PROCEEDINGS 1 day Seminar
on
Operation and Maintenance of Sanitation Systems in Urban Low Income Areas
Friday 1 October 1993, IHS

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I. Presentations

Background

The disposal of human excreta is one or the urban basic services which traditionally has been provided by the governments, but which has been affected badly by the lack of resources available. Conventional sewerage systems are not only extremely expensive, but they also require a level of water supply which is often not available, specifically in low-income areas. This has led many governments to adopt low-cost technologies, which are cheaper to construct and require less water to function. Moreover, the burden of operation and maintenance of these systems is considered to be minimal and can be carried out to a large extent by the users.

Over the last decade, problems have been experienced with sanitation systems constructed in low-income urban areas. Many have fallen into disuse for reason of early failure and/or misuse. This generally resulted in a lower service level to the target population and consequent deterioration of environmental conditions. At the same time, it has caused sepsis amongst policy makers, executing agencies and target populations with regard to the feasibility of these systems. The extent of nature of the problems or the possible causes of these problems have not yet been investigated in a structural manner.

A research project was launched in 1989 with financial assistance from the Netherlands' Ministry of Foreign Affairs, Directorate General for Development Cooperation (DGIS). The research studied the various aspects of operation and maintenance and evaluated their requirements from sanitation technologies as used in India and Thailand. These technologies are primarily based on wet disposal techniques such as small scale sewerage, septic tanks and pour-flush toilets, connected to single and double leaching pits, which are widely used in Asia. The findings, conclusion and recommendations aim to be made relevant for the respective countries and their institutions in this sector, for other countries in the region and for sanitation projects funded by the Netherlands' Ministry.

A draft final report was completed in August 1993. DGIS and the partner research institutions felt it necessary to present and review the major findings and conclusions of this project during a seminar, and to compare and discuss similar findings and experiences in other Dutch funded projects. The forum would then be invited to formulate conclusions and policy implications for future Dutch funded projects in this sector. The seminar was held on October 1, 1993 at the Institute for Housing and Urban Development Studies (IHS) and attended by a group of experts from the Netherlands' Ministry, Consultants and other professionals (see Annex II).

The program of the seminar is attached in Annex I.

Mr Marc Jansen, IHS, welcomed the participants to this one-day seminar and provided a brief background to this seminar. Mr Cor Dijkgraaf, director of IHS,

addressed the meeting by stressing the importance of building partnerships between institutions in the Netherlands and in developing countries for projects such as this research. Besides achieving the project objectives of the research, it also contributes to exchange of experiences between partner institutions and to assist in strengthening institutions in their capacity to undertake research. The director felt that in this respect, the research has achieved this second developmental goal. Mr Dijkgraaf concluded by wishing the seminar success it their deliberations.

Presentation of research findings and other experiences in the sector

The seminar consisted of a number of presentations, including:

1. Research on Operation and Maintenance of Sanitation Systems in Urban Low-Income Areas in India and Thailand, executed by IHS, IRC, HUDCO/HSMI, NHA and CMU
2. Rural Water Supply and Sanitation Program, Andhra Pradesh, India, executed by ETC Foundation
3. Manual Pit-Emptying Technology Program, Dar-es-Salaam, Tanzania, executed by WASTE Consultants
4. Integrated Environmental and Sanitary Engineering Projects, Kanpur-Mirzapur, India, executed by HASKONING Consultants

1. Research on Operation and Maintenance of Sanitation Systems in Urban Low-Income Areas in India and Thailand, executed by IHS, IRC, HUDCO/HSMI, NHA and CMU

The presentation was conducted by Mr Harry Mengers of IHS, Mr Sanjib Sarma of HUDCO/HSMI, Delhi, and Ms. Pornsawan Timasart of NHA, Bangkok.

The research project "Operation and maintenance of sanitation systems in urban low-income areas in India and Thailand", was carried out jointly by the Institute for Housing and Urban Development Studies (IHS) in Rotterdam, IRC International Reference Center from Water Supply and Sanitation in The Hague, the Human Settlement Management Institute (HSMI, the training and research wing of the Housing and Urban Development Corporation , HUDCO) in New Delhi, The National Housing Authority (NHA) in Bangkok and the Chiang Mai University (CMU).

Mr Mengers explained the background of the research and summarized the objectives and methodology of the research. The research aimed to (1) identify operation and maintenance aspects of sanitation systems, (2) evaluate the use and performance of these systems, (3) identify the role of user attitudes, and (4) evaluate the role of involved agencies.

The research was carried out by research teams in India and Thailand, assisted by professionals from IHS and IRC. A review of relevant literature, leading to the design of the actual research, was included. A pilot phase helped to focus the research and adjust research design. Each country team had prepared a report at the end of the final phase, which was presented and discussed in April 1992 during a national seminar in India and Thailand, and a concluding international seminar. These fora helped to disseminate and discuss the findings and recommendations. Professionals and sectoral policy makers and executives attended the seminars.

India

In India, sanitation projects are carried out by different national and international (donor) organizations. The different geographical conditions per area have resulted in a variety of technological solutions.

The research identified 6 types of systems, for which different user-related, institutional and environmental issues were specified. As for acceptance of sanitary systems, it was found that community mobilization by awareness-raising programs, organizing support for pit-emptying services and clear communication channels can positively influence user attitudes.

At the institutional level it was found that operation and maintenance aspects are often hardly taken into account in the planning and implementation phases of sanitation programs. Moreover, operation and maintenance responsibilities are often hardly defined, while a lack of capacity at the local level, poor cost recovery and a lack of funds for training as well as promotion hamper successful implementation of the projects.

With respect to health and environment, the surface sewage flows of household and public latrines were identified as major threats. On the other hand a need to relate the drainage with solid waste disposal problems was noted.

Thailand

In Thailand the research concentrated on 3 technological solutions, the cesspool, septic tanks and soak-pits and anderonic filters. Several institutions involved at the national and local level as well as the private sector were identified.

Regarding the user-related aspects, a lack of awareness concerning environment and the need for operation and maintenance was found. At the institutional level, attention for sanitation and the role of operation and maintenance were lacking. Thus, no separate budget is provided, nor is there a feedback system on the results of different approaches.

Lessons learned

The researchers concluded that the operation and maintenance of sanitation systems could be improved by (1) paying more attention in the planning phase for technical design aspects and the cost of O&M, (2) establishing a clear division of responsibilities with respect to management of O&M, (3) training and awareness raising at the user level, (4) improved coordination between agencies involved, (5) increased coverage and use of sanitation systems.

Discussion

After the presentations, several comments were made regarding the research project. It was noted that the experiences in other sanitation projects support to a large extent the findings of the research, although they may be rural. Particularly the institutional and user level aspects were found important. It was suggested that the conclusions may be more strongly formulated, so as to have a larger impact on the concerned institutions. In this regard it was said that already during the research lessons were presented and discussed with concerned agencies in India and Thailand. In India HUDCO, a techno-financial organization that finances low-cost sanitation, has already made operation and maintenance considerations part of their project appraisal procedures, while special training programs aim to make concerned agencies more aware and better equipped for operation and maintenance tasks. In Thailand, the NHA has imparted the findings in their ongoing review and adjustment of sanitation technologies for their housing and slum upgradation schemes, while the University of Chiang Mai has included the subject in the academic course curriculum.
It was also noted that further research is required to develop practical strategies and solutions for operation, coordination, maintenance and cost recovery systems with a maximum involvement of users and local responsible agencies.

2. Rural Water Supply and Sanitation Program, Andhra Pradesh, India, executed by ETC Foundation

Mr van Gussenhoven presented a detailed overview of his experiences with sanitation systems in the rural areas of Andra Pradesh, India. Details are provided in Annex 5.

It was emphasized that although the characteristics of sanitation systems in rural areas are different, many similarities were found as compared to the research findings of the OMS report. This is especially the case in relation to users attitudes, the need for introducing effective cost-recovery systems, decentralized responsibilities for planning and maintaining systems. The main requirement would be to find operational methods which will ensure that systems work better.

The project implementation, after some discouraging lessons, evolved into a direction in which communication between supplier and beneficiary of the facilities, the adaptation of a demand-based approach and the involvement of local volunteers and organizations, is given the highest priority.

3. Manual Pit-Emptying Technology Program, Dar-es-Salaam, Tanzania, executed by WASTE Consultants

The operation and maintenance aspects of this project mainly relate to emptying pits, for which several technical solutions were developed and tested. Mechanical removal was found not to be always suitable, as tankers can often not reach the houses to be serviced.

In this project, the pit-emptying service is therefore done manually and functions in a highly decentralized and privatized manner. The pit-emptyers get a basic training and are thereafter responsible for their own income, handling jobs in groups of three.

The users have to take the initiative to call for their services, and thus control the servicing of their pits. This aspect is highly appreciated, as in this way they deal with the pit-emptyers personally and it is possible to adjust the service to their household budget.

The government agency involved is still responsible for major equipment repairs, training of pit-emptyers and the distribution of licenses. Moreover, they actively promote the service and provide health education. Such a set-up is quite unusual, and the results prove to be positive, although the independent position of the pit-emptyers does lead to monitoring and control problems.

4. Integrated Environmental and Sanitary Engineering Projects, Kanpur-Mirzapur, India, executed by HASKONING Consultants

This sanitation project is carried out within the context of the Environmental and Sanitary Engineering Project in Kanpur-Mirzapur. The main objectives are to (1) develop an integrated infrastructural services system and (2) to demonstrate this integrated approach for use in other regions. Therefore, the two towns of Kanpur and Mirzapur serve as demonstration.

In the initial phase baseline community surveys and inventories of existing levels of service were taken as a basis for the planning. Through this, community involvement was sought. In its sanitation component, the project put an emphasis on institutional and human resource development aspects, the sustained involvement of various actors, education of users with special training for women, and cost recovery through pay & use based toilet and bath facilities.

Concerning Operation and Maintenance, the general conclusion in the project is that this aspect should be included in the planning phase and should influence the choice of technology. Further, a good technical database as well as clear definition of tasks of agencies involved in implementation were essential aspects.

Issues of Operation and Maintenance: Discussion and Recommendations:

From the morning presentations a number of key issues emerged:

1. The role of local agencies in view of decentralization of project planning, implementation and operation and maintenance, privatization of certain tasks, user control on implementation and coordination between the responsible actors in different stages of the project cycle.
2. Demand driven provision of low-cost sanitation facilities and services, which could also follow the mechanisms of the market. In addition, the desired generation of demand should be reflected against the public health goals and the required communication and education.
3. Approaches for finance and cost recovery mechanisms.

These issues need to be discussed with a view of the

a. Implications for funding agencies and donor support
b. Focal areas for research and development

Two groups were established that dealt with the identified issues. In a plenary session the conclusions and recommendations were presented, discussed and accepted.

The main conclusions and recommendations of the deliberations are:

1 The findings of the presented research project comply with experiences gained elsewhere. The conclusions do not only apply to an urban context, but also to a rural context. Further dissemination or the results and discussion is required.

2 In order to achieve sustainable sanitation systems, there is a need to develop strategies that take account of the limited capacity of local agencies and resources. Strategies should aim to use the least means and effort and achieve maximum results. They need to be developed in the field of technology, institutional (and community) strengthening and financial resource mobilization.

3 These strategies will need to impart an assessment of the needs, the identification of key-actors (from central government down to users and private sector) and follow an integrated approach, including issues of water supply and health promotion.

4 It was felt that decentralization of responsibilities to lower levels of government is required. This can only be made effective if the capacity of local agencies (municipalities) is increased and involvement in planning and implementation stages is established. The role of central agencies should be made more enabling towards local agencies during implementation.

5 Coordination between involved agencies and user control is regarded as a prime feature of any successful project or O & M service and should receive high priority.

6 Decentralization, coordination and user control are long-term goals and requires donor agencies to:
- accept a process approach;
- ensure long-term involvement and flexibility in approach; and
- have confidence in long-term impacts.

7 Demand-driven approach is supported by the meeting and should:
- be supported by understanding the users and their needs;
- enhance the demand by addressing the potential users and make them aware of health related sanitary measures and to actively promote sanitary options;
- adopt market methods of promotion and delivery of goods and services, based on market research and adapted to local conditions; and
- ensure reliable, value-for-money and technically sound goods and services.

8 Full cost-recovery cannot be adopted without considering the financial consequences for the urban poor. The meting expressed its concern about the international and indiscriminate pressure to adopt full cost-recovery for infrastructure services, which increases the financial burden of the urban poor. Sanitation could be seen as a public good that is in the interest of public health and a better urban environment. Hence, other financial options for delivering and servicing the whole package of basic infrastructure should be considered and investigated.

9 Further research is required in the following fields:
- strategies to strengthen the capacity of urban local bodies, both in implementing and providing maintenance services;
- strategies to adopt market oriented provision of sanitation, demand generation and delivery of maintenance services;
- alternative options for finance of investment for infrastructure and the provision of maintenance services;
- partnerships between communities, private sector and local government may be explored; and
- relation between promoting better cost-recovery and affordability in the context of urban poverty (alleviation).

The chairman thanked the participants for their useful contribution and participation and closed the seminar.

Annex 1.

INSTITUTE FOR HOUSING AND URBAN DEVELOPMENT STUDIES

IHS

PARTICIPANTS SEMINAR
OPERATION AND MAINTENANCE ASPECTS OF SANITATION
IN LOW-INCOME SHELTER AREAS

Friday 1 October, 1993
IHS

Name	*Organization*
Mr P. Teunissen	DGIS/DPO/SO
Mr J. Bijlmer	DGIS/DST/UR
Mr W. Ankersmit	DGIS/DST/TA
Ms A. Braken	DGIS/DAL/ZO
Mr H. Maas	Haskoning/Nijmegen
Ms I. Muller	WASTE Consultants/Gouda
Mr S. van Gussenhoven	ETC/Leusden
Mr S. Veenstra	IHE/Delft
Mr G. Galvis	CINARA/Colombia
Mr S. Sharma	HSMI/New Delhi
Ms P. Timasart	CHHSS/Bangkok
Ms M. Boot	IRC/Den Haag
Mr J. Smet	IRC/Den Haag
Mr J.T. Visscher	IRC/Den Haag
Mr H. Mengers	IHS/Rotterdam
Mr E. Frank	IHS/Rotterdam
Mr D. Edelman	IHS/Rotterdam
Mr M. Jansen	IHS/Rotterdam
Ms T. Kerkhoven	IHS/Rotterdam

Participants ICHPB 62 at IHS, Rotterdam:

Mr. Tei, Ghana (all day)

Mr. Eltegani, Sudan

Mr. Mvano, Tanzania

Mr. Bodhidatta, Thailand

Mr. Kibuuka, Uganda

Mr. Zaw Win, Myanmar

Mr. Somarriba R., Nicaragua

Ms. Mahmuda, Bangladesh (morning)

Ms. Diones, Philippines

Mr. Pinnawala, Sri Lanka

Ms. Kavakoglu, Turkey

Ms. Do, Vietnam

Ms. Pesto, Bosnia

Ms. Kneib, Germany

Mr. Kamath, India

Mr. Maung Maung Taw, Myanmar

Mr. Khin Maung Swe, Myanmar

Annex 2.

INSTITUTE FOR HOUSING AND URBAN DEVELOPMENT STUDIES

IHS

Seminar Programme
Dutch development cooperation experiences with
Operation & Maintenance of Sanitation Systems in Low-income Areas

IHS, 1 October 1993

09.45 - 10.00	Welcome and introduction
10.00 - 10.50	summary of the IHS/IRC/HSMI/NHA research
11.00 - 11.20	Mr van Gussenhoven (ETC Foundation) Rural Water Supply in Andhra Pradesh (India)
11.30 - 12.00	coffee/tea
12.00 - 12.20	Mrs I. Muller (WASTE Consultants) MAPET project (Dar es Salaam, Tanzania)
12.30 - 12.50	Mr H. Maas (Haskoning) Kanpur-Mirzapur project (India)
13.00 - 14.00	lunch
14.00 - 15.30	discussion on specific topics in working groups
15.30 - 16.00	coffee/tea
16.00 - 17.00	summary and conclusions
17.00 -	drinks offered by IHS

Annex 3.

ETC FOUNDATION

Hand out IHS Seminar oct.1 '93

INDIA: ANDHRA PRADESH

RURAL WATER SUPPLY AND SANITATION PROGRAMME

WITH NETHERLANDS ASSISTANCE (NAP)

Scope and history

The Indo Dutch cooperation in Andhra Pradesh (AP) dates back to 1978, when the first series of projects were designed and planned. These covered around 230 villages in six districts, to provide some 700.000 people with safe water through mainly piped systems. The schemes are constructed under the responsibility of the Panchayati Raj Engineering Department.

Implementation of a second phase started in 1986, which was designed on the basis of a wider approach, integrating also sanitation and "soft ware' components like health education and community participation, water quality monitoring and income generating activities for women. This second phase is now in an advanced stage of completion, and will supply an estimated 650.000 people by the year 2000, in four districts of the state.

A third 'generation' of projects is presently under preparation, on the same integrated basis, and is expected to start mid 1994, to cover some three hundred villages in one district, with a total design population of approximately 1.1 million.

The total costs for the first two programmes (AP-I and AP-II) will come to a total amount of approximately 70 million US$, of which some 60 million will be financed through Dutch financial assistance.

Justification

The areas where the projects are implemented are suffering from serious shortages in drinking water, mainly due to:

- scarcity of groundwater, seasonally as well as structurally;
- contamination of groundwater by excessive fluoride, causing a high incidence of fluorosis;
- defunct or poorly functioning 'safe' water supply systems constructed and operated by the Government;
- traditional surface water sources (streams and irrigation tanks) being very scarce and unreliable due to continuous drought conditions.

The population is mainly depending on agriculture, under very poor resource conditions. In the project areas per capita income varies from reasonable levels in districts with irrigation schemes to very low levels (up to 80 % of households under poverty line) in rain-fed agriculture areas.

Efforts to follow an integrated approach are motivated by the hypothesis that improving health through better water and sanitation is not merely a technical, but in the first place a socio/

economic and political problem.
For this and other reasons the role of Non Governmental Organisations in the programme is explicitly advocated in the Netherlands Assisted Programme.

Sanitation

The sanitation issue in the NAP projects in AP has been dealt with extensively but up to now with only very moderate successes.
Earlier projects implemented by the State Government proved to be failures. The main reasons being the same as observed elsewhere:

- socio/cultural hindrances;
- technical problems;
- lack of communication between supplier and beneficiary of the facilities.

The latest developments, nurtured by knowledge gained in pilot- and other projects (also UNICEF), are visible in the recently reformulated sanitation component: "Project Clean Village". This will again be closely linked to the water supply projects, and has the following essentials:

- Individual as well as communal facilities: private latrines, drains, soak pits, cattle sheds, *bathing cubicles; school latrines, smokeless stoves; compost pits, etc..*
- An intense coverage (minimum 75% of villagers have to participate before project is to be started).
- Close cooperation with other local institutions involved in public health;
- demand based approach: village committee has to make inventory of people willing to participate.
- Individual poor-flush, two pit latrines will be subsidised according to income classes. For well off households the contribution has to be 75% of the total cost (incl.superstructure). Lowest groups have to contribute in cash and kind, a minimum of Rs. 100.
- Total construction cost is estimated at 3000 - 3500 Rs.
- Strong involvement of local artisans and beneficiaries in construction.
- Low cost solutions adapted to local conditions, special role for women in project planning, masonry-training and extension activities.
- The role of the Government's engineering department is diminishing in favour of local bodies, beneficiary groups and NGO's.
- Strong emphasis on extension and awareness creation at the village level: seeking support from school teachers, village health workers, youth clubs, women clubs, cooperatives, etc.

The project has developed an extensive manual for implementation, and a monitoring system.

As far as maintenance is concerned, the users of all facilities are responsible, individually or through village committees or other local institutions. To this effect activities to mobilise people and structure maintenance 'systems' will be part and parcel of the project approach to implementation.

After a reluctant start in October '92, the first results are very promising in the sense that responses from villagers (low and higher income groups alike) are more than expected. Willingness to participate in preparation and implementation, as well as in training of women and youngsters in latrine construction, are very promising.

The main bottle neck being the **role of the government department**, which is not flexible enough

to assure an effective implementation of the project. Moreover, the notion of a more demand oriented concept, emphasising the preferences of the beneficiaries and the importance of extension and cooperation between different institutions active at the village level is very slowly understood and accepted.

Leusden, 30/09/1993.

annex 4.

HASKONING
Royal Dutch Consulting
Engineers and Architects

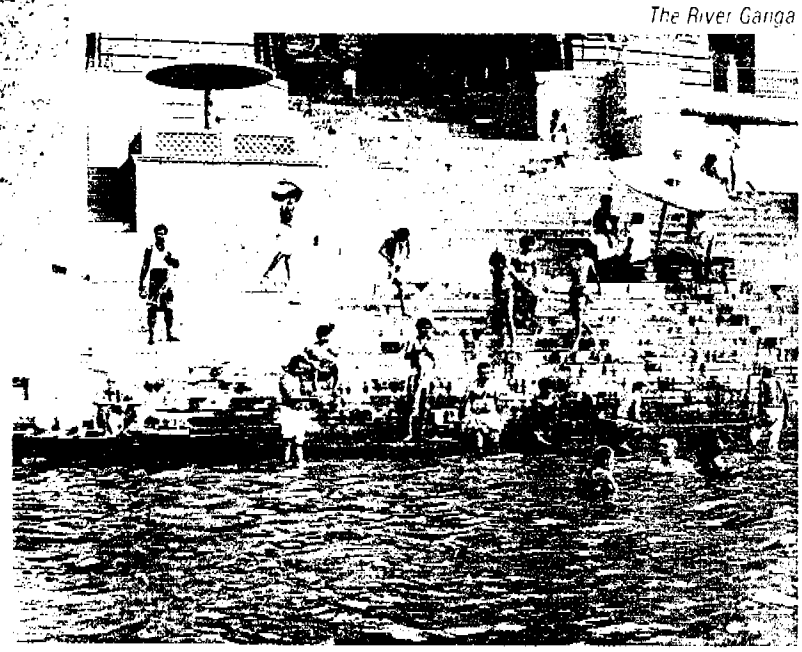
ENVIRONMENTAL AND SANITARY ENGINEERING PROJECT IN KANPUR AND MIRZAPUR INDIA

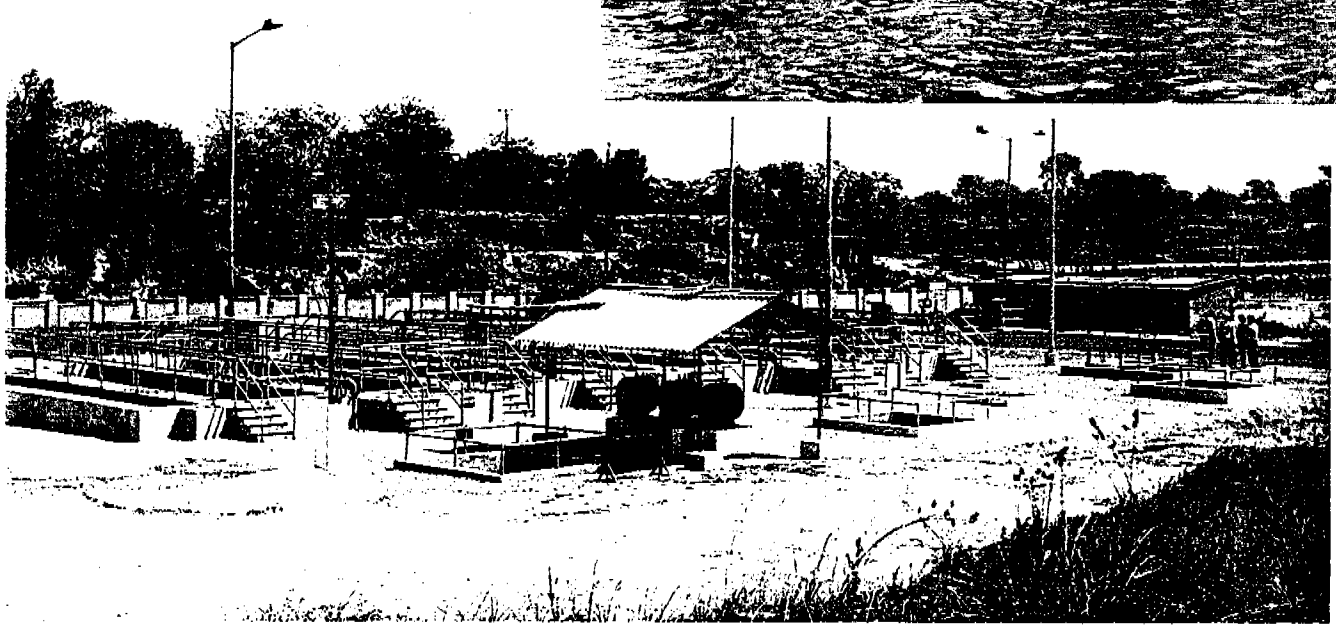
Female Masons at Construction Site

KANPUR

MIRZAPUR

The River Ganga





5 mld UASB Waste Water Treatment Plant at Kanpur

Assignment from

Government of the Netherlands under a bilateral agreement with the Government of India. The Ganga Project Directorate, Ministry of Environment and Forests, is the main counterpart for the project.

Period of assignment

1987-1992

BACKGROUND

The history of the project dates back to 1985 when the existing bilateral development cooperation sectors between India and The Netherlands were expanded with Environmental Protection and Management. This resulted in the Environmental and Sanitary Engineering Project in Kanpur and Mirzapur under the Ganga Action Plan.

The Ganga Action Plan was formulated in 1984 and aims at "Reduction and Prevention of Pollution of the River Ganga". In addition to prevention of pollution of the river Ganga, this project also aims at improvement of the environmental and living conditions of the people in Jajmau, an area in Kanpur, and in Mirzapur.

Integrated Approach

The project aims to resolve the problems of domestic and industrial wastes in an integrated manner. This implies that not only new and clean technologies are being introduced, but also due attention is being paid to the environment and the living conditions of the communities. The communities are closely involved in the project.

In order to accomplish the Integrated Approach, area categories were formulated based on baseline and community surveys. These area categories have been used to establish the interlinkages with regard to the planning of various sanitary facilities taking into account the existing service levels.

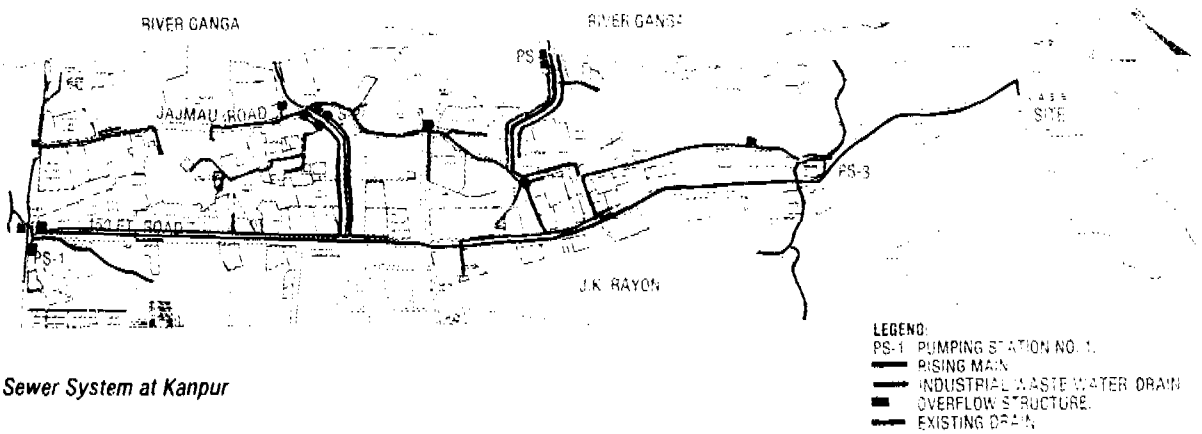
The technical integration combines efforts in the field of water supply, sanitation, sewerage, stormwater drainage, treatment of domestic and industrial waste water, disposal of treated effluent and solid waste management. The input of the social and health aspects comprises community participation, information and public health education. Training and Institutional development activities are also being carried out.

PROJECT SCHEMES

Interceptor Sewers

Both in Jajmau and Mirzapur there are sewage outfalls into the Ganga. Interceptor systems with pumping stations are being built to prevent the flow of untreated domestic and industrial waste water into the Ganga.

Pollution of River Ganga, Kanpur



Industrial Sewer System at Kanpur

Waste Water Treatment Plants using Upflow Anaerobic Sludge Blanket (UASB) Technology

The UASB technology, which has been since long established for the treatment of industrial waste water has recently been developed for treatment of domestic waste water in The Netherlands.

To study the application of the UASB process for treatment of tannery waste water a 40 m3 per day UASB pilot plant has been operated at the Pioneer Tannery in Jajmau from April 1989 to March 1990. In this pilot plant tannery waste water was diluted with domestic waste water before treatment. Based on the monitoring results. it has been concluded that tannery waste water can be treated efficiently in a UASB reactor if diluted in a ratio of 1:3 with domestic waste water at a hydraulic retention time of 8 hours. A 36 mld full scale UASB treatment plant is being built in Kanpur for treatment of a mix of tannery and domestic waste water.

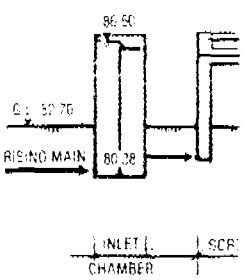
In order to optimise the design criteria under Indian conditions for treatment of domestic waste water a 5 mld UASB treatment plant has been in operation in Jajmau. Kanpur since April 1989. The 5 mld plant was started up without adding seed sludge since the influent sewage contained the necessary seeding material. The data collected over the monitoring period showed that treatment of domestic waste water in a UASB reactor gives satisfactory COD. BOD. and TSS reduction even with a hydraulic retention time of 6 hours. In

Interior view of UASB Reactor at Kanpur

Mirzapur a full scale 14 mld UASB treatment is now being built for treatment of domestic waste water. The UASB reactor will be followed by a high rate pond with 1 day retention time to meet the discharge standards.

Chrome Recovery Technology in the Tanneries of Jajmau

Through the introduction of the chrome recovery technology a substantial amount of chrome can be recovered and reused. This contributes to the prevention of pollution by reducing the dispersement of chrome in the environment and offers financial benefits to the tanners. A pilot plant was installed and operated at the



Pioneer Tannery in Jajmau between February and December 1989. Hides were tanned with 70% fresh chromium and 30% recovered chromium and compared with the hides tanned with 100% fresh chromium. The leather tanned with the recovered chromium appeared remarkably equal to the leather tanned in the normal way.

A cost benefit analysis clearly indicates that recovery of chromium and its reuse is very profitable. The ultimate goal is to recover chromium from all main tanning and retanning liquors and in this way to reduce the discharge of chromium in the environment by about 90%.

Rehabilitation and Augmentation of the Water Supply system

Leak detection surveys have been carried out in pilot areas in Jajmau and Mirzapur.

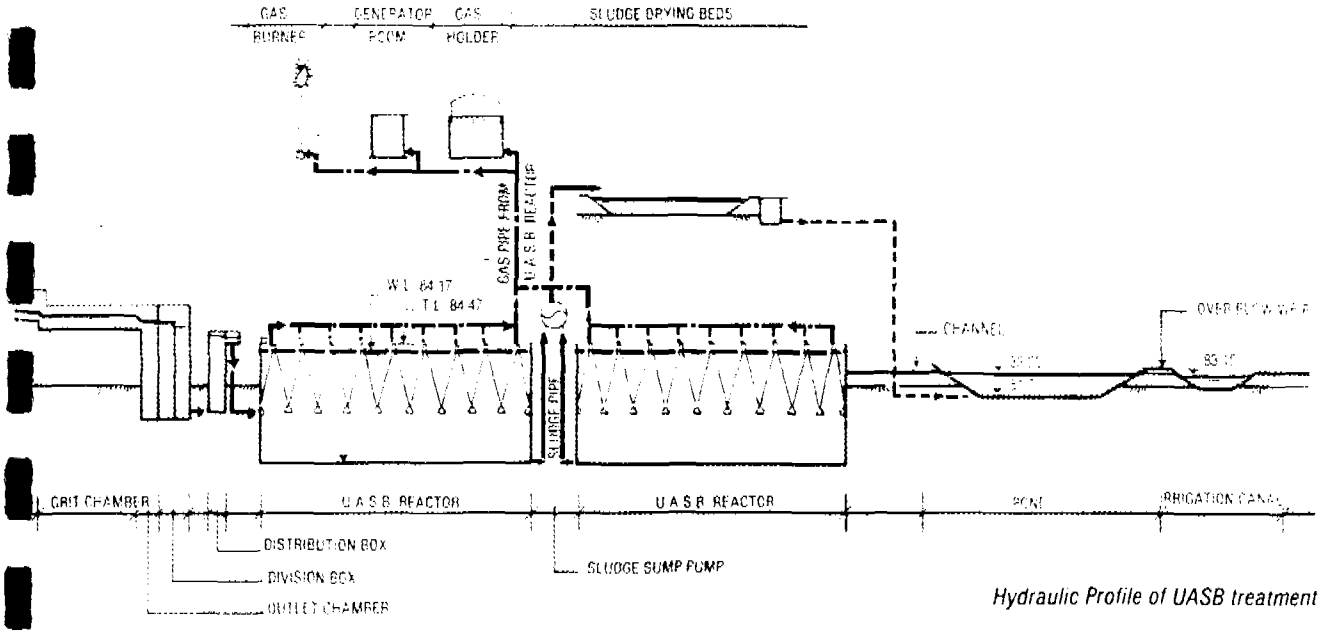
The amount of leakage and wastage i.e. the amount pumped into the system but not used by the consumers, is estimated to be 70% for Mirzapur and 40% for Jajmau. Naturally, this results in insufficient water and very unhygienic and insanitary conditions. The water supply systems in Mirzapur and Jajmau are being rehabilitated and augmented for future demands.

Overhead Tank Construction

The rehabilitation plan consists of a sequence of leak detection and repairs in isolated areas. In this case, the distribution system is first segregated into individual pressure zones. Thereafter the repair works start in an isolated area in one of the segregated pressure zones and expands from here to other isolated areas till the whole pressure zone has been covered. In the course of the programme house connections and public stand posts will be repaired and wherever required installed.

The augmentation consists of expansion of the production facilities, new overhead tanks and pipe lines.

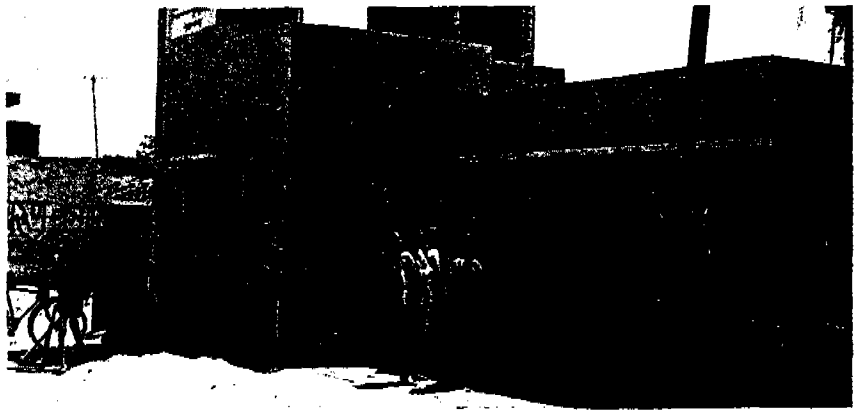
To provide immediate relief, a crash programme was carried out for installation of handpumps in areas with no piped water supply and tubewell regeneration for production increase.



Hydraulic Profile of UASB treatment plant at Mirzapur

Low Cost Sanitation

At present in both the project areas a large part of the population has no sanitary facility. Provision of low cost private pour flush latrines is being made. For people who cannot afford a private latrine or who do not have sufficient space in their premises, and for the floating population public latrines are being provided.



Community Toilet

Solid Waste Collection and Disposal

The present level of facilities for solid waste collection and disposal is insufficient. People generally dispose their waste on road sides. This creates health hazards and easily chokes sewer lines and storm water drains. Collected solid waste is often dumped on the banks of the river Ganga which pollutes the river. The proper collection, transportation and controlled disposal of solid waste is an essential part of any environmental upgrading programme. The emphasis is on systems management development within the solid waste management departments of the municipalities of the two towns.

Storm Water Drainage

In both towns during heavy rains many areas are flooded due to the improper functioning of the storm water drainage system either because of insufficient carrying capacity or on account of choking. This causes inconvenience as well as insanitary conditions. These storm water drains are therefore being upgraded, renovated and extended where needed to rectify bottlenecks.

Transfer of Know-how through Training and Institutional Development

Certain new technologies like the UASB process and chrome recovery are being introduced by this project. Transfer of know-how with regard to design and operation and maintenance aspects of these technologies is ensured through off and on-the-job training.

Training and Institutional. Development are being carried out for improvement of skills of local municipal staff and improvement of the organiational aspects of the agencies for better operation and maintenance of the facilities. Training modules are being developed for UASB

Proper Solid Waste Handling

Technology, Chrome Recovery and Reuse, Leak Detection, Financial Management in O&M Agencies and The Integrated Approach.

Promotion of Public and Occupational Health

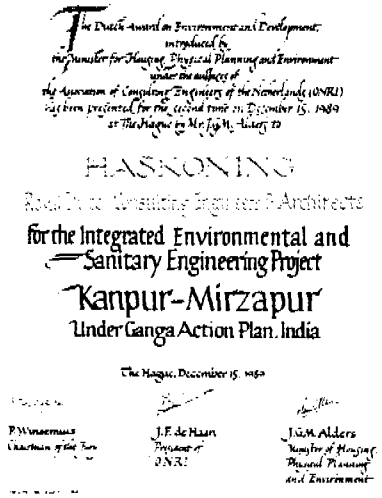
As public health standards are very low in the project areas, the target population is being educated to use the facilities in such a manner that their hygienic conditions improve. Also occupational health interventions for tannery workers in Jajmau and carpet weavers in Mirzapur are virtually non-existent.

Improvement of the occupational health situation will considerably contribute towards improvement of the living conditions of the work force in industries and is anticipated to have a spin-off effect to their families as well.

Proper Water Handling

Enhancement of the Knowledge, Attitudes and Practices of the Target Population

All technical interventions for a cleaner environment and healthier living conditions as listed above will not be sustainable without the active involvement of the people. In order to enhance the knowledge and the subsequent change in attitudes and practices of the beneficiaries, community workers are being actively involved in activities related to promotion of awareness, initiating social organization at grass root level, and transfer of knowledge. The project is carrying out programmes towards community development, women's aspects, and creating an awareness on the overall benefits of a clean Ganga.



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WATER, SANITATION, ENVIRONMENT and DEVELOPMENT

An alternative pit latrine emptying system

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Introduction

This paper addresses the development of an appropriate pit emptying service, including the design of suitable equipment, in Dar es Salaam, Tanzania. The basic perspectives which guided the project partners are presented as well as some information on how the Manual Pit Latrine Emptying Technology (MAPET) service is functioning. MAPET is community based, but will provide better service if integrated in the city-wide service system of Dar es Salaam. Project partners for this pilot project (1988 - 1992) were WASTE Consultants and the Dar es Salaam Sewerage and Sanitation Department.

Situation in Dar es Salaam

In Dar es Salaam, as in other large Third World cities, the great majority of houses have on-site sewage disposal, i.e. mostly pit latrines, some septic tanks. Pit latrines are used by 80% of the households. On the 1992 population of over two million inhabitants or 450,000 households, this means that Dar es Salaam has about 170,000 pit latrines. Obviously, when the pits are full, they must be emptied[1]. It is estimated that yearly about 50,000 m^3 of sludge from latrine pits need to be emptied. Add to this the demand for the desludging of septic tanks, and one realises that any pit emptying service agency faces a formidable task. Are the authorities in Dar es Salaam able to respond to this demand?

The Dar es Salaam City Council operates, through the Dar es Salaam Sewerage and Sanitation Department (DSSD) and the Health Department, its own vacuum tanker services with about five cesspit tankers in continuous operation each.

Apart from the formal system, there are informal, self-employed, pit emptiers who practise the traditional method[2]. Characteristic of this method is that, next to the full latrine pit a shallow hole is dug on the resident's plot, and that the sludge is scooped into this new hole by manual labour. Another characteristic is that, the pit emptier and the house owner deal with each other personally, without the interference of a (bureaucratic) organisation. In a process of face to face negotiations they agree on the price to be paid and the day of starting the work, and on the location of the hole for burying the sludge.

The existing services together do not have sufficient capacity to handle the rising need for pit emptying. A major shortcoming is that the voluminous size and weight of the vacuum tankers is unsuitable for narrow and unpaved roads in the densely built, unplanned areas. Especially the low-income areas lack adequate services because of the unsuitability of the vacuum tankers. The main requirement was, therefore, to design equipment appropriate for the densely settled areas; equipment that is manufactured and maintained locally. However, technical innovation alone is not enough to improve service delivery.

An alternative service

The new equipment and service is called MAPET (Manual Pit Emptying Technology). DSSD took responsibility for introducing MAPET through its own organization in Dar es Salaam, while WASTE Consultants acted as the advisor. The equipment is manually operated and is sufficiently small to be manoeuvred through narrow roads. Using local materials and components and widely known construction techniques, the equipment can be locally produced and repaired in small workshops. The operation of the equipment requires team work of three men, who - as experience bears out - stay voluntarily together for several years. As MAPET can function to a large extent independently from a centralized administrative organization and workshop, it is possible to decentralize its service to the neighbourhood level.

MAPET technical features and operation

A MAPET team consists of three men. One is the leader. In order to be allowed to rent the MAPET equipment he needs a certificate from DSSD. For this certificate the team must first do a training at DSSD. If a pit emptier is found dumping the sludge somewhere behind the bushes, he loses his certificate.

The MAPET team goes with two hand carts (one pump cart and a tank cart of 80 cm width) from the community centre to the customer. They can cover a distance of a couple of kilometres. They first negotiate with the customer where to dig a hole to bury the sludge. They then insert the hose-pipe into the squatting hole and connect it to the tank cart. The tank cart is connected to the hand pump with an air hose. The air is pumped out of the tank and the resulting vacuum causes the sludge to be sucked into the tank. The full tank is emptied into the hole.

Digging the hole constitutes most of the work and takes more than one hour. The 200 litre tank is full within five minutes. With heavy sludge it takes longer. Water is mixed into the sludge. By draining the hose-pipe out at full vacuum ('plug and gulp') the sucking can be intensified. Customers generally ask for 4 to 10 tanks to be taken out of their latrines. The pit emptiers earn about 2,000 to 5,000 shilling which they share among themselves. In order to make a living of the MAPET pit emptyings they should have at least one customer per day.

The process of MAPET introduction

The following points of view have guided the development of MAPET:

First, pit emptying is a service consisting of several components, of which the equipment is only one element. Other components are e.g. training to operate the equipment, repair facilities, the capacity to find customers, economic and financial aspects of the service organisation, and facilities for sludge disposal. All these components of the MAPET service have subsequently been addressed during the pilot project. Project experience has confirmed the importance of appropriate and locally constructed equipment. It has also confirmed the notion that a service can only be performed satisfactorily if all other components function properly.

Secondly, the introduction of new equipment, even more so of a whole new service, requires a step-by-step approach. This allows the innovations to be adjusted to local conditions at the appropriate time. This entailed e.g. that the basic MAPET equipment was constructed as a prototype in a few months' time, but that serious adjustments were made in response to the experiences of the immediate users, i.e. the pit emptiers, over a period of 3 years. Similarly, training of the mechanics took place over a number of years, as they carried out the improvements in the MAPET equipment in the DSSD's own workshop. A step-by-step approach also implied that other components of the MAPET service were developed only when the need arose. For example, when the pit emptiers found it difficult to generate a regular demand from customers, a system of informing and motivating customers and community leaders was developed.

Thirdly, the new service, including the equipment, should be based on the most appropriate elements of the existing pit emptying methods. That is, building upon what exists, on what is known and familiar to people and organisations. In this way MAPET is not a strange element, as it combines e.g. the modern vacuum technology of the cesspit tankers with the traditional system of on-site sludge disposal by manual labour. It also strengthens the so-called traditional element of personal interaction between pit emptiers and customers, which is an important feature of modern small-scale, informal business contacts.

Fourthly, a form of public-private cooperation was envisaged between the DSSD and the informal sector. The public authorities have ultimate responsibility for sanitation services as they concern public health. It was also recognised that the demand for employment is tremendous. In times of structural adjustment programmes, MAPET could not generate new employment opportunities in DSSD, a government institution, but only in the private, informal sector. The solution adopted was that the DSSD would be the owner of the MAPET equipment and lease it to the pit emptiers. The DSSD provides essential support services, such as performing large repairs, promotion of MAPET in new neighbourhoods, and training and supervision, while the pit emptiers are self-employed workers, responsible for earning their own income. They do not receive a basic salary from DSSD. In this cooperation DSSD has a position to control irregular sludge disposal by private emptiers.

Different forms of organisation and management are conceivable, with a different balance between public and private responsibilities. Several options are being tried out in Tanzania.

The resulting MAPET service has both advantages and disadvantages. Some of the advantages are that:

- The MAPET equipment can reach the most inaccessible houses.
- The service can be performed almost immediately, while the vacuum tanker service requires a long waiting time.
- And the possibility of regular social contact between residents and emptiers, which enables community influence and supervision.
- MAPET can offer 'service to size': small volumes suiting the customer's household budget.

Some of the disadvantages are that:

- The MAPET service is expensive per unit of volume (m^3) compared with that of the vacuum tankers.
- The method of sludge disposal (burying on the plot) is not suitable for areas with a high ground water table and very densely populated areas.
- Cash flows between the DSSD and the private pit emptiers are difficult to control in practice.

MAPET service as part of a city-wide system

The pilot project has shown that MAPET can function satisfactorily in local communities. The emptiers can identify their customers and earn a low but steady income, informal mechanics in the neighbourhood carry out minor repairs, a certain amount of sludge disposal takes place within the community, and in a general sense MAPET enjoys social acceptance in those communities where it is already working. Leaders in other areas that came to know about MAPET are eager to bring it into their neighbourhood as a solution to the public health problems. Some NGO community initiatives have identified MAPET as a

first priority to start a neighbourhood improvement campaign. On the other hand, residents and leaders would like to have more influence on the MAPET service, as they observe the potential for integration within the economic and health service system of the local community. Also they see the potential for income generation by the community.

However, MAPET is not an independent alternative to the tanker service. The size of the population requires the volume and hauling capacity of pit emptying as performed by the DSSD vacuum tankers[3]. In addition, MAPET should be operationally linked to the DSSD regarding sludge disposal. In areas with a high ground water table, MAPET cannot operate at present because of the absence of disposal facilities. Sludge must be removed from these areas and transported to central dumping stations of the city. The DSSD is the most likely organisation to use its vacuum tankers for this purpose. The aim is to combine the advantages of a community based service with the advantages of a strong organisation able to haul sludge through the city for final disposal. The required institutional arrangements (technical, financial, and operational) between the DSSD as a bureaucratic, government controlled organisation, the independently operating MAPET pit emptiers, and local communities are quite complicated. This is a formidable task, not less than the first introduction of MAPET.

The next phase of the MAPET project will include the development of an institutional framework for a neighbourhood based service, as well as the development of a sludge transfer system. The sludge transfer will initially be directed towards locally manufactured transfer stations as well as options for sludge treatment at neighbourhood level.

As in the first stage of the project, progress will be directed by the problems experienced by the organizations and operators directly involved at the city-wide and at the neighbourhood level. Solutions will be reached through a unique combination of the potential of these organizations in the public, private and community sectors.

References

1 Comparative Study on Pit Emptying Technologies, draft Final Report, WASTE Consultants, Gouda, The Netherlands, 1993

2 MAPET Progress Report 2, WASTE Consultants, Gouda, The Netherlands, 1988

3 The COMPET study has recommended to separate urban areas with pit latrines into typical large tanker, mini tanker and MAPET areas. The typical MAPET areas are those where even mini tankers do not have access. Large tankers appear to be the most economic (if adequately managed, which is often not the case) for hauling sludge to sludge disposal stations over distances more than 5 km from the pit.