUED

TABLE 3.18 (CONTINUED)

No.	Item	Unit	Quantity	Unit Price (Rp)	Total (Rp/dwelling)
III	HOUSECONNECTION				
A	PVC-Materials				
	PVC pipe to toilet (100 mm)	m	10	4,502	45,021
	PVC pipe for sullage connections (50 mm)	m	8	1,522	12,173
	Bend 100 mm (WC-connection)	m	1	6,329	6,329
	Floordrain bottom outlet (diameter 40 mm)	unit	1	10,150	10,150
	Kitchen sink outlet	unit	1	10,000	10,000
	Bend 100 mm	unit	1	6,329	6,329
	Bend 50 mm	unit	2	1,709	3,419
	T-piece (50 mm)	unit	1	3,465	3,465
	Reducing T (100-50 mm)	unit	1	11,920	11,920
	Reducing socket (50-40 mm)	unit	2	960	1,920
					+
	Subtotal III A				110,726
B	Other				
	Digging/laying 100 mm pipe [c]	m	10	1,800	18,000
	Digging/laying 50 mm pipe [c]	m	8	1,000	8,000
	Joining PVC parts	unit	8	1,750	14,000
					+
	Subtotal III B				40,000
C	Reinstatement works [c,d]				
	Footways (cement) outside [b]	m	2.2	2,866	6,369
	Floor inside (pipe 100 mm)	m	3.3	5,111	16,866
	Floor inside (pipe 50 mm)	m	8	4,600	36,800
					+
	Subtotal III C				60,035
					+
1	Subtotal III A - III C				210,761
2	10 % V.A.T. (on it 1)				21,076
3	15 % on costs (on it 1-2)				34,776
					+
	Subtotal III				266,613
	Total				930,221

TABLE 3.18 (CONTINUED)

Notes : a) the following distribution of the implemented local sewers in the pilot area in Sukasari (Tangerang) is assumed : 84.3 % 200 mm, 6.8 % 250 mm, 1.3 % 300 mm, 7.6 % 400 mm
b) length of reinstatement for footways = length of connection from inspection box to the toilet divided by 4.5
c) width of sewer trenches (mm) = 400 + diameter sewers
d) reinstatement costs cement footways (on the plot) = 5,772 Rp/m^2
reinstatement costs floors = 10,222 Rp/^{2}
these reinstatement costs include costs for demolition
e) is about half of the width of the street. However, in practice variation in this length is limited. Therefore, it is assumed to be constant for all areas

Based on : Quantities of project works, unit prices of Public Works and PVC pricelists [20], [21], [22], [25], [26], [29]
O&M equipment : [42]

TABLE 3.19 : INVESTMENT COSTS RUDIMENTARY SEWERAGE PER DWELLING
(existing low/middle income area, December 1988)

No.	Item	Unit	Quantity	Unit Price (Rp)	Total (Rp/dwelling)
I	COMMUNAL SEWERAGE [c]				
	PVC pipe 200 mm	m	2.70	60,841	164,270
	PVC pipe 250 mm	m	0.15	75,731	11,360
	PVC pipe 400 mm	m	0.15	150,768	22,616
			+		+
1	m sewer/dwelling [a]	m	3.00		198,246
2	CSD [b]	unit	0.03	500,000	15,000
3	Pumping station				
a	Mechanical/electrical equipment				23,000
b	Civil works				6,667
4	Office				6,667
5	10 % V.A.T. (on it 1-4)				24,958
6	15 % on costs (on it 1-5)				41,181
7	10 % interest on loan during constr (on it 1-6)				31,572
	TOTAL				347,290

Notes : a) 60 % of streets provided with sewers
b) 2 CSD's are constructed at both sides of the street every 200 meter
c) the following distribution of the implemented local sewers in the pilot area in Babakan Ujung (Tangerang) is assumed : 90 % 200 mm, 5 % 250 mm, 5 % 400 mm

Based on : Quantities of project works, unit prices of Public Works and PVC pricelists [20], [21], [22], [25], [26], [27]

TABLE 3.20 : TOTAL INVESTMENT COSTS CARROUSEL FOR 15,000 PEOPLE (Dec. '88)

No	Item	Costs (million Rp)	
		Total	For.Cur
I	EQUIPMENT		
1	Aeration basin	80	80
2	Settling tank	85	85
3	Sludge return unit	20	20
4	Sludge thickener	75	75
7	Electrical equipment	31	31
8	Laboratory equipment	18	18
9	Spare parts, tools	45	45
10	Transportation of equipment (it 1-9)	41	41
11	Installation and inspection equipment (on it 1-9) *	127	127
12	Power supply to site	7	
13	10 % V.A.T. on imported equipment (on it 1-11)	52	
14	2.5 % on costs (on it 1-13)	15	
15	10 % interest on loan during construction (on it 1-14)	60	52
	Subtotal I	658	575
II	CIVIL WORKS		
1	Aeration basin	85	
2	Settling tank	71	
3/4	Sludge return unit + sludge thickener	21	
5	Sludge drying beds	38	
6	Effluent canal 50 m	22	
7/8	Operation building	8	
16	Pipeworks	14	
17	Area development	31	
18	10 % V.A.T. (on it 1-17)	29	
19	15 % on costs (on it 1-18)	48	
20	10 % interest on loan during construction (on it 1-19)	37	
	Subtotal II	404	0
III	LAND (0.5 Ha)	149	
	TOTAL	1,211	575

Notes : design parameters : reduction in organic pollution : 95 %, wastewater flow : 2,250 m^3/day (750 kg BOD/day)
: * Costs and profit for contractor are included
Based on : Contracts Botabek Project [28], [31], [32], Landprices [19]

TABLE 3.21 : OPERATION AND MAINTENANCE COSTS CONVENTIONAL SEWERAGE
(For 15,000 people, December 1988)

No.	Item	Unit	Quantity	Unit Price (1000 Rp)	Total (million Rp)
I	OPERATION				
1	Personnel [a,b]	employee	5	1,200	6.0
2	Administration expenses				5.4
3a	Electrity connection pump.stat	KVA	20	25	0.5
3b	Electricity cons pump.stat	KWh	19,000	0.044	0.9
4	Fueling and maintenance vehicles	vehicle	1	6,000	6.0
II	MAINTENANCE				
1a	Manhole covers				5.4
1b	Civil works (without 1a)				5.9
2	Mech/El equip pump.stat				1.5
	TOTAL				31.6

Notes : - for a system serving 3000 dwellings/15000 people in a mixed area (40 % area type 1, 60 % area type 4)
a) O&M tasks : cleaning (choked) pipes, manhole cleaning and small repairs
b) 3 labourer and 2 overhead

Based on : O&M requirements sewerage in other countries and unit prices in Indonesia [23], [35]

TABLE 3.22 : OPERATION AND MAINTENANCE COSTS RUDIMENTARY SEWERAGE
(For 3,000 people, December 1988)

No.	Item	Unit	Quantity	Unit Price (1000 Rp)	Total (million Rp)
I	OPERATION				
1	Personnel	employee	5	1,200	6.0
2	Administration expenses				2.5
3	Electrity pumping station				0.3
II	MAINTENANCE				
1a	Manhole covers				0.7
1b	Civil works (without 1a)				0.6
2	Mech/El equip pump.stat				0.3
	TOTAL				10.4

Notes : a) for a system serving 600 dwellings/3000 people in area type 4
b) operation and maintenance include cleaning of CSD boxes and drains
c) 4 labourer and 1 overhead

Based on : estimations O&M requirements, unit prices in Indonesia

TABLE 3.23 : OPERATION AND MAINTENANCE COSTS CARROUSEL
(For 15,000 people, December 1988)

No.	Item	Unit	Quantity	Unit Price (1000 Rp)	Total (million Rp)
I	OPERATION				
1	Personnel	employee	4	1,200	4.8
2	Administration expenses				1.4
3a	Electrity connection	KVA	66	25	1.6
3b	Electricity consumption	KWh	230,000	0.044	10.0
II	MAINTENANCE				
1	Civil works				1.3
2	Mech/El equipment				8.3
	TOTAL				27.4

Notes : a) for a treatment plant with capacity 15,000 i.e.
b) major part (90 %) of electricity is consumed by the rotors; calculation of electricity consumption is based on an organic pollution of 50 gram BOD per capita per day.
c) 3 labourer and 2 overhead

Based on : O&M requirements in other countries, design data and unit prices in Indonesia [2], [23], [33]

ANNEX 3 : ESTIMATION OF HOUSEHOLD INCOME IN URBAN BOTABEK

Data about the income distribution in urban Botabek are not available. Therefore, the income distribution in this area is estimated in another way.

The household expenditures distribution is used as proxy of the income distribution. Distributions of household expenditures in urban areas are given for the different Indonesian provinces in the 1984 and 1987 BPS yearbooks [10,11].

It is found that these distributions are principally determined by the average household income.

In 1984, the average household income in urban Botabek was determined by Haskoning [14], so that the distribution for 1984 is fixed. This distribution has been brought to price level December 1988 by accounting for inflation (35.2 % in the period 1984-1988) and net income growth (this growth was 1.44 % per year in urban Indonesia in the period '84-'87, the same growth is assumed in urban Botabek in the period '84-'88). This growth is assumed to be equal for all income classes.

The average calculated monthly household income in December 1988 is 180,000 Rp.

ANNEX 4 : METHODOLOGICAL ISSUES OF SOCIAL ANALYSIS

1. Selection Procedure Not Sewered Area

The following procedure is applied to select a non sewered area in Tangerang :

- from population data of the Central Statistical Office in Tangerang 2 potential not sewered desa's (Gerendeng and Sukarasa) have been selected on the basis of population density
- an impression of the income profile and sanitary conditions in these desa's have been obtained in field visits. The conditions in Sukarasa seem to be more representative for the conditions in Sukasari before it was sewered than those in Gerendeng. For this reason Sukarasa has been selected. (the low income desa Gerendeng is located near the Cisadane river. A large percentage of the people living in this desa still defecate, wash and bath in the river, in contrast to Sukarasa).
- About 25 ha out of the total desa area of 140 ha has been selected (This area is bound by the following streets: Jalan Ki Asnawi, Daan Mogot, H.Embang Jaya, Satria; Excluded are the commercial areas, the unurbanized areas and a low income area near the Cisadane river).

2. Sampling Procedure

The surveyed households have been selected by the following procedure :

survey group 1 (Households with a house connection to the sewerage in Sukasari) :

Households have been selected at random from contractor's registrations of house connections (toilet connections). Half of the respondents are taken from first phase implementation (1982-1985) and half of second phase implementation (1987/1988)

survey group 2 (Households without a house connection to the sewerage in the sewered areas of Sukasari) :

Sewered streets (or block of streets) have been selected at random (taken into account the length of the street; for example the chance of selecting a street of 200 m length is two times as much as the chance to select a street of 100 m length). Next number of the dwellings in the selected streets have been collected. The households without house connections to the sewerage system could be identified with the help of the registration of the house connections. Per street 5 households have been selected at random.

survey group 3 (Households with house connections to the sewerage in the Perumnas area) :

The map of this area (including all streets in the Perumnas area) has been divided into 60 blocks. Next, 13 blocks have been selected at random. In each block 2 streets (taken into account the length of the streets) and per street 3 households have been selected at random from the collected housenumbers.

survey group 4 (Households in not sewered district (i.e. part of the desa Sukarasa) :

Comparable with selection in group 3

In the survey it appeared that not all data from contractor's registration are accurate; 13 % (13 out of 101 HH) of the selected respondents in group 1 don't have a house connection, while ca.30 % of the selected respondents in group 2 have a house connection.

3. Sample size

Assuming a normal distribution of the results, the incaccuracy of the results is expressed in the following formula (reliability is assumed to be 95 %) :

$$\text{inaccuracy} = 1.96 * \sqrt{((1-n/N)*p*(1-p)/n)}$$

in which,

n = sample size
N = size of the population
p = fraction of the respondents, scored on an answer choice

As N >> n, $\text{inaccuracy} = 1.96 * \sqrt{(p * (1 - p)/n)}$

The selected sample sizes of the survey groups have been based upon the tolerant inaccuracy of the results and the available budget for the survey. In the selection of this inaccuracy the stage of the Botabek project and of implementation of sewerage facilities in Indonesia have been taken into account.

Table 5.2 (in the text) includes the households surveyed. The inaccuracy in the answers is about 10-15 %, which is acceptable to find the tendency of the answers.

4. Design of Questionnaire

Basically the survey has to find answers to a number of questions regarding the functioning, appreciation and costs of /or willingness to pay for water sources and sanitation facilities. Besides it has to find relations between these variables (possible relations are described in the theoretical models), so that results can be comprehend.

Obtaining answers to these questions is possible with a number of techniques (e.g. in-depth interviews, structured interviews). However, the choice is limited by the manpower constraints and the need to produce usable outputs. Therefore, the community survey has been done on the basis of questionnaires administered by surveyors to randomly selected respondents. This implies that the questionnaire has to enable relatively inexperienced surveyors to ask relevant and clear questions to the respondents. Due to this, a questionnaire has been designed which contains mainly closed answer categories. The structure of the questionnaire is designed in such a way that to different type of respondents specific questions are asked. The structure of the community survey questionnaire is visualized in figure 5.7.
In this figure the introduction and closing of the questionnaire is not shown. In the introduction the surveyors introduce themselves to the respondents. Besides, it is checked if the survey group is right. If this is not the case the interview should not be executed.

After the introduction, the respondents are asked some questions about household characteristics and housing.

Section 2 of the questionnaire is about water supply. Respondents are differentiated into two groups :
- users of piped water (PDAM customers)
- users of other water sources

The first group is asked specific questions about their experience as PDAM customer, their apprecation for the service they receive, the cost of the service and about the use of other sources. The second group is asked about their water source and their interest to become PDAM customer.
Insight in the use of water resources is required in order to relate the use of water with the present and projected production of waste water and for assessment of the functioning of sewerage systems.

Section 3 is about the functioning and appreciation of the drainage system.

The fourth section is about sanitation facilities. In this section respondents are differentiated into users of on-site

sanitation facilities (survey group 2 and 4) and users of sewerage facilities (survey group 1 and 3).

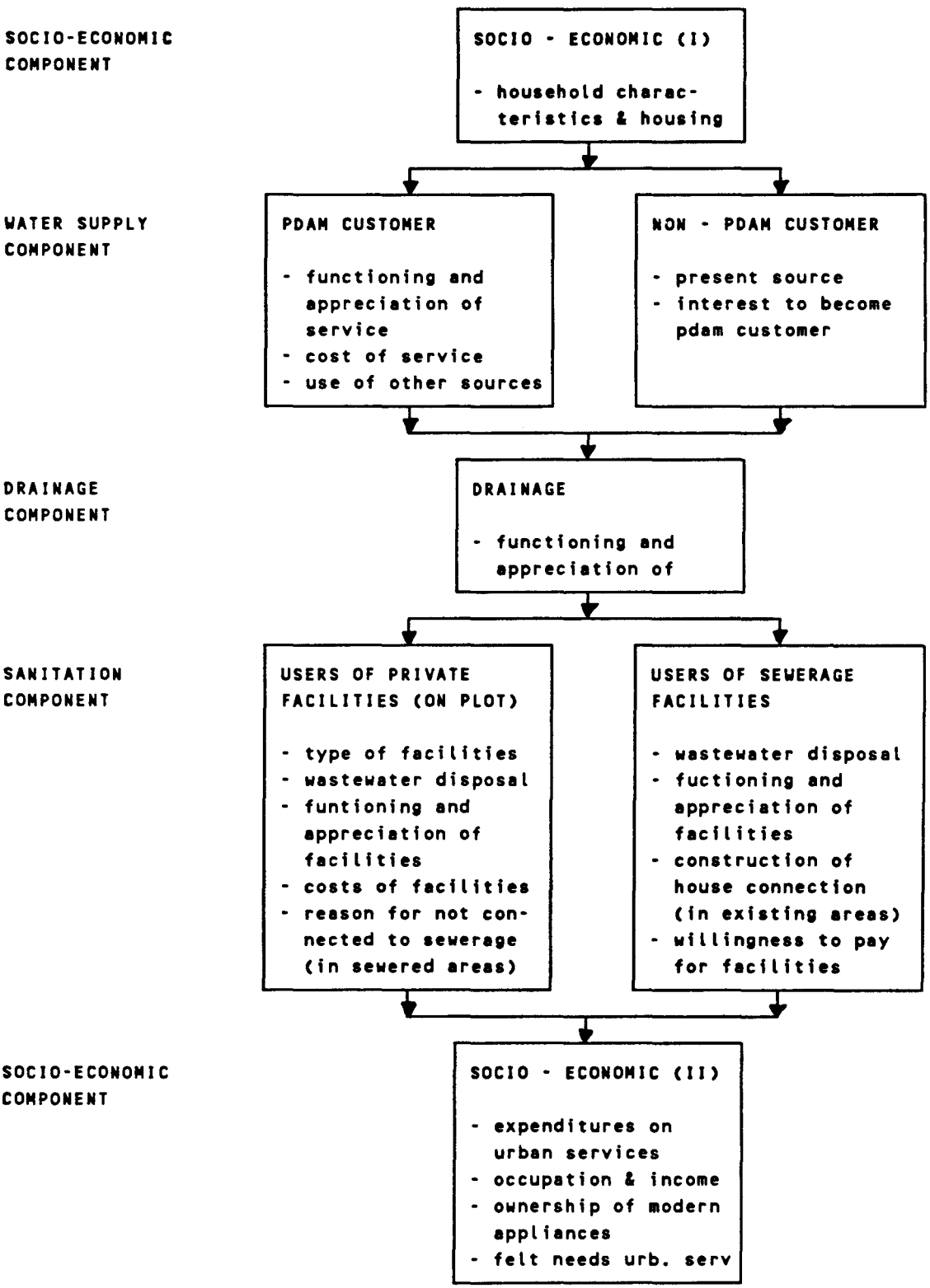
The first group is asked questions about the functioning, appreciation and costs of the on-site sanitation facilities. Next, the respondents in Sukasari which have not been connected to the sewerage system are asked about the reasons for this. The respondents using on-site sanitation facilities are also asked about their interest in a sewerage connection.

The respondents who use sewerage facilities are asked about the functioning and appreciation of their facilities.
Special attention is given to the construction of the house connection due to the disappointing results with respect to this in sewerage projects in Indonesia (most projects are characterized by a low percentage of sewer connections). The questions with respect to the house connections are only asked in the Sukasari area, as in the Perumnas area house connections have been included in the dwellings.
Next, users of sewerage facilities are asked about their willingness to pay for the operation and maintenance of the system.

The first and fifth section of the survey focuses on the socio-economic background of the repondents. The socio-economic module has been incorporated in the survey for understanding answers of questions in the previous sections. Special attention is given to income, expenditures and felt needs. The socio-economic module has been split up into two parts; questions with respect to income and expenditures are put at the end of the interview to prevent that respondents may become reluctant in an early stage. Questions with respect to felt needs are appropriate for closing the interview.
It is always difficult to obtain reliable income data from respondents. Therefore other indicators about the socio-economic status of the respondent's family are obtained by gathering data about the housing situation and the ownership of a number of modern appliances. With the above mentioned information it is possible to derive an accurate socio-economic typology of the respondents.

A sample questionnaire for the community survey is included in annex 5 of this report.

FIGURE 5.7 : STRUCTURE OF THE QUESTIONNAIRE



5. Data Processing and Analysis

For the processing of the data a computer programme was developed at DHV Amersfoort. This programme was split up into two parts :
- a programme for the input of the data
- a programme for the analysis of the data

The format of the output tables constructed by the programme already has been discussed in paragraph 5.1. In these cross table two variables are plotted (in many cases one of these variables is the survey group).

The variables in this programme are classified into 4 groups (on the basis of the 4 sections in the survey questionnaire) :
- water supply variables
- drainage variables
- sanitary variables
- socio-economic variables

Between the variables within each group inter-relations may be found by the computer programme. Besides inter-relations between the water supply/drainage/sanitary variables and the socio-economic variables may be found by the programme.

Scores of clusters of respondents with similar characteristics may be obtained (by the programme) by one or two successive selection(s) of certain scores of the variables (e.g. table 5.40 present the monthly expenditures on PDAM water by PDAM users with an income < 100,000 Rp/month. To obtain this table a selection on the variables "having PDAM connection" and "household income" is required).

Further the programme has one particular variable : "the interviewer code". Bias of a surveyor may be determined by analysis of the answers per surveyor.
In general, the answers obtained per surveyor are not significantly different.

7. Organization of the Survey

Activities are summarizied in fig. 5.8.

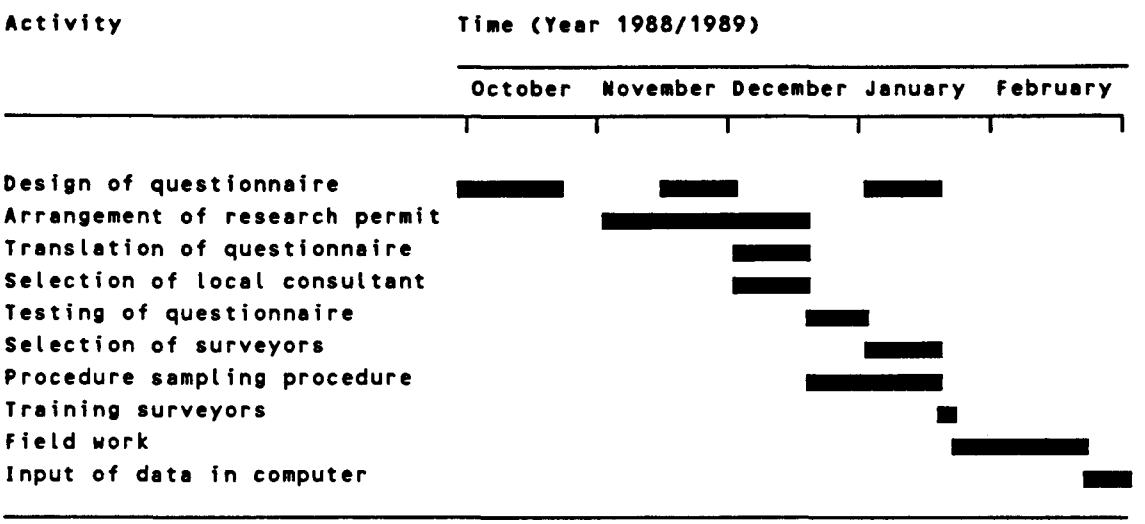
A draft version of the questionnaire was designed in October/November 1988. This version was sent to the supervisors of the Eindhoven University of Technology. This was also discussed with the supervisor at DHV. On the basis of the comments the draft version has been improved . Next, the questionnaire has been translated into Bahasa Indonesia. At the same time a local consultant has been selected. Main taks of local consultant were testing of the questionnaire, selection of surveyors and supervision of surveyors in the field. After the test of the questionnaire (sample size : 8 households; 2 in each survey group) a final version of the questionnaire (for the field work) has been designed (4 separate versions have been made for the 4 survey groups).
Also 5 senior university students of the Economic Faculty of the National University (at Jakarta) have been selected by the local consultant and the author. A training of two days was given by an experienced trainer (from Surabaya), familiar in the field of water supply and sanitation. In the training the questionnaire was explained. At the end the surveyors had to act in a role-play for practical application of what they have learned. Next, the field work started. After the first and second interview a session in the field was held to discuss the mistakes made by the surveyors. After that it had been ensured that the surveyors were ready for the job, 5-7 addresses and a map had been provided to each of them. New adresses were provided for the surveyors after checking the filled in questionnaire upon consistency and completeness. The local consultant supervised each surveyor several times during their work, to check if they did the job properly. Before starting with another survey group, a short refresher course was given.

The surveyors were instructed to meet the head of the household or the housewife (if the head was not at home); the other occupants of the household were not allowed to respond. If the head of the household or the housewife after trying three times on two different days had not been met, the interview had been cancelled. The non-response (by absence) was < 10 %.

If more households live in one dwelling unit, all households in this dwelling were interviewed.

Full support from the local government, the kelurahans and also the selected households were in general very cooperative. This support contributes considerably to the results of the survey.

FIG. 5.8 : ACTIVITY SCHEDULE OF THE SURVEY



ANNEX 5 : QUESTIONNAIRE SOCIAL SURVEY

IDENTIFICATION SHEET

Surveyor — Name : _____

Interview — Date : _____
Time : _____

(Select head of the household or his wife)

Respondent — Male/female
Name : _____
Adress : Jalan _____
RW : __ RT : ___

Group : ¦_____¦

Sukasari, with a house connection to sewerage =1
Sukasari, without a house connection to sewerage =2
Perumnas area, with a house connection to sewerage =3
Sukarasa/not sewered district =4

Note : Check if the group is right, especially in the case of group 1 and 2.
If not, cancel the interview.

Questions to filled in by the surveyor

Drainage :

YES = 1 NO = 2

Solid waste in drain ¦_____¦
Stagnant wastewater ¦_____¦

Sewerage : (Only for respondent group 1)

Yard connection : ¦_____¦
no yard connection =0
since 1982 =1
since 1987/1988 =2

SURVEY GROUPS

Group 1 : Households with a house connection to the sewerage in Sukasari

Fill in the following modules :

1	Social economic
2.1	Watersources and wateruse, general
2.2 or 2.3	PDAM users or not PDAM users
3	Drainage
4.1	Type of toilet and wastewater disposal
4.3.1	Sewerage, Functioning and appreciation
4.3.2	Sewerage, Sukasari : House connection construction by households
4.3.3	Sewerage, Sukasari : Connection of bathroom and kitchen
4.3.4	Sewerage, Willingness to pay

Group 3 : Households with a house connection to the sewerage in the Perumnas area

Fill in the following modules :

1	Social economic
2.1	Watersources and wateruse, general
2.2 or 2.3	PDAM users or not PDAM users
3	Drainage
4.1	Type of toilet and wastewater disposal
4.3.1	Sewerage, Functioning and appreciation (excl. questions 4.14 + 4.15)
4.3.4	Sewerage, Willingness to pay

Group 2 + 4 : Households without a house connection to the sewerage in Sukasari

and households in not sewered districts

Fill in the following modules :

1	Social economic
2.1	Watersources and wateruse, general
2.2 or 2.3	PDAM users or not PDAM users
3	Drainage
4.1	Type of toilet and wastewater disposal
4.2	Pits and septic tanks

MODULE 1 : SOCIAL ECONOMIC

1. 1 How many people usually live here and eat together in this household, counting all adults, children and infants ?

No of people : ¦_____¦

1. 2 How many households are living in this dwelling unit ?
By household is meant those who usually live and eat here together.

No of household(s) : ¦_____¦

1. 3 Since how many years you are living in this house ?

No of years : ¦_____¦

1. 4 Who is the owner of the house ?

owned by household	=1	¦_____¦
owned jointly with non-household member	=2	
house of employer or government	=3	
house of relatives,friends, etc.	=4	
other	=5	

1. 5 What is the approximate size of the dwelling ?
(if not known, the interviewer must estimate it)

¦_____¦

0 - 19 sq m	=1
20 - 39 sq m	=2
40 - 59 sq m	=3
60 - 79 sq m	=4
80 - 99 sq m	=5
> 100 sq m	=6

MODULE 2 : WATERSOURCES AND WATERUSE

SUB-MODULE 2.1 : GENERAL

2. 1 a Is piped water supply in this street ?
Do you have a PDAM water supply connection now ?

have connection	=1	¦_____¦
no connection, piped water supply in street	=2	
no connection,no piped water supply in street	=3	

b Do you use PDAM water from your neighbour's PDAM connection ?
YES = 1 NO = 2

¦_____¦

2. 2 a Which of the following watersources you (also) use ?
Is this source for the exclusive use of the household or shared with other households ?

Well with handpump (or bucket)		
Dugwell with electrical pump (Sanyo)		

not used =1
used, for exclusive use of household =2
used, shared with other households =3

b Do you also use water from the river for washing,bathing or other purposes ?
YES = 1 NO = 2

2. 3 From which source you get mainly your water for

a.drinking	
b.cooking	
c.washing clothes	
d.washing dishes	
e.bathing	

PDAM water =1
Well with handpump =2
Dugwell with electrical pump (Sanyo) =3
River =4

SUB-MODULE 2.2 : PDAM WATER USERS

2. 4 Is the following quality item of PDAM water good ?
YES = 1 NO = 2

Taste	
Smell	
Clean	

2. 5 a How many hours water is supplied a day ?

< 6 hours	=1	
6 - 10 hours	=2	
11 - 14 hours	=3	
15 - 19 hours	=4	
20 - 24 hours	=5	

b Do you receive enough water a day ?
YES = 1 NO = 2

2. 6 Do you boil PDAM water before drinking ?
YES = 1 NO = 2 _____

2. 7 Do you daily use other sources besides PDAM water ?
YES = 1 _____
NO = 2 ----------› 2.9

2. 8 (Only for those who use other sources daily)

Why do you use these other sources for mentioned purpose _____
more suitable for these purposes =1
cheaper =2
PDAM water not enough =3

2. 9 How much you monthly pay for your PDAM water supply ? _____
0 - 1999 Rp/month =1
2000 - 3499 Rp/month =2
3500 - 4999 Rp/month =3
5000 - 7499 Rp/month =4
7500 - 9999 Rp/month =5
› 10000 Rp/month =6

2.10 (Not for respondents in the Perumnas area)

Which of the following reasons was the most important reason for taking a PDAM connection ; Was that because of convenience of PDAM water or healthier or better quality (taste,smell,cleanness) ?

Convenience of PDAM water =1
Healthier =2
Smell/taste/cleanness better =3

most important reason : _____

2.11 Are you in general satisfied with the service of the PDAM water supply ? _____
YES = 1 NO = 2

SUB-MODULE 2.3 : NOT-PDAM WATER USERS

2.12 Do you boil well water before drinking ?
YES = 1 NO = 2 _____

2.13 I At present the connection fee = 5 monthly installments of Rp 35000 (total 175000 Rp). In case, that the monthly waterbill will be about 3000 Rp/month (350 l/day).

Would you like to become a PDAM customer now under these conditions?
YES = 1
NO = 2

Alternative I _____

2.14 And would you like to become a PDAM customer ?
II if the connection fee = 5 yearly instalments of Rp 40000 monthly waterbill = 3000 Rp (financing period 12 times longer)
III if the connection fee = 5 monthly instalments of Rp 18000 monthly waterbill = 3500 Rp (connection fee two times cheaper, monthly payments a little bit increased)

YES = 1 NO = 2

Alternative II _____
Alternative III _____

MODULE 3 : DRAINAGE

3. 1 Who maintains the drain ?

the people in the living area	=1	¦_____¦
local government	=2	
nobody	=3	

3. 2 Do you have reasons not to be satisfied with the drainage system in this street because of (more than one reason is possible)
YES = 1 NO = 2

regular get flooded	¦_____¦
solid waste in it	¦_____¦
stagnant wastewater in it	¦_____¦
regular bad smell	¦_____¦
children play in the drains with dirty water	¦_____¦

3. 3 Are you in general satisfied with the drainage system in this street ?
YES = 1 NO = 2

¦_____¦

MODULE 4 : SANITARY FACILITIES

SUB-MODULE 4.1 : TYPE OF TOILET AND WASTE WATER DISPOSAL

4. 1 What type of toilet you use ?

WC for exclusive use of household	=1	¦_____¦
WC shared with less than 4 households	=2	
Latrine for exclusive use of household	=3	---> fill in first 4.4, then go to 1.6
Latrine shared with other households	=4	.
other,specify _____	=5	.
no toilet,river,field	=6	.

4. 2 Do you flush your toilet automatically (rinsing tub) or with a bucket of water ?

automatic (rinsing tub)	=1	
with bucket of water	=2	¦_____¦

4. 3 Which of the following wastewater disposal systems you use ?
(Show drawing of septic tank and pit (see p. III.19), since confusion of tongues between these systems exist)
YES = YES NO = NO DON'T KNOW = ?

supporting questions to identify if system is pit or septic tank :

s1 Where is the water leaving your system going to ?

to the drain	=1	¦_____¦
discharged on surface	=2	
discharged underground	=3	

s2 How many number of units your system have, 2 or 1 ?
number _____

s3 Is the first unit watertied ? YES/NO

Fill in the code for the wastewater dispoasal system according to the coding table

none of them	=0	---› fill in first 4.4, then go to 1.6
pit	=1	
septic tank	=2	
sewerage	=3	
don't know	=4	

Wastewater disposal system ¦_____¦

4. 4 Where is the following wastewater discharged/going to ?
(Ask explicite if the following wastewater disposal is discharged to the mentioned wastewater disposal system)

FROM

a. Toilet		¦_____¦
b. Bathing		¦_____¦
c. Cooking		¦_____¦
d. Washing dishes		¦_____¦
e. Washing clothes		¦_____¦
to the sewer	=1	
directly to the drain	=2	
to the septic tank	=3	
to a pit ('cubluk')	=4	
directly to the open field	=5	
bathing/washing in river	=6	
do not know/not sure	=7	

SUB-MODULE 4.2 : PITS + SEPTIC TANKS

4. 5 In which year your system was constructed ?
year : _____

a (Only for those who have a pit)
What do you do if the pit is full ?
construct another one =1
empty it =2
never been full =3

- if answer 1 or 3 go to e

b How frequent your system have to be emptied ?
one time per 1 - 2 year =1
one time per 3 - 4 year =2
one time per 5 - 7 year =3
one time per 8 - 11 year =4
less than one time per 12 year =5
system constructed less than 12 years ago and never been emptied =0

c In case of emptying, who is emptying it ?
yourself =1
contractor =2
friends =3

d How much emptying cost each time ?
amount in Rp :

e Who constructed the pit/septic tank ?
yourself =1
contractor =2
friends =3

f How much construction will cost you now?
amount in Rp :

Year of construction : _____
Construction cost (1989) = _____ * _____ = Rp. _____
(cost year of construction * inflation correction)
(the interviewers have the inflation correction factors)

g Do you think that construction of septic tank/pit (your system) is expensive ?
YES = 1 NO = 2

h Do you think that operation and maintenance costs of your system are high ?
YES = 1 NO = 2

4. 6 Do you have the following problem with your system (septic tank/pit) ?
If 'yes' how many times this problem takes place ?

overflow of toilet/blockages	
bad smell	

no problems	=0
< 1 time a year	=1
1-4 times a year	=2
> 4 times a year	=3

4. 7 a Do you think that your system is
YES = 1 NO = 2

healthy	
convenient	

4. 8 (Only for respondents in the sewered areas of Sukasari)

For what reasons you have not been connected to the sewerage system ?

Was that because of (more than one reason is possible)
YES =1 NO = 2

cost of connection (reinstatement cost)	
you already had a proper system	
uncertainty about payments coming	
uncertainty about functioning	
inconvenience of building	
other, specify _____	

4. 9 a Do you know what is a sewerage system ?
YES =1
NO =2 ----> go to 1.6

- if 'known' fill in 4.13 (for past used system fill in 'present used system) and then question b
(people in Sukasari without sewerage connection have to fill in 4.13 + b)

b Do you want sewerage ?
YES =1 NO = 2

SUB-MODULE 4.3 : SEWERAGE

SUB-SUB MODULE 4.3.1 : FUNCTIONING + APPRECIATION

4.10 Is rainwater from the plot discharged to the sewer ?
(if 'yes', check it)
YES = 1 NO = 2 ¦_____¦

4.11 a Since you have the sewer connection, have you had the following problem with the sewer ? If 'yes' how many times this takes place ?

no problems	=0
< 1 time a year	=1
1-4 times a year	=2
> 4 times a year	=3

overflow from WC	¦_____¦
blocking of sewer on the plot/difficulties with discharging wastewater	¦_____¦
overflow inspection pits in the street	¦_____¦

b (Only if 'overflow' of toilet or inspection pits takes place)

Does this problem especially take place in rainy situations ?

YES = 1 NO = 2 DON'T KNOW = 3 no problems = 0

overflow from WC	¦_____¦
overflow inspection pits	¦_____¦

c (Only if 'overflow' of toilet or inspection pits takes place)

How long this problem takes each time ?

no problems	=0
< 1 hour	=1
1-3 hour	=2
> 3 hour	=3

overflow from WC	¦_____¦
overflow inspection pits	¦_____¦

4.12 (Explain first that in the last question was w.r.t. possible problems with sewerage, ask then :)

Are you in general satisfied with the functioning of the sewerage system ?
YES =1 NO = 2 DON'T KNOW = 3 ¦_____¦

4.13 Do you have the opinion that
YES = 1 NO = 2

a sewerage is more convenient; septic tank/pit doesn't have to be emptied anymore ¦_____¦
(for respondent group 3 : sewerage is convenient)

b construction cost of sewerage per dwelling (incl. yard and house connections) is cheaper than construction costs of septic tanks/pits ¦_____¦

c cost to operate and maintain the sewerage system is cheaper than that of septic tanks/pit ¦_____¦

d sewerage is healthier than pits/septic tanks ¦_____¦
(for respondent group 3 : sewerage is healthy)

e sewerage is modern ¦_____¦

4.14 (Only for respondents in Sukasari/group 1)
Before you had the sewer , did you have the following wastewater disposal system ?
(Show drawing of septic tank and pit (p. III.19), since confusion of tongues between these systems exist)
YES = YES NO = NO DON'T KNOW = ?

(see supporting questions under 4.3)

Fill in the code for past used wastewater disposal system according to the coding table

none of them	=0
pit	=1
septic tank	=2
don't know	=4

Past used wastewater disposal system ¦_____¦

4.15 (Only for respondents in Sukasari/group 1)
a What do you prefer the past used system (septic tank,pit) or sewerage or would it make no difference for you ?

prefer sewerage	=1	¦_____¦
prefer septic tank/pit	=2	
no difference	=3	

b (Only if sewerage is prefered)
What is the most important reason that you prefer sewerage ?

¦_____¦

more convenient; septic tank/pit doesn't have to be emptied anymore	=1
cheaper than past used system; septic tank/pit doesn't have to be emptied anymore	=2
is healtier	=3
is modern	=4
other, specify _____	=5

SUB-SUB MODULE 4.3.2 : SUKASARI : HOUSE CONNECTION CONSTRUCTION BY HOUSEHOLDS

(Only for respondents who got a yard connection during first phase implementation (around 1982)
(Explain about this connection)

4.17 Was it said to you that you could make connections with the yard-connection for discharging the wastewater of toilet,bathroom,kitchen etc. on your own costs ?
YES = 1 NO = 2

4.18 Did you make connections at your own costs (so by themselves, not by the project in 1985) ? If 'yes', which ?

no connections	=1
only toilet connections	=2
toilet and other connections	=3

- if '2' go to module 4.3.3
- if '3' go to module 4.3.4

4.19 Why you did not make connections by yourself ?

Was that because of (more than one reason is possible)
YES =1 NO = 2

cost of connection	
you already had a proper system	
uncertainty about payments coming	
uncertainty about functioning	
believe government should do it (later on)	
don't had clear view how to construct	

SUB-SUB MODULE 4.3.3 SUKASARI : CONNECTION OF BATHROOM AND KITCHEN

4.20 Was it said to you, when the toilet connection was constructed that you also could connect the wastewater from the kitchen, bathroom etc. with this connection ?
YES = 1 NO = 2 ¦_____¦

4.21 Why you did not connect the wastewater from the kitchen, bathroom with the sewerage system ?
Was that because of (more than one reason is possible)
YES =1 NO = 2

cost of connection ¦_____¦
you already had a proper system for discharge of wastewater from kitchen,bathroom ¦_____¦
uncertainty about functioning ¦_____¦
did not know that this was allowed/possible ¦_____¦

4.22 (Explain health benefits sewerage and possibility and allowance to make this additional connections)
a When you hear this, would you make these connections/this connection if it will cost you Rp 100000 ?
YES = 1 NO = 2 ¦_____¦

b And if you can pay this in three yearly instalments of Rp 35000 ?
YES = 1 NO = 2 ¦_____¦

- if answer of question a or b is 'yes' go to module 4.3.4

4.23 Why you do not want to connect the wastewater from the kitchen / bathroom with the sewerage system ?
Is that because of (more than one reason is possible)
YES =1 NO = 2

cost of connection ¦_____¦
you already have a proper system for discharge of wastewater from kitchen / bathroom ¦_____¦

SUB-SUB MODULE 4.3.4 : WILLINGNESS TO PAY

Instruction : Explain that in case everyone discharges all his wastewater to the sewerage, no wastewater is discharged to the drainage system anymore and no possible pollution of groundwater takes place anymore.
For a proper functioning of the sewerage system it must be operated and maintained well by an organization.

4.24 Do you think it is reasonable that you pay for operation and maintenance of sewerage,since you discharge wastewater on it ?

YES = 1 NO = 2 ¦_____¦

4.25 Are you willing to pay 3000 Rp per month for this sewerage-connection ?
Group 1 : in case you can discharge all wastewater to it and of a proper operation and maintenance of the system
Group 3 : in case you have no troubles in rainy season anymore and of a proper operation and maintenance of the system

YES = 1 ------> go to 1.6 ¦_____¦
NO = 2

4.26 Are you willing to pay 1500 Rp per month for this sewerage-connection ?
YES = 1 NO = 2 ¦_____¦

4.27 Why you don't want to pay for sewerage / pay more than the just mentioned amount ? Is that because of (more than one reason is possible)
YES = 1 NO = 2

can't afford that amount ¦_____¦
not satisfied with it ¦_____¦
want to spend/need my money for other things ¦_____¦
a pit or septic tank is cheaper/freely available ¦_____¦
the government should pay more ¦_____¦
other, specify _____ ¦_____¦

4.28 (Only for those who have the opinion that the government should pay (more))

Why do think that the government should pay (more) ?
government always pays these kind of projects =1 ¦_____¦
initiative came from the government =2
already paid tax =3
other, specify _____ =4

MODULE 1 : SOCIAL ECONOMIC (CONTINUED)

Select as respondent principal income earner or head of the household

1. 6 How much money your household pay monthly for the following items ? (recalculate)

payments (taxes) to local government	¦_____¦	Rp
payments to RW/RT	¦_____¦	Rp
rent of house	¦_____¦	Rp
solid waste collection *	¦_____¦	Rp
electricity (to PLN)	¦_____¦	Rp

* if included in payments to RW/RT or local government fill in '1' if nothing is paid fill in '0'

1. 7 How much money your household spend totally a month ? (codes see question 1.8.c) ¦_____¦

1. 8 a What is the present occupation of the head of the household ?

agriculture	=1	
mining and excavation	=2	
industry	=3	¦_____¦
construction	=4	
trade	=5	
transport and communication	=6	
government and defence	=7	
services	=8	
pensioned	=9	
unemployed	=0	

b How many household members earn a regular income in money ?

no of persons : ¦_____¦

1. 8 c (Record the household members in the first column)

How much money each member earns average monthly ?

member 1 (head of household)	_____	Rp
member 2	_____	Rp
member 3	_____	Rp
	==========	+
total cash household income	_____	Rp

Fill in the codes for the total cash household income and the income of the head of the household according to this coding table

cash income of head of the household	
total cash household income	

0 -10000		= 5
10001-20000	Rp	= 15
20001-40000	Rp	= 30
40001-60000	Rp	= 50
60001-80000	Rp	= 70
80001-100000	Rp	= 90
100001-125000	Rp	=110
125001-150000	Rp	=140
150001-200000	Rp	=160
200001-300000	Rp	=250
300001-500000	Rp	=400
>500000	Rp	=600
don't know		=0

1. 9 Do you own any of the following items ?
YES = 1 NO = 2

Radio	
TV	
Sepeda motor	
Mobil	
Video-recorder	

FELT NEEDS

Instruction : Recapitalize that the interview incluced questions with respect to water supply, drainage and wastewater disposal in the present situation. Say, you will finish with a question on services which the household want to see improved. Mention then the following improvements :

- water supply (improvement in continuity, quantity or quality)
- solid waste collection
- medical care
- wastewater disposal
  - (respondent group 1,2,4 : no wastewater to drains anymore + prevention groundwater pollution)
  - (respondent group 3 : no problems with sewerage in in rainy situations anymore)
- drainage (better discharge of rainwater; no flooding)

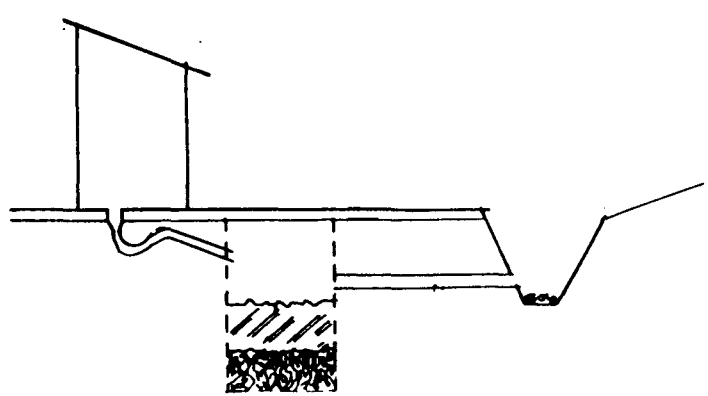
1.10 a Which of these services would you like to see improved first ?
b And which second ?

water supply	=1
solid waste collection	=2
medical care	=3
waste water disposal	=4
drainage	=5

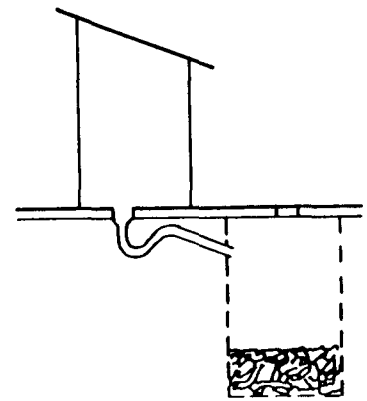
first priority : ¦_____¦
second priority : ¦_____¦

1.11 Do you want to pay for the improvements with first or second priority ?
YES = 1 NO = 2 ¦_____¦

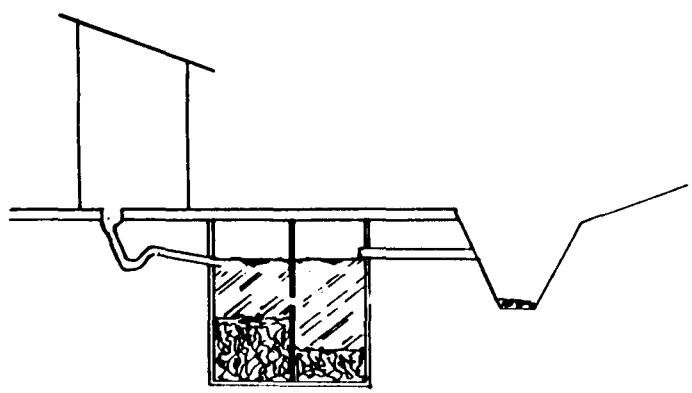
FIG 5.9 : ON-SITE SANITATION SYSTEMS



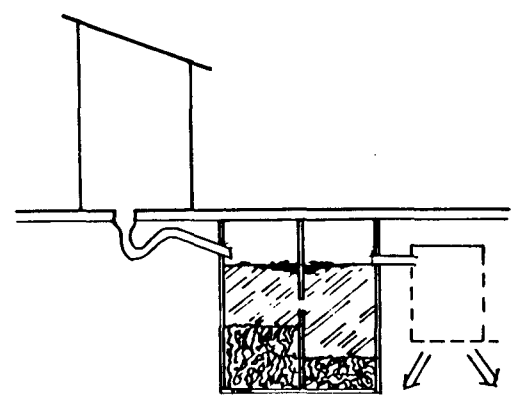
PIT WITH OVERFLOW
TO DRAIN



PIT



SEPTIC TANK WITH
OVERFLOW TO DRAIN



SEPTIC TANK WITH
SUBSURFACE
ABSORPTION SYSTEM

ANNEX 6 : SOCIAL ANALYSIS TABLES

TABLE 5.25 : HOUSEHOLD SIZE, HOUSEHOLDS PER DWELLING AND YEARS LIVING IN DWELLING

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	NR. IN HOUSEH.	NR. OF HOUSEH.	NR. YEARS LIVING
SUKASARI WITH SEW	88	88 100%	6.4	1.2	20.1
SUKASARI NO SEW.	35	35 100%	6.6	1.2	20.7
PERUMNAS WITH SEW	77	77 100%	5.9	1.0	7.2
SUKARASA/ NOT SEWRD	52	52 100%	6.8	1.1	23.8
TOTAL HOUSEHOLDS	252	252 100%	6.4	1.1	17.0

TABLE 5.26 : OWNERSHIP OF THE DWELLING

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHO IS THE OWNER OF THE HOUSE: OWNED BY HOUSEHOLD	OWNED JOINTLY	OWNED BY EMPLOYER	HOUSE OF RELATIVES	OTHER OWNER
SUKASARI WITH SEW	88	88 100%	84 95 %	0 0 %	0 0 %	2 2 %	2 2 %
SUKASARI NO SEW.	35	35 100%	34 97 %	0 0 %	0 0 %	0 0 %	1 3 %
PERUMNAS WITH SEW	77	77 100%	73 95 %	0 0 %	0 0 %	0 0 %	4 5 %
SUKARASA/ NOT SEWRD	52	52 100%	47 90 %	0 0 %	5 10 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	252 100%	238 94 %	0 0 %	5 2 %	2 1 %	7 3 %

TABLE 5.27 : SIZE OF THE DWELLING

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHAT IS APPROX. SIZE OF THE DWELLING: < 20 SQ.M	20-40 SQ.M	40-60 SQ.M	60-80 SQ.M	80-100 SQ.M	>100 SQ.M
SUKASARI WITH SEW	88	88 100%	1 1 %	5 6 %	12 14 %	17 19 %	13 15 %	40 45 %
SUKASARI NO SEW	35	35 100%	0 0 %	2 6 %	4 11 %	6 17 %	6 17 %	17 49 %
PERUMNAS WITH SEW	77	77 100%	0 0 %	4 5 %	8 10 %	40 52 %	25 32 %	0 0 %
SUKARASA/ NOT SEWRD	52	52 100%	0 0 %	2 4 %	5 10 %	8 15 %	8 15 %	29 56 %
TOTAL HOUSEHOLDS	252	252 100%	1 0 %	13 5 %	29 12 %	71 28 %	52 21 %	86 34 %

TABLE 5.28 : OCCUPATION HEAD OF THE HOUSEHOLD

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PRESENT OCCUPATION HEAD OF FAMILY AGRI-CULTURE	MINING / EXCAV.	INDUSTRY	CON-STRUCT.	TRADE	TRANSP./ COMM.	GOVM'T/ DEFENCE	SERVICES	PENSIONED	UNEM-PLOYED
SUKASARI WITH SEW	88	88 100%	0 0 %	1 1 %	11 13 %	3 3 %	33 38 %	1 1 %	9 10 %	3 3 %	11 13 %	16 18 %
SUKASARI NO SEW.	35	35 100%	0 0 %	0 0 %	2 6 %	1 3 %	15 43 %	1 3 %	8 23 %	3 9 %	4 11 %	1 3 %
PERUMNAS WITH SEW	77	77 100%	1 1 %	0 0 %	10 13 %	3 4 %	9 12 %	5 6 %	32 42 %	12 16 %	5 6 %	0 0 %
SUKARASA/ NOT SEWRD	52	52 100%	0 0 %	0 0 %	6 12 %	2 4 %	18 35 %	1 2 %	5 10 %	5 10 %	11 21 %	4 8 %
TOTAL HOUSEHOLDS	252	252 100%	1 0 %	1 0 %	29 12 %	9 4 %	75 30 %	8 3 %	54 21 %	23 9 %	31 12 %	21 8 %

TABLE 5.29 : FELT NEEDS (HH-INCOME <100,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	FIRST PRIORITY IMPROVED SERVICES WATER SUPPLY	SOLID WASTE	MEDICAL CARE	WATER DISPOSAL	DRAINAGE	DON'T KNOW
SUKASARI WITH SEW	88	30 34 %	3 10 %	3 10 %	6 20 %	9 30 %	9 30 %	
SUKASARI NO SEW.	35	7 20 %	0 0 %	0 0 %	5 71 %	1 14 %	1 14 %	
PERUMNAS WITH SEW	77	22 29 %	2 9 %	6 27 %	8 36 %	5 23 %	0 0 %	
SUKARASA/ NOT SEWRD	52	10 19 %	2 20 %	0 0 %	2 20 %	1 10 %	3 30 %	
TOTAL HOUSEHOLDS	252	69 27 %	7 10 %	9 13 %	21 30 %	16 23 %	13 19 %	

TABLE 5.30 : FELT NEEDS (HH-INCOME 100,000-200,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	FIRST PRIORITY IMPROVED SERVICES WATER SUPPLY	SOLID WASTE	MEDICAL CARE	WATER DISPOSAL	DRAINAGE	DON'T KNOW
SUKASARI WITH SEW	88	24 27 %	2 8 %	3 13 %	8 33 %	6 25 %	5 21 %	
SUKASARI NO SEW.	35	8 23 %	2 25 %	0 0 %	3 38 %	1 13 %	1 13 %	
PERUMNAS WITH SEW	77	32 42 %	4 13 %	5 16 %	11 34 %	6 19 %	6 19 %	
SUKARASA/ NOT SEWRD	52	11 21 %	1 9 %	5 45 %	2 18 %	1 9 %	2 18 %	
TOTAL HOUSEHOLDS	252	75 30 %	9 12 %	13 17 %	24 32 %	14 19 %	14 19 %	

TABLE 5.31 : FELT NEEDS (HH-INCOME >200,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	FIRST PRIORITY IMPROVED SERVICES: WATER SUPPLY	SOLID WASTE	MEDICAL CARE	WATER DISPOSAL	DRAINAGE	DON'T KNOW
SUKASARI WITH SEW	88	33 38 %	8 24 %	5 15 %	8 24 %	5 15 %	6 18 %	1 3 %
SUKASARI NO SEW.	35	20 57 %	3 15 %	8 40 %	5 25 %	3 15 %	1 5 %	0 0 %
PERUMNAS WITH SEW	77	23 30 %	7 30 %	7 30 %	3 13 %	3 13 %	2 9 %	1 4 %
SUKARASA/ NOT SEWRD	52	31 60 %	5 16 %	9 29 %	6 19 %	5 16 %	6 19 %	0 0 %
TOTAL HOUSEHOLDS	252	107 42 %	23 21 %	29 27 %	22 21 %	16 15 %	15 14 %	2 2 %

TABLE 5.32 : WILLINGNESS TO PAY FOR IMPROVEMENTS

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PAY FOR IMPROVE
SUKASARI WITH SEW	88	88 100%	59 67 %
SUKASARI NO SEW.	35	35 100%	24 69 %
PERUMNAS WITH SEW	77	77 100%	55 71 %
SUKARASA/ NOT SEWRD	52	52 100%	45 87 %
TOTAL HOUSEHOLDS	252	252 100%	183 73 %

TABLE 5.33 : PERCENTAGE OF PDAM CUSTOMERS BY INCOME CLASS AND SURVEY AREA

Survey group	Income Class (1000 Rp/Month)			
	≤100	101-200	>200	Total
Sukasari with Sew	18 60 %	15 63 %	25 76 %	59 76 %
Sukasari no Sew	5 71 %	5 63 %	12 60 %	22 63 %
Perumnas with Sew	18 82 %	27 84 %	15 65 %	60 78 %
Sukarasa/ not Sewrd	7 70 %	9 82 %	27 87 %	43 83 %
Total households	48 70 %	56 75 %	79 74 %	184 73 %

TABLE 5.34 : USE OF WATER WELL IN THE SURVEY AREA

Survey group	Well with handpump			Well with electrical pump		
	PDAM cust.	Not PDAM cust.	Total	PDAM cust.	Not PDAM cust.	Total
Sukasari with Sew	21 36 %	16 55 %	37 42 %	24 41 %	14 48 %	38 43 %
Sukasari no Sew	5 23 %	4 31 %	9 26 %	10 45 %	9 69 %	19 54 %
Perumnas with Sew	40 67 %	15 88 %	55 71 %	4 7 %	2 12 %	6 8 %
Sukarasa/not Sewrd	10 23 %	4 44 %	14 27 %	21 49 %	6 67 %	27 48 %
Total households	76 41 %	35 51 %	111 44 %	59 32 %	31 46 %	90 36 %

TABLE 5.35 : PURPOSES FOR WHICH PDAM WATER IS USED BY PDAM CUSTOMERS

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PDAM WATER IS THE MAIN WATER SOURCE FOR : DRINKING	COOKING	WASHING CLOTHES	WASHING DISHES	BATHING
SUKASARI WITH SEW	88	59 67%	57 97 %	55 93 %	22 37 %	23 39 %	31 53 %
SUKASARI NO SEW	35	22 63%	20 91 %	19 86 %	10 45 %	10 45 %	10 45 %
PERUMNAS WITH SEW	77	60 78%	36 60 %	36 60 %	32 53 %	29 48 %	47 78 %
SUKARASA/ NOT SEWRD	52	43 83%	42 98 %	42 98 %	21 49 %	18 42 %	27 63 %
TOTAL HOUSEHOLDS	252	184 73%	155 84 %	152 83 %	85 46 %	80 43 %	115 63 %

TABLE 5.36 : QUALITY AND QUANTITY PDAM WATER + USE OTHER SOURCES (PDAM CUSTOMERS)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	TASTE PDAM GOOD	SMELL PDAM GOOD	PDAM CLEAN	ENOUGH WATER	DAILY OTHER SRC
SUKASARI WITH SEW	88	59 67 %	54 92 %	41 69 %	54 92 %	58 98 %	42 71 %
SUKASARI NO SEW.	35	22 63 %	21 95 %	9 41 %	22 100%	22 100%	15 68 %
PERUMNAS WITH SEW	77	60 78 %	55 92 %	30 50 %	57 95 %	59 98 %	39 65 %
SUKARASA/ NOT SEWRD	52	43 83 %	41 95 %	23 53 %	41 95 %	43 100%	27 63 %
TOTAL HOUSEHOLDS	252	184 73 %	171 93 %	103 56 %	174 95 %	182 99 %	123 67 %

TABLE 5.37 : HOURS OF PDAM WATER SUPPLY

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	HOW MANY HOURS WATER SUPPLY A DAY < 6 HOURS	6 - 12 HOURS	12 - 18 HOURS	18 -< 24 HOURS	24 HOURS
SUKASARI WITH SEW	88	59 67 %	9 15 %	1 2 %	5 8 %	24 41 %	20 34 %
SUKASARI NO SEW.	35	22 63 %	1 5 %	2 9 %	1 5 %	9 41 %	9 41 %
PERUMNAS WITH SEW	77	60 78 %	2 3 %	3 5 %	5 8 %	27 45 %	23 38 %
SUKARASA/ NOT SEWRD	52	43 83 %	1 2 %	1 2 %	5 12 %	17 40 %	19 44 %
TOTAL HOUSEHOLDS	252	184 73 %	13 7 %	7 4 %	16 9 %	77 42 %	71 39 %

TABLE 5.38 : REASON FOR USING OTHER WATER SOURCES (PDAM CUSTOMERS)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHY USE OF OTHER WATER SOURCES MORE SUITABLE	CHEAPER	PDAM INSUFF.
SUKASARI WITH SEW	88	42 48 %	10 24 %	31 74 %	1 2 %
SUKASARI NO SEW.	35	15 43 %	5 33 %	10 67 %	0 0 %
PERUMNAS WITH SEW	77	39 51 %	5 13 %	33 85 %	1 3 %
SUKARASA/ NOT SEWRD	52	27 52 %	2 7 %	25 93 %	0 0 %
TOTAL HOUSEHOLDS	252	123 49 %	22 18 %	99 80 %	2 2 %

TABLE 5.39 : MONTHLY EXPENDITURES ON PDAM WATER

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR PDAM WATER < 2000 RP / M.	2000-3500 RP / M.	3500-5000 RP / M.	5000-7500 RP / M.	7500-9999 RP / M.	> 10000 RP / M.
SUKASARI WITH SEW	88	59 67 %	1 2 %	25 42 %	9 15 %	10 17 %	5 8 %	9 15 %
SUKASARI NO SEW.	35	22 63 %	0 0 %	8 36 %	4 18 %	8 36 %	1 5 %	1 5 %
PERUMNAS WITH SEW	77	60 78 %	0 0 %	9 15 %	17 28 %	18 30 %	7 12 %	9 15 %
SUKARASA/ NOT SEWRD	52	43 83 %	0 0 %	5 12 %	6 14 %	11 26 %	2 5 %	19 44 %
TOTAL HOUSEHOLDS	252	184 73 %	1 1 %	47 26 %	36 20 %	47 26 %	15 8 %	38 21 %

TABLE 5.40 : MONTHLY EXPENDITURES ON PDAM WATER (HH-INCOME <100,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR PDAM WATER < 2000 RP / M.	2000-3500 RP / M.	3500-5000 RP / M.	5000-7500 RP / M.	7500-9999 RP / M.	> 10000 RP / M.
SUKASARI WITH SEW	88	18 20 %	1 6 %	12 67 %	4 22 %	1 6 %	0 0 %	0 0 %
SUKASARI NO SEW.	35	5 14 %	0 0 %	2 40 %	1 20 %	1 20 %	1 20 %	0 0 %
PERUMNAS WITH SEW	77	18 23 %	0 0 %	6 33 %	7 39 %	3 17 %	1 6 %	1 6 %
SUKARASA/ NOT SEWRD	52	7 13 %	0 0 %	1 14 %	3 43 %	0 0 %	0 0 %	3 43 %
TOTAL HOUSEHOLDS	252	48 19 %	1 2 %	21 44 %	15 31 %	5 10 %	2 4 %	4 8 %

TABLE 5.41 : MONTHLY EXPENDITURES ON PDAM WATER (HH-INCOME 100,000-200,000 RP/M)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR PDAM WATER < 2000 RP / M.	2000-3500 RP / M.	3500-5000 RP / M.	5000-7500 RP / M.	7500-9999 RP / M.	> 10000 RP / M.
SUKASARI WITH SEW	88	15 17 %	0 0 %	5 33 %	2 13 %	4 27 %	1 7 %	3 20 %
SUKASARI NO SEW.	35	5 14 %	0 0 %	2 40 %	0 0 %	3 60 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	27 35 %	0 0 %	2 7 %	7 26 %	9 33 %	6 22 %	3 11 %
SUKARASA/ NOT SEWRD	52	9 17 %	0 0 %	1 11 %	1 11 %	3 33 %	1 11 %	3 33 %
TOTAL HOUSEHOLDS	252	56 22 %	0 0 %	10 18 %	10 18 %	19 34 %	8 14 %	9 16 %

TABLE 5.42 : MONTHLY EXPENDITURES ON PDAM WATER (HH-INCOME >200,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR PDAM WATER < 2000 RP / M.	2000-3500 RP / M.	3500-5000 RP / M.	5000-7500 RP / M.	7500-9999 RP / M.	> 10000 RP / M.
SUKASARI WITH SEW	88	25 28 %	0 0 %	7 28 %	3 12 %	5 20 %	4 16 %	6 24 %
SUKASARI NO SEW.	35	12 34 %	0 0 %	4 33 %	3 25 %	4 33 %	0 0 %	1 8 %
PERUMNAS WITH SEW	77	15 19 %	0 0 %	1 7 %	3 20 %	6 40 %	0 0 %	5 33 %
SUKARASA/ NOT SEWRD	52	27 52 %	0 0 %	3 11 %	2 7 %	8 30 %	1 4 %	13 48 %
TOTAL HOUSEHOLDS	252	79 31 %	0 0 %	15 19 %	11 14 %	23 29 %	5 6 %	25 32 %

TABLE 5.43 : MONTHLY EXP. ON PDAM WATER RELATED TO USED WATERSOURCES (PDAM CUST)

DAILY USE OF OTHER SOURCE BESIDES P	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR PDAM WATER < 2000 RP / M.	2000-3500 RP / M.	3500-5000 RP / M.	5000-7500 RP / M.	7500-9999 RP / M.	> 10000 RP / M.
DAILY OTHER SRC	123	123 100%	1 1 %	40 33 %	25 20 %	28 23 %	9 7 %	20 16 %
	61	61 100%	0 0 %	7 11 %	11 18 %	19 31 %	6 10 %	18 30 %
NO ANSWER	68	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	184 73 %	1 1 %	47 26 %	36 20 %	47 26 %	15 8 %	38 21 %

TABLE 5.44 : REASON FOR TAKING PDAM CONNECTION (PDAM CUSTOMERS)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	MOST IMPORTANT REASON TO HAVE PDAM CONN. CONVE-NIENCE	MORE HEALTHY	BETTER TASTE
SUKASARI WITH SEW	88	58 66 %	9 16 %	36 62 %	13 22 %
SUKASARI NO SEW.	35	22 63 %	7 32 %	13 59 %	2 9 %
PERUMNAS WITH SEW	77	0 0 %	0 0 %	0 0 %	0 0 %
SUKARASA/ NOT SEWRD	52	43 83 %	7 16 %	27 63 %	9 21 %
TOTAL HOUSEHOLDS	252	123 49 %	23 19 %	76 62 %	24 20 %

TABLE 5.45 : SATISFACTION WITH PDAM WATER (PDAM CUSTOMERS)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	SATISFIED PDAM
SUKASARI WITH SEW	88	59 67 %	51 86 %
SUKASARI NO SEW.	35	22 63 %	21 95 %
PERUMNAS WITH SEW	77	60 78 %	52 87 %
SUKARASA/ NOT SEWRD	52	43 83 %	41 95 %
TOTAL HOUSEHOLDS	252	184 73 %	165 90 %

TABLE 5.46 : INTEREST IN PDAM CONNECTION (NON PDAM CUSTOMERS)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WANT PDAM ALT. I	WANT PDAM ALT. II	WANT PDAM ALT. III
SUKASARI WITH SEW	88	29 33 %	1 3 %	3 10 %	1 3 %
SUKASARI NO SEW.	35	13 37 %	1 8 %	3 23 %	2 15 %
PERUMNAS WITH SEW	77	17 22 %	0 0 %	1 6 %	2 12 %
SUKARASA/ NOT SEWRD	52	9 17 %	1 11 %	1 11 %	0 0 %
TOTAL HOUSEHOLDS	252	68 27 %	3 4 %	8 12 %	5 7 %

TABLE 5.47 : SOLID WASTE, STAGNANT WASTEWATER IN DRAINS ACCORDING TO RESPONDENT AND SURVEYOR

			SURVEYOR		RESPONDENT	
SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	SOLID WASTE	STAGNANT WASTEW.	SOLID WASTE	STAGNANT WASTEW.
SUKASARI WITH SEW	88	88 100%	20 23 %	34 39 %	16 18 %	29 33 %
SUKASARI NO SEW	35	35 100%	13 37 %	19 54 %	13 37 %	17 49 %
PERUMNAS WITH SEW	77	77 100%	9 12 %	9 12 %	10 13 %	9 12 %
SUKARASA/ NOT SEWRD	52	52 100%	18 35 %	30 58 %	18 35 %	24 46 %
TOTAL HOUSEHOLDS	252	252 100%	60 24 %	92 37 %	57 23 %	79 31 %

TABLE 5.48 : TYPE OF TOILET

			WHAT TYPE OF TOILET DO YOU USE					
SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PRIVATE WC	SHARED WC	PRIVATE LATRINE	SHARED LATRINE	OTHER TYPE WC	KALI OR FIELD
SUKASARI WITH SEW	88	88 100%	84 95 %	4 5 %	0 0 %	0 0 %	0 0 %	0 0 %
SUKASARI NO SEW.	35	35 100%	33 94 %	2 6 %	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	77 100%	77 100%	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
SUKARASA/ NOT SEWRD	52	52 100%	52 100%	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	252 100%	246 98 %	6 2 %	0 0 %	0 0 %	0 0 %	0 0 %

TABLE 5.49 : FLUSHING OF TOILET

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	HOW DO YOU FLUSH YOUR TOILET: RINSING TUB		WITH BUCKET	
SUKASARI WITH SEW	88	88 100%	2	2 %	86	98 %
SUKASARI NO SEW.	35	35 100%	2	6 %	33	94 %
PERUMNAS WITH SEW	77	77 100%	5	6 %	72	94 %
SUKARASA/ NOT SEWRD	52	52 100%	7	13 %	45	87 %
TOTAL HOUSEHOLDS	252	252 100%	16	6 %	236	94 %

TABLE 5.50 : DISCHARGE OF TOILETWATER PER SURVEY GROUP

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHERE DOES TOILET WASTEWATER FLOW TO: TO SEWER		DIRECTLY TO DRAIN		SEPTIC TANK		TO PIT (CUBLUK)		TO OPEN FIELD	
SUKASARI WITH SEW	88	88 100%	88	100%	0	0 %	0	0 %	0	0 %	0	0 %
SUKASARI NO SEW.	35	35 100%	0	0 %	0	0 %	7	20 %	28	80 %	0	0 %
PERUMNAS WITH SEW	77	77 100%	77	100%	0	0 %	0	0 %	0	0 %	0	0 %
SUKARASA/ NOT SEWRD	52	52 100%	0	0 %	0	0 %	22	42 %	30	58 %	0	0 %
TOTAL HOUSEHOLDS	252	252 100%	165	65 %	0	0 %	29	12 %	58	23 %	0	0 %

TABLE 5.51 : DISCHARGE OF SULLAGE PER SURVEY GROUP

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHERE DOES SULLAGE FLOW TO: TO SEWER		DIRECTLY TO DRAIN		SEPTIC TANK		TO PIT (CUBLUK)		TO OPEN FIELD		BATH + WASH IN RIVER	
SUKASARI WITH SEW	88	88 100%	14	16 %	74	84%	0	0 %	0	0 %	0	0 %	0	0 %
SUKASARI NO SEW	35	35 100%	0	0 %	35	100%	0	0 %	0	0 %	0	0 %	0	0 %
PERUMNAS WITH SEW	77	77 100%	65	84 %	12	16 %	0	0 %	0	0 %	0	0 %	0	0 %
SUKARASA/ NOT SEWRD	52	52 100%	0	0 %	51	98 %	1	2 %	0	0 %	0	0 %	0	0 %
TOTAL HOUSEHOLDS	252	252 100%	79	31 %	172	68 %	1	0 %	0	0 %	0	0 %	0	0 %

TABLE 5.52 : FUNCTIONING SEWERAGE : FREQUENCY WC OVERFLOW

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PROBLEMS SEWERAGE : WC OVERFLOW < 1 x A YEAR	1-4 x A YEAR	> 4 x A YEAR	NO PROBLEMS
SUKASARI WITH SEW	88	88 100%	2 2 %	0 0 %	1 1 %	85 97 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	77 100%	2 3 %	5 6 %	1 1 %	69 90 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	165 65 %	4 2 %	5 3 %	2 1 %	154 93 %

TABLE 5.53 : FUNCTIONING SEWERAGE : FREQUENCY BLOCKAGES/DIFFICULTIES DISCHARGE

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	DISCHARGE PROBLEMS WITH SEWER < 1 x A YEAR	1-4 x A YEAR	> 4 x A YEAR	NO PROBLEMS
SUKASARI WITH SEW	88	88 100%	4 5 %	0 0 %	0 0 %	84 95 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	77 100%	5 6 %	2 3 %	3 4 %	67 87 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	165 65 %	9 5 %	2 1 %	3 2 %	151 92 %

TABLE 5.54 : FUNCTIONING SEWERAGE : FREQUENCY OVERFLOW MANHOLES (IN STREET)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PROBLEMS SEWERAGE : OVERFLOW INSPECT PIT < 1 x A YEAR	1-4 x A YEAR	> 4 x A YEAR	NO PROBLEMS
SUKASARI WITH SEW	88	88 100%	0 0 %	0 0 %	1 1 %	87 99 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	77 100%	8 10 %	5 6 %	2 3 %	62 81 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	165 65 %	8 5 %	5 3 %	3 2 %	149 90 %

TABLE 5.55 : FAIRNESS AND WILLINGNESS TO PAY FOR MONTHLY SEWERAGE CONTRIBUTION

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	FAIR TO PAY	PAY Rp 3000	PAY Rp 1500
SUKASARI WITH SEW	88	88 100%	84 95 %	24 27 %	35 40 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	77 100%	68 88 %	10 13 %	29 38 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	165 65 %	152 92 %	34 21 %	64 39 %

TABLE 5.56 : WILLINGNESS TO PAY FOR SEWERAGE (HH-INCOME <100,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PAY Rp 3000	PAY Rp 1500
SUKASARI WITH SEW	88	30 34 %	3 10 %	12 40 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	22 29 %	3 14 %	6 27 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	52 21 %	6 12 %	18 35 %

TABLE 5.57 : WILLINGNESS TO PAY FOR SEWERAGE (HH-INCOME 100,000-200,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PAY Rp 3000	PAY Rp 1500
SUKASARI WITH SEW	88	24 27 %	4 17 %	14 58 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	32 42 %	4 13 %	10 31 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	56 22 %	8 14 %	24 43 %

TABLE 5.58 : WILLINGNESS TO PAY FOR SEWERAGE (HH-INCOME >200,000 RP/MONTH)

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	PAY Rp 3000	PAY Rp 1500
SUKASARI WITH SEW	88	33 38 %	17 52 %	8 24 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	23 30 %	3 13 %	13 57 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	56 22 %	20 36 %	21 38 %

TABLE 5.59 : REASONS WHY GOVERNMENT SHOULD PAY (MORE) FOR SEWERAGE

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHY SHOULD GOVERNMENT PAY MORE: ALWAYS PAYS	INITI-ATIVE	PAID TAX	OTHER REASON
SUKASARI WITH SEW	88	8 9 %	1 13 %	4 50 %	3 38 %	0 0 %
SUKASARI NO SEW.	35	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
PERUMNAS WITH SEW	77	16 21 %	6 38 %	3 19 %	7 44 %	0 0 %
SUKARASA/ NOT SEWRD	52	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	24 10 %	7 29 %	7 29 %	10 42 %	0 0 %

TABLE 5.60 : COST OF EMPTYING ON-SITE SANITATION SYSTEM

WASTEWATER DISPOSAL SYSTEM	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR CONSTRUCTION PIT/SEPTIC TANK: < 5000 RP	5000-10000 RP	10000-15000 RP	15000-20000 RP	20000-25000 RP	25000-300(RP
PIT	58	26 45 %	1 4 %	10 38 %	7 27 %	4 9 %	2 7 %	2 7 %
SEPTIC TANK	29	18 62 %	1 6 %	6 33 %	3 17 %	4 22 %	3 17 %	1 6 %
SEWERAGE	165	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	44 17 %	2 5 %	16 36 %	10 23 %	8 18 %	5 11 %	3 7 %

TABLE 5.61 : BY WHOM CONSTRUCTION OF ON-SITE SANITATION SYSTEM IS DONE

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	WHO CONSTRUCTED THE PIT/SEPTIC TANK: YOURSELF	CONTRACTOR	FRIENDS
SUKASARI WITH SEW	88	0 0 %	0 0 %	0 0 %	0 0 %
SUKASARI NO SEW.	35	35 100%	3 9 %	29 83 %	3 9 %
PERUMNAS WITH SEW	77	0 0 %	0 0 %	0 0 %	0 0 %
SUKARASA/ NOT SEWRD	52	52 100%	3 6 %	45 87 %	4 8 %
TOTAL HOUSEHOLDS	252	87 35 %	6 7 %	74 85 %	7 8 %

TABLE 5.62 : COST OF CONSTRUCTION ON-SITE SANITATION SYSTEM

SANITATION SYSTEM	NR. IN SAMPLE	NR. IN SELECTION	HOW MUCH DO YOU PAY FOR CONSTRUCTION PIT/SEPTIC TANK (1000 Rp): -50	51-100	101-150	151-200	201-300	301-500	501-7
PIT	58	57 98 %	8 14 %	24 42 %	12 21 %	9 16 %	3 5 %	1 2 %	0 0
SEPTIC TANK	29	29 100%	4 14 %	10 34 %	5 17 %	3 10 %	3 10 %	3 10 %	1 3
SEWERAGE	165	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %	0 0
TOTAL HOUSEHOLDS	252	86 34 %	12 14 %	34 40 %	17 20 %	12 14 %	6 7 %	4 5 %	1 1

TABLE 5.63 : FUNCTIONING ON-SITE SANITATION SYSTEM : FREQUENCY OVERFLOW/BLOCKAGES

WASTEWATER DISPOSAL SYSTEM	NR. IN SAMPLE	NR. IN SELECTION	OVERFLOW OF TOILET WITH PIT/SEPTIC TANK: < 1 x A YEAR	1-4 x A YEAR	NO PROBLEMS
PIT	58	58 100%	4 7 %	2 3 %	52 90 %
SEPTIC TANK	29	29 100%	1 3 %	3 10 %	25 86 %
SEWERAGE	165	0 0 %	0 0 %	0 0 %	0 0 %
TOTAL HOUSEHOLDS	252	87 35 %	5 6 %	5 6 %	77 89 %

TABLE 5.64 : APPRECIATION OF ON-SITE SANITATION SYSTEM

SURVEY GROUP	NR. IN SAMPLE	NR. IN SELECTION	CONSTR. EXPENS.	MAINTEN. EXPENS.	SYSTEM HEALTHY	SYSTEM CONVEN.
SUKASARI WITH SEW	88	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
SUKASARI NO SEW.	35	35 100%	15 43 %	3 9 %	32 91 %	34 97 %
PERUMNAS WITH SEW	77	0 0 %	0 0 %	0 0 %	0 0 %	0 0 %
SUKARASA/ NOT SEWRD	52	52 100%	32 62 %	18 35 %	45 87 %	47 90 %
TOTAL HOUSEHOLDS	252	87 35 %	47 54 %	21 24 %	77 89 %	81 93 %