

MASTER

Transfer of manual pit emptying technology (MAPET) to unplanned urban areas in Southern Africa

de Vreede, Esther

Award date:
1998

[Link to publication](#)

Disclaimer

This document contains a student thesis (bachelor's or master's), as authored by a student at Eindhoven University of Technology. Student theses are made available in the TU/e repository upon obtaining the required degree. The grade received is not published on the document as presented in the repository. The required complexity or quality of research of student theses may vary by program, and the required minimum study period may vary in duration.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain



TECHNOLOGY AND DEVELOPMENT STUDIES

Faculty of Technology Management

Eindhoven University of Technology

M.Sc. Theses Series TDS 1998: 98.13

Supervisors

J. Rijnsburger
H.C.J.J. Gaillard
A.P. Nagel
A.E. Szirmai

WASTE

Technology & Development Studies (EUT)
Business Engineering (EUT)
Technology & Development Studies (EUT)

Transfer of Manual Pit Emptying Technology
(MAPET) to unplanned urban areas
in Southern Africa

Esther de Vreede

December 1998

EXECUTIVE SUMMARY

Between 1988 and 1992 the Netherlands Ministry of Development Co-operation financed a technology development project in Dar es Salaam, Tanzania. WASTE developed this so-called Manual Pit Emptying Technology (MAPET) in co-operation with the Dar es Salaam Sewerage and Sanitation Department (nowadays part of the Waste Management Department). The MAPET equipment, a handpump and a 200-l vacuum tank, is used by MAPET teams to empty pit latrines in unplanned urban areas. These areas are not accessible for the conventional vacuum tankers.

Methodology

Dar es Salaam is not the only city coping with these pit emptying problems. Also other cities in developing countries are looking for solutions to their problems. Therefore the main problem addressed in this research is:

How can the MAPET service be expanded within Dar es Salaam, and how can the service be transferred from Dar es Salaam to other unplanned urban areas?

Therefore, the aim of the research is to find possibilities for this expansion and transfer of the MAPET service. To investigate the problem a theoretical model is developed, whereby the MAPET service is seen as an integrated system. The MAPET service itself consists of the 'people', the 'equipment', the 'organisation' and 'information'. Various actors are concerned with the MAPET service, including the local and central government, Non-Governmental Organisations (NGO's), Community-based organisations (CBO's), and the formal and informal sector. Especially for a comparison between countries it is important to analyse institutional aspects, like politics, economy, technology, health care and physical environment, and social and cultural issues.

Results

One of the major findings regarding the MAPET service in Dar es Salaam, is that the service as developed is running dry. While the need for MAPET is increasing because of inadequate tanker services, the present emptiers are not able to increase their market. There are interests from other organisations, the Town Development Committees of Vingunguti and Buguruni, but in those areas on-site sludge disposal is not possible. So far no adequate system for the transfer of the sludge was developed. Other problems for re-implementation of the MAPET service are a missing adequate organisation setting and the lack of finances.

The need for pit emptying services in unplanned areas, recently became a problem in Durban, since many latrines were built only a couple of years ago. The problem is of lesser scale than in Dar es Salaam as is indicated by the need for MAPET teams of 16 and 99 teams respectively. Until now initiatives come from the Metropolitan Council and not from the residents as such. However, community participation is needed to support reorganisation of the social institutions after the collapse of the apartheid regime.

Final conclusions

Currently we cannot speak of a 'transfer' of the MAPET service, since no supply side of the MAPET system is at hand. First of all blueprints of the MAPET equipment must be designed and in addition a Mobile Sludge Transfer System must be developed to transfer the sludge for treatment and final disposal. It can be concluded that the municipal departments in Dar es Salaam and Durban are not capable of arranging a transfer of the MAPET service.

Since hardly anything is left of the MAPET service, a new start should be made in both cities. The major points of attention for Dar es Salaam should be the organisation setting and to raise funds or subsidies, or otherwise micro-credits. Durban should focus on the (re)design of the equipment and a mobile sludge transfer system. In addition, attention should be paid to the participation of communities.

Recommendations

To arrive at a sustainable MAPET service, also outside of the Dar es Salaam areas of Mwananyamala and Tandale, it is a necessity to introduce an intermediary organisation. This organisation would be responsible for the revival of the MAPET service and for the co-ordination of a transfer to other unplanned urban areas. Since WASTE was the

developer of the MAPET service they ought to serve as intermediary organisation, until they find a suitable and adequate Southern organisation that is capable of overtaking WASTE's tasks and responsibilities.

Firstly, they should co-ordinate that blueprints are made and that MAPET components are standardised. This should be done in co-operation with the Durban Metropolitan Department of Wastewater Management. Once, the designs are available, and thus a supply side is created, WASTE should co-ordinate and monitor transfer of the MAPET service to other unplanned areas. This should be done according to an integrated international approach. Thereby cities from various developing countries are to co-operate on the central problem of emptying pit latrines in unplanned areas. Greater understanding and insight will be the outcome of sharing experiences between the cities.

Specific recommendations for Dar es Salaam include:

- MAPET service managed and co-ordinated by NGO or CBO instead of municipal department;
- Involve of communities in the service.
- Additional training for emptiers, not only technical, also focused on entrepreneurial skills.
- Continuous promotion and education to increase health care awareness and acquaintance with the MAPET service.

Specific recommendations for Durban include:

- Involve of communities in the service.
- Determine customers' criteria by carrying out social studies in the informal settlements.
- Design blueprints of the MAPET equipment.
- Integrated health care promotion and education, not only responsibility of Health Department.

PREFACE

“And certainly there were many others... from whom I had assimilated a word, a glance, but of whom as individual beings I remember nothing. A book is a great cemetery in which, for the most part, the names upon the graves are effaced.” Marcel Proust - Time Regained

In the period of my M.Sc. research, the list of persons to whom I am indebted for co-operation, assistance, criticism and encouragement has grown very long. Hopefully, I will be excused for singling out a few upon whom I called most frequently for support.

Above all I would like to thank Mr. Jaap Rijnsburger of WASTE for giving me the opportunity to go ‘that other world’, so many miles south of us. He taught me very much of the development work and projects in practice, after years of theories and even more theories at the University. I started the fieldwork in Tanzania, looking for the remainders of the MAPET service. During those months I was supported by Mr. Jasper Kirango, who is a very busy man managing the Waste Management Department and taking care of his lovely family. Wherever he could he tried to help and support me, most of all by improving my Kiswahili. Thanks to him, I can understand a little bit more than just ‘Habari’.

After a wonderful time in Tanzania, I continued my research in South Africa. Not as much a culture shock as when I arrived in Dar es Salaam, but also this country has made a big impression on me and left me with memories I will never forget. I was welcomed very friendly by all people from the Durban Metropolitan Department of Wastewater, but I would especially like to express my gratitude to Mr. Chris Olivier for giving me the opportunity to work within his department for as long as I was in Durban.

Having a backpack full of memories (and of course a great deal of information) I returned to the Netherlands after six months of sunshine. What more typically Dutch than rain, rain and rain to accompany me during my final phase of writing this thesis. The staff of Technology and Development Studies deserves special compliments for guiding me to the point where I have to leave all of them behind at the Eindhoven University of Technology. Most work was done by Mr. Herman Gaillard, who had to read my draft reports over and over again. And thanks to his inspiring comments, the end is near and I will be on my way to ...

Wherever I’m going to, how blissful or how dark the situation may be, I know I’ll always have my family and friends around me. During my stay in Tanzania and South Africa, or maybe even especially during my stay there, they gave me so much support, love and friendship. Besides the practical things I experienced in Africa, it was most of all a period of self-realisation. Without my mother Mrs. Leonie van den Beuken, I wouldn’t be where I am right now. Not only by giving birth to me, but for all the things she has done for me the past 26 years, I would like to dedicate this report especially to her.

GLOSSARY

CBO

A Community-Based Organisation is any form of organisation that draws its members from the same neighbourhood, that is, a geographical area that is also a socio-administrative unit. It can be a women's group, youth group, credit organisation, neighbourhood management committee etc., in short any organisation that has a certain degree of formality, structure and regularity in its functioning, and applies certain membership criteria. In many, countries, local governments will only consider community groups as partners in service provision, if they are formerly registered as a CBO.

NGO

The term NGO can refer to such diverse organisations as churches, universities, labour organisations, environmental organisations and lobbies. Sometimes even donor organisations fall under this heading. Generally, Non-Governmental Organisations (NGO's) are intermediate organisations that are not directly and continuously involved in community projects. NGO's are not only advocate, they can also be involved in awareness-raising, and decision-making. NGO's can act as intermediaries between grassroots initiatives (CBO's) and municipal governments, or serve the ideological, political, or altruistic interest of international organisations

On-site sanitation

Includes communal facilities that are self-contained within the site, in contrast to sewerage and dry latrines where excreta is removed from the site

Pathogens

Disease-causing micro-organisms, many of which are aquatic

Pit latrine

Latrine with a pit for accumulation and decomposition of excreta and from which liquid infiltrates into the surrounding soil

Sanitation

The means of collection, treatment and disposal of human excreta and community liquid waste in a hygienic way so as not to endanger the health of individuals or the community as a whole and not to endanger the physical environment

Sludge

Wastewater that includes human excreta

South-South co-operation

Co-operation between organisations in developing countries, without the interaction of a Western organisation from a developed country

Sullage

Wastewater from bathing, laundry, preparation of food, cooking and other personal and domestic activities that does not contain excreta

Technology transfer

A technology or technical system moves across national boundaries, whereby the technology shifts from a supplier to a receiver

Unplanned areas

Unplanned areas are (mostly) low-income residential areas that have grown without planning before construction. As such, they lack any physical infrastructure such as roads, drainage and sewerage. The quality of housing and the facilities such as pit latrines can be relatively good, not worse than in planned areas. It is the lack of public infrastructure that is more typical. Also the term informal settlements is used in this report indicating the same sort of areas

LIST OF APPENDICES

A	WASTE profile	i
B	Pit latrines	ii
C	Organisational structure MAPET	iii
D	Vacu-tug system	v
E	Operationalisation of elements	vii
F	Dar es Salaam surveys	ix
G	Customer survey results	xiv
H	Calculation for MAPET teams needed	xix
I	Existing and proposed treatment ponds	xx
J	Introduction to Dar es Salaam actors	xxi
K	Estimates of income derivation	xxv
L	Introduction to Durban actors	xxix
M	Sanitary coverage in Tanzania and South Africa	xxxii

PART I

METHODOLOGICAL ISSUES

1 THEORETICAL ISSUES

Many developing countries cope with problems related to sanitation. Especially in dense urban areas where low-income communities are living, installation of a sewerage system, with its high costs and need for piped water supply, is not a feasible option. For such communities, on-site disposal – dealing with excreta where they are deposited – offers a hygienic and affordable solution. Many residents are using pit latrines, but one of the problems with these pit latrines is that they fill up in five years (on average). Developing countries in Southern Africa¹, but also countries in other parts of the world, use various different pit emptying methods and services. However, most of those countries do not have a solution to service the unplanned areas of their cities.

In Dar es Salaam, Tanzania, a manual pit emptying service was developed to service the unplanned areas. It became known as MAPET, *Manual Pit latrine Emptying Technology*, after the handpump equipment that facilitates pit latrine emptying in unplanned areas.

1.1 Development of the MAPET service

1.1.1 MAPET stage I

Between 1988 and 1992 DGIS, the Netherlands Ministry of Development Co-operation, financed a technology development project in Dar es Salaam. This project, which became known as MAPET, was initiated by WASTE (Gouda, the Netherlands, see appendix A) in co-operation with the Dar es Salaam Sewerage and Sanitation Department (DSSD). The MAPET-I (pilot) project was based on the observations that 90% of the population of the unplanned areas in Dar es Salaam rely on on-site sanitation, mainly pit latrines (see appendix B). In addition, conventional pit emptying services, using vacuum tankers cannot supply to the unplanned areas and traditional manual pit emptying is expensive and unhygienic, since the emptiers have to touch the sludge.

The objectives of the project were to contribute to the improvement of environmental sanitation in unplanned urban areas and of the informal practise of traditional pit emptying, also resulting in more income generation for the pit emptiers. Therefore effective and hygienic pit emptying services were needed, as far as possible with locally available technology. Criteria concerning the technology included:

1. reduction of dependence on expensive imported fossil fuel;
2. no demolition of squatting slab and super structure of the pit latrines;
3. no sludge entering the pump to prevent risk of blockages and breakdowns of the equipment;
4. accessibility through small paths and gates to inner courts; and
5. local construction and maintenance in Tanzania.

Box 1-1: The MAPET service

(Source: chapter 4 of *MAPET; a neighbourhood-based pit emptying service with locally manufactured handpump equipment in Dar es Salaam, Tanzania*, by M.S. Muller and J. Rijnsburger (WASTE))

Features of the MAPET service have the following socio-economic benefits:

- MAPET creates employment opportunities for unskilled men working in the informal sector. The MAPET emptiers “lease” the equipment from DSSD, which owns it, and earn their income by charging a fee to the customers whose latrine pit they empty. As the emptiers pay for the repairs that are carried out at local workshops, MAPET also stimulates this part of the informal sector.
- MAPET results in a community-based service, as the activity radius of the MAPET emptiers is within a particular neighbourhood.

People

By means of two social surveys and meetings with leaders, women and other residents, the following customers' criteria for satisfactory pit emptying services were discovered:

- Good quality (no waiting time).

¹ NiZA (Nederlands Instituut voor Zuidelijk Afrika) defines Southern Africa as: Angola, Botswana, Lesotho, Mauritius, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe

- The cost should be affordable and fit in with a household expenditure pattern of buying goods and services in small quantities.
- Social accessibility (direct negotiations with pit emptiers).
- Physical accessibility (booking office in own neighbourhood).

The MAPET services are community based in that they serve the residents of a delimited neighbourhood, can respond to the demands of residents and community leaders, and has the equipment stationed within the neighbourhood. Women benefit from improved environmental health conditions. They can also influence service delivery, as the booking office is located in their neighbourhood.

A team of MAPET emptiers consists of three men, each of whom is self-employed. The team leader selects his team members. Together they decide on how to co-operate in the work and how to share the income they earn as a team. The emptiers set their own price level through negotiations with the customers. They depend on their own efforts to find work. Each team has its own territory or neighbourhood.

The emptying job starts with contacting the customer, negotiating over the price, picking up the MAPET equipment from its parking place and taking it to the customer's house. The latter may take from 30 to 60 minutes. A hole is dug for sludge disposal and the latrine sludge is prepared for pumping. This preparation entails mixing the sludge with water (to make it more fluid) and paraffin (to reduce the smell). After the hosepipes have been connected the sludge pumping can start (photo 1-1). Depending on the sludge's viscosity and the pumping head, it can take five to twenty minutes to fill up one 200-litre tank with sludge. When a tank is full, the hosepipes are disconnected and the tank is manoeuvred next to the dug hole, and topped over in discharge position. A pressure relieve valve is opened and the sludge flows into the hole. After putting the tank back in its original position, pumping can start anew and the vacuum tank is filled again. This routine is repeated until the required amount of sludge has been taken out. The equipment is then cleaned and returned to the (neighbourhood-) parking place.

Equipment

The equipment has two main components: a handpump and a 200-litre vacuum tank, both mounted on pushcarts. Two flexible hosepipes belong to the equipment, i.e. a 3/4-inch hosepipe as air connection between the pump and the tank, and a 4-inch hosepipe of 4 metres to drain the sludge from the pit. There are several auxiliaries, including a mixing rod for stirring the sludge to the required viscosity, a hook for picking rags and other material that blocks the flow of the sludge, a spade and a hoe for digging the hole for sludge disposal, a chisel and a hammer for widening the squatting hole or making a hole in the latrine wall for the sludge hose-pipe.

Maintenance of the MAPET equipment is ensured by applying construction techniques generally known and applicable in local enterprises and by training of the DSSD mechanics in the construction and repair of MAPET components. The DSSD, as the owner of the MAPET equipment, leases this equipment to the MAPET emptiers and is responsible for major repairs, while the emptiers uses local workshops or their own skills for small repairs.

Two ways of sludge disposal are practised, the one most often applied is on-site disposal (photo 1-2). It takes place when the water table is low and when there is sufficient space on the plot. Off-site disposal (not much practised yet) takes place when the water table is too high or when the plot has no space for on-site disposal. On-site disposal implies burying the sludge on the residential plot itself. The team has to return after one or two days to fill up and cover the hole containing the sludge. The sludge has to be left some time to allow leaching of the liquid before the sludge can be covered with soil. When off-site disposal is necessary, the sludge has to be transported to a permanent or temporary disposal site somewhere in the neighbourhood. To make off-site disposal a regular practice, a system of sludge transfer and treatment is necessary.

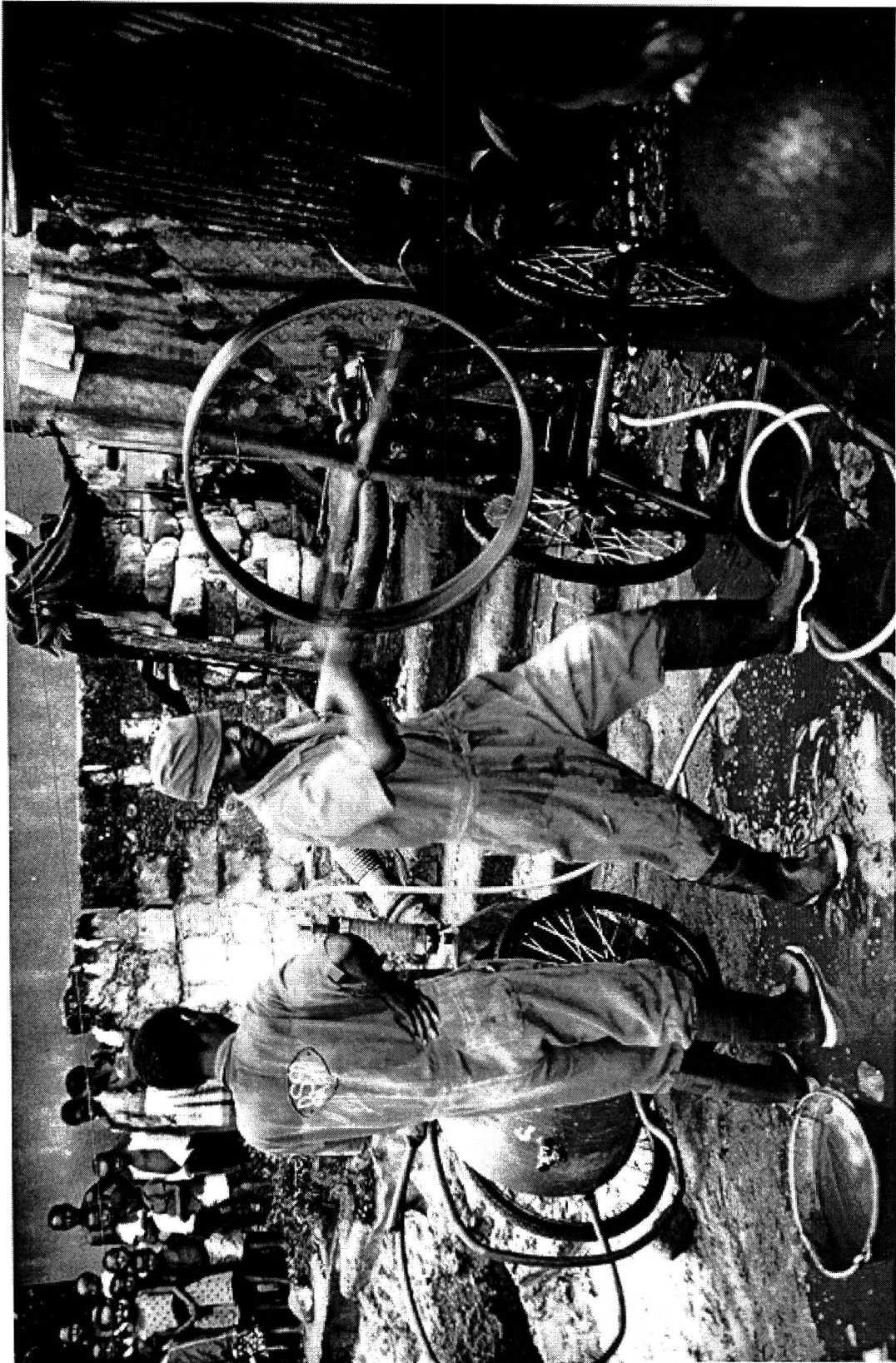


Photo 1-1: MAPET emptying



Photo 1-2: On-site disposal

Information

Pit emptying as the sole source of income relies on a steady supply of customers in an area that is small enough to be covered without motorised transport. The net income for a team member would have to be at least equal to the subsistence level, which was estimated in 1992 at TSh. 15,000/- for urban Dar es Salaam. The average charge for a tank load was the equivalent of TSh. 500/-. AS the average job consists of five tank loads, a team earns TSh. 2,500/- per customer, which usually constitutes their daily income, as it is normally not possible to empty more than one latrine per day.

MAPET promotion is essential to establish the service in a new area. After the initial campaign, the staff should also be available to facilitate communication and solve incidental misunderstandings between MAPET emptiers, residents, municipal employees and others. An important component of promotion is public health education. Awareness about the health aspects of the operation and emptying of pit latrines is one of the means of motivating people to take action about their full latrine pit.

1.1.2 COMPET

From 1991-1993 WASTE co-operated on the Comparative Study on Latrine Pit Emptying Technology (COMPET), which has been a joint field study with the DSSD, with inputs from Manus Coffey Associates (MCA, Ireland) and the International Reference Centre for Wastes Disposal (IRCWD, Switzerland). The study compared performance and effectiveness of three pit emptying technologies. All three technologies, large vacuum tankers, mini vacuum tankers and MAPET, were simultaneously in use in Dar es Salaam at that time. COMPET allowed for a limited expansion from 3 to 7 teams operating the MAPET service in Dar es Salaam.

For Dar es Salaam it was concluded that accessibility is the key parameter for the input of the three technologies. MAPET is effective where tankers simply cannot operate. At equal accessibility mini tankers can be applied more efficiently than MAPET, provided short hauling distances between pit and dumping station. Cases from other countries show that the mini tankers become less efficient at hauling distances of more than 5 km, the range within which they have been applied in Dar es Salaam. Similarly large tankers can be applied more efficiently than mini tankers.²

Other parameters indicate that MAPET is more labour intensive to operate than the large or mini tanker services. But the labour costs for MAPET can be fully recovered from the negotiated fees, and the willingness to pay for a relatively more expensive MAPET service is related to its availability at short notice and customer control of its performance.

1.1.3 MAPET stage II

In 1994 WASTE, in co-operation with DSSD, made a request at the Dutch embassy for a follow-up project: MAPET-II. The proposal for this project was entitled: "Expansion of Manual Pit Emptying Services and further Development of Sludge Transfer Technology for Low-Income Squatter Areas in Dar es Salaam, Tanzania". In Stage II the MAPET service developed in Stage I was meant to be expanded to cover other unplanned areas of Dar es Salaam, and an additional system for sludge transfer was to be developed (especially for areas with shallow groundwater). Also an institutional framework was to be established for the support and monitoring of pit emptying by community operators as well as private operators, and adequate resources had to become available to address similar demands in other towns of Tanzania. MAPET-II aimed at introducing the MAPET system at a much larger scale, but because of other "non-urban" priorities the request for funding was denied by DGIS.

1.2 Relevance of the research

Every year, 2.5 million children die of diarrhoea that could have been prevented by good sanitation. Human excreta are responsible for the transmission of diarrhoea, schistosomiasis, cholera, typhoid, and other infectious diseases affecting thousands of millions. If people have such diseases their excreta is likely to contain pathogens that pass on the diseases to other people. These pathogens are generally swallowed with food or drinking water, although some may enter the human body through the skin. Pathogens can be transmitted through water, hands, flies and other insects, soil and plants (figure 1-1).

²See WASTE, *Comparative study on Pit Emptying Technologies (COMPET) executed in Dar es Salaam, Tanzania*

Overall, the World Health Organisation estimates that nearly 3.3 million people die annually from diarrhoeal diseases, and that a staggering 1.5 thousand million suffer from parasitic worm infections stemming from human excreta and solid wastes in the environment.³ Without adequate sanitation, the environment is exposed to pathogens. Therefore, the primary relevance for using MAPET seen from the residents' point of view is improving the sanitary facilities by facilitating manual pit emptying services for the inaccessible unplanned areas. This will prevent environmental pollution and might thus lead to a reduction of diseases; where poor health keeps families in a cycle of poverty and lost income. For the pit emptiers MAPET is a more efficient and more hygienic way of emptying the pit latrines (no physical contact with the sludge) and it is also a way of raising their income.

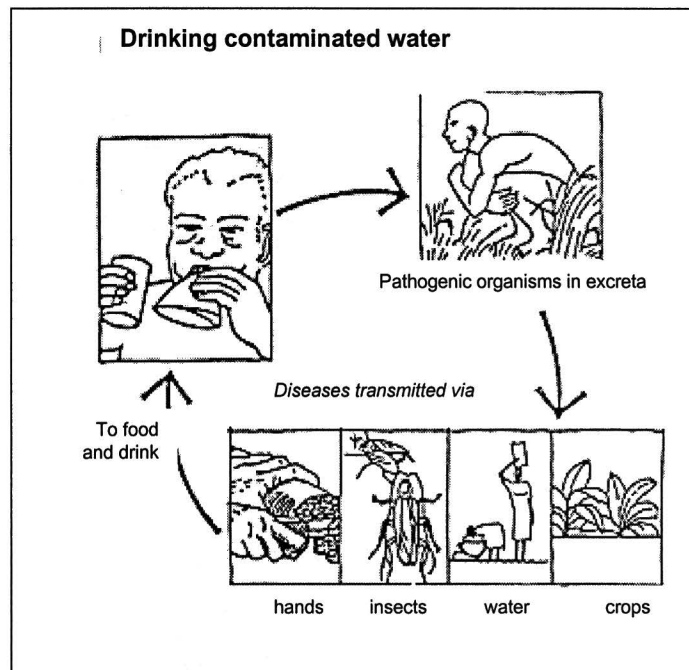


Figure 1-1: Transmission of diseases

This research contributes to solving the problems concerning pit latrines in unplanned urban areas. The theoretical model used for Dar es Salaam and Durban can also be applied to other cities in developing countries. However, it needs adjustment to the specific circumstances of those cities. The MSc. research results can also be used for the Urban Waste Expertise Programme⁴ with regard to the development of waste management systems (liquid and solid) and related infrastructure and service provision. WASTE is the initiator and executing agency for the UWEP programme as a whole.

1.3 Problem definition and aim of the research

The MAPET service has been applied on a small scale in a few unplanned areas in Dar es Salaam (e.g. Mwananyamala, Tandale, Mburahati, and Kinondoni) as a solution to the problem of accessibility of those areas. By now more cities in developing countries are looking for solutions to similar pit emptying problems, but the DSSD in Dar es Salaam does not have the capacity for organising and co-ordinating a transfer of the system to other urban centres, or even for an expansion within Dar es Salaam. Of course the DSSD is not meant to be an international co-operating organisation, but its core business is to service the municipal residents in the field of sanitation and pit latrines.

With the MAPET service, WASTE had the ideological intention to develop an appropriate system that could easily be adjusted to other situations and was therefore not recorded in patents. Unfortunately, without patents

³ See WSSCC and WHO, *The Sanitation Promotion Kit: The burden of poor sanitation*

⁴The Urban Waste Expertise Programme (UWEP) aims to collect and disseminate information about innovative waste management practices in the cities of the South. The six year programme (1995-2001) works from the principle that the more knowledge people and organisations gain on this topic, the greater the chance that this knowledge will be implemented to improve waste management in the cities.

and without definite technical drawings of the machines that were finally applied in Dar es Salaam, there is a lack of clarity about the legal rights concerning the blueprints of the equipment. There are various drawings of different prototype components and assemblies, which contain valuable information on variables to adjust to local conditions. But these variables need identification of and adjustment to these conditions.

These are some of the reasons to start a new project concerning the possibilities for expansion within Dar es Salaam and transfer of the MAPET service to other unplanned urban areas. WASTE prefers for this system transfer to be a South-South co-operation between organisations in developing countries.

Plainly the problem is:

How can the MAPET service be expanded within Dar es Salaam and how can the service be transferred from Dar es Salaam to other unplanned urban areas?

To structure the research, four research questions were derived from the problem definition:

1. How is the MAPET service operating in 1998, compared to the situation during MAPET stage I?
2. Mobilisation of the present Durban pit emptying situation and circumstances?
3. Which elements are affecting a transfer of the MAPET system?
4. Which preconditions are essential for expansion of the MAPET service within Dar es Salaam? And which preconditions are essential for a transfer to Durban?

Durban was chosen as the second case study, because the Durban Metropolitan Department of Wastewater Management made the most recent request for the implementation of the MAPET service.

The main aim of the research is:

To find possibilities for expansion of the MAPET service within Dar es Salaam, and for transfer of the service to other unplanned urban areas.

1.4 Conceptual definitions and theoretical model

Basic urban services

Municipalities are responsible for making sure that they provide at least the basic services to the people in their district. There are numerous services and service levels that can be provided, but the most important are (figure 1-2): Water supply, Liquid waste management⁵, Solid waste management, and the built environment (housing and roads).

It is of vital importance for the successful establishment of the basic urban services to involve all the actors in an integrated system. Organisations that are responsible for the urban services are under influence of the policies set by the central government. Such an organisation can be a municipal department, an informal private business, a formal private business, a Non-Governmental Organisation (NGO) or a Community Based Organisation (CBO). A distinction between formal and informal private sector activities is made, since private enterprises are characterised by a higher level of capital investment, a larger scale of operation and easier access to influential officials in the government and economic sectors. Special attention will be given to the informal sector, considering MAPET as an informal service.

Various institutional aspects should be taken into account in order to safeguard the integrated approach: Political, Technological, Economical, Environmental and Social/Cultural aspects.

⁵Many people use the terms sanitation and *waste management*, but I'd rather say *liquid waste management* (including sanitation) and *solid waste management*. The reasons for this is that very often the term *water supply and sanitation* is used, where for most of the concerned organisations, city council officials and decision-makers the priority lies on water supply. And when speaking of waste management, most of the time solid waste management is meant (or at least prioritised), excluding liquid waste management. Besides that sanitation, related to water supply, focuses mainly on the construction-side of the systems, where waste management concentrates more on operation and maintenance, which is also very important for the sustainability of the systems used.

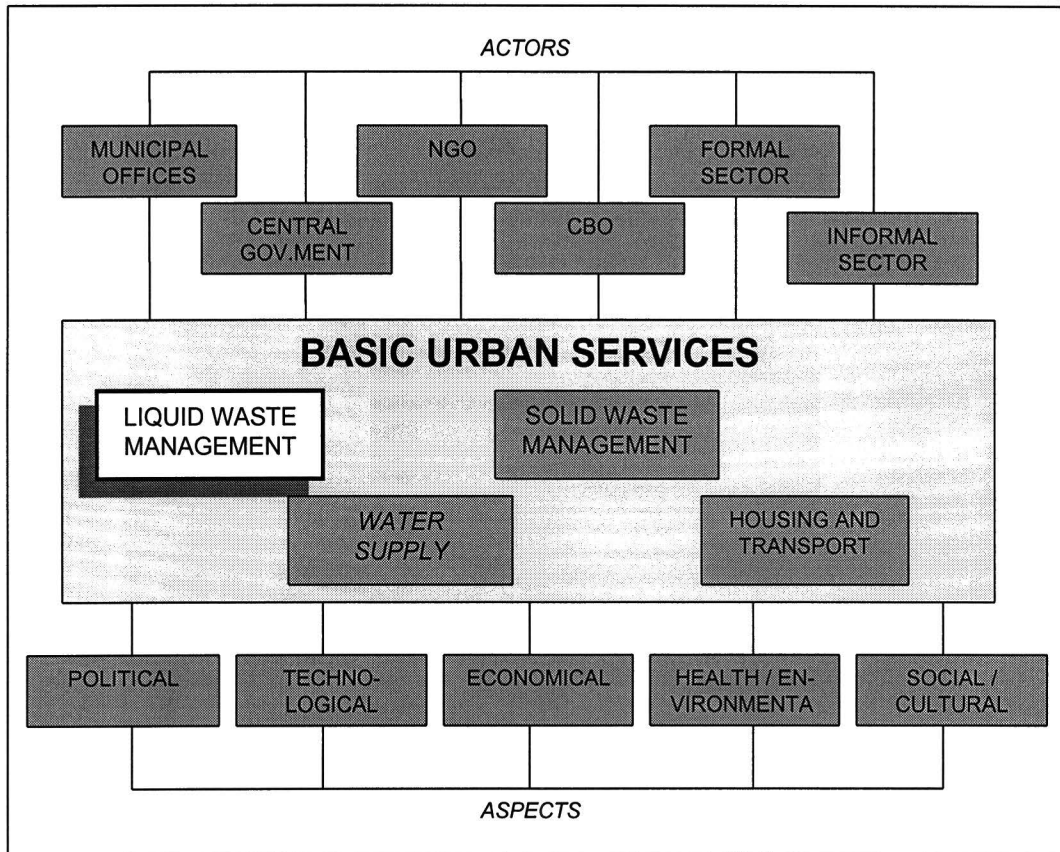


Figure 1-2: Framework for integrated basic urban services (Source: Klundert, A. van de, 1996)

Liquid waste management

Liquid waste management includes more than just sanitation and sewage disposal. It also involves grey water (washing water), industrial effluent and stormwater drainage.⁶ In general liquid waste may be defined as a combination of the liquid or water-carried wastes removed from residences, institutions, commercial and industrial establishments. Management of liquid wastes has the basic requirement of ensuring that all wastewater and excreta generated within the human environment are disposed hygienically to avoid health hazards.⁷ The safest and most hygienic technology for disposing human excreta is by central sewerage systems, but most cities in developing countries cannot afford these systems and therefore have to implement other sanitation systems, like bucket latrines, (un)improved pit latrines and septic tanks.

This research only discusses pit latrines and problems concerning the emptying of those latrines. The functional elements in a liquid waste management system for pit latrines are developing and constructing the pit latrines, the people “producing” human excreta, on-site storage and treatment, emptying systems, transfer stations and treatment ponds (see figure 1-3).

Pit latrine emptying

This research focuses on the element of collection of the latrine sludge, so to say the emptying of the pit latrines. Several methods can be used to empty latrines. In most urban settlements vacuum tankers are used: large tankers (5,000 litres) as well as mini tankers (2,000 litres). However, as mentioned before, not all-urban areas are accessible for these tankers. In those cases manual emptying methods like MAPET and traditional emptying are used. Another examples of pit emptying methods are the vacu-tug designed by MCA (Ireland) and UNCHS/Habitat (Kenya) (a motorised sort of MAPET, see appendix D). Since a comparison of different emptying methods is out of the scope of this research, no further attention will be given to this topic.

⁶ Some cities exclude drainage from liquid waste, but they include in the municipal department that is responsible for transport and housing

⁷See M.E. Kaseva, *The African city in sustainable human settlements development; a case of urban waste management in Dar es Salaam, Tanzania*

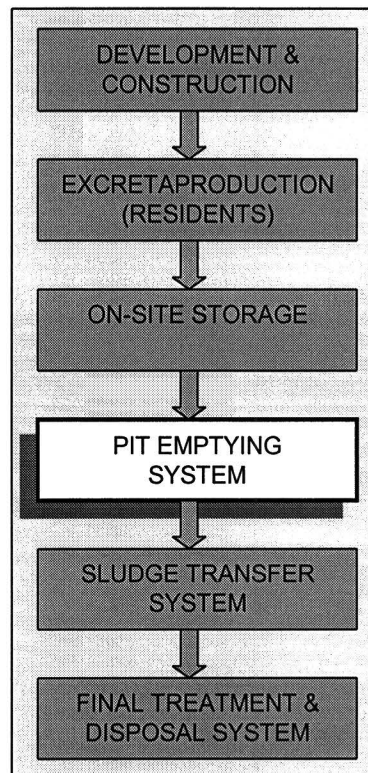


Figure 1-3: Functional elements of a liquid waste management system for pit latrines
(Source: Pfeffer, J., 1992)

The MAPET service

The MAPET service was developed as a solution to urban sanitation problems in Dar es Salaam. Rural areas also have problems related to sanitation and liquid waste, but those problems are different from the urban problems and are, therefore, not included in this research. The scale on which MAPET is operating presently is very small (only 0.11% of the pits that need to be emptied annually⁸).

The scope of this research concerns the MAPET service; however, it can not be seen apart from the other urban services. There is also a vice versa impact on the actors involved and on influencing aspects. To prevent misunderstandings about definitions concerning the MAPET service and the MAPET system, those concepts will be defined, as well as MAPET's environmental issues.

The *MAPET service* is a community based manual pit emptying service with locally manufactured equipment, a handpump and a vacuum tank, used by the MAPET emptiers to empty the pit latrines from residents of the neighbourhood. The developed technology is based on the informal business and sludge disposal elements of the traditional practice of pit emptying. Different elements of the informal MAPET service are:

- The emptiers do not (legally) own the equipment, though they are the only people working with it; instead they pay a lease fee.
- The lease fee should cover the costs of large repair and overhaul of the equipment done by the DSSD workshop.
- The business is not registered.
- The team and the equipment are monitored by the DSSD/MAPET staff, who acts as liaison with the CCM office (per branch) and DSSD, and arranges for maintenance during the project.
- The monitoring/liaison staff is paid for by the DSSD.

The *MAPET system*⁹ exists of four components. It comes down at the skills and knowledge embodied in people (pit emptiers and the residents), skills and knowledge related to the equipment (development, operation and

⁸Approximately 270,000 pits need to be emptied every 5 years of which (at least) 10% need to be emptied manually (see MAPET reports). Of these 54,000 pits that need to be emptied annually, at the moment approximately 60 pits (0.11%) are emptied per year (based on one MAPET team having 5 emptying jobs per month).

⁹The term "system" is used instead of "technology" since misunderstandings occur with definitions of the MAPET technology as being the MAPET equipment (only a part of the whole technology), while the technology is concerned with all the four components (the entire MAPET system). The MAPET equipment, as a part of the MAPET system, consists of a handpump

maintenance of MAPET and sludge transfer system)), information (procedures, financing, and promotion and education programmes) and organisation (structure in which all the actors co-operate) applied for the MAPET service.¹⁰

MAPET environment

Pit emptying is not the responsibility of the municipal authorities alone. Either can households, communities, private enterprises or non-governmental organisations (NGO's) alone achieve a system of sustainable services. The needs and capabilities of the community should be the starting point¹¹, but for the MAPET service, like other urban services, to be sustainable (economical as well as environmental and technical), it is of vital importance that all actors are involved in the planning and implementation process. This group of actors can be divided into local and central government, NGO's, community-based organisations (CBO's), the private sector and donor agencies.

In order to safeguard an integrated approach and to establish a sustainable system the following aspects will be considered:

- *Politics*: The society's goal and priorities for sanitation and pit emptying services, supported by a clear division of roles and responsibilities of the various actors.
- *Technology*: Technology choices that match local resources (expertise, management, materials, and capital).
- *Economics*: Income and employment opportunities of pit emptying services, as well as affordability of the service also providing full cost recovery.
- *Environment*: Standards regarding sanitation, pollution and health care.
- *Culture*: Interests of all actors, and their beliefs and values regarding sanitation and pit emptying services.

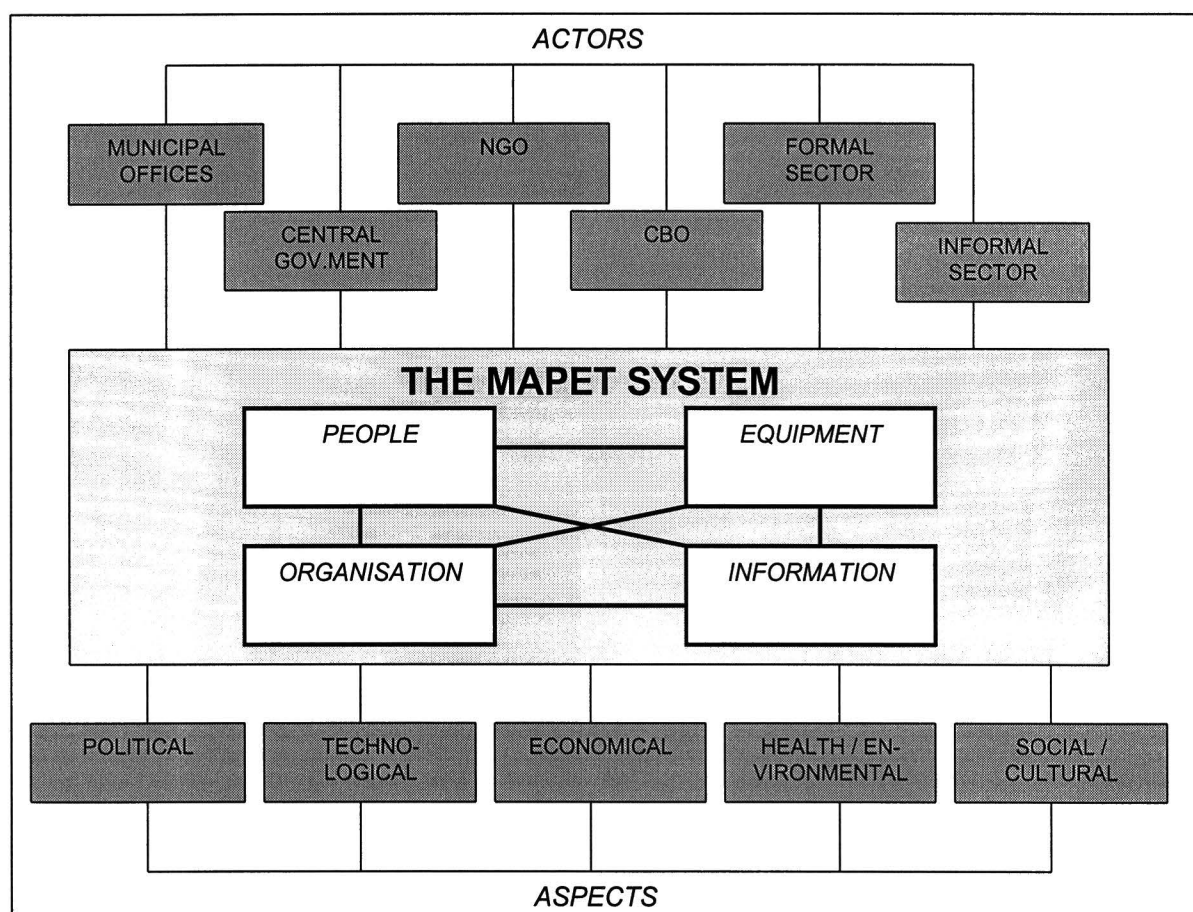


Figure 1-4: Framework for integrated MAPET service

cart, a vacuum tank-cart, an air hosepipe, a sludge hosepipe and a mixing rod. There are two types of tank carts: the standard type, which has an exchangeable 200 litre drum shaped sludge tank, and the *Kibuyu* (Kiswahili for 'gourd'), which has a low point of gravity with a gourd shaped tank, integrated in the cart frame.

¹⁰ Based on the framework for technology based development by ESCAP (1989)

¹¹ See M.S. Muller, et al, *The potential for community-based waste services in cities in the South*

The institutional aspects and the actors related to the MAPET service form the framework for an integrated MAPET service (figure 1-4). Integration means that various dimensions are considered simultaneously, tuned to each other and woven into a balanced and sustainable approach.¹² The dimensions in this integrated MAPET system are:

- involvement of all the actors;
- dealing with all the elements of the MAPET system: people, equipment, information and organisation;
- dealing with the interactions between the MAPET system and other relevant systems, like vacuum tanker services and sewerage, but also housing, transport and solid waste management.
- including different levels of 'living communities' within urban areas, with different characteristics determining the type of service required;
- approaching the issue from the perspective of various aspects (political, environmental, etc.).

1.5 Operationalisation

The main aim of this research is to find possibilities for transfer of the MAPET service. Transfer of the MAPET service can be seen from at least two viewpoints: the supply side (the actors involved in the MAPET service in Dar es Salaam, Tanzania) and the demand side (e.g. the Wastewater Management Department of the Durban Metropolitan, South Africa).

To carry out the two case studies of Dar es Salaam and Durban, firstly the elements of the theoretical framework need to be made operational. For the case studies in Dar es Salaam and Durban the theoretical model is applied to the specific situations and circumstances. The operationalisation of the variables on which the model is based are reported in appendix E.

¹²See A. van de Klundert (WASTE), *Solid Waste Management Karachi*

2 EMPIRICAL ISSUES

2.1 *Population and research unit*

The research units in this research are the unplanned urban areas of Southern African countries. The research consists of two case studies in Dar es Salaam, Tanzania and Durban, South Africa. Therefore the population consists of the residents of the unplanned areas of those two cities, whom are using pit latrines. They are the ones who decide whether or not to have their pit latrines emptied.

2.2 *Sampling procedure*

A customers' survey was carried out to determine their opinions of the MAPET service and to see what they think should be improved in the Dar es Salaam situation. This survey included the former customers of the MAPET service, although all residents of the unplanned areas are considered to be potential customers. The questionnaire used is reported in appendix F.

54 Customers were questioned of whom very little speak English. Consequently a translator of the Community Infrastructure Programme was hired to translate the interviews. Since the MAPET service is an informal business, the customers are not registered. Therefore Yahaya (leader of the only MAPET team left) introduced me to the customers. Therefore there will be biases in the results. Obviously, this should be taken into account with the conclusions and recommendations. Results from the survey can not be generalised and are therefore not applicable to other urban areas. Also the reliability of some of the results should be reviewed. Different results appeared from the interviews with the customers related to the interviews with the emptiers.

Besides the customers also the five remained emptiers were interviewed as well as several key persons from the DSSD, Sustainable Dar es Salaam Project, PLAN International, Town Development Committees in Vingunguti and Buguruni and the Health Department.

There was not enough time (5 weeks) in Durban to do a survey on (potential) customers' needs. As a short-cut various interviews with key persons of the National Sanitation Co-ordination Office, Durban Metro Wastewater Management, Durban Metro Health Department, SANTAG, a community leader in Umlazi area and Sani-tech.

2.3 *Methods of data collection*

The theoretical framework consists of various elements. For each of the elements different methods for data collection used for Dar es Salaam and Durban (tables 2-1 and 2-2). For the literature survey various documents and letters were analysed, ranging from the MAPET reports by WASTE (containing a lot of information of the MAPET service as it was set up in 1988-1992) to National Sanitation Policies and from statistical reports to other research reports on sanitation and pit emptying. During the preparation of the research advisors of WASTE were interviewed about their experiences with the MAPET service.

To get specific information, interviews with key persons of municipal departments and NGO's etc. formed a short cut to gather information. Sometimes structured interviews were used, sometimes non-structured interviews. The interview with the MAPET emptier from the 'Yahaya' team turned out in a group interview and sometimes more into a discussion group, discussing what should be done to improve the MAPET service in Dar es Salaam.

In South Africa I was invited to attend a workshop on peri urban sanitation, organised by the Ministry of Water Affairs and Forestry. In this way a lot of information on the current South African situation regarding appropriate, affordable and sustainable sanitation systems was gathered.

Table 2-1: Methods of data collection in Dar es Salaam

Elements	Literature study	(Structured) personal interviews key persons						Group interview emptiers	Customer survey	Observations
		DSSD	Mechanics	HD	PLAN	TDC's	SDP			
<i>MAPET</i>										
Organisation	X	X		X				X	X	
People	X	X				X		X	X	
Information	X	X	X	X				X	X	
Equipment	X	X	X					X	X	X
<i>ACTORS</i>										
Government	X									
Local gov.	X	X		X			X			
NGO's	X				X					
CBO's	X					X				
Formal sector	X	X		X			X			
Informal sector	X									
<i>ASPECTS</i>										
Political	X									
Technological	X									
Economical	X									
Environmental	X									
Social	X									

Table 2-2: Methods of data collection in Durban

Elements	Literature study	(Structured) personal interviews key persons					Workshop MAAF	Observations
		MWM	Systems Br	HD	Sani-tech	NaSCO		
<i>MAPET</i>								
Organisation	X	X						
People	X	X				X		X
Information	X	X	X	X				
Equipment	X	X	X		X			
<i>ACTORS</i>								
Government	X					X	X	
Local gov.	X	X		X		X	X	
NGO's	X							
CBO's	X			X		X		
Formal sector	X	X			X		X	
Informal sector	X							
<i>ASPECTS</i>								
Political	X							
Technological	X							
Economical	X							
Environmental	X							
Social	X							

2.4 Techniques of analysis

For the several methods of data collection different techniques were used. For the literature study of the many books and reports gathered the contents were analysed to find information that was important for the research. For the survey a questionnaire with open and closed questions was used; from the answers frequencies per answer were calculated and for some answers ordinal scales were used, for all others nominal. Also the interviews with key persons resulted in answers on nominal scales.

PART II

RESULTS OF THE CASE STUDIES

3 MAPET IN DAR ES SALAAM, TANZANIA

A comparison of the MAPET situation during and shortly after the MAPET-I project with the situation of the service in 1998 shows that many things have changed. Not only the elements of the MAPET service changed; also important transitions took place in the environment where MAPET is imbedded in.

3.1 The need for MAPET

Until 1973, Dar es Salaam was the capital city of Tanzania; it remains the commercial, industrial, cultural and transport centre of the country. In 1988 Dar es Salaam had a population of 1.36 million, with an average growth rate of 9.7%. Ten years later the Dar es Salaam population has more than doubled and the city continues to attract migrants from all over the country. Its present population is estimated to be 3.0 million residents, growing at an annual rate of 8 per cent.¹³ Besides immense pressure on the available services and infrastructure, this rapid urbanisation has implied unprecedented demand for housing accommodation and employment opportunities, which the Dar es Salaam City Council has failed to cope with. That is one of the reasons why Dar es Salaam faces an infrastructural and social service management crisis. This crisis is also emanating from the national economic problems of the late-1970s when the Tanzanian Gross Domestic Product (GDP) declined in real terms from an average of 5.1% per annum to less than 2% between 1976 and 1986 as a result of falling commodity prices. And also because of the collapse of the East African Community, the war in Uganda, and successive droughts that forced the importation of food grains.¹⁴

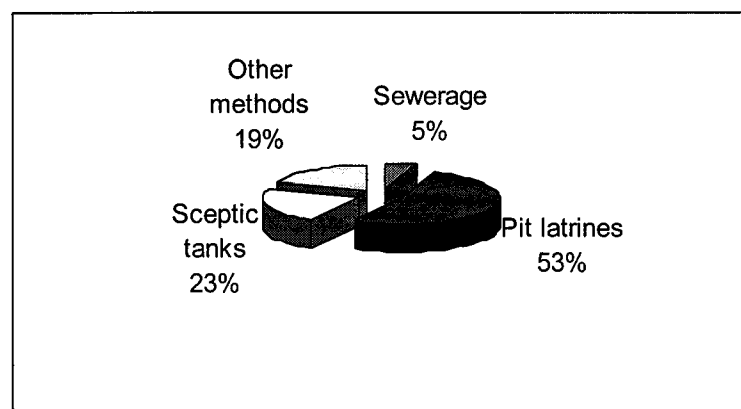


Figure 3-1: Sanitary facilities in Dar es Salaam (Source: M.E. Kaseva, 1998)

The manifestation of the rapid urbanisation has been the mushrooming of unplanned settlements, where at least 70 per cent of the total city residents live. Some of these settlements have developed on areas prone to flooding and which will be difficult or too expensive to improve when resources for doing so will either be available. Only 5% of the Dar es Salaam population are connected to the sewerage system, discharging effluent into oxidation ponds. Many of the oxidation ponds no longer operate due to the lack of maintenance, resulting in raw sewerage discharges into the surface drainage system and directly to the ocean. Of the remaining 2.85 million people, approximately 53% of the city households rely on cost-effective pit latrines.¹⁵ However, limited vacuum tanker services and high ground water tables in certain areas also result in unsanitary wastes flowing in surface drains and gullies to the main rivers and the ocean.

Aside from the limited capacity for vacuum tanker services, a large part of the unplanned areas are inaccessible for these tankers due to the lack of or poor conditions of roads. Traditional emptiers, who use traditional manual methods, provide the alternative sanitation service for the population in the unplanned areas. These self-employed emptiers can reach every house. They empty the pits with a spade and a bucket and bury the sludge in a newly dug

¹³ The city's annual growth rate of approximately 8 per cent means that nearly 200,000 people have to be accommodated each year. This number is likely to rise significantly by the year 2010 when the urban population of the country is expected to rise to 50 per cent of the total compared to the present 35 per cent.

¹⁴ See SDP, *Environmental profile of the metropolitan area* (p. 4-18)

¹⁵ See M.E. Kaseva, *The African city in sustainable human settlements development – a case of urban waste management in Dar es Salaam, Tanzania* (p.52)

pit adjacent to the latrine on the residential plot. The price charged by traditional emptiers appears high in relation to the income earned by the residents of these neighbourhoods. Both emptying services, provided by the DCC and by the traditional emptiers, each have serious drawbacks. Therefore, although many latrine pits are full and should be emptied, no suitable and affordable service was available until the MAPET service was developed.

Table 3-1: Calculation of MAPET teams needed in Dar es Salaam

<i>Need for MAPET teams in Dar es Salaam</i>	
Total population	3 million
Population using pit latrines	1.59 million
Number of pit latrines	159,000 pits
Number of pits to be emptied by MAPET	79,500 pits
Average period for pits to fill up	4 years
Number of pits to be emptied per annum	19,875 pits
Pits (customers) serviced per team per annum	200 pits
MAPET teams needed	99 teams

Because of absence of mini tankers and the inefficient operation and expensive costs of the large tanker services¹⁶, as well as their inaccessibility to the unplanned areas it is assumed that approximately 50% of the pit latrines need to be emptied by MAPET teams.¹⁷ Dar es Salaam has an annual demand for 19,875 pits to be emptied by MAPET. This results in a demand for at least 99 MAPET teams, involving 297 emptiers. A detailed calculation of the number of MAPET teams needed in Dar es Salaam is given in appendix H.

3.2 *The MAPET service*

Ten years after the start of the MAPET service in Dar es Salaam, it seems like the service is running dry. A lot of things have changed over the years and thus a whole new start must be made. A mobilisation of the current MAPET situation and the possibilities for expansion, or rather for 're-implementation' of the MAPET service is described according to the elements and indicators from the theoretical model (figure 1-4).

3.2.1 Organisation

The MAPET-I project (1988-1992) was executed by a local team in Dar es Salaam and supported by WASTE during short visits to Dar es Salaam. The local team consisted of a DSSD staff member, a MAPET co-ordinator and two DSSD mechanics. WASTE rendered its support through a physical planner (also project leader), a technician and a sociologist.

Within the framework of the MAPET project a type of formal-informal co-operation was established between the DSSD and the private, self-employed MAPET emptiers, whereby the DSSD is the owner of the equipment and is responsible for its maintenance. To confirm MAPET's integration in the DSSD structure, the DSSD management established a MAPET Section in the Low-Cost Sanitation (LCS) division.

This MAPET section does not exist anymore. The financial MAPET account was fed by Dutch project funds, but the transferral of expected payments of lease fees and loan instalments to the account did not materialise. "The MAPET project is just one of the many responsibilities of this [LCS] division. The head of the LCS division even reported that nearly all its operations (construction of pit latrines, health education, pit emptying services and management of treatment ponds), except the building of pit latrines, have come to a halt due to lack of funding."¹⁸ The public-private partnership that should ideally have emerged does not exist. The DSSD is currently detached from the MAPET team(s), apart from sporadically referring customers, who come to the DSSD, to the MAPET team based there. The DSSD still has the final responsibility for pit latrine emptying services in Dar es Salaam, but this is only focused on vacuum tanker services.

One of the responsibilities of the DSSD staff as well as of WASTE was monitoring and evaluating the service. Currently no staff is involved in the MAPET service, resulting in a lack of information of the on-going process.

¹⁶ See Sustainable Dar es Salaam Project, *Papers on "Sinza pit emptying technology project"*

¹⁷ A 1993 report of SDP on accessibility and technologies indicated that in 65% of the areas MAPET is needed

¹⁸ See L.B.M. Tomesen et al, *Formulation report: Manual Pit Emptying Project (MAPEP)* (p. 60)

Also control and support of the operation and maintenance are missing. Aside from the lack of staff, also the links with CCM party branch offices and with the DCC health assistants ceased to exist.

The present MAPET situation does not include any form of community participation, whereas CBO's might have some degree of authority, responsibility and control. The only actors involved in performing the service are the pit emptiers and to a very small extent the DSSD. Urban services like MAPET ought to be a responsibility of several actors; the most important actors are governmental agencies and communities. In the case of the MAPET service neither the government nor the community is involved. Nowadays the MAPET service is like a private business without municipal support, contrary to the public-private co-operation during the development of the service.

The motivation to implement the MAPET service in other neighbourhoods is minimal. Some neighbourhoods, like Vingunguti and Buguruni have a form of community organisation (the Town Development Committees) and community leadership, but it is impossible to implement the MAPET service in these areas without a proper organisational setting.

3.2.2 People

A participatory approach was applied whereby the MAPET system and services were developed in response to the experiences and comments of the people most directly involved in using the equipment, i.e. the pit emptiers, DSSD mechanics and businessmen in the informal sector, and the residents of the unplanned areas. Issues related to the mechanics will be discussed in the paragraph about the MAPET equipment.

3.2.2.1 Pit emptiers

The MAPET service is an informal activity and is therefore not registered, which makes it difficult to locate the MAPET teams. Consequently it might be possible that there are one or two more teams still operating, but during the research in 1998 only one of the seven MAPET teams that started could be traced. This team, of which Yahaya is the leader, is based at the DSSD plot in Mwananyamala. The 'Yahaya' team consists of 5 pit emptiers: two former teams who are now operating together to share the expenses. Their areas of operating are mainly Mwananyamala and Tandale.

Typical for these emptiers as well as the whole Tanzanian informal sector (95% of the informal sector population) is that they have at the most completed primary education. To become MAPET emptiers the men received a practical training focused mostly on the physical practise of the MAPET service. Less attention was given to entrepreneurial skills that are also needed for a sustainable service.

MAPET emptiers are self-employed workers belonging to a low-income group with low-income customers. In the beginning most MAPET teams were working on a full-time basis, being busy with either pit emptying or looking for customers. Or at least, that is how it was planned during the MAPET-I project. Interviews with the remaining emptiers indicate that they have about 5 emptying services per month. This results in an average monthly income of Tsh. 83,000/-¹⁹, of which all expenses have to be paid. This leads to the conclusion that if all emptiers were working each of them will receive at the most Tsh. 16,600/- per month.

As already noted during the MAPET review by Tomesen (1996), the MAPET emptiers do not try to expand their services, as there is a huge demand for pit emptying services. The problem is that the emptiers look at the MAPET service as an income generating activity, not as a real job. Therefore they do not save any money for future repair or maintenance; instead they use the total income for their daily costs for living.

No records of any kind were kept to provide future sponsors or other interested organisations with information, as on the contrary they want to request for sponsorship. This is another example of the lack of entrepreneurial knowledge and skills to run a private business on their own.

Not only the emptiers lack the motivation or the capability for expansion, also no initiatives come from the DSSD or the DCC/SDP to expand or even to support the MAPET service. The 'Yahaya' team is slowly "running

¹⁹ See appendix G, table 6: an average income per customer of Tsh. 16,600/- and an average of 5 emptying jobs per month (appendix F, interview with emptiers) results in an average monthly income of Tsh. 83,000/- per team

dry”, and will tend to do more secondary jobs to generate income. For a revival of the MAPET service another organisational setting will be necessary, whereby emptiers perform the actual pit emptying, but whereby management and control of the service is in hands of another party.

3.2.2.2 Residents

The four main customers' criteria for pit emptying services are²⁰:

- The services should be of good quality.
- The costs should be reasonable and affordable.
- The social accessibility (i.e. the relationship between the providers and the customers) should be satisfactory.
- The physical accessibility should be reasonable.

The MAPET services score well on most of the above criteria. In most of cases (78%, see appendix G, table 4) the services are performed within one or two days after an agreement has been reached with the emptiers. The customer can also rely on the emptiers, as it is in their own interest to perform the service on the agreed day.

Personal negotiations with the pit emptiers are the only way of securing the services. Since the emptiers' place of contact was in the immediate neighbourhood at the CCM branch offices, customers spent a minimum amount of time and money on contacting them. However, with the change of Tanzania's political system from a one-party system to a multiparty system, CCM's influence decreased and the branch offices are therefore no longer used as central booking offices. Consequently the physical accessibility has decreased. Almost half of the customers come to the DSSD office in Mwananyamala to apply for the MAPET service (appendix G, table 1). Other customers contact the emptiers personally (they live in the same neighbourhood, they see them passing by with the equipment or they meet the emptiers while they are servicing their neighbours or relatives).

Some customers consider it unhygienic to bury the sludge on their plot. Sometimes there simply is not enough space on the plot to dig another hole or the groundwater table is too high to bury the sludge without the risk of drinking water getting polluted. A second disadvantage of MAPET is the price per volume of sludge. Compared with the large tanker services, MAPET is the most expensive per m³ of sludge.²¹ The price for DSSD tanker services was set by the Tanzanian government and included a large subsidy element. Since these subsidies dropped and because of commercialisation, the rates for tanker services increased rapidly. Nowadays, individual customers at least have to pay Tsh. 20.000/- for a 5000 litres' vacuum tanker service (which was Tsh. 1,200/- in 1988), compared to approximately Tsh. 34.000/- for 5000 litres of MAPET drums.²² The differences in prices are not as big as was concluded from the COMPET study and although more expensive than tanker services, the MAPET price is considered reasonable and affordable by 94% of the customers (see appendix G, table 7).

However, the vacuum tankers cannot operate in the unplanned areas of Dar es Salaam, making MAPET the only available pit emptying service for these areas. And in addition people prefer services that are flexible and negotiable. Poor people can only afford small expenses, considering they have a low income. With MAPET the customers are the ones that decide how many drums are taken out, while the vacuum tankers always empty the whole pit.

A striking issue resulting from the interviews is that none of the interviewed customers is aware of any kind of CBO operating in their neighbourhoods (see appendix G, table 11). This might indicate that either there are no CBO's or that they are not known by the MAPET customers. For a future expansion of the MAPET service it is important to involve the residents, whether or not by involving already existing CBO's. Many people do not know the MAPET services or do not know how to contact the emptiers. This applies to the areas where MAPET is not operating, but also to areas where MAPET is operating.

²⁰ See M.S. Muller, and J. Rijnsburger (WASTE), *MAPET; Development and pilot implementation of a neighbourhood-based pit emptying service with locally manufactured handpump equipment in Dar es Salaam, Tanzania* (p. 36)

²¹ From the COMPET study was concluded that MAPET is also more expensive per m³ of sludge compared to mini tanker services, but because of a lack of maintenance and a lack of spare parts these tankers are not operational anymore

²² See appendix G, table 6: the average price the customers pay per 200-l drum is Tsh. 1.365/-

3.2.3 Information

3.2.3.1 Procedures

Several monitoring activities were planned for the DSSD and the HD, i.e. monitoring the quality of the service, maintenance and repair of the equipment to keep it operational, and interdepartmental co-operation between the DSSD and the HD to motivate residents to have their pits emptied before they overflow. But monitoring is difficult, as there are no specific standards available regarding the emptying of pit latrines and the treatment of sludge. No monitoring and controlling activities have been carried out for the last couple of years.

Another missing aspect is the availability of blueprints. Several drawings of various prototypes exist, but standardisation of the parts and components is needed before expansion and transfer of the service will be possible. Therefore definite technical drawings need to be designed.

3.2.3.2 Finances

An important aspect of the (financial) sustainability of the MAPET service is the cost recovery. The MAPET team does not bear any investment costs since these expenditures were covered by donor funds. The cost recovery of the equipment was planned by lease fee payments of the MAPET teams to the DSSD. The past ten years the teams have been using the MAPET equipment, but the lease fee was only paid sporadically. Since the emptiers, and not the DSSD, are responsible for maintenance and repair, it is argued that the emptiers instead of the DSSD own the equipment. The lease fee was also meant to cover the costs of large repair and overhaul of the equipment. Instead the emptiers have to pay Tsh. 2,000/- for each time they enlist the DSSD workshop (see appendix F, interview with DSSD mechanics).

The monthly subsistence income was estimated at Tsh. 30,000/- (1995). With 5 emptiers in the 'Yahaya' team and on average 5 emptying jobs per month, the monthly wage of each emptier does not exceed Tsh. 16,600/-. This is only 55% of the subsistence level. Therefore, the emptiers also perform secondary jobs as cleaning. These low-income levels are an important cause of the absence of savings of any kind, resulting in a cash shortage as soon as larger repairs have to be paid for. For instance the purchase of other tyres for the equipment is considered too expensive for the emptiers and thus they currently operate the equipment without tyres.

3.2.3.3 Promotion and education

When looking for the first customers to test the equipment, it became clear that public promotion of the MAPET service was necessary. All of kinds of activities were put to the test in the MAPET promotion routine. The successful promotion activities resulted in community leaders putting pressure on DSSD to extend the MAPET services.

However, no monitoring and no follow up took place. Nowadays nothing is done about promotion of the MAPET service or health care education regarding the necessity to empty pit latrines. Promotion and marketing of the MAPET service is needed in all unplanned areas, since many residents are not aware of the existence and advantages of MAPET. Research done by the Sustainable Dar es Salaam Project in Sinza indicated that only 4% of the residents know about MAPET.

3.2.4 Equipment

3.2.4.1 Development and manufacturing

The MAPET equipment can entirely be assembled in Tanzania with local supplies, except for the leather piston ring. Despite efforts to interest a local manufacturer, this part has to be imported. Two other parts, the flexible sludge hosepipe and the standard DSSD hosepipe couplings, can be supplied locally, but at high costs. Rubber parts are made by small, informal workshops, while precision woodwork (e.g. bearings) are ordered with the Building Research Unit (BRU). Metal components for the handpump (e.g. the flywheel drive) and the vacuum tank are made by the central facilities' workshop of the Small Industries Development Organisation (SIDO). The DSSD workshop mechanics assemble the components into a full set of MAPET equipment.

For a new order of the MAPET equipment, components need to be standardised and proper technical drawings have to be made, since no blueprints are available. The equipment needs technical adaptations to the problem

areas identified during the last years. It might be possible to benefit from the availability of new materials, parts and machines in the market. Implementing MAPET on a larger scale will involve a larger scale of equipment construction than was needed for the MAPET-I project. The DSSD does not have the capacity for such large-scale manufacturing (need for 99 MAPET teams, and thus for 99 new sets of equipment).

The costs for single construction of a complete MAPET unit proved to be the equivalent of Tsh. 100,000/-.²³ These include manufactured components, readily bought components, consumables (gas, welding rods, paint), transport (to obtain materials and quotations, to follow-up orders, collect components) and incentives for DSSD mechanics.

3.2.4.2 Operation and maintenance

Local maintenance capabilities were built up through the participation of DSSD mechanics in all development phases of the MAPET technology. Through this participation the know-how on operating and design principles, material application, procurement of parts and their assembly have been transferred to the employees of the organisation that has main responsibility for maintenance. In practice responsibilities for maintenance have developed in such a way that a separation is made between small maintenance and repair, taken care of by the emptiers themselves, and special maintenance and repair which has to be performed by the DSSD mechanics. Little maintenance carried out like greasing and pump leakages.

Minor repairs are paid for by the MAPET emptiers out of their earnings for the day. This, however, also limits the amounts that can be spent on such repairs. Most of these repairs are spot welding of loosened parts and repair of tyre punctures. At the moment the DSSD Workshop has little to do with the MAPET service since there is only one MAPET team left. That team sometimes uses the DSSD workshop services in case of major breakdowns, but most of the time the emptiers are not willing to spend any money on such major repairs. It is unclear how often maintenance and repair take place, since no records are kept after the end of the MAPET-I project.



Photo 3-1: MAPET equipment 1998

Major problems with the equipment include the lack of dumping methods (on-site or off-site), transport of the equipment can be difficult due to bad road conditions, and the MAPET equipment can not be transported over

²³ See L. Hemelaar, *Financial analysis of the Manual Pit Emptying Technology and service (MAPET)* in 'The collection of household excreta' (p.51)

big distances. The following observations and major findings related to the MAPET equipment (photo 3-1) were analysed during reviews of the MAPET-I project and the MAPET service in 1996²⁴ and 1998:

1. Handpump: *“Although heavier, the reliability and durability of the diaphragm pump have shown to exceed that of the piston pump considerably. Engineers of the DSSD believe that the diaphragm pump is more expensive than the piston pump, but the engineers considered it absolutely feasible that a modified (lighter) version of this pump could be locally manufactured. This would have the advantage that parts could be standardised and all spare parts would be locally available. According to the emptiers the diaphragm pump is more effective than the piston pump”*²⁵. One of the main problems of the customers (37%, see appendix G, table 9)) is that sand and mud remain at the bottom of the pit after it is emptied.
2. Carts and wheels: *“Both the engineers at DSSD as the emptying teams expressed a strong preference for used car wheels instead of tricycle wheels”*²⁶, because they are cheaper. But on the other hand they are heavier than tricycle wheels. This problem will be most important in the rainy seasons (the “short rains” in November/December and the “long rains” between March and May) when the roads are very bad. One way to lessen this problem is to use a smaller tank (100-ℓ in stead of 200-ℓ) which makes the equipment lighter and therefore easier to transport. WASTE once proposed to use a smaller tank but this was never worked out in practise. The MAPET equipment seen in Manzese (12/03/1998) did not have wheels at all. The emptiers transport it by a pick up truck and then carry it to the pit latrine.
3. Hosepipe and couplings: *“All hoses in use by the operational teams are punctured or cracked and have been patched up with wooden pieces, rags and ropes. While pumping, mud is applied to leaking spots. The teams do not invest in the replacement of broken hoses, which reduces the efficiency of the pump in operation”*.²⁷

3.2.4.3 Sludge transfer, treatment and disposal

MAPET is rooted in the traditional practice to bury latrine sludge on-site on the customers’ plot. A shallow hole is dug into which the latrine sludge is to be deposited. After one or two days the sludge in the hole can be covered with the excavated soil. The MAPET emptiers have been trained to cover the sludge with a layer of dry soil of at least one foot.

In Dar es Salaam the population accepted the burying of sludge, even close to their living quarters, provided the process of emptying and burying was performed hygienically and the sludge if fully out of sight (covered properly). According to the interviews done in 1998 in some of the informal settlements, approximately 25% of the customers have major problems with the disposal of sludge (see appendix G, table 9). The main problems are that there is no sufficient space to dig a hole or that there is a high groundwater table. This condition exists permanently in the low parts of unplanned areas, in some waterlogged areas, and seasonably in most areas during the long rains. The soil then has no leaching capacity. In that situation the burying of sludge should not take place so as to avoid upflow and soiling of the surface with fresh sludge.

Both constraints necessitate another routine of sludge removal: to haul sludge by means of the tank carts to a transfer station where it can be temporarily disposed of, or waiting for long distance hauling to a final treatment facility (in the case of Dar es Salaam: one of the sewage treatment ponds). WASTE made a research proposal (MAPET-II) to solve these problems, but the project was not funded and therefore until now not proceeded except for research done by a few Dutch students.

The alternative to burying sludge on-site was sought in the use of transfer stations: large concrete tanks with a capacity of 10,000 litres. Two such transfer stations have been built, but neither have been used, because of problems with the costs for leasing the needed land and because of poor accessibility.²⁸ Moreover, a system with so-called fixed transfer stations necessitates a large number of stations (a few hundred at a grid of 1 to 2 km distance). This is a capital-intensive infrastructure, which in many areas would only be used during a short period of the year. The experiences led to the conclusion that, given the obscure planning procedures and the high capital investment required, it would not be appropriate to attempt to realise a network of fixed transfer stations in Dar es Salaam. This led to the idea of developing a mobile transfer station.

²⁴ See L.B.M. Tomesen et al, *Formulation report: Manual Pit Emptying Project (MAPEP)*

²⁵ See L.B.M. Tomesen et al, *Formulation report: Manual Pit Emptying Project (MAPEP)* (p. 5)

²⁶ See L.B.M. Tomesen et al, *Formulation report: Manual Pit Emptying Project (MAPEP)* (p. 7)

²⁷ See L.B.M. Tomesen et al, *Formulation report: Manual Pit Emptying Project (MAPEP)* (p. 8)

²⁸ See M.S. Muller and J. Rijnsburger, *MAPET, a neighbourhood-based pit emptying service with locally manufactured handpump equipment in Dar es Salaam, Tanzania* (p. 49, 50)

A preliminary study has been done into the possibilities of using a mobile sludge transfer station (MSTS), which can travel with the emptying teams if needed, and which is not hampered by planning procedures, e.g. a tank trailer that is pulled by a tractor. The MSTS tank volume can be less than a fixed transfer station (2 m³ instead of 10), which is sufficient to cater for the average daily MAPET jobs. The MSTS tank can discharge daily in the treatment ponds and, like the tankers, be guarded overnight in a central depot.

MSTS tanks can be used in more than one area. An effective and efficient use of the MSTS system will require some fine-tuning of communications between DSSD and the MAPET emptiers. The MAPET teams will have to be able to indicate where and when the MSTS tanks are needed, and the DSSD has to be able to schedule the routing of the tanks.

There is no point in having a transfer system unless there is somewhere for the waste to go to. That is, treatment and final disposal of sludge are the final part of the collection system. However, the treatment ponds in Dar es Salaam are not working efficiently or are not working at all. Plans have been made to improve and expand the treatment plants (see appendix J).

3.3 MAPET actors

3.3.1 Government of Tanzania

In 1971 the Government of Tanzania launched a twenty-year Water Supply Programme (1971-1991) with the objective of providing adequate clean and safe domestic water supply within 400 metres of every household. In general, water resources management and urban sanitation needed to be strengthened. The task of providing the envisaged water supply and sanitation facilities to the total population before 2002 and ensuring sustainable services necessitated the preparation of a comprehensive National Water Supply and Sanitation programme 1993-2002.²⁹

The Government of Tanzania is in the midst of introducing fundamental reforms in a bid to reverse a prolonged downturn in the economy. Nearly all social services, including health, water and sanitation, are affected by these reforms. Till 1996, the government efforts have been directed at making good sanitation systems available in urban areas and to provide clean and safe water to the majority of Tanzanians, especially in rural areas. Most of these services were free of charge. However, in 1991, the Ministry of Water, Energy and Minerals (MWEM) issued new guidelines, maintaining the idea of keeping these services accessible, but introducing the need for financial contributions by end users. In order to achieve this objective and also to lessen the administrative burden involved in running these services, MWEM advocates the setting up of independent entities by consumers to own and run public services for more autonomous operation under these reforms.³⁰

3.3.2 Local Government

Dar es Salaam City Council

Though the Dar es Salaam City is growing very fast, service extension does not couple with increase in population and demand; the services are almost stagnant and centrally localised. Other shortcomings of the existing services include:

- Poor emptying services offered by the DSSD and the HD due to inadequate emptying vehicles. Trucks, which were donated in the 1980s, started to experience increased maintenance problems after a few years, following a breakdown in preventative maintenance. Currently the HD has 6 trucks on the road out of the 20 supplied trucks, while the DSSD has only 3 trucks on the road out of the received consignment of 8 trucks. Since 1994 the mini-tankers have been out of order due to inability to obtain spare parts, but probably more to lack of maintenance and vandalising for spare parts.
- Services located far from the residential areas.
- No motivation/incentives to the crews (e.g. the crews are low paid and working gears/tools are lacking).
- Bureaucracy within the DCC leading to corruption of the emptying workers.

²⁹ See Ministry of Water, Energy and Minerals (United Republic of Tanzania), *National Water Supply and Sanitation programme 1993-2002*

³⁰ See L.B.M. Tomesen, et al, *Formulation report: Manual Pit Emptying Project (MAPEP)*

The DSSD (established in 1983, see appendix J) is one of the City Council departments of Dar es Salaam that is responsible for the emptying of pit latrines. For the delivery of pit emptying services, DSSD owns and operates a small fleet of large vacuum tankers. With the ongoing restructuring of the Dar es Salaam City Council into three municipalities (Ilala, Kinondoni and Temeke) also the structure, responsibilities and functions of the DSSD are changing (see appendix J). Since March 1998 the DSSD is merged into the Waste Management Department (WMD), which is established to provide efficient and effective waste management services in Dar es Salaam. The WMD exists of a City Council Head Office, tasking more planning, co-ordination and monitoring, and a waste management division for each of the municipalities. Approximately 10 people will be working for the liquid waste divisions.³¹

The issue of privatisation of pit emptying services is considered as one way of improving the existing unreliable and poor tanker services provided by the City Council departments. By privatisation the following changes are planned:

1. The departments may continue to provide the services under new rates in competitive basis.
2. They may lease the operating trucks to private people at agreeable rates and conditions.
3. Embark on joint venture operation with the private companies.

Privatisation in this case means involvement of different independent institutions, individuals, and/or organisations that will be able to provide the services independently at agreeable rates and conditions. Whereas the DCC under its department of Health will remain as a co-ordinator and inspector ensuring that private operators are following all policies and regulations. The department will also be responsible in suing anyone violating the laws (e.g. haphazard disposal of sewage on the streets or crude dumping of any kind of liquid waste).

Sustainable Dar es Salaam Project

The Sustainable Dar es Salaam Project (SDP, see appendix J) was formulated during a major City Consultation in 1992 as a pilot demonstration within the set up of the global Sustainable Cities Programme of the UNCHS (Habitat). In this sense, Dar es Salaam was the first city to experience this demonstration. The highest priority was set on Solid Waste Management. Another environmental issue is the management of surface water and liquid waste. Several aspects are being dealt with under this environmental issue. At present four main items are being addressed:

- Managing pit latrines, septic tanks and sullage.
- Sewer upgrading and extension.
- Industrial effluent pollution control.
- Managing public toilets.

A pilot project on pit emptying was carried out in Sinza in 1995 as a joint project of DCC/SDP and Life Programme. The purpose of the pilot project was to determine the most appropriate and economic levels of charging for services of emptying pit latrines, septic tanks and sullage as a privatised activity. The following major conclusions were reached as a result of this pilot project:

- existing residential areas with high water tables require proper trunk sewerage systems;
- new areas planned for residential houses with on-site sanitation require changes in design of the pits to provide for proper lining which will end up being more expensive compared to off-site sanitation;
- the basis for privatisation of tanker services was set and the minimum cost of operating the facility per trip was established at Tsh. 13,500/-.

Baseline studies have been carried out to determine the state of sewerage with the aim to improve and upgrade the sewer system. Some sewer trunk and the treatment plants are old and malfunctioning, requiring replacement or overhaul. The main problem, with upgrading sewerage systems is lack of funds to underwrite the enormous cost that this exercise entails.

This problem could partly be solved by DCC allocating funds from fees paid for sewerage services. But revenue collection for sewerage services is behind schedule, but this should improve with the change of the coming of DAWASA, the Dar es Salaam Water and Sanitation Authority. DAWASA is the former NUWA (the National Urban Water Authority), incorporating the sewerage functions of the former DSSD.

³¹ See Dar es Salaam City Commission, *Waste Management Department; structures, functions, manpower and equipment requirements*

Although efforts have been made to incorporate SDP within DCC, this has not yet been fully and formally effected and linkage between the two is not clear. This lack of clear linkage contributes to the fact that most Commissioners claim ignorance of what SDP is doing and how it is relevant to DCC.³²

3.3.3 NGO's

PLAN International is engaged in the socio-economic development of Vingunguti and Buguruni (40% of the PLAN's budget comes from Foster Parents, see appendix J). In 1994 a project was started by PLAN: "Introduction of community based MAPET to Buguruni & Vingunguti - Ilala district". A planning for implementation was made and some pit emptiers and mechanics were trained by the DSSD. PLAN would provide the initial funds for training and protective clothing. They also would support the promotion of the MAPET service to increase people's awareness and use of MAPET and facilitate health care education. The project was not executed, but PLAN is still interested in supporting the Town Development Committees of Vingunguti and Buguruni with the implementation of the MAPET service.

3.3.4 CBO's

Important features of CBO's are that its members live in the same area, have multiple social ties, share economic and other interests, and have strong ties with their community. This is also true for the Town Development Committees (TDC's) of Vingunguti and Buguruni, which are still interested in implementation of the MAPET service in their neighbourhood. According to the TDC leaders MAPET is very good and useful in these areas, but only if a sludge transfer system is developed since on-site burying is not possible.

The TDC leaders suggested several improvements for the MAPET service. They are really interested and wanting to co-operate as soon as a new MAPET project would be started in their areas.

3.3.5 Formal sector

Private sector participation is getting more and more important in municipal waste services. It means that the role of governmental departments is devolved to the private sector, whereas the City Council departments assume the regulatory and controlling role. Until now, these are just plans that have not been worked out yet. There are several private pit-emptying companies (tanker services), but so far none of them is officially registered at the DCC. Besides that, a lot of changes are going on within the DCC, because of the restructuring into three municipalities.

3.3.6 Informal sector

In Dar es Salaam a considerably large informal sector exists (56% of total employment³³), since the formal employment opportunities are limited to the low economic development in Tanzania as a whole and Dar es Salaam in particular. Informal sector businesses are noted for a general lack of good record keeping or other business arrangements, and the informal sector predominantly (95%) provides employment opportunities for primary school leavers or below. The ILO has classified the vast majority (95%) of these informal businesses as survival activities with limited growth potential and enterprises.³⁴

Combined however, they produce a value added that is equal to 32% of the officially recorded Gross Domestic Product (GDP)³⁵. This suggests that the informal sector is not necessarily a marginalised sector, but a profitable entity and a major source of income and employment opportunities. Under the circumstances it is apparent that the informal sector (employing the majority of the workforce) will continue to be very important in providing daily services to city residents and therefore a sector that needs much attention, and must be involved in development decision-making and implementation.

³² See Oyeke, T.O. et al (UNDP/United Republic of Tanzania), *Evaluation of Sustainable Dar es Salaam project*

³³ See Ministry of Labour (United Republic of Tanzania), *1991 National informal sector survey* (p. 5)

³⁴ See A. van de Klundert and M.S. Muller (WASTE), *Community based waste collection and small scale enterprise development in Dar es Salaam* (p. 15)

³⁵ See Ministry of Labour (United Republic of Tanzania), *1991 National informal sector survey* (p. 23)

The major problems affecting the informal sector businesses are the unavailability of capital and credits, the non-payment of debts, the lack of market/customers and the lack of equipment and spare parts. Four main types of assistance were identified by operators to be most important. In terms of priority, the availability of loans was ranked top among the major forms of assistance needed. It was followed by permanent sites for their businesses, availability of raw materials and marketing of the products and services.³⁶

3.4 Institutional aspects

A historical moment occurred when the country passed through a transition from 30 years of one party political rule to multiparty political system, following the general election in October/November 1995. Although the same political party CCM, which has ruled all these years, remained in power, there have been changes of personalities in the government offices responsible for implementation of the project. Not unexpectedly the new bureaucrats have had changed opinion and altitude on the operations of the project.

Hand in hand with the political changes, the government has continued to implement policies aimed at transforming the previously centrally planned to market-oriented economy. This has entailed privatisation of public enterprises, re-definition of government roles shifting from the previous role as a provider to being a facilitator of the private and popular sectors in development process. Over the last two years consumers of various services have gradually found themselves paying or sharing with the Government the costs of services such as health and education which hitherto were met by the government. This change has, however, implied a higher cost of living to the people without corresponding increase in real incomes.³⁷ The GDP per capita was estimated at US\$ 110 (1992).

The average national sanitation coverage in urban Tanzania was estimated at 79% (1990)³⁸. Major facilities commonly used include flush toilets, pit latrines (89.3%), VIP latrines (3.3%) and other methods. Sanitation services in urban areas throughout the country are still very poor and inadequate. One of the critical issues in the operation of pit latrines is their hygiene, both personal and environmental.

Along the East African coast, where Islamic influence is strong, people are, in principle, averse to touching human excreta. They refuse to apply human excreta, even when composted and sterile, as fertiliser on the land, although it is known that plants grow well on the site of old latrines. The social status of pit emptying is low. Nevertheless, a MAPET emptier using mechanical equipment has a higher social status than a traditional emptier (frogmen).³⁹

3.5 Conclusions

A comparison of the old MAPET situation with the present situation shows that many things have changed over the years. Not only the MAPET service itself, but as important are the transitions that took place in the MAPET environment.

The Sustainable Dar es Salaam Project was launched after the end of the MAPET-I project in 1992 as a project for and by the people of Dar es Salaam. The multilateral donor institutions are therefore assisting the Government of Tanzania to build the local capacity required to cope with the challenges of sustainable urban development. One of the environmental issues is the management of surface waters and liquid waste. The ultimate goal is to build a capacity within the local government administrative structure to plan and manage the urban development for the city by involving the private sector, NGO's and CBO's.

One of the major transitions during for Tanzania was the change from a one-party-system to a multiparty-system in 1995. The government introduced several fundamental reforms, among which the change from a centrally planned to a market-oriented economy. This led to a privatisation of the public services, whereby these are no longer the operating organisations, but organisations to control and regulate the private companies whom are now performing the services.

³⁶ See Ministry of Labour (United Republic of Tanzania), *1991 National informal sector survey* (p. 44)

³⁷ See T.O. Oyieke, et al (UNDP/United Republic of Tanzania), *Evaluation of Sustainable Dar es Salaam project*

³⁸ See MWEM (United Republic of Tanzania, *National water supply and sanitation programme 1993-2002* (p. 19)

³⁹ See J. Anschütz, *The collection of human excreta" a literature review* in 'The collection of household excreta' (p. 15)

One of these public organisations is the DSSD, nowadays assimilated into the Waste Management Department. The DSSD had a fleet of large tankers and a few mini tankers, but there are only three operating tanker vehicles left to operate the pit emptying services (although there is a (unconfirmed) sponsorship of approximately 20 tanker vehicles coming up). Charges for the tanker services have increased enormously since the beginning of the MAPET-I project (from Tsh. 1,200/- to over Tsh. 20.000/-), because the DSSD no longer receives subsidies from the government, except for the salaries for the DSSD staff.

In addition to the pit emptying services the DCC also faces problems with the sewerage system. The planned expansion, in the areas suitable for sewerage, has so far not been achieved. In other areas it is often not possible to construct a sewerage system because of the ground conditions. Therefore most of the areas still rely on on-site sanitation (e.g. pit latrines and septic tanks). Another problem involves the disposal of sludge, because of the fact that of the five the treatment plants constructed since 1988, only two are used by the public tanker services and the plants are not reachable for the MAPET emptiers.

The formal-informal co-operation between the DSSD and the MAPET emptiers does not exist anymore, just like the special MAPET section, which was created within the Low-Cost Sanitation division. Therefore, there is no control and monitoring over the MAPET teams and their performances. One of the things that are not controlled is the lease fee, which the emptiers should pay for leasing the MAPET equipment from the DSSD. This makes the emptiers work with the equipment as if they own it instead of the DSSD. Also the responsibilities with respect to maintenance and repair have shifted from the DSSD to the MAPET emptiers. The major reason for these problems is a lack of finances at the DSSD, which limits the department to perform only basic activities.

The MAPET service was meant to be a full-time job for the emptiers, but it appears to be a part-time job (approximately 5 emptying jobs per month) which is the reason that they also perform secondary jobs. That is how they see the MAPET service, as income generation, not as a real job. Besides that the equipment is getting very old and is therefore working inefficient. There are problems with the handpump, the carts and the tyres, and the hosepipes and the pit emptiers do not have protective clothes (boots, gloves, etc. for which they got a loan from the DSSD) anymore.

It is difficult for MAPET emptiers of the one team left to market themselves. They sometimes go into the neighbourhoods to promote themselves, but the co-operation of the CCM branch offices no longer exists. These branches could introduce the MAPET services and the emptiers to the residents. Nowadays customers have to go to the DSSD office to find the MAPET emptiers or they have to contact them.

4 MAPET IN DURBAN, SOUTH AFRICA

South Africa is a country that is well known for its political change and economic disparity. Almost 70% of urban black people live without running water, sanitation or electricity. Durban, situated in the province of Kwazulu/Natal, inherits from apartheid an urban form that is fragmented, and racially structured. The vast majority of the poor are located on the growing informal urban settlements. VIP latrines are believed to be a sustainable form of sanitation for dense informal settlements on the grounds of affordability and are the lowest level of service that should be available.

4.1 The need for MAPET

Durban's natural, built and social environments were profoundly transformed and in many areas seriously damaged during the 1980s and early 1990s. Economic decline, failed neo-liberal reforms and the collapse of apartheid created many problems. Economic decline resulted in growing unemployment, and urban reforms helped create an outsider class of workers on the one hand, and increasing upward occupational mobility and higher wages for an insider workforce on the other hand. Urban reforms, rapid urbanisation and township decompression reinforced the racial city form by concentrating greater numbers of poor black people on the urban periphery.⁴⁰

These people often end up in informal settlements. Usually these informal settlements have none, or at best, very limited provision of service. Provision of water supply and sanitation services to the developing and water scarce areas is one of the goals of the South African Reconstruction and Development Programme (RDP). The RDP is a framework for national development aimed at addressing issues of poverty and inequality through economic growth. It requires the involvement of communities and their civic organisations in the upgrading and provision of housing, infrastructure, and urban basic services in the townships and informal settlements. In the majority of cases socio-economic, technical and water supply conditions do not favour water-borne sanitation systems. As a result, ventilated improved pit latrine (VIP) systems are regarded as the most suitable sanitation system for most situations.⁴¹

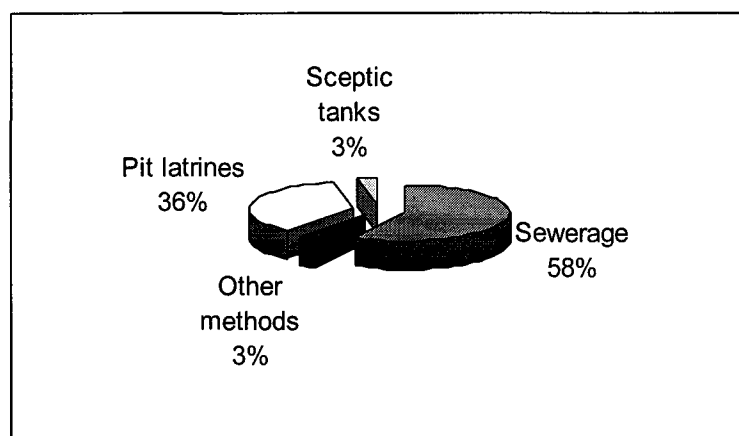


Figure 4-1: Sanitary facilities in Durban (Source: Water Research Commission, 1993)

Approximately 36% of the Durban population relies on (un)improved pit latrines (figure 4-1). Many of the (VIP) latrines in the Durban Metropolitan Council area of jurisdiction were built in 1993-94; as a result most of them will fill up in the coming years. Large and mini vacuum tankers can service a large part of the latrines that need emptying; these tankers are operated by the City Council or private contractors.

The difficulty lies in the access of dwellings within established high density informal housing and unplanned settlements where interconnecting access is merely sufficient to deal with pedestrian traffic and where access is

⁴⁰ See D. Hindson, et al, *Durban's tomorrow today*

⁴¹ The RDP refers to the minimum of an "adequate safe sanitation facility per site". This is interpreted in the National Sanitation Policy as being a VIP toilet in a variety of forms, or equivalent, as long as it meets certain criteria in terms of cost, sturdiness, health benefits and environmental impact

impossible for the vacuum tankers. Since vacuum tankers cannot operate in these conditions, this generally results in unsatisfactory and unhygienic methods of pit emptying, for example manual methods by using a bucket and a rope.⁴²

It is assumed that approximately 10% of the pit latrines can not be emptied by vacuum tankers. In Durban there is an annual demand for 3,153 pits to be emptied by MAPET, resulting in a demand for 16 MAPET teams and 48 emptiers (table 4-1). A detailed calculation of the number of MAPET teams needed in Durban is given in appendix H.

Table 4-1: Calculation of MAPET teams needed in Durban

<i>Need for MAPET teams in Durban</i>	
Total population	3.5 million
Population using pit latrines	1.26 million
Number of pit latrines	252,200 pits
Number of pits to be emptied by MAPET	25,220 pits
Average period for pits to fill up	8 years
Number of pits to be emptied per annum	3,153 pits
Pits (customers) serviced per team per annum	200 pits
MAPET teams needed	16 teams

4.2 The MAPET system

The decision to start a MAPET pilot project in Durban was decided upon by the Metropolitan Department of Wastewater Management. MAPET was chosen because of its qualities of using technologies known by people in the urban informal settlements and the reliability in the field.

4.2.1 Organisation

Sanitation in Durban only became a Metropolitan function in July 1996 and is now controlled by the Metro Department of Wastewater Management (MWM). Therefore the MWM will be the organisation co-ordinating and monitoring a MAPET pilot project in Durban. Other actors that must be involved are a contractor (maybe an NGO or CBO), the community and the pit emptiers from the neighbourhoods where the service will be implemented.

In general, there are no adequate communication systems between local authorities and the communities in South Africa. This leads to lack of support from the community, who see projects just being implemented in their area, contrary to the guidelines of the RDP. There is also a significant lack of communication within councils, between the various departments that are involved in sanitation. This leads to situations where sometimes, for example, the finance department reports that they cannot afford to provide full water borne sanitation for the entire community, while the technical department reports that funds are available within the council to provide such a level of service.⁴³

The MWM will subsidise one or two prototype units manufactured and a Mobile Sludge Transfer System (MSTS) during the pilot project, but the contractor will have to pay the capital costs for the MAPET equipment used for the actual service. Operating or running costs will be paid out of the income derived by the service. An outline of the feasibility of the MAPET service will be given in paragraph 4.2.3.

The Systems Branch of the MWM will arrange the manufacturing of the prototype MAPET equipment. After that the prototype will be tested and proven by the Strategic Planning Branch (as the actual co-ordinator of the pilot project) co-operating with the contractor selected to manage the MAPET service. The testing and proving needs to be done in co-operation with the contractor, which might be a CBO or NGO, and the pit emptiers that have been selected. They have to participate in this "trial and error" process to transfer the know-how concerning the equipment to them, for being able to maintain and repair this equipment in the correct and most optimal manner.

⁴² See A. West, *Preliminary report on pit latrine emptying proposal within the area of the Durban Metropolitan Council and Africon Engineering International, The distribution and servicing of VIP latrines in the Durban Metropolitan Area*

⁴³ See Makheta Development Consultants, *Support to peri-urban sanitation strategy in South Africa*

4.2.2 People

4.2.2.1 Residents

It is proposed to start a pilot MAPET project in Umlazi (photo 4-1), the biggest township in the Durban Metropolitan Area. Consisting of 26 units, this township is very large in relation to the other communities, and housing surveys from the Metro Housing Department provide estimates of 400,000 people living in this area.⁴⁴

In Umlazi different types of sanitation are found. A part of the households is connected to the sewerage system, others use pit latrines (11,000 VIP latrines and 20,000 unimproved latrines⁴⁵), but there are also many people without any type of sanitation. The project only focuses on problems regarding emptying of the pit latrines that are not accessible by vacuum tankers.



Photo 4-1: Umlazi area - Durban

Since there are differences regarding sanitation provision within the Umlazi area, it is suggested to identify two different sub-areas of Umlazi: one undeveloped area and an area that has (partially) been upgraded. Most of the areas have environmental health officers and committees that are involved in the upgrading and development of the settlement they are living in (most projects have to do with housing, and wastewater and refuse disposal). These committees should be the starting point for the MAPET project in those areas.

The problem in South Africa, and thus also in Durban, is that residents who pay rent also expect that the services are taken of. They expect the government to pay for such services, but sanitation is in the first place a household responsibility.

4.2.2.2 Pit emptiers

While there is a job shortage (21.5% of the total workforce is unemployed; 19.3% is working in the informal sector⁴⁶), manual methods of emptying latrines by excavation will be a viable option as there will always be labour willing to do the work. Local community representatives confirmed that there would be no shortage of

⁴⁴ See D. Scott and G. Ridsdale, *Social assessment of Southern Durban* (p. 14)

⁴⁵ See Africon Engineering International, *The distribution and servicing of VIP latrines in the Durban Metropolitan Area*

⁴⁶ See DBSA, *Kwazulu/Natal, statistical macroeconomic review* (p. 61)

residents that would be willing to empty latrines. Employment creation and income generation thus become key goals, as well as improving the traditional method for emptying the latrines by using a bucket and a rope.⁴⁷

4.2.3 Information

4.2.3.1 Finances

Pit emptying as the sole source of income relies on a steady supply of customers in an area that is small enough to be covered without motorised transport. The net income for a team member would have to be at least the minimum wage of R. 50/- per day⁴⁸. Several financial options are discussed in appendix K. It shows that with a capacity of 1 m³ per day (equivalent to 5 drums) and a contractor's profit of 15%, the price for the customers will be approximately R. 44/- per drum, or R. 218/- for 5 drums. Operating at a capacity of 2 m³ and a contractor's profit of 20% this will be R. 26/- per drum or R. 252/- per day, assuming that the capacity of 2 m³ equals one customer.

Almost all communities, with very few exceptions, expect that the national or local government will provide them with full services at no costs. These communities come from a background where, due to inequitable provision of services in the past, the 'white' and elite sections of the community were provided with access to high levels of service. However, the rest of the population was not able to pay for the same level of services. Depending on capital subsidies the emptiers receive from the MWM, costs for operation and maintenance need to be paid for by the customers.

Crime in South Africa, and especially in the Kwazulu/Natal Province, is perceived to be a significant threat to the country's overall stability and to the welfare of its citizens. Criminal activity, such as assault and armed robbery, is particularly high in areas surrounding many hotels and public transportation centres, especially in major cities. Therefore it is suggested that payment for the MAPET service will be done in the form of plastic tokens. A token will have the monetary value of the removal of one drum of the vacuum tanker, i.e. 200-l. This way it will never be necessary for the pit emptiers to carry cash on their person because the municipal offices or contractor's appointed seller will accept tokens in exchange for return payment (or accumulative account) from registered pit emptiers only.⁴⁹

4.2.3.2 Promotion and education

Many South African local authorities report that they do not provide sufficient health and hygiene promotion in the communities. These efforts were left only to the Health Department (HD), which is often not included in sanitation projects, and does not deliver the sanitation specific messages. Communities will only sustain, manage and be proud of their facilities if they feel motivated to do so. Health and hygiene promotion and education is the best way to achieve this understanding, and can be best done by dedicated multi-disciplinary teams and should not be left to general community health workers alone.⁵⁰ Promotion and education is therefore a responsibility of the MWM, the HD, the contractor and concerned CBO's and NGO's.

4.2.4 Equipment

4.2.4.1 Development of the MAPET equipment

To start the pilot project in Durban, firstly prototypes of the MAPET equipment and sludge transfer system have to be developed. This will be executed by the Systems Branch according to drawings that will be designed by the Strategic Planning Branch. This design is based on drawings of several prototypes used for the development of the equipment in Dar es Salaam. After the development, the field-testing and adjustment of prototype equipment can begin. During this process the contractor's mechanics and the pit emptiers have to be included for know-how transfer to and training of those people. Once the equipment is proved to be sustainable more units

⁴⁷ See Africon Engineering International, *The distribution and servicing of VIP latrines in the Durban Metropolitan Area*

⁴⁸ 6 Rand to one US dollar

⁴⁹ See A. West, *Preliminary report on pit latrine emptying proposal within the area of the Durban Metropolitan Council* (p. 4)

⁵⁰ See Makheta Development Consultants, *Support to peri urban sanitation strategy in South Africa*

will be constructed. A preliminary cost estimate for the manufacturing of one MAPET unit is R. 5,000/- (probably R. 8,000 to 10,0000 /- for a prototype).⁵¹

4.2.4.2 Operation and maintenance

Operation and maintenance often is a problem, regardless of the technology used. Many local authorities blame the lack of payment for services and thus inadequate resources. Very few accept that unaffordability of high levels of service contributes to the problem of poor payment, as well as the lack of operation and maintenance programmes. Where alternative sanitation has been used, in many cases councils do not have the right equipment and vehicles required for the specific technology.⁵²

Maintenance of the MAPET equipment will be ensured by applying construction techniques generally known and applicable in the informal settlements of Durban, and by training mechanics and pit emptiers in the construction and repair of specific MAPET components. An operation and maintenance programme needs to be developed to ensure the sustainability of the equipment and therefore also the sustainability of the service.

4.2.4.3 Mobile Sludge Transportation System

Sani-tech is a private company, operating large and mini tanker services in Durban, based on governmental contracts. For the problem of transfer of the sludge to final disposal sites, they use a 4000-l polyethylene tank strapped onto an adapted loadbed of a truck. Although they say that this is not the perfect solution, it is serving its purpose for transfer of the sludge to wastewater treatment plants.

4.3 MAPET actors

4.3.1 Central government

The National Sanitation Policy paper (1996) has been produced by the National Sanitation Co-ordination Office (NaSCO) under the Ministry of Water Affairs and Forestry (MwAF, see appendix L). It talks about the needs and wishes of ordinary people, particularly their desire for healthy living conditions. It is also concerned with those issues that can affect the delivery of service, especially the economy and the environment. The major aim of national policy on community sanitation is to improve the health and quality of life of the whole population: "some for all, rather than all for some". Improved sanitation facilities will reduce the incidence of disease, but only if there is improved hygiene practice and behaviour as well. Health department personnel at local level will play an important part in the promotion and education activities that are essential for success.

The government has set realistic limits on the amount of grants and subsidies that will provide for services. In summary, the government may support local authorities, for municipal services such as sanitation, with the funds needed to build the basic minimum level of service. The basic level of service is one that will be adequate to protect everyone's health, since improved health helps people to work better and spend less on doctors and medicines. The basic level of service in South Africa is the VIP latrine.

A sanitation improvement programme should help people to help themselves. Government programmes must involve community members in local planning, organisation and implementation. The whole community should take part in some way, especially the women and children. The main responsibility for providing household sanitation rests with the family or household. The role of local government is to help make this possible, or to carry out those functions which can be done more efficiently at a community level. Both provincial and national government will support and assist local government to fulfil this responsibility.⁵³

4.3.2 Local government

The greater Durban Metropolitan Area, which previously encompassed 49 local authorities, stretches roughly from the Tongaat River in the north, to Cato Ridge in the west and to the Umkomaas River in the south. As far as the Durban Metropolitan Area is concerned, local government consists of a Metropolitan Council which

⁵¹ See A. West, *Preliminary report on pit latrine emptying proposal within the area of the Durban Metropolitan Council* (p. 6)

⁵² See Makheta Development Consultants, *Support to peri urban sanitation strategy in South Africa*

⁵³ See National Sanitation Task Team, *National Sanitation Policy; White Paper, Republic of South Africa*

oversees region-wide services such as the bulk provision of water and electricity, sewage purification and arterial roads. The Metropolitan Council has an Executive Committee which is responsible for management, planning, policy and financial control of the Council, and several standing committees to oversee region wide services such as the bulk provision of water and electricity, sanitation, environmental protection and metropolitan housing.

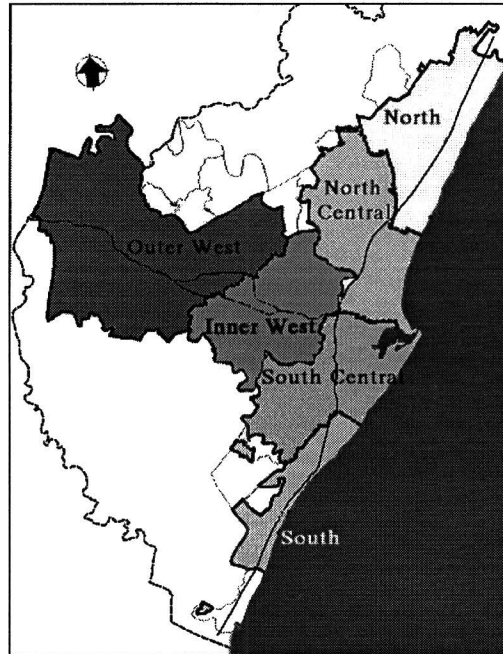


Figure 4-2: The Durban Metropolitan Area

Six Local Councils (North Central, South Central, North, South, Inner West and Outer West) are located within the metropolitan area, and are shown in figure 4-2. The six Local Councils are responsible for local functions such as road maintenance, refuse removal, local museums, and recreational facilities.

The Kwazulu/Natal Sanitation Task Group (SANTAG, see appendix L) facilitates co-ordination and networking between departments and organisations, and encourages each department and organisation to make sanitation a priority in their area of responsibility. The Durban Metropolitan Council in its restructure created the Waste & Water Services unit, one of whose departments is that of Wastewater Management. The main responsibilities of that department have been identified (see appendix L) and includes adequate pit emptying services.

4.3.3 NGO's

In South Africa there are several non-governmental organisations that are especially focused on water and sanitation. For instance Mvula Trust (see appendix L). Their mission is to improve the health and welfare of poor and disadvantaged people in rural and peri-urban communities by increasing access to safe and sustainable water and sanitation services. Therefore they facilitate various community-based projects based on a bottom-up approach, i.e. demand-driven.

4.3.4 CBO's

Many areas in Durban are represented by community structures, often divided in a number of sub-committees that operate in specific fields. Involvement of these CBO's in upgrading of the informal settlements is very often restricted, because of a lack of skills and finance. If the CBO's are to be fully involved in the implementation of MAPET, their business skills will need to be raised to a level where they could run the business themselves. The RDP requires that communities are trained not only in the skills immediately necessary to implement projects, but also those skills required to enable individuals to fully contribute their talents to the good of the country. Therefore training principles of the RDP need to be addressed.⁵⁴

⁵⁴ See Africon Engineering International, *Investigation report for a sanitation servicing strategy for Besters Camp* (p.15)

4.3.5 Formal sector

Sani-tech is one of the private organisations performing pit emptying activities. They operate a fleet of large and mini tankers for the emptying of pit latrines in the formal settlements, although their main business is the provision of chemical toilets. They only work with local government contracts, receiving R. 160/- per pit emptied (8 to 12 pits per day). The local government takes care of payment of the customers. They pay less than the R. 160/- since latrine emptying activities are highly subsidised.⁵⁵ The mini tankers (imported from MCA, Ireland) and the transfer system are operating for the eighth year, owing to good maintenance of the equipment.

4.3.6 Informal sector

The existing official statistical base for measuring and monitoring the informal economy is severely inadequate in South Africa. The best estimate is that the informal economy absorbs between four and five million workers (9-12%), and contributes roughly 9% to the GDP. It may be assumed that the vast majority of informal workers are black.⁵⁶ In Durban approximately 19% of the total labour force works in the informal sector, 59% is formally employed. As a result almost 22% of the labour force is unemployed.⁵⁷

4.4 Institutional aspects

Since the mid-1980s, and culminating in the first multi-racial elections of 1994, South Africa has undergone a vast change from a racist, splintered state with power exclusively in the hands of the white minority, to a modern democracy. In this democracy ideally all citizens are entitled to freedom, education, a decent living-standard and economic empowerment.

Salaries are paid according to qualifications, experience and merit, irrespective of race. As a result of the rapid improvement in the qualifications of Black people, the gap in salary differences between black and white employees is closing steadily, and equal pay for equal qualifications and experience has been Government policy for a long time.

In recent years South Africa's industrial base has been widened to such an extent that the country could manufacture most of its essential imports should circumstances so demand. The main stimuli for industrial development in South Africa have been an abundance of natural resources, Government incentives, a strong entrepreneurial reservoir with the necessary know-how, a growing market and a vast labour pool. The underlying strength of the economy is further reinforced by rapid urbanisation that again stimulates industrial development in many spheres.

There is currently a vast backlog in the provision of water and sanitation services to the urban and rural areas of South Africa. Approximately 19,000,000 people lack proper sanitation facilities.⁵⁸ The estimated capital costs of remedying these deficiencies varies between R. 4.4 billion and R. 13 billion over the next ten years.

Political and criminal violence, in particular, continued throughout 1995, especially in the provinces of Kwazulu/Natal, the Eastern Cape and Gauteng. Between May 1994 and May 1995, political violence claimed more than 900 lives in Kwazulu/Natal and political killings in the province accounted for 61 per cent of the national total. Crime is an extremely complex social and economic problem in any society. It is probably more complex in South Africa than in most countries because of the exacerbation of general trends by the apartheid system.

An important issue that needs to be taken into account concerns the different cultural opinions regarding sanitary facilities and services. Differences are to be expected between the biggest black populations, the Zulu and the Xhosa.

⁵⁵ See Africon Engineering International, *Investigation report for a sanitation servicing strategy for Besters Camp* (p.12)

⁵⁶ See C.M. Rogerson, *Rethinking the informal economy of South Africa* (p. 6)

⁵⁷ See DBSA, *Kwazulu/Natal, Statistical macroeconomic review* (p. 61)

⁵⁸ See P.J. Pybus (Water Research Commission), *Preliminary guidelines for private sector participation in water supply and sanitation services* (p. E-1)

4.5 Conclusions

The environmental and development problems faced by the Durban Metropolitan Area are not merely a legacy of apartheid. They also are the result of one and a half decades of economic decline, failed reforms and rapid urbanisation. This rapid urbanisation and social differentiation on the urban periphery has resulted in growing competition for scarce resources, fast and widespread degradation of natural environments, and the breakdown of social institutions.

The collapse of the previous racial order opened the way for fundamental reorganisation and rebuilding of the city, but social disintegration and continuing violent conflict also threaten institutional breakdown, system failure and irrespective decline. Because of this new relationship can be build, with major attention for privatisation and community participation. Community participation as such, is not much practised yet.

In case of the MAPET service involvement of CBO's and communities is necessary to establish a sustainable service. Until now, initiatives come from the local authorities, but more attention should be paid to the demands and needs of the communities.

MAPET is needed in various informal settlements, or unplanned areas in Durban. Although on much lesser scale than in Dar es Salaam (need for 16 and 99 MAPET teams respectively). Since there is no equipment and blueprints at hand, firstly new blueprints have to be designed. This will be done by the Strategic Planning Branch of the Metro Department of Wastewater Management. After that the Systems Branch will establish the manufacturing of the equipment.

PART III

FINAL CONCLUSIONS & RECOMMENDATIONS

5 FINAL CONCLUSIONS

The MAPET-I project, to develop and implement the MAPET service in Dar es Salaam, did not establish a sustainable MAPET service. Because of a lack of co-ordination, monitoring and evaluation (mainly caused by a lack of funding) the MAPET service implemented in Dar es Salaam is slowly running dry, unlike the expected expansion of the MAPET service to other parts of the city.

This does not mean that the MAPET service is not a good solution for emptying pit latrines in unplanned urban areas. It is one of the very few solutions for emptying pit latrines in unplanned urban areas that are available at the moment. With the number of pit latrines that are in use, there definitely is a need for services like MAPET. Therefore the MAPET service must be improved and transferred to other unplanned urban areas.

5.1 *Transfer of the MAPET service*

In the short term we cannot speak of a “transfer” of the MAPET service from one country to another. Two main parties have to be distinguished in a transfer: the supplier and the receiver (figure 5-1). As the MAPET service was already operating in Dar es Salaam for almost ten years, it was hoped that on the basis ten years of experience, the DSSD could operate as a supplier of the MAPET system. Other municipalities, e.g. Durban, would function as the demand side. However, from the present MAPET situation in Dar es Salaam no transfer or expansion can be accomplished; the DSSD does not have the expertise to function as a supplier of the MAPET system.

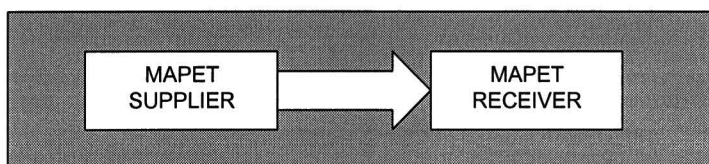


Figure 5-1: MAPET transfer

Like in other cities, the municipal departments of Dar es Salaam and Durban that are responsible for pit emptying do not state the core business of technology transfer and the responsibilities that come with the transfer of technologies and systems like MAPET. Therefore another organisation needs to be involved to co-ordinate and control the co-operation between the several actors that are involved in the MAPET service and the MAPET transfer.

5.2 *The MAPET service*

In Dar es Salaam as well as in Durban a new start has to be made to (re)develop the MAPET service. Before implementing the service, each city has to fulfil the necessary preconditions based on the theoretical framework of an integrated MAPET service. Without those preconditions the MAPET service will not be sustainable. For each of the two cities conclusions are drawn from the case study results.

5.2.1 **MAPET in Dar es Salaam, Tanzania**

MAPET has advantages for application all over Dar es Salaam (such as informal sector income generation, flexibility, and the customers’ willingness to pay for MAPET service). The COMPET study revealed that, for economic efficiency, the tanker technologies should be applied in all areas with access for tanker vehicles. However, the mini tankers are no longer in use in Dar es Salaam and there is a scarcity of adequate large tanker services.

There evidently is a need for MAPET, since approximately 53% of the Dar es Salaam population use pit latrines for excreta and wastewater disposal. Assuming that currently vacuum tankers at most can service 50% of the pits, it can be concluded that 19,875 pits need to be emptied annually by MAPET teams, resulting in a need for 99 teams.

The major problems in Dar es Salaam have to be solved preceding implementation. For Dar es Salaam the major problems concern a well-defined organisational setting resulting in management skills and capacity (including government support), as well as the lack of financial resources, which is a problem all over Tanzania.

Liquid waste management is of minor importance, whereas solid waste management projects get most attention and therefore more funding. All waste, solid or liquid, are health hazards for the people exposed to the waste. It would be better if solid waste projects were combined with liquid waste issues, including pit emptying. The lower priority for liquid waste is partly caused by a lack of municipal support for all emptying services: institutional bottlenecks as well as resource limitations (especially capital). As regards MAPET there was no commitment from anyone except the emptiers themselves, causing a lack of control and monitoring, and unsatisfactory co-ordination of the teams. To lower the costs, and improve and expand the service, community participation could be highly beneficial to the local government. With the ongoing reorganisation of the Dar es Salaam City Commission into three municipalities, the Waste Management Department should have more time and capacity left for co-ordination and control over, for instance, the MAPET service.

The only residents involved nowadays are the existing customers of the MAPET service. However, this has nothing to do with community participation in the service. This comes back to the new organisational setting that is needed. In short, the MAPET service should be demand-driven: *a bottom-up approach*. Consequently the service should be implemented with structural participation of the community to lead to a form of community ownership whereby the residents or representative CBO's are responsible for the operation of the MAPET service and whereby maintenance of the equipment is ensured. This could be sustainable contrary to the former formal-informal co-operation with the DSSD, because by participation of the community, a social network within the neighbourhood would be created to ensure the quality and sustainability of the MAPET service. At the moment social and physical accessibility to the MAPET service is minimal and because MAPET is only operated on a very small scale, many residents of unplanned areas do not know about this method for pit emptying.

The emptiers are 'living by the day' (short-term vision). They do not have structural plans for the acquisition of more customers or for savings for future maintenance and repair of the equipment. In order to support and strengthen entrepreneurial capacity, it is essential to support the economic empowerment of the emptiers. Although the MAPET emptying is considered too heavy to do for women, they feel responsible for keeping the latrines in good condition. Some women, as community members and as businesswomen, have indicated their willingness and ability to organise people and manage a businesslike operation. Both these capacities are required if the MAPET service is to be implemented.⁵⁹

Besides organisational bottlenecks, there also are various technological problems. The main problem is the method of disposal, since on-site disposal is causing many problems. Therefore another routine of sludge removal must be developed to haul sludge to a transfer station where it can be temporarily disposed by means of the tank carts. Two so-called fixed transfer stations (figure 5-2) were built during the MAPET project. However, a system with these fixed transfer stations necessitates a large number of stations and it is very difficult to become the owner of a piece of land to build the stations on. Therefore, mobile transfer stations need to be developed.

Currently there are two Town Development Committees (TDC's, which are community elected committees) in the unplanned areas of Vingunguti and Buguruni who are interested in implementing the MAPET service in their neighbourhoods, in co-operation with PLAN International. The project was cancelled 4 years ago because of inadequate sludge disposal methods. At the moment PLAN International is working on a project proposal, together with WASTE, combining liquid and solid waste management in those two areas. One of the major features will be the design of a system for sludge transfer and disposal.

⁵⁹ See M.S. Muller, *The collection of household excreta, the operation of services in urban low-income neighbourhoods* (p. 25)

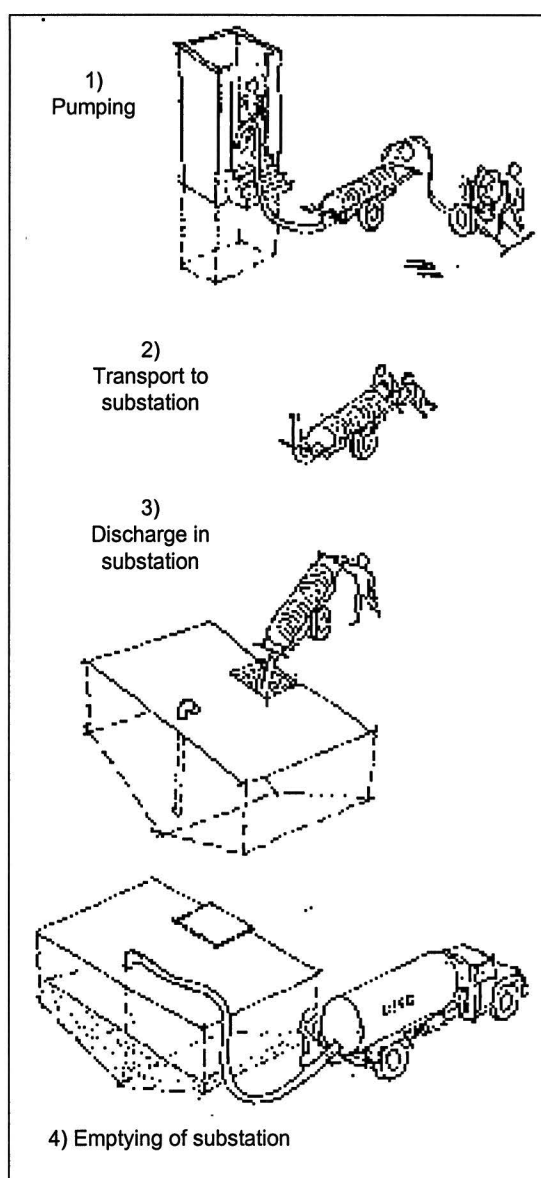


Figure 5-2: Off-site disposal

The conclusions regarding the MAPET service in Dar es Salaam are reported in table 5-1; the problems are highlighted.

Table 5-1: Final conclusions Dar es Salaam

<i>ELEMENTS & INDICATORS</i>	<i>CONCLUSIONS</i>
<i>The MAPET system</i>	
Organisation	
Staff members	No staff members involved
Support office	No support office or special MAPET division to co-ordinate MAPET activities
Booking offices	Bookings can only be done at DSSD office or with emptiers personally
Ownership:	Authority lies with the DSSD
Authority	Responsibility (O&M) with MAPET emptiers
Responsibility	No control of the service takes place
Control	No communities or CBO's involved
Community participation	
People	
Level of education of emptiers	At the most completed primary education
Working experience of emptiers	Traditional emptiers or other jobs
Entrepreneurial skills (open-mindedness, long-term orientation, competitiveness)	Short-term orientation and no open-mindedness and competitiveness
MAPET income generation of emptiers	Low income, below subsistence level, need for secondary

	jobs
Customers' criteria:	
Quality	Compared with other options quality is good
Costs: willingness and affordability to pay	Costs are considered reasonable and affordable
Social accessibility	There are no booking offices in the neighbourhoods
Physical accessibility	Unplanned areas are not accessible for tankers
Need for pit emptying services in unplanned areas	99 MAPET teams would be needed
Information	
Monitoring & Evaluation	No monitoring and evaluation activities carried out
Availability of blueprints	No blueprints available, only technical drawings of various prototypes of the equipment
Lease fee payment for equipment	No structural lease fee payment
Record keeping	No records were kept after the MAPET-I project
Cost recovery	Only recovery of labour costs, funding of capital investment
Profitability	MAPET income per emptier is below subsistence level
Promotion and education	No promotion and education nowadays
Equipment	
Standardisation of components	No blueprints and no standardisation
Capacity for manufacturing	Large scale manufacturing not possible at DSSD/WMD
Knowledge for manufacturing and operation and maintenance	Transferred by participation of emptiers and mechanics in MAPET-I project
Availability of materials and parts	Probably still available, maybe new materials on the market
Frequency of O&M	Not known, no records kept
Costs for O&M	Tsh. 2,000/- for major repairs by DSSD workshop
Quality of equipment	Various technical problems, equipment is getting old and tough to work with
Sludge transfer and disposal	On-site burying is becoming a problem, no MSTs available, scarcity of adequate treatment plants
MAPET actors	
Central government	
Sanitation policy	Policy is not up to date and more focused on construction than on operation and maintenance of the systems
Responsible department	Ministry of Water, Energy and Minerals
Local government	
Responsible department	DSSD/WMD (pit emptying services), HD (promotion and education), SDP (managing urban development)
Standards for sanitation and pit emptying	Not available
Manpower WMD – liquid waste	Approximately 10 people
Capacity vacuum tankers DSSD/HD	Currently 3 & 6 vacuum tankers operational
NGO's	
Interested organisations	PLAN International
CBO's	
Interested organisations	TDC's of Vingunguti and Buguruni
Neighbourhood upgrading activities	In other areas focused on refuse disposal and road construction
Formal sector	
Number of enterprises performing vacuum tanker services	Approximately 7, but not registered so far
Informal sector	
Subsistence level	Tsh. 30,000/- per month (1995 estimate)
Level of education	95% of informal workers at the most primary education
MAPET aspects	
Political	
Political system	Multiparty-system since end of 1995
Technological	
Sanitary facilities Tanzania	84.6% of the population use pit latrines, and this is increasing
Economical	
Income per capita Tanzania	US\$ 110 (GNP estimate 1992)
Division formal/informal sector	Informal sector is very important in Dar es Salaam (32% of value added and 56% of total employment)
Health/environmental	
Public health standards regarding sanitation	Not available
Social/cultural	
Gender	MAPET work too heavy, but managerial activities can very well be done by women. They feel responsible for clean keeping of latrines
Values regarding sanitation/sludge	Islamic aversion regarding human excreta

5.2.2 MAPET in Durban, South Africa

The situation in Durban is of course different from the situation in Dar es Salaam. The pit latrine emptying problem is of a smaller scale than in Dar es Salaam, although both cities have 3.0 to 3.5 million habitants. In Durban approximately 252,200 pits are in use, most of them in the areas Umlazi and Inanda/Ntuzuma. Assuming that vacuum tankers can serve at least 90% of the pits, 3,153 pits can be served by MAPET annually. This indicates a need for 16 MAPET teams all over Durban.

The major problem in Durban is the participation of the residents and communities and the design of the equipment. The Metropolitan Department of 'Metro Wastewater Management' (MWM) within the Water & Waste Service Unit is responsible for adequate wastewater disposal facilities. Planning and implementation of the MAPET service in Durban has only started recently and so far it is not an integrated approach. Initiatives come from the side of the MWM, resulting in a top-down approach instead of a bottom-up approach, based on community demand and needs. Literature indicates that many South African projects were performed without structural co-operation of the communities and other actors as NGO's and private sector enterprises. Generally these projects functioned worse than those did where the community was involved.⁶⁰ Selection of the pit emptiers still needs to take place, and since there is a job shortage in Durban manual methods of emptying latrines may be a viable option as there will always be labour willing to do the work. Local community representatives confirmed that there would be no shortage of residents that would be willing to empty latrines.⁶¹

Another problem is the design of the equipment. No blueprints are available from the MAPET service in Dar es Salaam, but capacity is obtainable from the MWM Systems Branch to adjust the designs to conditions in Durban and to manufacture prototypes of the MAPET equipment. However, not only is adjustment to local conditions needed, but also standardisation of the components is necessary for a possible expansion. Blueprints have to be made to transfer this knowledge and the designs (back) to Dar es Salaam. Durban will come across the same problems as in Dar es Salaam concerning the transfer of the sludge. Sani-tech has solved this problem for their mini tanker services by the introduction of a polyethylene tank strapped on a truck's loadbed. Co-operation between WASTE, Dar es Salaam, Durban and Sani-tech should lead to the development of an adequate transfer system for the MAPET sludge.

A major influence on the South African situation is the inequality between black and white, resulting from the former apartheid system. There still are big disparities between the black and the white population. The 'First World' that is characterised by well-developed industrialisation, modern telecommunication and sewerage connections is the total opposite of the 'Third World' with explosive population growth, high unemployment rates, malnutrition and inadequate sanitation systems or none at all. Since both 'worlds' are existing in South Africa, it is obvious that black population expects the same quality and services that the white population gets.

However, the amount of money that households from the unplanned areas can afford, and are willing to pay, for basic urban services (including pit emptying) is much less than what the richest people can afford. The affordability and willingness to pay should be determined early in the planning process, through surveys and discussions with the community to be served. More work should be done on this issue. In general, more than two-third of the black households earns less than R. 1,000/- per month (1990), spending at the most 15-20% of household income on "housing", thus including pit emptying services.

The conclusions regarding the MAPET service in Durban are reported in table 5-2; the problems are highlighted.

Table 5-2: Final conclusions Durban

ELEMENTS & INDICATORS	CONCLUSIONS
<i>The MAPET system</i>	
Organisation Staff members Support office Booking offices Ownership: Authority Responsibility Control	At present two members of MWM Suggested support office in community halls Idem Authority with MWM Responsibility with contractor/emptiers to be selected Control by community and metropolitan departments
Community participation	No communities or CBO's involved
People	

⁶⁰ See Makhetha Development Consultants, *Support to peri urban sanitation strategy in South Africa, part 1* (p. 5)

⁶¹ See Africon Engineering International, *The distribution and servicing of VIP latrines in the Durban Metropolitan Area*

Level of education of emptiers	Not appropriate
Working experience of emptiers	Not appropriate
Entrepreneurial skills (open-mindedness, long-term orientation, competitiveness)	Will be needed, at least for contractor/CBO that is co-ordinator of the MAPET service
MAPET income generation of emptiers	Should be at least the subsistence level of R. 54 per day
Customers' criteria:	No social studies carried out yet
Quality	--
Costs: willingness and affordability to pay	--
Social accessibility	--
Physical accessibility	--
Need for pit emptying services in unplanned areas	16 MAPET teams would be needed
Information	
Monitoring & Evaluation	Not appropriate
Availability of blueprints	To be designed by Strategic Planning Branch MWM
Lease fee payment for equipment	Subsidy for capital investments by MWM
Record keeping	Not appropriate
Cost recovery	Recovery of labour costs at least at subsistence level
Profitability	Also cost recovery of overhead costs and O&M
Promotion and education	Usually only done by HD
Equipment	
Standardisation of components	No blueprints available
Capacity for manufacturing	For pilot project capacity at Systems Branch
Knowledge for manufacturing and operation and maintenance	Only MAPET know-how by MAPET report and magazine article
Availability of materials and parts	To be investigated by Systems Branch
Frequency of O&M	Not appropriate
Costs for O&M	To be covered by customer costs
Quality of equipment	Not appropriate
Sludge transfer and disposal	MSTS not available, but similar system operated by Sani-tech for mini tankers; adequate treatment plants available
MAPET actors	
Central government	
Sanitation policy	Lowest level of service is VIP latrine
Responsible department	National Sanitation Co-ordination Office under Ministry of Water Affairs and Forestry
Local government	
Responsible department	MWM (wastewater management, planning for full sewerage recovery by 2050), SANTAG (implementation of national sanitation policy in Province of Kwazulu/Natal)
Standards for sanitation and pit emptying	Lowest level of service: VIP latrines, no standards for emptying
Manpower MWM	Approximately 150 people
Capacity vacuum tankers	Good for planned areas/formal settlements
NGO's	
Interested organisations	Not appropriate
CBO's	
Interested organisations	Not appropriate
Neighbourhood upgrading activities	Various CBO's in Umlazi and other areas, working on construction of water supply and sanitation systems and refuse disposal
Formal sector	
Number of enterprises performing vacuum tanker services	Various organisations servicing large and mini tankers
Informal sector	
Subsistence level	R. 50 per day
Level of education	Predominantly primary education
MAPET aspects	
Political	
Political system	Multiparty-system, aftermath of apartheid
Technological	
Sanitary facilities South Africa	32.5% of population use (un)improved latrines
Economical	
Income per capita South Africa	US\$ 2,290 (1992 estimate), 'black' population US\$ 620
Division formal/informal sector	In Durban 19% is employed in the informal sector
Health/environmental	
Public health standards regarding sanitation	Only standards for lowest level of service and groundwater pollution, not for pit emptying
Social/cultural	
Gender	Managerial activities can very well be done by women
Values regarding sanitation/sludge	Inequality between white and black caused by apartheid; problems to be suspected with Zulu and Xhosa culture

5.2.3 A comparison of the two case studies

Major differences between Dar es Salaam (Tanzania) and Durban (South Africa) exist. The Gross National Product (GNP) per capita in the two countries was US\$ 2290 in South Africa against US\$ 110 in Tanzania (1992 estimates). However, when South Africa is divided into a 'black' and a 'white' population, the black population accounts for an average GNP per capita of US\$ 620.⁶²

The cities both have a population of approximately 3 million habitants and they both cope with the problem of full pit latrines that need to be emptied. That is about all the two cities have in common. The pit-emptying problem in Dar es Salaam is of much bigger scale than in Durban, resulting in a need for MAPET teams of 99 and 16 teams respectively.

The organisation capacity is much more developed in Durban than in Dar es Salaam, as can be seen from the number of people working in the wastewater management departments of Dar es Salaam and Durban (respectively 10 versus 150). Technical capacity also shows huge differences, which can be indicated by the number of adequate wastewater treatment plants (2 versus 31 respectively).

The MAPET service should not be formalised, but should remain an informal service, where the emptiers as informal sector operators operate closely with their customers who very often work in the informal sector too. Most of the people living in the unplanned areas belong to the low-income group and their financial situation causes them to have a very short-term view regarding their expenses. This is one of the reasons why the customers favour MAPET. They can negotiate about the price they have to pay per drum and about the amount of drums they want to have emptied. Tanker services do not offer this flexibility, since vast amounts have to be emptied and high prices have to be paid.

Nowadays, there is a strong move towards a 'demand' or 'market-driven' approach rather than the previously used 'supply' or 'product-driven' approach of public works. This is largely in response to policy directives from major international institutions such as the World Bank and the International Monetary Fund, which perceive the inefficiency of a burgeoning public sector to be counter-productive to overall economic development and restructuring. Therefore it is important to set up an integrated approach, also involving CBO's or other community representatives. This will lead to a feeling of ownership of the MAPET system and therefore the residents will take the responsibility of operating and maintaining the system, instead of relying on the local government.

The main differences and similarities between the problems in Dar es Salaam and Durban are summarised in table 5-3.

Table 5-3: Comparison Dar es Salaam vs. Durban

<i>PROBLEMS in Dar es Salaam</i>	<i>ELEMENTS & INDICATORS</i>	<i>PROBLEMS in Durban</i>
<i>The MAPET system</i>		
No staff members involved	<u>Organisation</u> Staff members	--
No support office or special MAPET division to co-ordinate MAPET activities	Support office	--
Bookings can only be done at DSSD office or with emptiers personally	Booking offices	--
No control of the service takes place	Ownership: Control	--
No communities or CBO's involved	Community participation	No communities or CBO's involved
<u>People</u>		
Short-term orientation and no open-mindedness and competitiveness	Entrepreneurial skills (open-mindedness, long-term orientation, competitiveness)	--
Low income, below subsistence level, need for secondary jobs	MAPET income generation of emptiers	--
There are no booking offices in the neighbourhoods	Customers' criteria: Social accessibility	No social studies carried out yet
99 MAPET teams would be needed	Need for pit emptying services in unplanned areas	16 MAPET teams would be needed

⁶² See Africa, South of the Sahara 1995

No monitoring and evaluation activities carried out	<u>Information</u> Monitoring & Evaluation	--
No blueprints available, only technical drawings of various prototypes of the equipment	Availability of blueprints	To be designed by Strategic Planning Branch MWM
No structural lease fee payment	Lease fee payment for equipment	--
No records were kept after the MAPET-I project	Record keeping	--
Only recovery of labour costs, funding of capital investment	Cost recovery	--
MAPET income per emptier is below subsistence level	Profitability	--
No promotion and education nowadays	Promotion and education	Usually only done by HD
No blueprints and no standardisation Large scale manufacturing not possible at DSSD/WMD Not known, no records kept Various technical problems, equipment is getting old and tough to work with On-site burying is becoming a problem, no MSTs available, scarcity of adequate treatment plants	<u>Equipment</u> Standardisation of components Capacity for manufacturing Frequency of O&M Quality of equipment Sludge transfer and disposal	No blueprints available -- -- -- MSTs not available, but similar system operated by Sani-tech for mini tankers; adequate treatment plants available
MAPET actors		
Policy is not up to date and more focused on construction than on operation and maintenance of the systems	<u>Central government</u> Sanitation policy	--
Not available Currently 3 & 6 vacuum tankers operational	<u>Local government</u> Standards for sanitation and pit emptying Capacity vacuum tankers	Lowest level of service: VIP latrines, no standards for emptying --
MAPET aspects		
84.6% of the population use pit latrines, and this is increasing	<u>Technological</u> Sanitary facilities	--
US\$ 110 (GNP estimate 1992)	<u>Economical</u> Income per capita	US\$ 2,290 (general 1992 estimate), 'black' population only US\$ 620
Not available	<u>Health/environmental</u> Public health standards regarding sanitation	Only standards for lowest level of service and groundwater pollution, not for pit emptying
--	<u>Social/cultural</u> Values regarding sanitation/sludge	Inequality between white and black caused by apartheid (sewerage versus inadequate sanitation); problems to be suspected with Zulu and Xhosa culture

6 RECOMMENDATIONS

6.1 *Transfer of the MAPET service: an adequate integrated approach*

Since there is no supply side at hand, a co-operation between the actors in Durban and in Dar es Salaam is the best way to establish a revival of the MAPET service and to create a new supply side. Both cities are facing similar problems and by working together on this problem of pit emptying, they can initiate a learning process by sharing their experiences in a systematic way. This process of co-operation generates ever-widening circles of communication, information exchange, and collaboration. This in turn produces very real, and valuable, additions to collective “know-how”: greater understanding and insight. These can further evolve and strengthen if more cities participate.

Only if the designs of the equipment are adapted, components are standardised (thus leading to standard blueprints of the equipment) and an appropriate sludge transfer system has been developed, can the MAPET service be transferred to other cities. A third organisation will be necessary to function as a transfer mechanism between supplier and receiver since municipal agencies are not capable of arranging a technology transfer. This third party, or intermediary organisation, should co-ordinate and monitor the transfer and function as a representative of the service, so that people can obtain information about MAPET at a central point. According to WASTE, transfer of the MAPET service should preferably be a South-South co-operation from one developing country to another. Since WASTE was responsible for the development of the MAPET service, they can best serve as the intermediary organisation to control and co-ordinate the revival of the MAPET service, and after that support and control transfer of the MAPET system to other cities.

In this way a structured body can be formed, which can only be achieved if an international integrated approach between the intermediary organisation and the actors in both countries is applied. For all the actors concerned, i.e. for suppliers and receivers as well as WASTE, it must be clear (by contract) what the responsibilities of each of the actors are. On this international level, structured consultations need to take place between WASTE and the actors in Dar es Salaam and Durban.

WASTE will be responsible for the short and middle-long term MAPET-plans. However, one of those middle-long term plans will be the identification of a representative Southern organisation that is capable of overtaking WASTE’s tasks and responsibilities related to the MAPET service. Responsibilities of WASTE as intermediary organisation will include:

- Identification of cities that are facing similar pit emptying problems (some organisations, in for instance Bamako, already contacted WASTE for more information on the MAPET service).
- Supply of the theoretical model to be used in that city for national identification of the MAPET elements.
- Support the identification of the actors in the specific city (in co-operation with the responsible organisation, mostly a municipal department). Thereby taking into account the national aspects related to the MAPET service and the necessity of a demand-driven ‘bottom-up’ approach instead of a top-down approach.
- Promotion of community participation and management.
- Support the actors by identification of their responsibilities.
- Support the actors by finding fund-raisers and writing project proposals.
- Co-ordination of the co-operation between the cities that are interested in implementation of the MAPET service to share their experiences, for instance by e-mail discussions, workshops etc.
- Co-ordination of the creation of blueprints of the MAPET equipment, resulting in standardisation of the components and parts (in co-operation with the DSSD mechanics and the MWM in Durban).
- Co-ordination of the development of an adequate Mobile Sludge Transfer System, applicable in Tanzania as well as in South Africa (in co-operation with Sani-tech, the WMD and the MWM).

The theoretical model (figure 1-4) used to identify possibilities for implementation of the MAPET service in Dar es Salaam and Durban is also applicable to other countries and cities. One of those cities, coping with similar pit emptying problems in the unplanned urban areas is Bamako, Mali. The model is not only applicable to Southern African countries, but will be applicable for all developing countries coping with similar problems. An answer to the national and local pit emptying problems in unplanned urban areas will be found in the implementation of an integrated system on international level. This will be co-ordinated by WASTE (figure 6-1) and lead to an integrated national approach by participation of all the actors.

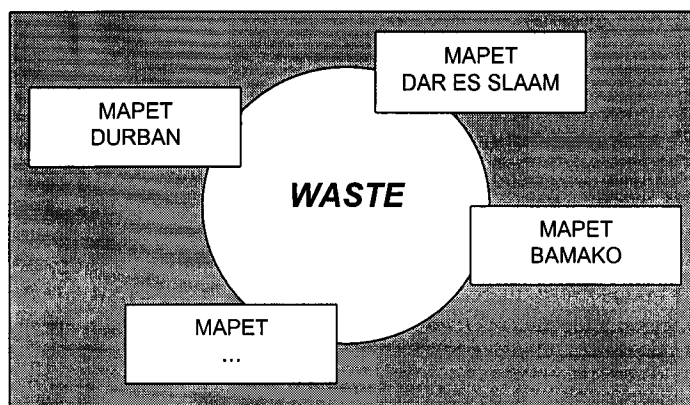


Figure 6-1: Integrated international MAPET setting

Of the whole range of cities coping with pit emptying problems, Dar es Salaam and Durban are expected to be two extremes. Other cities that are considering implementation of the MAPET service can identify possibilities for implementation of the MAPET service by application of the theoretical framework for an integrated national MAPET approach. To implement the MAPET service on a local level, a city has to analyse all the elements of the framework. For each city the concerned actors need to be identified, existing of the local and the central government, NGO's, CBO's, the formal private sector and the informal sector, which is very important in most developing countries. In addition, the elements of the MAPET service (Organisation, People, Information and Equipment) need to be investigated. Lastly, the aspects related to the MAPET service need to be analysed.

6.2 Recommendations for implementation of the MAPET service

First of all the main operational problem of the transfer of the sludge needs to be solved. Without a design for a mobile sludge transfer system (MSTS), the MAPET service will not be sustainable, neither economically nor environmentally. On the short term, therefore, a MSTS must be developed, sharing experiences between the Dar es Salaam and the Durban actors. Not only the MSTS needs to be developed, but also the MAPET equipment itself needs redevelopment: adjustment to the local conditions and improvement of technical defects.

From the results of the two case studies is concluded that redesigning the MAPET equipment should be done by WASTE in co-operation with the Durban MWM. The MWM is better equipped than the Dar es Salaam WMD. In this way, Durban can function as supplier of design of the MAPET equipment. Developing the MSTS can best be done in co-operation with the public departments WMD and MWM, and private organisations like Sanitech (not to invent the wheel again, since they already have experience with transfer systems). In addition, the residents (and CBO's) that are about to implement the MAPET service need to participate. They have the most up-to-date information on possibilities and constraints of their neighbourhoods. Involving the future customers can be arranged best by involving CBO's in all phases of the project (community participation), taking into account that also the disadvantaged and minority groups, as women, youth and disabled, are included.

Community participation and ownership means readiness of both the local governments and the communities to accept certain responsibilities and activities in the MAPET service. There are several factors to consider in making a community participation approach work.⁶³

1. *Motivation*: incentives for both parties to co-operate must exist if interaction and involvement are to be sustained. For the community, the interest is to create a cleaner environment by emptying the pit latrines in time and in a hygienic way. Motivation by the community might be improved by making them responsible for the MAPET system by creating a form of community ownership. In addition, promotion and education regarding sanitary behaviour of the residents will be needed. A MAPET promotion campaign is essential. An important component of the promotion campaign is public health education. Awareness about the health aspects of the operation and emptying of pit latrines is one of the means of motivating people to take action about their full latrine pit. The HD is responsible for the increase of the local awareness of the importance of sanitation, pit emptying and its link to a good health. However, health care education and promotion, together with the promotion of the MAPET service itself is not only the responsibility of the HD. It should be a co-operation between all actors.

⁶³ See Y.M. Yeung and T.G. McGee, *Community participation in delivering urban services in Asia*

2. *Community leadership*: the organisation of a community must be considered if a community is to play a more participatory role. The more organised a community, the better equipped it is for participating in development. Many communities need empowerment and capacity building especially towards a more prominent role for women. Training can be done by drama, pamphlets, discussion groups and household visits.
3. *Learning approach*: initiating an approach like community participation means that public and private agencies and the residents involved must be willing to innovate and learn from experience. This means initiating monitoring and evaluation of the project ensure that both successes and mistakes are lessons to be learned. Therefore, feedback mechanisms have to be introduced and executed.
4. *Resources for community development*: communities have problems with the emptying of full latrines, but they have few options because of their limited access to funds. For a successful implementation of the MAPET service, local resources (i.e. labour) within the communities should be used as much as possible to reduce costs.

Besides community participation, also municipal participation of the WMD, the MWM and the HD is needed. Especially control of the MAPET emptying services is to be done by the municipal departments, since they have final responsibility pit emptying service.

Actors that need to be involved in Dar es Salaam are staff and mechanics responsible for liquid waste at the Waste Management Department (WMD), the Health Department, the SDP working group on 'surface waters and liquid waste', interested CBO's and NGO's, and the remaining pit emptiers. For Durban, the group of actors should consist of the Metro departments of Wastewater Management (MWM) and Health, Kwazulu/Natal Sanitation Task Group (SANTAG), interested CBO's, NGO's, and future pit emptiers.

In Dar es Salaam, major attention should be given to a well-defined organisational structure, including capacity building and empowerment of the CBO's. In addition funding of the capital investments has to be arranged. Without funding, the service will not be economically sustainable. To start a new MAPET service in Dar es Salaam, the first areas for implementation will be Vingunguti and Buguruni. The Town Development Committees (TDC's) of these two neighbourhoods have shown a lot of interest in the MAPET service.

In Durban, major attention should be given to participation of the residents and CBO's, especially because of the inequalities between the black and the white population. Various social studies have to be carried out, in the two sub-areas, to identify the actual need for pit emptying and the criteria the potential customers set for pit emptying services in Durban. From research in Dar es Salaam is concluded that the main customers' criteria involve good quality, affordable costs, social and physical accessibility. The assessment of what people are willing and able to pay is best done by the community itself (co-ordinated by consultants) based on local information, rather than outsider's income surveys based on household income questionnaires. Capacity and willingness to pay requires an assessment of priorities and an in-depth understanding of the importance of the service that is provided both for the well being of individuals, families and the community as a whole. This assessment has to be done prior to the project-planning phase.⁶⁴

In addition, the blueprints of the equipment and a system for transfer of the sludge to the treatment plants need to be designed. The MWM might invite participation of tenders in order to appoint the specialist contractor to manage and control the MAPET service. The contractor (private company or CBO) will be responsible for the operation and scheduling of the MAPET service, with the pit emptiers performing the actual pit emptying. Possible pit emptiers need to be mobilised and trained in how to perform the pit emptying and how to maintain and repair the equipment. The community resources available and their needs for pit emptying together with the criteria (like price, quality and accessibility) they set for pit emptying services have to be mobilised by several social studies to be performed by consultants (e.g. Mvula Trust).

Specific recommendations for Dar es Salaam and Durban are given in table 6-1.

⁶⁴ See DWAF, *Guidelines for training and capacity building in sanitation projects* (p. 8)

Table 6-1: Recommendations for Dar es Salaam and Durban

DAR ES SALAAM			DURBAN	
PROBLEMS	RECOMMENDATIONS	ELEMENTS & INDICATORS	PROBLEMS	RECOMMENDATIONS
<i>The MAPET system</i>				
<p>No staff members involved</p> <p>No support office or special MAPET division to co-ordinate MAPET activities</p> <p>Bookings can only be done at DSSD office or with emptiers personally</p> <p>No control of the service takes place</p> <p>No communities or CBO's involved</p>	<p>Make MAPET responsibility of CBO or NGO, less responsibilities for WMD</p> <p>Co-ordination and support by NGO, control by WMD and HD</p> <p>Booking for MAPET services at CBO office</p> <p>Community control and control by WMD and HD</p> <p>Promotion of community participation by involving CBO's in MAPET service</p>	<p><u>Organisation</u></p> <p>Staff members</p> <p>Support office</p> <p>Booking offices</p> <p>Ownership: Control</p> <p>Community participation</p>	<p>--</p> <p>--</p> <p>--</p> <p>--</p> <p>No communities or CBO's involved</p>	<p>--</p> <p>--</p> <p>--</p> <p>--</p> <p>Involvement of CBO's or community leaders from the start</p>
<p>Short-term orientation and no open-mindedness and competitiveness</p> <p>Low income, below subsistence level, need for secondary jobs</p> <p>--</p> <p>There are no booking offices in the neighbourhoods</p> <p>80 MAPET teams would be needed</p>	<p>Additional training on basic entrepreneurial skills of how to run a business</p> <p>Better promotion of the MAPET service, continuous marketing for more customers</p> <p>--</p> <p>Booking of MAPET service at CBO offices</p> <p>Prioritising liquid waste and pit emptying in projects and policies</p>	<p><u>People</u></p> <p>Entrepreneurial skills (open-mindedness, long-term orientation, competitiveness)</p> <p>MAPET income generation of emptiers</p> <p>Customers' criteria:</p> <p>Social accessibility</p> <p>Need for pit emptying services in unplanned areas</p>	<p>--</p> <p>--</p> <p>No social studies carried out yet</p> <p>--</p> <p>25 MAPET teams would be needed</p>	<p>--</p> <p>--</p> <p>Carry out social studies in an early stage to determine customers' criteria and willingness and ability to pay</p> <p>--</p> <p>Prioritising liquid waste and pit emptying in projects and policies</p>
<p>No monitoring and evaluation activities carried out</p> <p>No blueprints available, only technical drawings of various prototypes of the equipment</p> <p>No structural lease fee payment</p> <p>No records were kept after the MAPET-I project</p> <p>Only recovery of labour costs, funding of capital investment</p> <p>MAPET income per emptier is below subsistence level</p>	<p>Define feedback mechanism for monitoring and evaluation</p> <p>Support MWM (Durban) by designing the blueprints</p> <p>Arrange subsidy if micro-credits for capital investments</p> <p>Additional training on record keeping and its necessity</p> <p>Fund-raisers or micro-credits for capital investment</p> <p>Promotion and marketing of the MAPET service to increase number of customers</p>	<p><u>Information</u></p> <p>Monitoring & Evaluation</p> <p>Availability of blueprints</p> <p>Lease fee payment for equipment</p> <p>Record keeping</p> <p>Cost recovery</p> <p>Profitability</p>	<p>--</p> <p>To be designed by Strategic Planning Branch MWM</p> <p>--</p> <p>--</p> <p>--</p> <p>--</p>	<p>--</p> <p>Design blueprints by MWM in co-operation with WASTE and WMD (Dar es Salaam)</p> <p>--</p> <p>--</p> <p>--</p> <p>--</p>

No promotion and education nowadays	Implement continuous promotion and education programmes	Promotion and education	Usually only done by HD	Responsibility of HD, but in co-operation with other actors
No blueprints and no standardisation	Support MWM (Durban) by designing the blueprints	<u>Equipment</u> Standardisation of components	No blueprints available	Design blueprints by MWM in co-operation with WASTE and WMD (Dar es Salaam)
Large scale manufacturing of MAPET equipment not possible at DSSD/WMD Not known, no records kept	Identify other (informal) workshops / businesses capable of manufacturing Additional training on record keeping and its necessity	Capacity for manufacturing	--	--
Various technical problems, equipment is getting old and tough to work with	Adapt equipment to present conditions and improve technical faults (i.e. use 100-l drums, not 200-l)	Frequency of O&M	--	--
On-site burying is becoming a problem, no MSTs available, scarcity of adequate treatment plants	Development of MSTs for all areas in co-operation with MWM and WMD	Quality of equipment	--	--
		Sludge transfer and disposal	MSTs not available, but similar system operated by Sani-tech for mini tankers; adequate treatment plants available	
MAPET actors				
Policy is not up to date and more focused on construction than on operation and maintenance of the systems	Prioritise liquid waste management and research into emptying technologies for unplanned areas	<u>Central government</u> Sanitation policy	--	--
Not available	Develop adequate standards for pit emptying Expand and improve vacuum tanker service	<u>Local government</u> Standards for sanitation and pit emptying	Lowest level of service: VIP latrines, no standards for emptying	During policy making take into account pit emptying problems to be expected
Currently 3 (DSSD) & 6 (HD) vacuum tankers operational		Capacity vacuum tankers	--	--
MAPET aspects				
84.6% of the population use pit latrines, and this is increasing	Expand MAPET services to serve all customers of unplanned areas	<u>Technological</u> Sanitary facilities	--	--
US\$ 110 (GNP estimate 1992)	Keep MAPET prices as low as possible	<u>Economical</u> Income per capita	US\$ 2,290 (general 1992 estimate), 'black' population only US\$ 620	Educate people that it is better to have "some for all, than all for some"
Not available	Development of public health standards related to pit emptying	<u>Health/environmental</u> Public health standards regarding sanitation	Only standards for lowest level of service and groundwater pollution	Development of standards for pit emptying by MWM
--		<u>Social/cultural</u> Values regarding sanitation/sludge	Inequality between white and black caused by apartheid; problems to be suspected with Zulu and Xhosa culture	Additional research into cultural opinions regarding sanitation, pit emptying and sludge

7 RELEVANT LITERATURE

- Africa, South of the Sahara*, London, 24th edition, 1995
- Africon Engineering International, *The distribution and servicing of VIP latrines in the Durban Metropolitan Area*, Durban, 1995
- Africon Engineering International, *Investigation report for a sanitation servicing strategy for Besters Camp*, Durban, 1996
- Africon Engineering International, *Report on the condition of water and waste facilities in the Durban Metropolitan Area*, Durban, 1996
- Baarda, D.B. and M.P.M. de Goede, *Methoden en Technieken; praktische handleiding voor het opzetten en uitvoeren van onderzoek*, Houten, 1995
- Bagachwa, M.S.D. and A.V.Y. Mbelle (EDS.), *Economic policy under a multiparty system in Tanzania*, Dar es Salaam, 1993
- Bureau of Statistics (Planning Commission, Tanzania), *Demographic and Health survey 1996 – Tanzania*, Dar es Salaam, 1997
- Bureau of Statistics (Planning Commission, Tanzania), *Statistical abstract: 1995*, Dar es Salaam, 1997
- Cotton, A. et al (Loughborough University UK), *On-plot sanitation in low-income urban communities: a review of literature*, 1995
- Dar es Salaam City Commission, *Waste Management Department; structures, functions, manpower and equipment requirements (draft report)*, Dar es Salaam, 1998
- Department of Constitutional Development (Republic of South Africa), *Municipal service options: a guideline for local authorities*, s.l., s.a.
- Department of Water Affairs and Forestry (Republic of South Africa), *A draft strategy to manage the water quality effects of dense settlements in South Africa*, Pretoria, 1998
- Department of Water Affairs and Forestry (Republic of South Africa), *Guidelines for training and capacity building in sanitation projects*, Pretoria, 1997
- Development Bank of Southern Africa, *Kwazulu/Natal, statistical macroeconomic review*, Johannesburg, 1992
- Durban Water and Waste, *Metropolitan wastewater management*, Durban, 1996
- Egmond-de Wilde de Ligny, E.L.C. van (Eindhoven University of Technology), *Technology development and international technology transfer: part 1 and 2*, Eindhoven, 1996
- EIM, *Entrepreneurship, economic growth and what links them together*, Zoetermeer, 1997
- Fourie, A.B., and M.B. van Reyneveld, *Environmental impact of on-site sanitation, a literature review with particular application to South Africa*, Johannesburg, 1993
- Franceys, R. and J. Pickford, R. Reed (World Health Organisation), *A guide to the development of on-site sanitation*, Geneva, 1992
- Gaillard, H. (Eindhoven University of Technology), *Methodological issues related to cross-cultural research*, Eindhoven, 1995
- Heymans, C. (DBSA), *Local government and beyond: observations and suggestions*, Johannesburg, s.a.
- Hindson, D., R. Peart and N. King, *Durban's tomorrow today, sustainable development in the Durban Metropolitan Area*, Durban, 1996
- Idelovitch, E. and K. Ringskog (The World Bank), *Private sector participation in water supply and sanitation in Latin America*, Washington DC, 1995
- ILO/UNDP, *Employment generation in urban works programmes in Tanzania*, Dar es Salaam, 1991
- Kaseva, M.E., *The African city in sustainable human settlements development; a case of urban waste management in Dar es Salaam, Tanzania*, *The Tanzanian Engineer* Vol. 6 (1998) no. 3, p. 52-61
- Kibendela, E., *Employment crisis in urban areas: problems and prospects: The case study of Dar es Salaam*, Dar es Salaam, 1995
- Kiwasila, H. and E. Mwakifuna, *Report on meetings with neighbourhood leaders*, Dar es Salaam, 1992
- Klein, M. and N. Roger, *Back to the future: the potential in infrastructure privatisation*, Oxford, no date
- Klundert, A. van de, and M.S. Muller (WASTE), *Community-based waste collection and small scale enterprise development in waste recycling in Dar es Salaam; technical advisory mission*, Gouda, 1998

- Klundert, A. van de (WASTE), *Solid Waste Management Karachi*, Gouda, 1996
- Mabogunje, A.L. et al (UNDP/United Republic of Tanzania), *Managing sustainable growth and development in Dar es Salaam*, Dar es Salaam, 1995
- Makhetha Developments Consultants, *Support to peri urban sanitation strategy in South Africa; Part 1: summary of findings; Part 2: Summary of recommendations and guidelines*, Johannesburg, 1998
- Ministry of Foreign Affairs (the Netherlands), *Urban poverty alleviation, Sector policy document of Development Co-operation Vol. 5*, The Hague, 1994
- Ministry of Labour (United Republic of Tanzania), *1991 National informal sector survey*, Dar es Salaam, 1992
- Ministry of Water, Energy and Minerals (United Republic of Tanzania), *National Water Supply and Sanitation programme 1993-2002*, Dar es Salaam, 1993
- Muller, M.S. ed. (WASTE), *The collection of household excreta; the operation of services in urban low-income neighbourhoods*, Urban Waste Series 6, Gouda, 1995
- Muller, M.S., et al (WASTE), *The potential for community-based waste services in cities in the South*, Gouda, 1995
- Muller, M.S. and J. Rijnsburger (WASTE), *MAPET; a neighbourhood-based pit emptying service with locally manufactured handpump equipment in Dar es Salaam, Tanzania, MAPET project, final report*, Gouda, 1994
- Murre, M.C.M., *Community participation*, in International course on 'low-cost water supply and sanitation', International Institute for Hydraulic and Environmental Engineering, Delft, 1992
- National Sanitation Task Team, *National Sanitation Policy; White Paper, Republic of South Africa*, Pretoria, 1996
- National Sanitation Task Team, *National Sanitation Programme; start-up phase*, Pretoria, 1996
- National Sanitation Task Team, *The National Sanitation Programme; status report*, Pretoria, 1998
- Oyieke, T.O. et al (UNDP/United Republic of Tanzania), *Evaluation of Sustainable Dar es Salaam project*, Dar es Salaam, 1997
- Pickford, J., *Low-cost sanitation; a survey of practical experience*, London, 1995
- PLAN International, *Consultants report for the Buguruni and Vingunguti community project*, Dar es Salaam, 1992
- Proceedings of the closing seminar of the Comparative study on Pit Emptying Technologies*, Dar es Salaam, 1993
- Rogerson, C.M. (DBSA), *Rethinking the informal economy of South Africa*, Johannesburg, 1996
- Sani-tech, *Sani-tech's experience of using the Micravac mini tanker on a bulk pit latrine emptying contract*, Durban, 1993
- Scott, D. and G. Ridsdale, *Social assessment of Southern Durban*, Durban, 1997
- Semboja, J. and O. Therkildsen, *Service provision under stress in East Africa*, Cumbria, 1995
- Sustainable Dar es Salaam Project, *Environmental profile of the metropolitan area*, Dar es Salaam, 1992
- Sustainable Dar es Salaam Project, *Papers on "Sinza pit emptying technology project"*, Dar es Salaam, s.a.
- Sustainable Dar es Salaam Project, *Summary of proceedings of the workshop on SDP III*, Dar es Salaam, 1997
- Sustainable Dar es Salaam Project, *Workshop summary of proceedings on managing wastewater and liquid waste*, Dar es Salaam, (working document update) 1997
- Todaro, M.P., *Economic development* (sixth edition), London, 1997
- Tomesen, L.B.M. et al, *Formulation report; Manual Pit Emptying Project (MAPEP)*, Schoorl, 1996
- UNCHS/UNEP, *Implementing the urban environment agenda, Volume 1 of the environmental planning and management source book*, Nairobi, 1997
- UNCHS/UNEP, *City experiences and international support, Volume 2 of the environmental planning and management source book*, Nairobi, 1997
- UNCHS/UNEP, *The urban environment forum directory, Volume 3 of the environmental planning and management source book*, Nairobi, 1997
- Vreede, E.N. de, *Comparative country study: Tanzania & South Africa*, Eindhoven, 1998

- WASTE, *MAPET II: Expansion of Manual Pit Emptying Services and further Development of Sludge Transfer Technology for Low-Income Squatter Areas in Dar es Salaam, Tanzania*, Gouda, 1993
- WASTE, *Comparative study on Pit Emptying Technologies (COMPET) executed in Dar es Salaam, Tanzania*, Gouda, 1993
- WASTE, *Social study of pit latrine emptying in Dar es Salaam, MAPET project, progress report no. 6*, Gouda, 1989
- Water Research Commission, *Preliminary guidelines for private sector participation in water supply and sanitation services*, Pretoria, 1995
- Water Research Commission, *Urban sanitation evaluation*, Pretoria, 1993
- Water Research Commission, *Water & Sanitation handbook, for community leaders*, Pretoria, 1994
- West, A., *Preliminary report on pit latrine emptying proposal within the area of the Durban Metropolitan Council*, Durban, 1998
- Wright, A. (The World Bank), *Strategic Sanitation Approach, COMPET seminar proceedings*, Dar es Salaam, 1993
- WSSCC and WHO, *The burden of poor sanitation, the Sanitation Promotion Kit, s.l.*, 1997
- Yeung, Y.M. and T.G. McGee, *Community participation in delivering urban services in Asia*, Ottawa, 1986
- Zyl, J.C. van (DBSA), *Needs-based development strategy and the RDP; some broad issues*, Johannesburg, 1995

APPENDICES

APPENDIX A

- WASTE PROFILE -

WASTE is a consulting company for development projects in Africa, Asia and Latin America. WASTE works for organisations that aim at a sustainable improvement of the living conditions of the low-income population and of the urban environment in general.

Fields of work

WASTE is active in three fields:

- Solid waste management and resource recovery.
- Low-cost sanitation and liquid waste management.
- Community based environmental improvement.

The focus of activities is on low-income urban areas in order to develop with local residents tools and means for their own development, enabling them to improve their living conditions, the environment and to create employment as a sound economic base for their future.

Another important focal point for WASTE is the role of small-scale entrepreneurs and their (potential) contribution to the provision of urban services and their integration in the municipal services e.g. in resource recovery and the removal of urban waste.

Expertise and alliances

WASTE has a multidisciplinary consultancy team comprising an environmental specialist, a solid waste management specialist, a planner, a sociologist and an environmental economist, based in Gouda, the Netherlands and an associate sanitary and environmental engineer in Karachi, Pakistan.

WASTE has established international alliances with other multidisciplinary organisations in the South, which have gained their spurs in various aspects of the field of waste. The partners in this alliance work together in the identification, implementation, monitoring and evaluation of research and projects, and in the formulation of a vision and models for the urban environment. The allies are:

- The Institute for the Development of Social Economy (IPES), Lima, Peru.
- The Centre of Economics and Health Association (Acepesa), San José, Costa Rica.
- The Association for the Protection of the Environment (APE), Karachi, Pakistan.

Company and development goals

WASTE considers community participation to be both an aim of development and a tool for achieving the immediate objectives of development projects. All projects should contribute to the ultimate aim that men and women, disadvantaged groups as well as communities are able to decisively influence the events that affect their lives. More directly, projects of WASTE solicit the participation of men and women in articulating their gender-specific needs and shaping the contents of the projects concerned. This ensures that the interventions match the local conditions of life, and that improvements will be sustained by the local population. WASTE is officially registered as a not-for-profit organisation.

Local co-operation

WASTE carries out assignments in close co-operation with its local partners. Through short-term inputs, regular support is given to local organisations that run their projects and are ultimately responsible for them. Meetings are held, and training, planning and management support is given to strengthen local efforts and the projects' sustainability. WASTE actively involves local institutions, private entrepreneurs, NGO's and public government departments to build up a framework in support of the project.

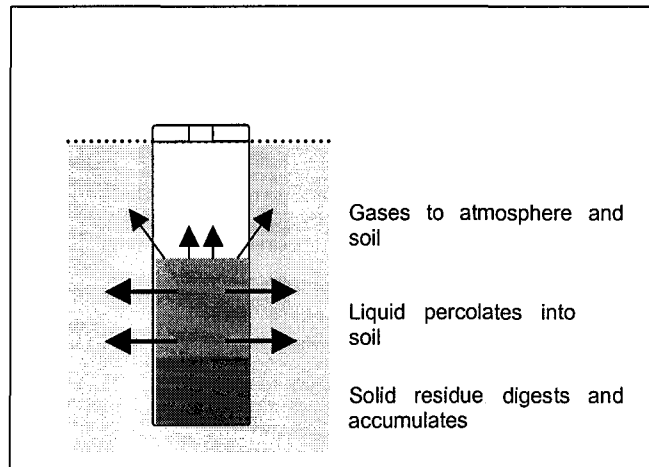
Knowledge exchange

WASTE acts as a catalyst and a knowledge broker between sources of information or expertise and projects demands. Therefore, a network of expertise is constantly maintained and expanded in order to generate appropriate knowledge applicable to situations elsewhere. The emphasis of this network is on countries in the South, to stimulate the exchange of experiences among the countries concerned. WASTE provides technological and methodological support.

APPENDIX B

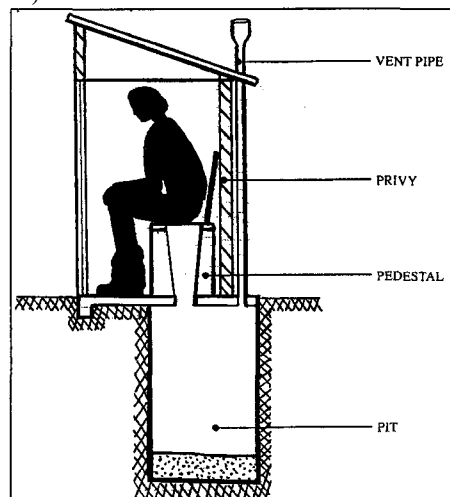
- PIT LATRINES -

The principle underlying all types of pit latrines is that excreta and anal cleansing materials can be deposited in a hole in the ground. Its basic components are a superstructure to provide user privacy, a hole or seat set into a slab which covers the pit, and a pit beneath the slab into which excreta is deposited. Pit latrines only receive a small amount of water. Since the pit is not sealed, this liquid is allowed to seep from the pit into the surrounding ground. Excreta in the pit undergoes complex chemical and biological reactions which lead eventually to decomposition to innocuous, humus-like solids, water and gases. The remaining water and gases dissipate into the ground or air, leaving a solid residue in the pit. This solid residue accumulates in the pit, gradually coming to resemble rich soil. During decomposition, disease-causing pathogens are killed, a process which may take up to two years.



Source: J. Pickford (1995)

There are several forms of pit latrines. The most appropriate type of pit latrine depends on the local situation, including the level of the groundwater and the traditions and culture of the users. Pit latrine use is not free from operational difficulty. Complaints about pit latrines most frequently mention odours and insect nuisance. The escape of odours and flies through a squat hole may be greatly reduced by using ventilating pipes, the so-called Ventilated Improved Pit Latrine (VIP).



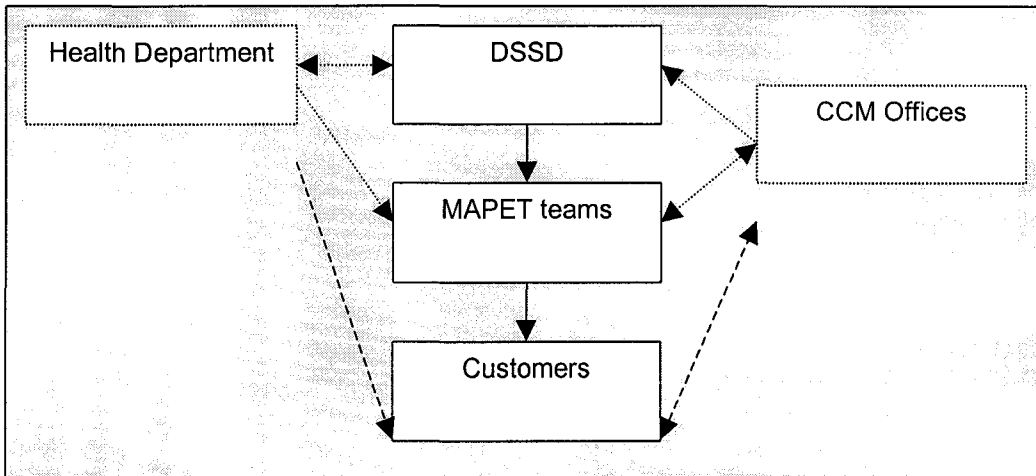
Source: Department of Constitutional Development South Africa, 1998

Vents may be made from PVC, asbestos, cement, mud and split bamboo or built into the latrine superstructure. For maximum effect, flyproof netting should be fixed across the top of the vent and it should extend about 500 mm above flat or sloping roofs or to the apex of conical roofs to benefit from a draught passing across the pipe. Flies that hatch in the pit try to reach a source of light. If the superstructure is sufficiently dark, the flies move towards the vent top, are trapped by the flyproof netting and eventually die.¹

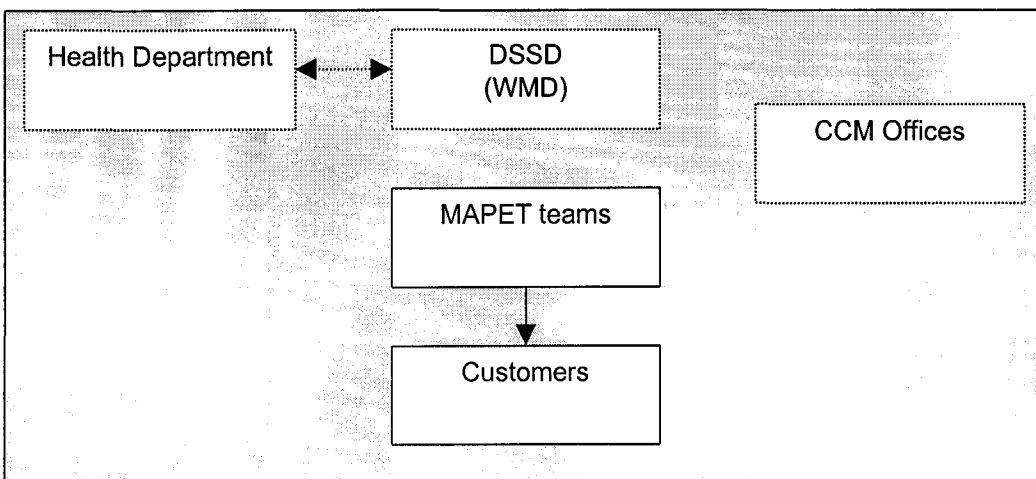
¹ See A. Cotton et al, *On-plot sanitation in low-income urban communities* (p. 6-9)

APPENDIX C - ORGANISATIONAL STRUCTURE MAPET -

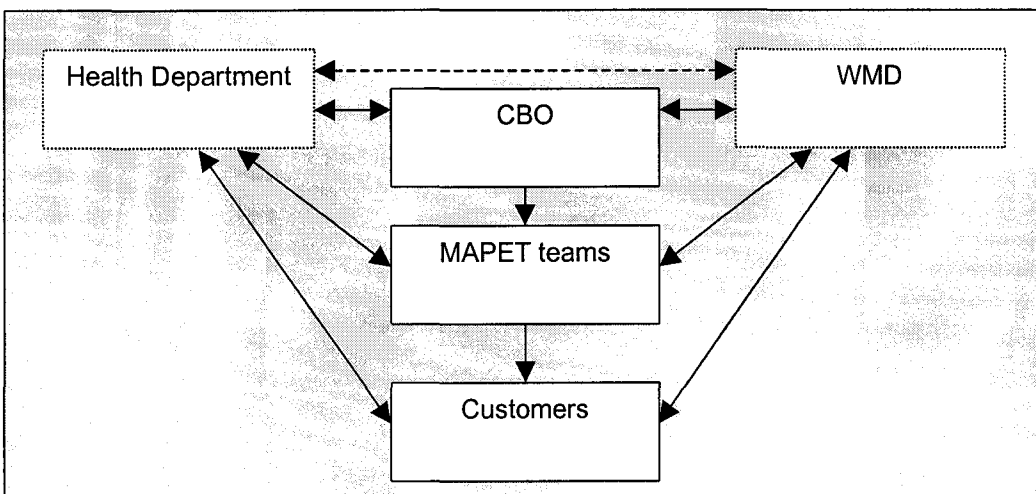
C.1 Former MAPET structure – Dar es Salaam



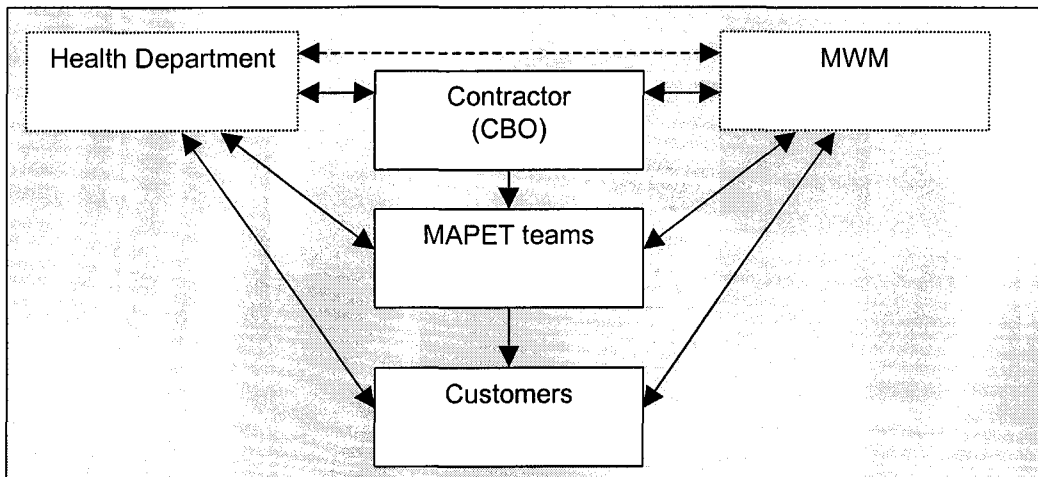
C.2 Present MAPET structure – Dar es Salaam



C.3 Future MAPET structure - Dar es Salaam



C.4 Future MAPET structure – Durban



APPENDIX D

- VACU-TUG SYSTEM -

UNCHS (Habitat) Settlement Infrastructure & Environment Programme
Waste & Wastewater Management Paper No. 10/95

Evaluation of novel pit-latrine exhauster with improved access for low-income settlements

Graham Alabaster, UNCHS (Habitat) & Manus Coffey, MCA

INTRODUCTION

The problems of sanitation faced by the urban poor in many cities throughout the developing world are all too apparent with the disease profile of many slum dwellers showing a high incidence of waste-related disease. For many, the only option, governed by their ability to pay, is the basic unimproved pit latrine. Although this is obviously a better option than open defecation, there are many problems with its use in low-income areas where they cannot be adequately maintained due to lack of pit emptying facilities. Many studies have been undertaken which have highlighted the need for an appropriate technology which can be implemented as a micro-enterprise within the communities, thus relieving the burden of city authorities to provide a service which they cannot afford. UNCHS(Habitat) have recently implemented a project together with partner Manus Coffey Associates to develop and field-test a new approach to the problem. The Kenya Water for Health Organisation (KWAHO) implemented the trials with The International Water and Sanitation Centre (IRC) being invited to monitor the social-economic feasibility. This paper reports the interim results for the project which is currently on-going in a low income area of Nairobi.

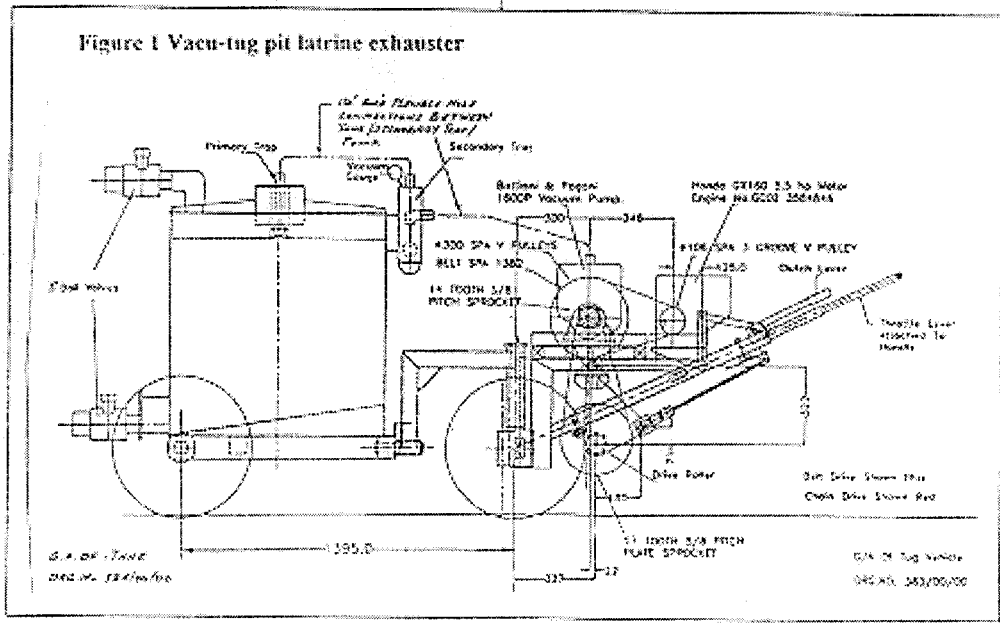
BACKGROUND

The criteria for development of the technology were as follows:

1. The service must be affordable by the urban poor, the capital cost must be affordable by entrepreneurs who could potentially develop a micro-enterprise and; the operational costs must be recovered from revenue generated.
2. It must be able capable of access to some of the most dense urban areas where conventional systems are unable to penetrate.
3. It must be capable of being constructed, operated and maintained using local materials and skills.
4. The technology should be capable of transporting wastes to an appropriate disposal point and provide sufficient vacuum to enable pumping of dense consolidated sludge.

The technology that was developed comprised an articulated vacuum tank and pumping assembly (Figure 1). The vacuum tank is fabricated from mild steel with a nominal volume of 500 L (equivalent to 1 load). The tank is fitted with a check valve, a sight glass and two 75 mm ports, for sludge inlet and vacuum pump connection. The assembly is mounted on a steel frame fitted with second-hand car wheels and hubs. The tug assembly comprises a small frame-mounted 4 kW petrol engine with a belt drive to connect it to either a sliding vane vacuum pump or a friction roller to drive the vehicle. In traction mode, the engine can propel the vehicle at speeds of up to 5 kph. When connected to the vacuum pump it is capable of exhausting at 1,700 L/minute. The pump can be reversed to pressurize the tank to assist the discharge of sludge to the sewer or raise it to discharge into a transfer tank. The engine is mounted on a hinged plate with a rod linkage to apply tension to the belt drive. The vehicle is fitted with a motorcycle throttle and lighting system. A detachable drawbar is used for towing. The unit is equipped with 4 m of 3" diameter PVC hose connected to the tank with aluminium quick-release couplings. The area selected for the trial was Kibera, the largest low-income urban area in Nairobi, Kenya which covers an area of 225 hectares and accommodates an estimated 470,000 people. Its

Figure 1 Vacu-tug pit latrine exhauster



**UNCHS (Habitat) Settlement Infrastructure & Environment Programme
Waste & Wastewater Management Paper No. 10/96**

yearly growth rate is estimated at 1.2%. Excreta disposal is mainly by traditional pit latrine. Although in theory most households have access to a latrine, in practice it is limited to 50-200 persons per latrine. Apart from the problem of over-full pits, the density of occupation precludes the digging of new pits.

The trial was arranged in association with Nairobi City Council through the primary health care unit of the Public Health Department. Their consent was required for the disposal of the sludge to the municipal sewer. The Chief of Kibera was also consulted during the planning stages. The vacu-tug was established as a micro enterprise with Kibera residents visiting the KWAHO office within the area and paying the fee up front. Appropriate record keeping and monitoring of the operations were also established to ensure full operational data were available. The vacu-tug is operated by two trained operators who are also responsible for daily maintenance. Monthly maintenance is carried out by a local mechanic. During the first week of operation the maximum no. of loads per day was 9. The maximum distance between anywhere in the low-income area and the nearest sewer manhole is 2 km. The operations are therefore planned so as on a certain day a particular area was serviced. A willingness to pay study was undertaken to set the price for desludging for the consumer.

RESULTS

The machine has now been operating within the low-income area for a total of 27 days during the period January - July 1996 (which covers both wet and dry seasons in Nairobi). During this period the vacu-tug has emptied over 80 pits equivalent to 197 loads and has reduced the expenses of service provision for most households and landlords. The cost of 6 loads is equivalent to the cost of digging 1ft depth of latrine. The vacu-tug has proved capable of negotiating many of the dwellings within the settlement which would not normally be accessed.

Some operation problems were encountered and as a result small design modifications have been made. In terms of operational problems, there were some delays experienced in the project execution due to the theft of the engine and vacuum pump. This has necessitated replacement and improvements in the security arrangements for garaging of the vacu-tug. Problems were also reported by the operators during the rainy periods when traction of the vehicle, especially when full, was difficult. Minor problems in the design of the vacu-tug have emerged as a result of the exhaustive field trials but these have been resolved without affecting operation. The modifications were, in most cases, suggested by the operators. A theoretical analysis of the capital and operational costs which were established at the projects outset were as follows:

Capital costs per annum

Capital cost of vehicle	US\$ 5,000
Economic life	4 years
Interest rate	20%
Maintenance	10%
Depreciation (25% x US\$ 1,500)	US\$ 1,250
Interest on capital (20% x US\$ 5,000)	US\$ 1,000
Total capital costs	US\$ 2,250

Operating costs per annum

Maintenance 10% x US\$ 5,000	US\$ 500
Labour costs 2 x Ksh 2,000/month	US\$ 900

Fuel costs 3 litres x 35 Ksh x 5.5 day x 52 weeks per year	US\$ 566
Oil	US\$ 200
Total operating costs	US\$ 2,186
TOTAL ANNUAL COSTS	US\$ 4,416

Income

Assume 8 loads (of 400 litres) per day x 5.5 days per week x 52 weeks per year = 2,288 loads per year. Assume 2,000.

Total "prime" cost per load = 4,416/2000 =	US\$ 2.2
Charged Cost per load = Ksh 350	US\$ 3

Profit and operating overhead = 36%

At a theoretical waste generation rate of 50 l/cap/annum

Cost = US\$ 0.3/cap/annum

Table 1 indicates the volumes of sludge collected during the first few months of the trial. It can be seen that the volume collected is approaching the maximum estimated to completely cover capital and operational costs. The low figures in May and June are due to the rainy season making traction difficult.

Table 1 Volumes of Sludge Collected during trial period (estimated maximum =4000 l/d)

Month	Average volume of sludge collected per day (l/d)
January	3200
May	1750
June	1750
July	2500

CONCLUSIONS

The vacu-tug has proven an efficient means of providing an exhaustion service in a low income area where conventional systems are unaffordable and unable to gain access. The price for desludging was set to cover full operations and maintenance costs. The price was also significantly less than the costs of digging a new latrine.

Minor operation difficulties were encountered with the prototype but were quickly modified based on advice from the operators. Difficulties were experienced during the rainy season and this may affect operations. Every effort must be made to ensure that the desludging apparatus is stored in a safe place to prevent theft.

When established as a micro-enterprise within a low income settlement, the system performed well and according to current results would be sustainable without external assistance.

Further field-testing will be required to establish a full economic analysis of the system and to develop methods to dispose of the sludge where a local authority sewer is not readily available.

For further details contact Dr. G.P. Alabaster UNCHS (Habitat), P.O. Box 30030 Nairobi, Kenya.
Phone: +254 2 623054 Fax: +254 2 624265
e-mail: graham.alabaster@unep.org

APPENDIX E

- OPERATIONALISATION OF ELEMENTS -

MAPET system

<i>Organisation</i>
<ul style="list-style-type: none"> • number of staff members • time spent on MAPET (as % of total working time) • existence of support office or special division responsible for co-ordination of pit emptiers • existence of booking office (physical accessibility) • ownership (authority, responsibility, control) • community participation/management

<i>People</i>
<p><i>Pit emptiers</i></p> <ul style="list-style-type: none"> • type of training for MAPET emptying • level of education • working experience • entrepreneurial skills (long-term orientation and competitiveness²) • income generation through MAPET activities • income generation through secondary jobs • time spend on MAPET service <p><i>Residents</i></p> <ul style="list-style-type: none"> • willingness and ability to pay • customers' criteria: quality of the MAPET service (waiting time, cleanliness, costs, flexibility), costs, social and physical accessibility • 'need' for MAPET: number of pits that need to be emptied annually (sludge production per year)

<i>Information</i>
<p><i>Procedures</i></p> <ul style="list-style-type: none"> • procedures for controlling payment of the lease fee • availability of technical drawings and reports • procedures for monitoring and evaluation • records on frequency and sort of O&M <p><i>Finances</i></p> <ul style="list-style-type: none"> • financial sustainability of the service • profitability ((subsistence) wages and prices) • funding and financing systems • amount of lease fee paid for use of MAPET equipment <p><i>Promotion & Education</i></p> <ul style="list-style-type: none"> • existence of promotion programmes to promote the MAPET service in unplanned areas • health care and sanitary behaviour education of residents

<i>Equipment</i>
<p><i>Development of the equipment</i></p> <ul style="list-style-type: none"> • standardisation of parts • degree of participation (in which phases of the project, service) • availability and costs of materials, components and tools • capacity for manufacturing <p><i>Operation and maintenance</i></p> <ul style="list-style-type: none"> • quality of the equipment • costs for operation, maintenance and repairs • frequency of maintenance and repair <p><i>Sludge transfer and disposal</i></p> <ul style="list-style-type: none"> • physical limitations to on-site disposal • existing alternatives for transfer and disposal (number, location)

² See EIM, *Entrepreneurship, economic growth and what links them together* (p. 40)

MAPET actors*Central government*

- Sanitation related departments and organisation and their responsibilities
- Sanitation policy regarding pit latrines and pit emptying

Local government

- Sanitation related departments/organisations and their responsibilities (including tanker services and sewerage systems)
- Manpower related to sanitary services
- Policies and standards regarding pit emptying

NGO's

- Interested NGO's
- Sanitation related activities, or other activities for upgrading neighbourhoods

CBO's

- Existence of these organisations
- Activities regarding neighbourhood upgrading
- Interest in implementation of MAPET

Formal sector

- Number of enterprises performing tanker services (capacity)
- Capacity for tanker services

Informal sector

- Subsistence level
- Educational level
- Division formal/informal

Institutional aspects*Political*

- Political system

Technological

- National sanitary facilities

Economical

- Income per capita
- Unemployment rates

Health/Environmental

- Quality of sanitary systems
- Environmental pollution

Social/Cultural

- Gender responsibilities regarding sanitation
- Religious and racial values regarding sanitation

APPENDIX F - DAR ES SALAAM SURVEYS -

1. *Introduction letter customers' questionnaire*
2. *Questionnaire for customers*
3. *Summary of interview with MAPET emptiers*
4. *Summary of interview with DSSD mechanic*
5. *Summary of interviews with DSSD staff*

1. Introduction letter (Kiswahili)

April 24, 1998

DSSD/HQ/079 VOL.III/14

Kwa yeyote anayehusika

Wilaya

Kata

Mtaa

YAH: KUKUSANYA TAKWIMU ZA MRADI WA MAPET (MANUAL PIT EMPTYING TECHNOLOGY)

Tume ya jiji la Dar es Salaam, ikishirikiana na wahisani ina nia ya kuboresha huduma za kunyonya majitaka katika maeneo ya makazi yasiyoweza kupata huduma za magari ya kunyonya majitaka kutokana na ukosefu wa barabara. Moja ya huduma zinazopendekezwa kuboreshwa ni unyonyaji majitaka kwa kutumia pampu ya mkono (Manual Pit Emptying Technology).

Hivyo tunaomba mtote ushirikiano wenu kwa watumishi wanaokusanya takwimu zitakazoweza kusaidia kuboresha huduma hii.

J.M. Kirango

MKUU WA IDARA – WMD – DCC

Nakala kwa: Katibu Mtendaji – Kata

2. Questionnaire for customers

Name of the household: ...

Neighbourhood: ...

1. How do you get in contact with one of the MAPET teams when you want your pit latrine emptied?
 - a) Through the DSSD
 - b) Personal (where can you find the MAPET teams?)
 - c) Through CCM branch office
 - d) Other, please specify...
2.
 - a1) How often have you requested the MAPET emptiers to empty your pit latrine?
Once / Twice / Thrice / More often
 - a2) When was that?
...
3. Did you use other methods of pit emptying before or after the MAPET emptying?
If yes, please specify...
4. How long did you have to wait after your request until the MAPET team starts with the emptying (waiting time)?
... days
5. How long does the emptying service take on average (duration time)?
... hours
6.
 - a1) How much did you pay for one load/drum?
 - a2) How many loads (on average) were emptied from your pit latrine?
7. Do you think the costs are reasonable (good service)? And affordable?

	Reasonable	Affordable
Very good	<input type="radio"/>	<input type="radio"/>
Good	<input type="radio"/>	<input type="radio"/>
Bad	<input type="radio"/>	<input type="radio"/>
Very bad	<input type="radio"/>	<input type="radio"/>
No answer	<input type="radio"/>	<input type="radio"/>
8. Do you know other methods for emptying your pit latrine, except for MAPET?
 - a) Frogmen
 - b) DSSD tankers
 - c) HD tankers
 - d) Private companies - tankers
 - e) Don't know / no answer
9. What do you think are the main problems with the MAPET service and the equipment?
...
10. What should be changed according to you (possible improvements)?
...
11. Are you familiar with any kind of community-based organisation within your neighbourhood?
If yes, please specify...

3. Summary of interview with MAPET emptiers

The one MAPET team that could be traced does now exist of five emptiers of two former teams who are now operating together: *Yahaya, Stevin, Emanuel, Francis, Majuto*. They operate mostly in the areas of Mwananyamala and Tandale. There is on other team in Mburahati, but it is not operating because of a lack of spare parts. The teams in Kinondoni and Kunduchi also are not operating anymore, so they are the only team left.

There's no permanent place to stall the equipment, sometimes they leave it on the customers plot until they go to the next customer, if transport is available they bring it to the DSSD plot in Mwananyamala, and sometimes at CCM offices, but only rarely because they charge money for it.

Most customers contact the emptiers through the DSSD, when vacuum tankers cannot provide the service they send the customers to the MAPET team. Sometimes the emptiers go into the neighbourhoods to promote the MAPET service by telling the people what they do and try to get some customers there.

No information is available on the frequency with which the customers request the MAPET service. If a request comes in and if they don't have any other jobs at that moment, they can start right away, and otherwise the customers have to wait until they have finished that job. On average 5 customers per month are served. And 2 drums per customer (is different from what can be concluded from the customers survey). It is possible to service two customers a day, if they want the whole pit emptied it will take one day, but most of the time they spend 1 day per customer. Customers pay 5000 Tsh. for a whole latrine pit and 2000 Tsh. for a part of that. Depending on the financial situation of the customer it is possible to bargain about the price and then it can be some lower price. The emptiers think that the customers consider the MAPET prices to be reasonable and affordable.

All the emptiers who are working on a job share all costs and revenues. The profit they have after emptying a customer's latrine is shared by as many pit emptiers as have worked on that specific job, thus after payment for equipment and transport. The MAPET activities do not generate enough income to make a living, therefore they also have to do other secondary jobs as cleaning, etc. During the MAPET-I project they kept a record of how much money was spend on maintenance and repair, but nothing is recorded after the project was ended. So they have no idea how much money they are spending on maintenance and repair.

Regarding the equipment they say that the pump is still good, but the emptiers do not have enough money to buy new tyres, those are very expensive. (At first they used car tyres, but after that they switched to tricycle tyres, nowadays they do not have tyres at all.) There is no maintenance carried out, only (small) repair. For minor breakdowns they do not go to the DSSD but try to fix it themselves, for bigger problems they go to the DSSD Workshop, if this is not possible because of time they go to informal sector workshop. But they have no idea how often that is, since nothing is recorded for the last couple of years. In principle there are enough (spare) parts and tools for maintenance and repair available, but some are to expensive (this question can better be answered by the DSSD mechanics according to the emptiers).

Looking at their background they all have completed primary education. Yahaya was a traditional pit emptier (frogman), all the others started without pit emptying experiences. After a practical training they got licenses (certificates) written by the DSSD, but those are not really official. Occasionally the DSSD is contacted for transport of the equipment (3000 Tsh. for car and petrol) if needed and when customers who cannot be helped by the vacuum tankers are referred to the MAPET team (number of times unknown).

CCM offices used to do some promotion in the neighbourhoods. Nowadays the emptiers sometimes go to the neighbourhoods to promote themselves and to explain what the MAPET service is about. Nothing is done by the Health Department, not even the environmental control they are responsible for. This is a problem since there are no standards available. The emptiers do know that they may not dump the sludge on open spaces (on-site disposal), that they have to use the right dumping methods, and do not to cause any environmental pollution. If the ground water table is to high, they have to dig a wider and less deeper hole, so that the water doesn't come up, this means more work, especially during the rainy season.

If it would be possible the emptiers would prefer to operate as a (informal) private business with a support office (agent), under the condition that they still have the same amount of income and thus don't have to spend to much money on a agent. Or they would like to work for an entrepreneur, because then they are secured by a monthly income, even without enough customers

The emptiers would like to request for sponsorship. Also a central point/booking office where people can find MAPET would be needed (nowadays potential customers who come to the DSSD for MAPET get send away, because the people there don't feel like looking for the emptiers, if they cannot trace them right away).

4. Summary of interview with DSSD mechanic

Interview with DSSD mechanic *Mr. Xavier Haule*.

According to Mr. Haule there are three MAPET teams left: 'Yahaya' team in Mwananyamala, 'Wasili' team and 'Joseph' team in Mburahati, but he's not sure whether they are still operating or not because they do not contact the DSSD anymore. If the teams in Mburahati are still operating they do the entire O&M themselves. Yahaya's team only comes to the DSSD workshop for major breakdowns and some maintenance like greasing and preventing pump leakages is done. How often they enlist the DSSD workshop is not known since nothing was recorded after the end of the MAPET-I project. Irrespective of the type of O&M the emptiers have to pay 2,000 Tsh. for every activity.

The main problem for O&M of the equipment are missing spare parts and the availability of leather piston rings, at the moment they are not available in Tanzania and have to be imported from the Netherlands. When operating on a larger scale, production of the leather piston rings should be possible in Tanzania, but at the moment that is not profitable.

There are some interested organisations, like the SIDO (Small Industry Development Organisation) and the Mechanical Engineering department of the University of Dar es Salaam, who are capable to manufacture some of the spare parts needed for the MAPET equipment. But these organisations are not aware of the non-patent situation of MAPET and therefore think they are not allowed to manufacture it themselves. As a result the DSSD workshop (well equipped for all kinds of O&M), pit emptiers and sometimes informal sector workshops are the only ones working on the equipment. Manufacturing of a set of equipment cost approximately 250.000 Tsh. back then. Nowadays it can be twice as much (estimated by Haule).

Demand for pit emptying services is very high; especially for MAPET since access to the pits is not possible in some neighbourhoods and tanker services are too expensive for most people. According to Mr; Haule the MAPET concept is good, but the problem is the administration, co-ordination and organisation of the service.

5. Summary of interviews with DSSD staff

Interview with Head of the DSSD (nowadays head of the Waste Management Department): *Mr. Jasper Kirango*.

According to Mr. Kirango there might be two MAPET teams left: one in Tandale/Mwananyamala ('Yahaya' team) and one in Mburahati. Teams that are not operating anymore are now performing other jobs. There are no formal licenses for the emptiers, but they got a certificate for completing the training to show he's qualified. Training took place for former traditional emptiers, who were transformed into MAPET emptiers, but also other interested people were trained. The licenses/certificates were given after good training on operation of the machine and on preventive maintenance.

Nowadays the DSSD got nothing to do with the MAPET service anymore. Except for sporadically situations when the emptiers are to serve big customers/institutions who want contacts, receipts, etc. Sometimes some repair is carried out by the DSSD mechanics, which are trained for such activities regarding the MAPET equipment. How much the emptiers pay for these services is an arrangement between them and the mechanics. Nothing is recorded.

Most of the parts and materials needed for the MAPET equipment can be gathered locally, except for the leather piston ring that needs to be imported. The MAPET equipment where the emptiers are working with nowadays is in very bad shape and tough to work with.

Dumping methods used by the teams are on-site burying and off-site disposal, the latter one only sometimes when operating in Mwananyamala near the fixed transfer station at the DSSD plot when on-site burying is not possible they use the transfer station at the DSSD

The DSSD office is the only central point where residents can get information about the MAPET services. Most project information, however, is not available at the DSSD, but at WASTE, the Netherlands. The HD has got nothing to do with the MAPET services, no control by health assistants in the wards is carried out, but also there are no standards or by-laws for pit emptying and the like.

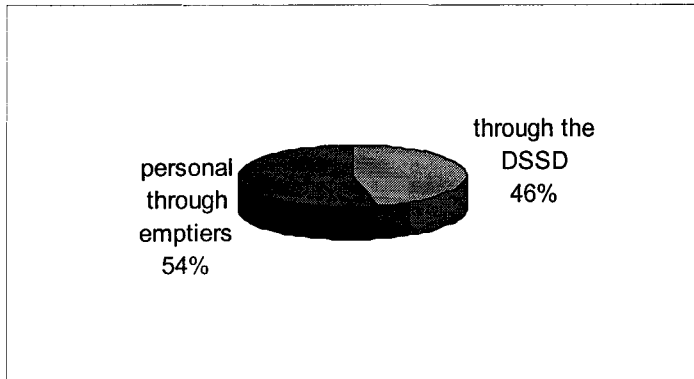
For improvement of the MAPET service the organisational setting needs to be reviewed and it is no use starting again until the institutional set up is in place. The only organisation with official interest in the MAPET service is PLAN international (NGO). According to Mr. Kirango the emptiers will prefer working privately with a support office (agent).

APPENDIX G - CUSTOMER SURVEY RESULTS -

54 Customers were questioned about the performance of the MAPET service. The customers live in the areas of Mwananyamala, Tandale and Kinondoni. The following data resulted from their answers to the questions.

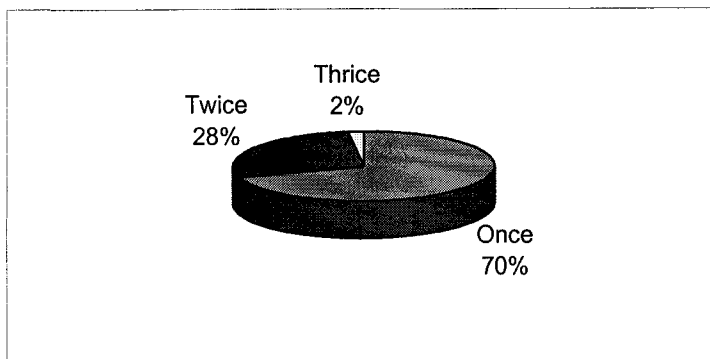
1. Way to contact MAPET team

Through the DSSD	25
Personal through emptiers	29



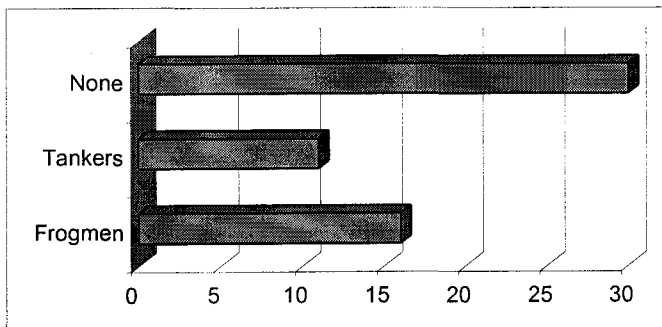
2. Frequency for MAPET request

Once	38
Twice	15
Thrice	1



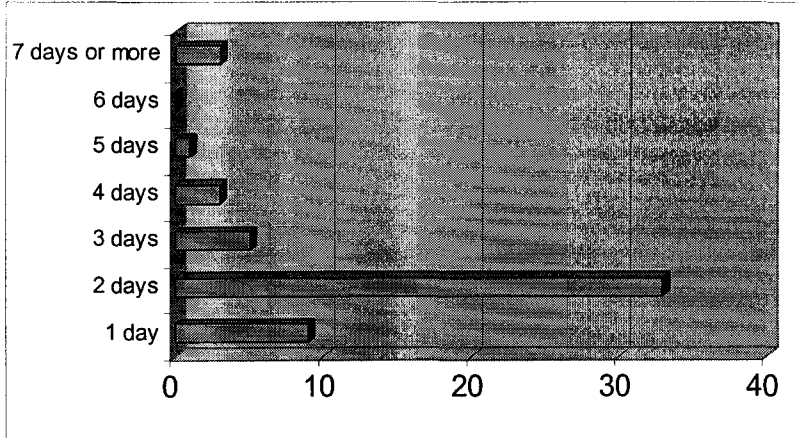
3. Other methods used for pit emptying

Frogmen	16
Tankers	11
None	30



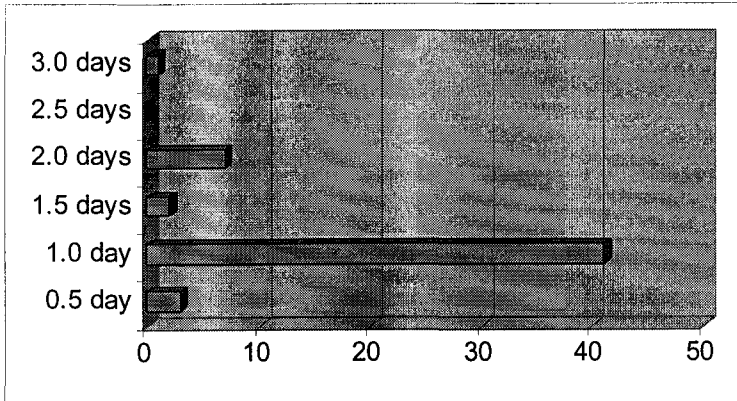
4. Waiting time

1 day	9
2 days	33
3 days	5
4 days	3
5 days	1
6 days	0
7 days or more	3



5. Duration time

0.5 day	3
1.0 day	41
1.5 days	2
2.0 days	7
2.5 days	0
3.0 days	1



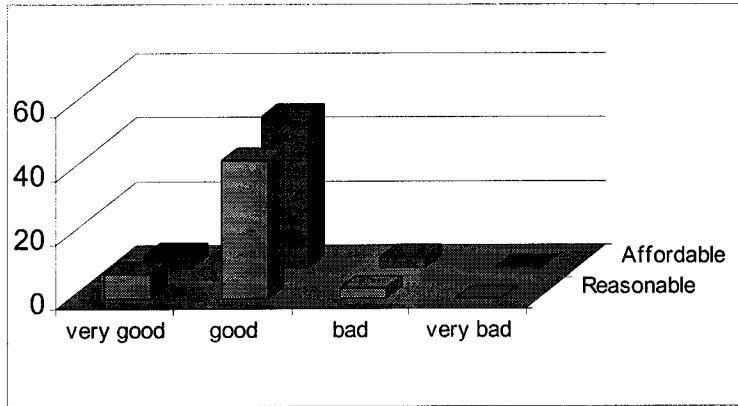
6. Price paid (per drum/total)

no. drums	price/drum	price
15	1000	15000
		15000
8	1500	12000
		12000
10	1500	15000
5	4000	20000
3	1000	3000
9	1500	13500

no. drums	price/drum	price
12	1500	18000
		15000
8	1625	13000
17	1500	25500
16	1000	16000
16		30000
15	1500	22500
20	1000	20000
8	1000	8000
15	1000	15000
10	1500	15000
15	1667	25000
5	1000	5000
8	2000	16000
10	1000	10000
14	1000	14000
5	1500	7500
4	1500	6000
6	1500	9000
		12000
3	1000	3000
22	1000	22000
		17000
12	800	9600
26	1500	39000
12	2000	24000
1	4000	4000
15	1500	22500
10	1000	10000
13	1500	19500
12	1000	12000
		15000
3	800	2400
8	1500	12000
		15000
5	1000	5000
13	1000	13000
		20000
3	1000	3000
16	1000	16000
6	1500	9000
16	1000	16000
12	1500	18000
6	2000	12000
8	800	6400
10	1000	10000
486	62692	763400
10.6	1363	16596 average
(46 customers)	(45 customers)	(54 customers)

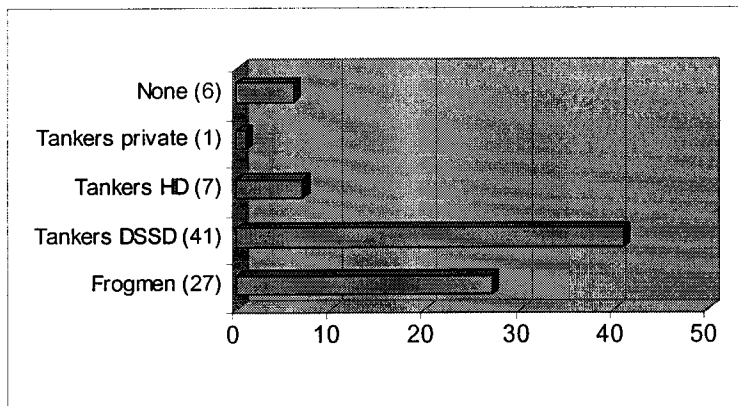
7. Reasonable and affordable costs?

	Reasonable	Affordable
Very good	8	4
Good	43	47
Bad	3	3
Very bad	0	0



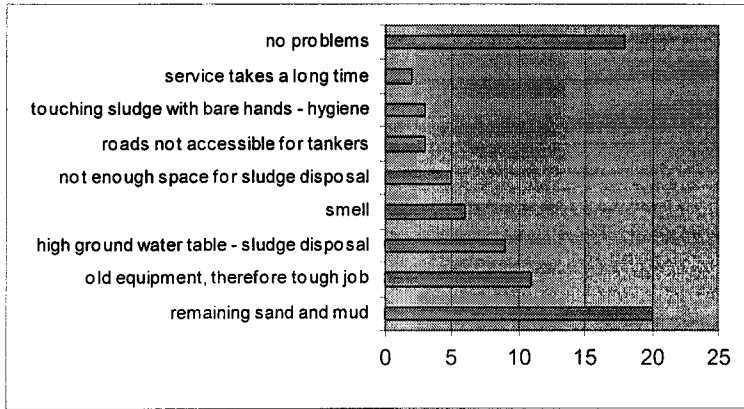
8. Other pit emptying methods known

Frogmen	27
Tankers DSSD	41
Tankers HD	7
Tankers private	1
None	6



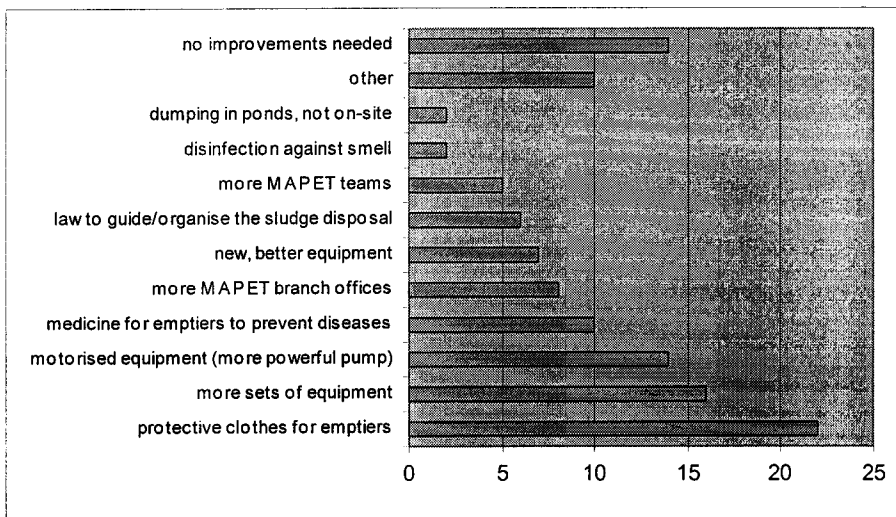
9. Main problems

Remaining sand and mud	20
Old equipment, therefore tough job	11
High ground water table - sludge disposal	9
Smell	6
Not enough space for sludge disposal	5
Roads not accessible for tankers	3
Touching sludge with bare hands - hygiene	3
Service takes a long time	2
No problems	18



10. Improvements suggested

Protective clothes for emptiers	22
More sets of equipment	16
Motorised equipment (more powerful pump)	14
Medicine for emptiers to prevent diseases	10
More MAPET branch offices	8
New, better equipment	7
Law to guide/organise the sludge disposal	6
More MAPET teams	5
Disinfection against smell	2
Dumping in ponds, not on-site	2
Other	10
No improvements needed	14



11. Existence of CBO's

None of the 54 customers interviewed was familiar with any kind of community based organisation within their areas.

APPENDIX H - CALCULATION FOR MAPET TEAMS NEEDED -

<i>Need for MAPET teams</i>	<i>Dar es Salaam</i>	<i>Durban</i>
Total population	3 million	3.5 million
Population using pit latrines	1.59 million (53%)	1.26 million (36%)
Number of pit latrines	159,000 pits ³	252,200 pits ⁴
Percentage of pits serviceable by tankers (depending on accessibility and capacity)	50%	90%
Number of pits to be emptied by MAPET	79,500 pits (50%)	25,220 pits (10%)
Average period for filling up of pits ⁵	4 years	8 years
Number of pits to be emptied per annum	19,875 pits	3,153 pits
Daily capacity of one MAPET team (average of 1 customer per day = 1 pit per day) ⁶	1 pit	1 pit
Annual capacity of one MAPET team (10 months * 4 weeks * 5 days * 1 pit) ⁷	200 pits	200 pits
Number of MAPET teams needed	99 teams	16 teams

³ Based on an average of 10 persons/pit

⁴ As a result the pits are used by 5 people on average

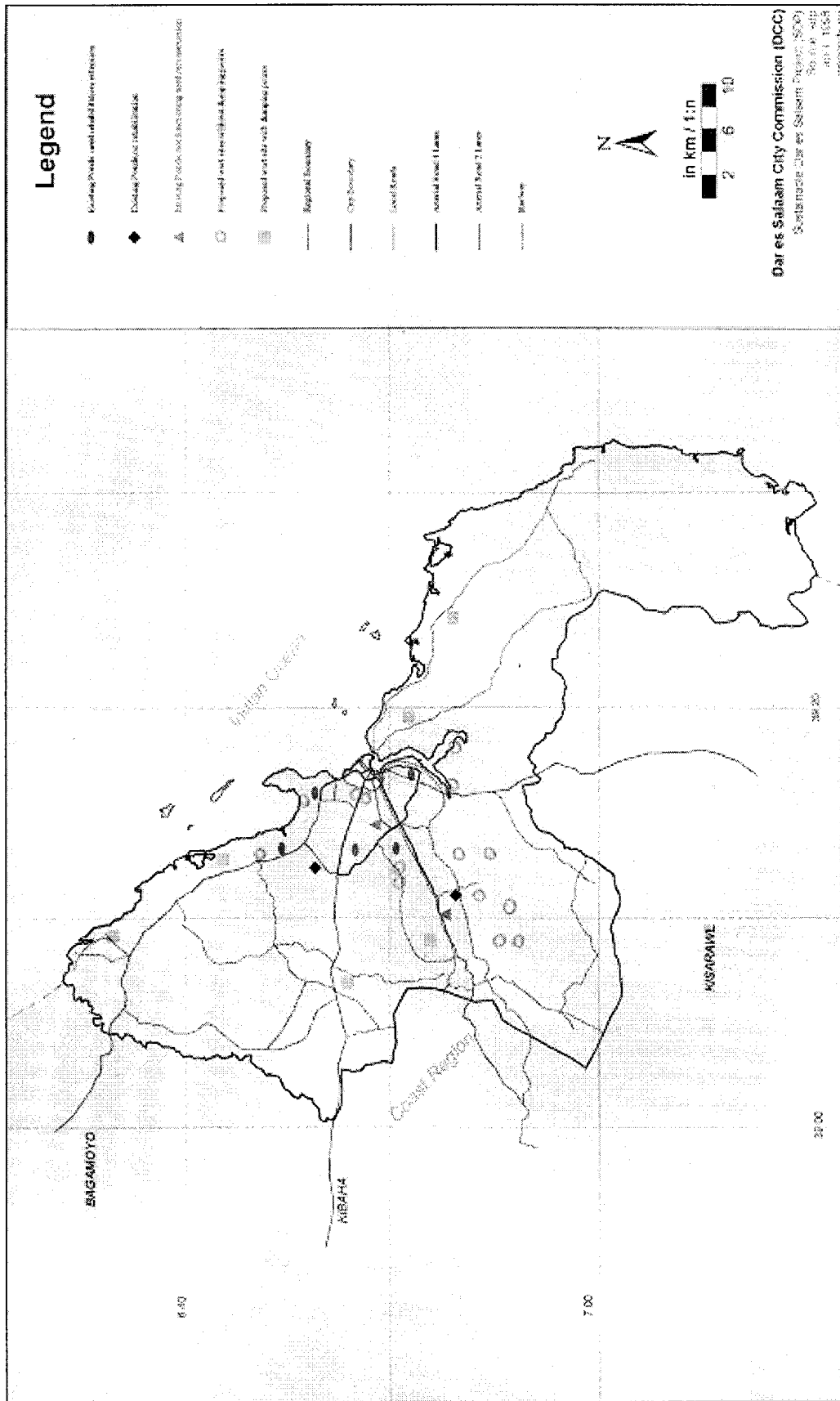
⁵ The theoretical pit fill is 0.05 m³/person/year (Pickford, 1995, p. 41). With an average of 10 [5] persons using one pit, 0.5 m³ of sludge has to be taken out yearly from each pit. Given the average volume of 2 m³ (10 drums of 200-l) taken out by the MAPET service, the required frequency of MAPET emptying would be every 4 [8, see also Africon Engineering International, 1996, p. 7] years

⁶ See appendix G table 5

⁷ See Ministry of Labour (United Republic of Tanzania), 1991 *National informal sector survey* (p. 25): Dar es Salaam informal enterprises operate 10 months per annum on average. Assumption: same capacity for Durban.

APPENDIX I

- EXISTING AND PROPOSED TREATMENT PONDS -



APPENDIX J

- INTRODUCTION TO DAR ES SALAAM ACTORS -

1. *Dar es Salaam Sewerage and Sanitation Department / Waste Management Department*
2. *Dar es Salaam Health Department*
3. *Sustainable Dar es Salaam Project*
4. *PLAN International*

1. Dar es Salaam Sewerage & Sanitation Department (DSSD) / Waste Management Department (WMD)

During the colonial era sanitation activities were mainly confined to urban areas. Most of urban sewerage and drainage systems were constructed under colonial rule. Such systems were left under local governments for operation and maintenance. In the early 1980s, most of the sewerage and drainage systems in urban centres had failed, so in 1982 the drainage and sewerage division was established in the Ministry of Lands, Housing and Urban Development to be responsible for urban sanitation. The division having noted sanitation problems confronting squatter areas and urban fringes established a low cost sanitation unit under the auspices of the UNDP project to conduct research in appropriate latrinisation.

The DSSD⁸ was established in 1983, this being one of the major components of the project, funded by the World Bank, to rehabilitate the then defunct Dar es Salaam sewerage and sanitation facilities. The DSSD was formed as a semi-autonomous department within the City Council. Responsibilities of DSSD are:

- maintenance of separate sewer system;
- operate and maintain sewage pumping stations;
- operate and maintain systems of waste stabilisation ponds and waste water dumping stations;
- design and construct sewer connections and extension;
- design and construct on-site, low-cost sanitation facilities;
- operate a fleet of pit and septic tank emptying tankers;
- health education promotion;
- revenue collection.

Sources of revenue for the department are:

- sewer charges from a few paying institutions and individuals;
- sewer unblocking (private connections);
- sewer connections by the residents;
- construction of on-site sanitation facilities, e.g. VIP latrines and septic tanks;
- pit/septic tank emptying (mainly tanker services).

The collected revenue is for meeting all the operational costs of the department except the wages of the employees, which are provided as a subsidy from the Central Government.

DSSD started pit-emptying services in 1983 after acquiring 8 tankers purchased under the Dar es Salaam sewerage and sanitation improvement project. In addition to the DSSD service there are 11 other institutions that deal with cesspit emptying, but they only service their own estates and not the general public. Only DSSD and Health Department of the City Council provide these services to the public.

Customers apply for emptying services when their pits are full and they pay in advance. The service is delivered after some time, depending on the number of outstanding orders and the number of tankers on the road. Customers living in unplanned areas or areas without proper address (e.g. street names, house numbers) have to come to the booking office on the day of the service delivery to accompany the tankers.

The DSSD operates 5 stations for wastewater dumping. All dumping stations, with the exception of one that flows directly to the sea, are connected to a series of treatment ponds. All tankers in the city share these stations, and a small fee is charged per trip dumped. An attendant stationed in each dump records all the trips dumped daily by each respective institution. According to DSSD records, in 1991 a total of 18,643 loads equivalent to 93,215 m³ of wastewater was dumped. In 1992 a total of 13,745 loads equivalent to 68,725 m³ of wastewater was dumped into these stations and in 1995 only 11,258 trips were recorded which implies 56,290 m³ of wastewater).

⁸ See *Proceedings of the closing seminar of the Comparative study on Pit Emptying Technologies*, 8-11 March 1993

Apart from inadequate pit emptying facilities to service the ever-increasing demand, there are other problems hindering the delivery of an efficient service:

1. Lack of accessibility by large tankers to unplanned areas. In most unplanned areas the roads are narrow and access to the houses is often impossible. In such areas cesspit emptiers cannot render a service. The only solution is the use of traditional emptiers and the in 1989 introduced MAPET service.
2. Lack of proper addresses. In unplanned squatter areas and even in planned areas it is difficult to identify customer houses because there are no streets, and if there are they are not named or numbered.
3. Pit filled with sand or dried sludge. People in Dar es Salaam prefer pits of 3 to 4 metres deep in order to avoid regular emptying. It is true that it takes very long (i.e. 10 to 15 years) before they are full, depending on ground conditions and the number of people using the pit latrine. Gradual sludge deposition takes place at the bottom of the pit. Eventually the pit is filled by dry sludge that cannot be removed by cesspit emptiers.
4. Treatment facilities. The emptying of pits will progressively increase in the future because there are no immediate plans to install more waterborne sewerage in Dar es Salaam. The limitations are adequate water supply and enormous investments required constructing more sewerage. The available treatment facilities are likely to fail in the near future due to large volumes of sewage/sludge being dumped. One pond was already filled up in 1993 and others are to follow.
5. Scattered customers. The tankers operating have to travel long distances to provide service to customers scattered all over the city. Due to economic constraints of the residents, only one to two trips are paid for by the customer. Thus, very few trips are collected per day and therefore it takes about two to three weeks for someone to get service.
6. Lack of funds for purchase of spare parts. Due to the above problem it is difficult to operate profitably and thus revenue collected is not adequate to maintain vehicles on the road, since the subsidy for operating the fleet is not provided, about half of the fleet is grounded for lack of funds to purchase spare parts.
7. Low tariffs. The emptying rate was fixed by the government in 1988. But operating costs in the meantime have increased enormously. For example, in 1988 the price of one litre of fuel was Tsh. 26/- and in 1993 it was Tsh. 158/- per litre. The costs of spare parts and other petroleum products are even more expensive, but the rate remained Tsh. 1200/- and 2400/- per load for residential and commercial premises respectively. In 1998 tanker prices have rapidly increased to Tsh. 20,000/- for residential and Tsh. 25,000/- or more for industrial premises.

Since March 1998, the DSSD no longer exists in this form but is part of the City Council's *Waste Management Department*⁹ (WMD), which is established to provide efficient and effective waste management services in the city of Dar es Salaam. This department has to exclude all possible weaknesses and deficiencies, enabling it to effectively accommodate the service providers in the private sector, by integrating the dispersed waste management functions to a fully responsible organisation.

The WMD exists of a Head Office (City Council) with two centralised operational sections, i.e. Landfill Sites Development and the Workshop for equipment maintenance and repair, and three Municipal Waste Management Departments for the three municipalities Ilala, Kinondoni and Temeke. Tasking more planning, co-ordination and monitoring, the WMD aims at having more active programs. Aiming at having an active implementation of programs and close follow-up, the primary and secondary waste management operations are assigned at the Municipal and Ward levels whereby each municipal waste management department has two operational sections, one for solid waste and one for liquid waste.

The (proposed) functions for Liquid Waste Management Division are:

- carry out cesspit emptying operations;
- collaborate with the Works Department (storm water drains);
- liaise with sewerage and drainage authorities (i.e. of oxidation ponds);
- promote and facilitate the privatisation of liquid waste services;
- supervise and control privatised operations;
- collect cesspit emptying charges;
- enforce on liquid waste management legislations and by-laws;
- liaise with personnel from Health Department at municipal and ward level.

⁹ See Dar es Salaam City Commission, *Waste Management Department; structures, functions, manpower and equipment requirements (draft report)*

2. Dar es Salaam Health Department (HD)

The tasks of the HD, headed by the City Health Inspector, include the following:

- health awareness campaigns for the public;
- vaccination of children under 5 years old;
- city environment cleanliness including disposal of solid and liquid waste, roads, public toilets, etc.;
- inspections of cleanliness of business premises;
- food inspection;
- health education for the public;
- approval of business premises hygienical conditions before trading licenses provided to an enterprise.

3. Sustainable Dar es Salaam Project (SDP)

The Sustainable Dar es Salaam Project¹⁰ (SDP) is part of the global Sustainable Cities Programme (SCP) which is a Joint Programme of Habitat and UNEP. The SCP provides municipal authorities and their partners in the public, private and community sectors with an improved environmental planning and management capacity. The SCP is undertaking demonstration project in 15 cities worldwide. These demonstrations result in the formulation of Local Agenda 21, which include environmental management strategies, actions plans and priority technical co-operation and capital investment projects for the city concerned. SDP is the first demonstration project and was launched in 1992.

The SDP was launched in 1992 as project for and by the people of Dar es Salaam. The multilateral donor institutions are therefore assisting the Government of Tanzania to build the local capacity required to cope with the challenges of sustainable urban development. The ultimate goal is to build a capacity within the local government administrative structure to plan and manage the urban development for DSM by involving the private sector, Non-Governmental Organisations (NGO's) and community groups.

Being a demonstration project, SDP aspires to show how the local government in partnership with the private sector and local communities in the city are able to work. SDP focuses on substantive participation of all stakeholders in the urban development process. Whilst presently the project is confined to DSM-City, the ultimate goal is to gradually transfer and adapt the experiences from SDP to other towns in Tanzania. It is needless to underline here that already SDP has been ranked by HABITAT II CONFERENCE as one of the best project practices on human settlements.

The SDP is concentrating on nine (priority) environmental issues. These are:

1. Improving solid waste management.
2. Upgrading unserviced settlements.
3. Servicing city expansion.
4. Managing surface water and liquid wastes.
5. Air quality management and urban transportation.
6. Managing open spaces, recreational areas, hazard lands, green belts and urban agriculture.
7. Managing the economy and integrating petty trading.
8. Co-ordinating city centre renewal.
9. Managing coastal resource.

The primary goal of SDP is to improve the local (municipal and communal) capacities to foster sustainable environmental planning and management. The ultimate aim is to ensure that DSM-City is able to effectively meet the needs of its booming population gradually improving their living and working environment. Therefore the main objectives of the SDP are:

- To enhance the local capacity to jointly plan, co-ordinate and manage environmental interaction.
- To promote substantive participation of all stakeholders (residents) in the plan generation, implementation programmes and projects.
- Prepare a long-term dynamic investment strategy where partners in urban development co-operate in a synergetic manner.

¹⁰ See 'leaflets on SDP' and SDP, *Summary of proceedings of the workshop on SDP III*

4. PLAN International (PLAN)

PLAN is an international, humanitarian, child-focused development organisation without religious, political or governmental affiliation. Child sponsorship is the basic foundation of the organisation. PLAN's vision is of a world in which all children realise their full potential in societies that respect people's rights and dignity.

PLAN strives to achieve lasting improvements in the quality of life of deprived children in developing countries through a process that unites people across cultures and adds meaning and value to their lives. PLAN is committed to achieving excellence in meeting the needs of the people it serves by continuous improvement of its programs, processes and services.

PLAN International works in several poor areas in the port of Dar es Salaam and in rural areas in Mwanza. Account is taken of the population's basic needs when compiling the various projects and time and money have been reserved for improving sanitation and healthcare. The ultimate aim of PLAN International is to help the inhabitants up to the point where no more help is needed.

APPENDIX K

- ESTIMATES OF INCOME DERIVATION -

K.1 Income derivation with capacity of 1 m ³ per day		
ASSUMPTIONS:		
Capital costs/unit	5000,00 Rand	
Lifetime/unit	5,00 years	
Depreciation	Linear	
Running costs/drum ¹¹	3,00 Rand	
Treatment costs/m ³ ¹²	7,65 Rand	
Labour costs	50,00 Rand/labourer/day	
1 Team consists of	3,00 emptiers	
1 year @	40,00 weeks @	5,00 days
1 drum	0,20 m ³	
Capacity	1,00 m ³ /day	
Capacity	5,00 drums/day	1,00 customer/day
Contractor's profit (15 %)	0,15	
Fixed costs		
MAPET unit	1000,00 per year	
	5,00 per day	
	1,00 per drum	
Variable costs		
Running costs	3,00 per drum	
	15,00 per day	
Treatment costs	1,53 per drum	
	5,00 per day	
Labour costs		
Emptiers	150,00 per day	
	30,00 per drum	
Overhead ¹³	15,00 per day	
	3,00 per drum	
TOTAL COSTS per day	190,00 RAND	
TOTAL COSTS per drum	38,53 RAND	
Contractor's profit	28,50 per day	
	5,78 per drum	
MAPET PRICE	218,50 per day	
	44,31 per drum	

¹¹ See A. West, *Report on pit latrine emptying proposal within the area of the Durban Metropolitan Council* (p. 6)

¹² See Africon Engineering International, *Investigation report for a servicing strategy for Besters Camp* (annex D.2)

¹³ See Africon Engineering International, *Investigation report for a servicing strategy for Besters Camp* (annex D.3)

<i>K.2 Income derivation with capacity of 1.5 m³ per day</i>		
ASSUMPTIONS:		
capital costs/unit	5000,00 Rand	
Lifetime/unit	5,00 years	
Depreciation	Linear	
Running costs/drum	3,00 Rand	
Treatment costs/m ³	7,65 Rand	
Labour costs	50,00 Rand/labourer/day	
1 Team consists of	3,00 emptiers	
1 year @	40,00 weeks @	5,00 days
1 drum	0,20 m ³	
Capacity	1,50 m ³ /day	
Capacity	7,50 drums/day	1,00 customer/day
Contractor's profit (15 %)	0,15	
Fixed costs		
MAPET unit	1000,00 per year	
	5,00 per day	
	0,67 per drum	
Variable costs		
Running costs	3,00 per drum	
	22,50 per day	
Treatment costs	1,53 per drum	
	7,50 per day	
Labour costs		
Emptiers	150,00 per day	
	20,00 per drum	
Overhead	15,00 per day	
	2,00 per drum	
TOTAL COSTS per day	200,00 RAND	
TOTAL COSTS per drum	27,20 RAND	
Contractor's profit	30,00 per day	
	4,08 per drum	
MAPET PRICE	230,00 per day	
	31,28 per drum	

<i>K.3 Income derivation with capacity of 2 m³ per day</i>		
ASSUMPTIONS:		
capital costs/unit	5000,00 Rand	
lifetime/unit	5,00 years	
Depreciation	Linear	
Running costs/drum	3,00 Rand	
Treatment costs/m3	7,65 Rand	
Labour costs	50,00 Rand/labourer/day	
1 Team consists of	3,00 emptiers	
1 year @	40,00 weeks @	5,00 days
1 drum	0,20 m3	
Capacity	2,00 m3/day	
Capacity	10,00 drums/day	1,00 customer/day
Contractor's profit (15 %)	0,15	
Fixed costs		
MAPET unit	1000,00 per year	
	5,00 per day	
	0,50 per drum	
Variable costs		
Running costs	3,00 per drum	
	30,00 per day	
Treatment costs	1,53 per drum	
	10,00 per day	
Labour costs		
Emptiers	150,00 per day	
	15,00 per drum	
Overhead	15,00 per day	
	1,50 per drum	
TOTAL COSTS per day	210,00 RAND	
TOTAL COSTS per drum	21,53 RAND	
Contractor's profit	31,50 per day	
	3,23 per drum	
MAPET PRICE	241,50 per day	
	24,76 per drum	

<i>K.4 Income derivation with capacity of 2 m³ per day, contractor's profit of 20%</i>		
ASSUMPTIONS:		
capital costs/unit	5000,00 Rand	
lifetime/unit	5,00 years	
Depreciation	Linear	
Running costs/drum	3,00 Rand	
Treatment costs/m ³	7,65 Rand	
Labour costs	50,00 Rand/labourer/day	
1 Team consists of	3,00 emptiers	
1 year @	40,00 weeks @	5,00 days
1 drum	0,20 m ³	
Capacity	2,00 m ³ /day	
Capacity	10,00 drums/day	1,00 customer/day
Contractor's profit (20 %)	0,20	
Fixed costs		
MAPET unit	1000,00 per year	
	5,00 per day	
	0,50 per drum	
Variable costs		
Running costs	3,00 per drum	
	30,00 per day	
Treatment costs	1,53 per drum	
	10,00 per day	
Labour costs		
Emptiers	150,00 per day	
	15,00 per drum	
Overhead	15,00 per day	
	1,50 per drum	
TOTAL COSTS per day	210,00 RAND	
TOTAL COSTS per drum	21,53 RAND	
Contractor's profit	42,00 per day	
	4,31 per drum	
MAPET PRICE	252,00 per day	
	25,84 per drum	

APPENDIX L

- INTRODUCTION TO DURBAN ACTORS-

1. *Department of Water Affairs and Forestry*
2. *National Sanitation Co-ordination Office*
3. *Kwazulu-Natal Sanitation Task Group*
4. *Durban Metro Wastewater Management Department*
5. *Water Research Commission*
6. *Urban Sector Network*
7. *Mvula Trust*

1. Department of Water Affairs and Forestry

The governmental Department of Water Affairs and Forestry (DWAF) assists with promoting and supporting the development of a National Sanitation Programme. In the long term the function of sanitation services lies with the local government structures, but DWAF will continue to fulfil the roles of monitoring and support. This is because water and sanitation are closely related, and there would be few, if any health benefits from the water programme if sanitation was to be neglected, and vice versa.

However, DWAF alone cannot do sanitation. It is essential that the programme is run in close co-operation with other departments such as Health and Education as well as NGO's and the private sector and local authorities.

2. National Sanitation Co-ordination Office

Since the formation of the National Sanitation Task Team (NSTT) in 1995, sanitation policy development has advanced significantly. Liaison between various ministries has become effective and the development of a sanitation sector became a co-ordinated and logical process. The National Sanitation Co-ordination Office (NaSCO) had been established as the executive arm of the NSTT. It's goal is to develop a National Sanitation Programme based on the National Sanitation Policy Paper and practical experience, to co-ordinate with other programmes and to ensure flexible delivery.

The function of NaSCO is largely co-ordination, training and strategy development. Its outputs will result in a coherent national strategy, establishing effective provincial sanitation task groups and delivery mechanisms and hence real sanitation improvements at the local level.

3. Kwazulu-Natal Sanitation Task Group

The Kwazulu-Natal Sanitation Task Group (SANTAG) consists of an inter-sectoral group of people from all sectors including six provincial departments (Water Affairs and Forestry, Environmental Affairs and Tourism, Health, Education, Constitutional Development and Provincial Affairs, Local Government and Housing); NGO's; CBO's; the private sector and others; who are jointly responsible to implement the National Sanitation Policy in the province of Kwazulu-Natal.

SANTAG facilitates co-ordination and networking between departments and organisations, and encourages each department and organisation to make sanitation a priority in their area of responsibility by:

1. Appointing a sanitation co-ordinator.
2. Encouraging the creation and filling of a post of an Assistant Director in DWAF tasked with sanitation.
3. Encouraging improved sanitation, health and hygiene education in schools, public places and homes.
4. Facilitate policies and procedures for the development of sanitation projects and their implementation.
5. Facilitate capacity building with all stakeholders in rural sanitation.
6. Encourage an inclusive and representative team approach to the implementation in the province.
7. Organise that all role players in Health Promotion, Hygiene and Health Education are part of the HEATT team.
8. Ensure continuity, equity, responsibility and consistency with the implementation of the Sanitation Policy in Kwazulu-Natal.
9. Work towards action all times.
10. Be committed to implementing Reconstruction and Development Programme principles at all times.

4. Durban Metro Wastewater Management Department

The Durban Metropolitan Council in its restructure created the Waste & Water Services unit, one of whose departments is that of Wastewater Management. The main responsibilities of the department have been identified in general terms. The erstwhile Durban City Council in its restructure created the Waste & Water Services unit, one of whose departments is that of Waste Water Management (WWM). The main responsibilities of the department have been identified in general terms.

1. *Waste water treatment works*: the operation, maintenance, design and construction of some 31 works of various sizes from package plants, stabilisation ponds up to major highly technical plants is required to ensure compliance with the permits issued by the department of Water Affairs and protect the natural environment.
2. *Systems operation and maintenance*: one of the major problems and concerns identified in the broader Metropolitan area has been the deterioration of the sewerage reticulation system in a number of areas creating potential severe health and water pollution problems. This has primarily been due to the lack of resources, financial, human and physical, to carry out adequate operation and maintenance of the existing system coupled with abuse (accidental, unknowing or deliberate) of elements of the system (pumping stations, manholes, etc.).
3. *Design and engineer support*: the Metropolitan department will be responsible for the standards applicable for all design work in the Metropolitan area and will carry out itself, or by means of consultants employed directly or by developers, or others all trunk sewer, pumping station and treatment works design and reticulation design. The department will be fully responsible for strategic planning and programme development and all designs carried out by others must be in conformity with such strategic work.
4. *Air and water pollution control*: It is considered that both water and air pollution control should be totally a Metropolitan function as both facets have no regard to political boundaries. This has been accepted in principle in discussions with officials of the current Substructure Councils. Air pollution control and monitoring has been carried out in Durban in the Water & Waste Services unit by the department as the pollution control inspectorate deal with both types of pollution emanating from premises.
5. *Business and public communication services*: a considerable effort is required to ensure that the public (the department's users) are aware of the services provided, are provided with correct accounts for payment and are given a rapid response to requests, queries, etc. A particularly important aspect of the department's works, in conjunction with other authorities (e.g. solid waste, litter, health), is the "educational" aspect wherein the public is advised about the importance of the sewerage system, its correct usage and what results if it is abused (e.g. environmental pollution, potential health problems) and this was dealt with by a recent report.

The City Council of the Durban Metropolitan Area have passed a resolution that Durban should be fully connected to sewerage systems and the DWM are working on plans to substantially achieve this goal within the year 2050.

5. Water Research Commission

The Water Research Commission (WRC) was established in 1971 under the Water Research Act. The WRC's terms of reference are:

- to promote the co-ordination, communication and co-operation in the field of water research;
- to establish water research needs and priorities;
- to fund research on a priority basis;
- to promote the effective transfer of information and technology.

The WRC derives income from levies on water consumption. The funds are collected for the WRC, on a commission basis, by the Department of Water Affairs and Forestry. The WRC does not undertake in-house research, but funds research under contract with other agencies.

6. Urban Sector Network

The Urban Sector Network (USN) is a national association of South African NGO's involved in development and governance issues. In 1988 the USN was created to build on the successes of its affiliates' projects. At first this co-operation was informal and tailored to specific projects. The advent of democracy in 1994 made it possible to create formal, national structures.

USN promotes active involvement of the poor in decision-making and implementation of policy and development programmes, assists poor communities to meet their housing and service needs, promotes sustainable human settlements and promotes institutional transformation at local government level. This is done by capacity building and training, engaging local authorities around administrative re-organisation and planning, facilitation and/or management of participatory housing and service delivery, facilitating income generation and employment creation, etc.

7. Mvula Trust

The mission of Mvula Trust is to improve the health and welfare of poor and disadvantaged South African s in rural and peri-urban communities by increasing access to safe and sustainable water and sanitation services. The core development policy objectives of the Mvula Trust are effectiveness, efficiency and sustainability. To achieve these the Mvula Trust is committed to:

- Ensuring the participation and empowerment of the beneficiaries, communities, and local authorities, it serves to sustain the initiatives that have been launched.
- Demand-responsive approaches as a means of enhancing sustainability, building local capacity, promoting cost-efficiency and ensuring sound public financing.

The Mvula Trust is an independent organisation, staffed by an experienced executive, accountable to a distinguished Board of Trustees drawn from its major stakeholders, funded from a variety of sources, and operating in a transparent and publicly accountable manner.

The Mvula Trust operates with due recognition of the strategic policy framework of the government and works in close co-operation and partnership with other major development agencies. The Trust promotes efficient partnerships between public, private and non-governmental bodies in service improvement at national, regional and local levels.

APPENDIX M

- SANITARY COVERAGE IN TANZANIA AND SOUTH AFRICA -

Distribution of sanitation types in Tanzania (Source: Demographic Health survey 1996 by Bureau of Statistics)

Sanitary facility	Urban	Rural	Total
Own flush toilet	3.6 %	0.5 %	1.2 %
Shared flush toilet	1.4 %	0.3 %	0.5 %
Traditional pit latrine	89.3 %	81.9 %	83.5 %
VIP latrine	3.3 %	0.4 %	1.1 %
No facility	1.7 %	16.0 %	12.8 %
Other	0.7 %	0.9 %	0.8 %

Distribution of sanitation types in South Africa (1990-figures)

Sanitation type	Population	Population (%)
Full water-borne	15,718,000	64.1 %
Sceptic tank	439,000	1.8 %
Bucket	1,926,000	7.0 %
VIP latrine	266,000	1.1 %
Unimproved latrine	5,253,000	21.4 %
Other	398,000	1.6 %
None	491,000	2.0 %
Total	24,491,000	100 %

M.Sc. Theses in Technology and Development Studies in 1996

- 96.1 Myriam Derks: Análisis e identificación de la problemática en el proceso de la ejecución de vivienda de interés social en Costa Rica
- 96.2 Jan Willem Dijk: An appropriate Marketing Management Method that supports the Building Material Industrialization in Tanzania
- 96.3 Annemarie van Iwaarden: The quality of locally produced wood-based panels in the relation to market demand in Tanzania: an explorative survey of customer satisfaction regarding the quality of wood-based panels for the Tanzanian construction sector
- 96.4 Ivo Jongsma: Small scale cement production in Tanzania
- 96.5 Saskia Rijkenberg: Adaptations to a cost control system: cost control as a tool to achieve productivity improvement on building sites of Skanska Jensen Int. in Tanzania.
- 96.6 Marten Treffers: The Informal Building Process in Dar es Salaam, Tanzania. A Contribution to the Upgrading of the Informal Construction Sector and to the Formulation of a Management Plan for Hazard Lands
- 96.7 Arjen Veltman: Pre-feasibility study on the Establishment of a Furniture Factory. An assignment of FUNBAMBU San José, Costa Rica
- 96.8 Anita van Dalen: Analysis of the provision of economic infrastructure related to industrialization, in large regional towns in Tanzania
- 96.9 Raymond Duijsens: Metal Industry and Technical Education in Tanzania: model for matching demand and supply of knowledge and skills
- 96.10 Donné van Engelen: Public policy making and the rise and fall of the Tanzanian manufacturing sector
- 96.11 Wessel Schulte: Technology and quality of care in Muhimbili Medical Centre, Tanzania. Methodology to study the role of technology from the viewpoint of total quality. Factors marring total quality and possible management actions
- 96.12 Gijs van Haastrecht: Training Courses for Logistic Improvement
- 96.13 David Gonsalves: Energy conservation opportunities at Tanzania Bottlers Ltd. The position of the soft drinks industry in the Tanzanian industry: an exploration
- 96.14 Yvonne van der Ven: Privatization at Tanzania Harbours Authority (THA). Case study: THA's grain terminal
- 96.15 Hans Puttenstein: Quality of the telephone service of the Tanzania Telecommunications Company Limited TTCL)
- 96.16 Wim van Rooy: The dynamics of Kilombero Sugar Company (Tanzania) 1962-1992: an analysis of technology changes
- 96.17 Pascal Hop: Information management aspects of ATS route planning, now and in the future: a case study in civil aviation in Tanzania
- 96.18 Thom van der Veer: Productivity of a Tanzanian Battery Factory. The case of Matsushita Electric
- 96.19 Fred van der Westerlaken: Feasibility study for a production facility for pipe fittings in Tanzania
- 96.20 Jeroen Heggelman: Energy Management system

- 96.21 Annelies Balkema: Industrial Waste Water Treatment in Dar es Salaam, the Vingunguti Waste Stabilization Ponds
- 96.22 Joost Raaphorst: The introduction of an environmental information system in Tanzania
- 96.23 David van Horen: The eutrophication of Lake Victoria, East Africa
- 96.24 Bart van Campen: Diffusion of solar water heating technology in Tanzania
- 96.25 Jeroen van der Linden: A comparison of energy sources for the economically viable decentralized generation of electricity in rural areas
- 96.26 Harro Zanting: A Systematic Assessment of Water Pollution in Lake Victoria
- 96.27 Michel Gebbinck: Assessment of a sustainable process for the TOOLnet Access Point (an email service provider) in Peru.
- 96.28 Pieter Dijke: Future possibilities for Mini Hydro Power in Tanzania
- 96.29 Hanneke van de Ven: Assessment of the sustainability of the small-scale brick-burning industry in Tanzania, with special attention to biomass energy use: an explorative study
- 96.30 Jeroen Gelinck: A case study on the possibilities and constraints of GIS for urban planning and management in Dar es Salaam
- 96.31 Erwin Mikkers: The use of photovoltaic technology in Benin: the problems with PV-systems and energy alternatives in a rural village
- 96.32 Bianca de Wit: Possibilities for exploiting wind energy Identification of regions with potential markets for windpumps and/or wind turbines

M.Sc. Theses in Technology and Development Studies in 1997

- 97.1 John van Rijn; The implementation of building Techniques in Gedaref. The search for appropriate designs and building techniques for primary schools and health centres and their implementation in Gedaref (Sudan)
- 97.2 Marie Odile Zanders; An assessment of Domestic Waste Water Pollution for the Lake Victoria Region
- 97.3 Marcel Cloo and Pjotr Ekelmans; The role of MIC Tanzania Ltd in the development of the Tanzanian telecommunication sector. Tanzania in search of an appropriate telecommunication technology
- 97.4 Geert Bergman; Measuring Industrial Efficiency in Developing Countries. Theory and a case study: bottling of Coca-Cola in Dar es Salaam, Tanzania
- 97.5 Francine Jansen; Analysis of the housing situation in Minsk (Belarus)
- 97.6 Bartelt Bongenaar; Part 1) Evaluation of the role of the Tanzania Industrial Research and Development Organisation; Part 2) The satellite receiver design
- 97.7 Mark Pantus; Implementation of a total quality assurance system in electronics. A study of total quality in a Philippine electronics company

- 97.8 Jan Buis; Productivity measurement in the Costa Rican low-income housing projects. The search for an adequate methodology
- 97.9 Casper Esmeyjer; Production and application of lime in Tanzania; with special reference to the construction sector.'
- 97.10 Warner Werkhoven; Mapping the effects and impacts of refugees sites. The case of the 1994-1996 influx in the Kagera region, Tanzania.
- 97.11 Otto Bos; Energy Conservation in Tanzanian Industry. Manual Energy Conservation for Tanzanian Metal Industry.
- 97.12 Bas Sturkenboom: Analysis Aeronautical Navigation Service Organisation in Tanzania. Technology audit Aeronautical Fixed Service provision via low-speed Aeronautical Fixed Telecommunication Network.
- 97.13 Gertrude Zijl and Robbert Lassche: Testing a Technology Audit Methodology. A rapid assessment of six small and medium scale enterprises in Tanzania.
- 97.14 Jurgen Busink and Sander Wilson: Testing a Technology Audit Methodology. A rapid assessment of eleven enterprises in Costa Rica.
- 97.15 Rick van der Kamp: Technology and Human Resources in the Indonesian Textile Industry - The role of technological progress, education and Human Resource Development in economic performance.
- 97.16 Menno Prins: Manufacturing Statistics. Reconstructing Tanzanian Manufacturing Value Added 1965-1995
- 97.17 Hans de Klerk: Telecommunication Network Planning in Developing Regions. The Technological Possibilities Applied to North-Kivu (Zaire)
- 97.18 Wendy Schellens-Haans: Attitudes and behavioural change with respect to the environment. Design and implementation of a training course for secondary schools in the Republic of Belarus.
- 97.19 Jeroen Thielemans: Estudio Comparativo de Impacto Ecológico en Estructuras "Bloques de Concreto vs. Paneles con Bambú". Un enfoque de Análisis de Ciclo de Vida.

M.Sc. Theses in Technology and Development Studies in 1998

- 98.01 Arwin Hoekstra: ADOBE WASI: Difusión y Transferencia de la Tecnología Constructiva Mejorada. Un Estudio de los Problemas y Oportunidades en los Asentamientos Urbano Marginales de la Ciudad del Cusco, Perú
- 98.02 Jeroen van den Brink: Scrap and Scrap Recycling in the Tanzanian Industry
- 98.03 Suzanne Jacobs: Changing Commuter Traffic of Car Owners from San Ramon.
- 98.04 Marcel Radstake: The Search for an Adequate Strategy for the Development of Telecommunication in North Kivu (Zaire). Based on Experiences of the East Asian Newly Industrialised Countries (NICs).
- 98.05 Pascal Schreur: Analysis of the construction process of low-income housing in Costa Rica. A search for opportunities to improve the performance of the construction process and the applicability of technology-based research methodology.
- 98.06 Mohini Keunen: Present and future electricity generation: possibilities and restraints of large and

small scale hydro power plants, case of the State of Kerala, India.

- 98.07 Corné Spreij: Prerequisites for automation processes in developing countries.
- 98.08 Mischa Kok: The development of an instrument to evaluate the sustainability of urban development projects.
- 98.09 Bert van der Plas: Energy efficiency improvement in the brown sugar industry of Costa Rica. A case study of energy conservation opportunities in small brown sugar mills in Bajo la Paz.
- 98.10 Jan Cloin: PV on Thatch. A search for opportunities of sustainable implementation of PV in Manicaland, Zimbabwe.
- 98.11 Sander Knirim: Pre-feasibility study on bamboo matboard production in Tanzania.

If you would like to receive a copy of one of the above indicated M.Sc. theses, please contact:

Department of Technology and Development Studies
Eindhoven University of Technology
MSc. research co-ordinator E. Van Egmond
DG 1.02
PO Box 513
5600 MB Eindhoven
The Netherlands