

The Collection of Household Excreta

The Operation of Services in
Urban Low-income Neighbourhoods

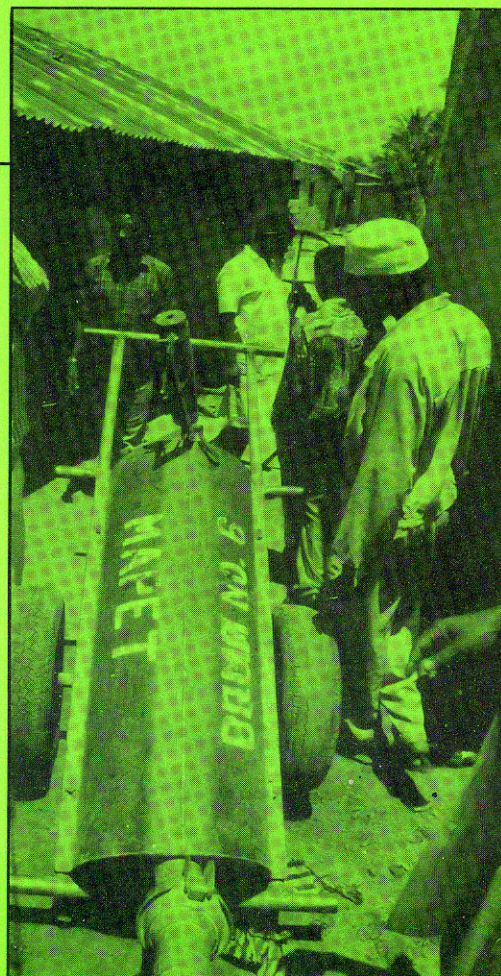
Urban Waste
Series 6

Maria S. Muller
(Editor)

WASTE
advisers on urban environment and development



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GLOSSARY

Excreta	collective name for faeces and urine
Faecal sludge	solid excreta that have been separated from the liquid parts
KVIP	Kumasi Ventilated Improved Pit latrine
Nightsoil	fresh human excreta
Scavengers/ sweepers	men and women who take away waste (human excreta and solid wastes) from latrines, court yards, and streets - terms used in India -
Vault	watertight tank for storage of excreta
Waste collectors	general term for people who collect human and/or solid waste, being self-employed or working in small enterprises in the informal sector

Introduction

Collection and disposal of human excreta are a serious sanitation problem in most of the cities in developing countries. This is especially felt in low-income urban settlements and unplanned areas of those cities where establishing of a waterborne sewerage system is hampered by multitude of limitations. Pit latrines of different kinds and bucket latrines are a common sanitation facility in many parts of African and Asian cities. It is well-known that these facilities require careful operation and maintenance by the owners and users. Unless this is done, pit and bucket latrines pose a risk to public health and so affect the capacities for socio-economic development of the population.

This raises questions as to what services exist in low-income settlements for the collection and disposal of human excreta from these latrines: how are they organized, what technology is used, how do they dispose of the collected sludge and nightsoil, and how do they fit into the urban waste management system.

Public authorities are responsible for creating the conditions in which sanitation operations can take place which are safe, effective and efficient. Many of these operations can be left to the private sector, but the city authorities remain responsible for ensuring that these operations are coordinated within the urban waste management system.

This publication reveals an extensive literature pertaining to pit latrines and bucket latrines in low-income settlements in cities. However, their focus is more on the construction of individual facilities than on keeping them in operation as part of the total urban sanitation system.

The case studies presented in this publication address the question of how pit and bucket latrines are kept in operation. This is a matter of how the primary collection and disposal of human excreta are organised and how it is financed. But beyond that, treatment and final disposal must be ensured. The case studies do not deal with the technical requirements of this process, but rather point to the institutional linkages required to ensure that this secondary and final part of the sanitation system takes place.

The main purpose of this publication is to create an awareness, rather than to provide answers to the question of "how to ensure that this is a durable activity?". Four case studies are included, one of which is a pilot project called "Manual Pit Latrine Emptying Technology (MAPET)" implemented in Dar es Salaam (Tanzania). The other cases present the methods utilized in low-income settlements in parts of the cities of Ghaziabad (India), Accra (Ghana), and Yichang (China). Together they provide a cross-section of different cultural and socio-economic conditions influencing different methods for collection of human excreta from pit and bucket latrines.

In addition, WASTE has elaborated a method for the financial analysis of latrine services. As a test, data are used from the MAPET case as an example of an informal micro-enterprise in the sanitation sector. Its inclusion in this publication is meant to stimulate discussion about the validity of this type of analysis. It could be interesting to compare public and private services in one and the same city by this analytical method.

The impetus for this publication was the experience gained from the disposal of waste of the Dar es Salaam Sewerage and Sanitation Department (DSSD) through the MAPET

project, and the wish to compare that with, and learn from, similar experiences in other cities. MAPET is essentially a set of equipment and services for primary collection at the neighbourhood level. The brief for the case studies was therefore, to describe the operation of primary collection of human excreta from pit and bucket latrines and to analyse all aspects related to this, including socio-economic, institutional and environmental aspects.

This brief gives the four case studies - all written by engineers - a multi-disciplinary content, of which the technical features of excreta collection forms only one aspect.

The researchers who studied these cities met at an international workshop held in Colombo, Sri Lanka, in February 1996 and deliberated on their experiences. The case studies presented in this publication are therefore attempting to provide a comprehensive account of those city specific practices of collection, treatment and disposal of human excreta in low-income urban settlements. It is believed that these experiences will pave the way for further research and development aiming at effective and efficient methods of excreta collection and disposal meeting the needs and demands in urban low-income settlements.

Apart from organizing the workshop in Colombo, SEVANATHA in the person of Mr. H.M.U. Chularathna¹, edited the case studies for which many thanks are due, both to SEVANATHA and to Mr. H.M.U. Chularathna personally.

Following this Introduction, the first chapter reviews the literature pertaining to the collection of human excreta. The four case studies on Dar es Salaam, Ghaziabad, Accra, and Yichang are then presented, as well as the financial analysis of MAPET in Dar es Salaam. The last two chapters are based on discussions by the participants of the workshop in Colombo. They identify institutional connections between the neighbourhood level of services and the municipal framework. In addition, essential dimensions of environmental health, economic value and financial viability, and cultural norms and community participation are highlighted as conditions for improving and sustaining the collection of human excreta from households.

¹ H.M.U. Chularathna is an urban planner working with SEVANATHA.

I The Collection of Human Excreta: A Literature Review by Justine Anschütz

1.1 Introduction

Sanitation in cities in the South deserves to get more attention in the coming years than it has had until now. The lack of adequate sanitation for large sections of the urban population poses a threat to public health and to the environment and thus affects the capacity of people and cities to contribute to economic development and to improve the quality of their lives.

This publication is concerned with sanitation for low income residential areas in cities, specifically focussing on pit latrines and bucket latrines. These two toilet types have in common that the sludge and nightsoil is to be collected and then transported to a site for final treatment and disposal.

The underlying theme is the following. One has to recognize that large number of urban residents, especially those earning very low incomes, will not have access to any form of sewage system for many years to come. Those residents will have to rely on types of low-income sanitation, such as single pit or twin-pit latrines, bucket latrines, ventilated improved pit (VIP) latrines, or pour-flush toilets which are relatively cheap to install and require fairly little space. It is therefore in the interest of the whole urban community to ensure that these facilities are operated in the best possible manner. In particular, it is necessary to dispose of human excreta in a manner that minimizes the health risks to low-income neighbourhoods and cities in general, and reduces the pollution of drinking water sources.

The removal of human excreta from bucket or pit latrines in urban residential areas is an infrastructure service for which public agencies have often, by law, had final responsibility. The issue is, under what conditions can this specific type of service be made efficient and effective? Does it only depend on the political will of the urban and national elite, or also on community control, on governmental decentralisation, on introducing new forms of privatisation, on improved mechanisms for cost recovery, or on the design of more appropriate technologies? Authoritative answers are far away.

The collection and disposal of nightsoil has been practised for centuries, particularly in those areas where human excreta are traditionally used in agriculture, such as China (Rybczynski, 1980). In communities without a sewerage system, bucket latrines are common (Nimpuno et al., 1981). In urban India for example, according to recent estimates, 33% use bucket or dry latrines (Bijlani & Rao, 1990). And in Dar es Salaam, 80% of the 2 million inhabitants use pit latrines (Hoek-Smit, 1991).

The literature on sanitation gives more attention to the installation of facilities than to their regular operation. The issues raised are more often those of how to make the design and construction cheaper and more attractive, how to persuade people to buy and use a latrine, or how to set up credit programmes to encourage rapid introduction of latrines among certain sections of the population. Very little attention is given to the effective functioning of latrines over a long period of time. In particular the necessity of removing the sludge as a condition for their effective and continued functioning is often glossed over in many documents. It is also surprising to notice the peaks in the

literature. After "classic" publications in the late seventies and early eighties there was a lull. Only in the last two years there is renewed attention for the construction and maintenance of latrines.

The collection of human excreta from private latrines in urban low-income neighbourhoods is an infrastructure service that consists of several activities for which various organisations are responsible. These activities are:

- Storing the excreta (in or under the toilet)
- Removing the excreta (nightsoil or sludge) from the latrines
- Transferring the excreta to the place of disposal
- Treatment of the excreta
- Final disposal of the sludge

The following paragraphs give a brief review of the methods employed in the collection service.

1.2 Methods for the Removal of Excreta

1.2.1 The Removal of Nightsoil from Bucket Latrines

One of the oldest and most simple sanitation techniques is the bucket latrine, widely used in Asia and Africa, in which excreta are deposited directly in a container or bucket, and periodically removed for disposal (Rybczynski, 1980). A squatting slab or seat is placed immediately above a bucket which is filled within a few days by the excreta of an average family. Sometimes the latrine has a raised floor, with a collecting chamber underground. The bucket is positioned adjacent to an outside wall and is accessible from the street or lane (Feachem & Cairncross, 1978). The bucket system is frequently used in slum areas, because space requirements are small and construction costs low (Baumann & Karpe, 1980).

Usually a sweeper or "scavenger" calls regularly -preferably everyday, but more typically once or twice a week- to empty the bucket (Feachem & Cairncross, 1978). Sometimes another type of receptacle is used instead of a bucket, or the human excreta are collected directly from the floor of the chamber of the bucket latrine.

Most frequently, the bucket is emptied into a tank or wagon and immediately replaced, but this is clearly not a very hygienic operation (Feachem & Cairncross, 1978). It is inevitable that excreta are spilled in the streets. And the remaining layer of nightsoil in the bucket provides an "excellent" breeding environment for flies, insects and pathogens.

1.2.2 The Removal of Sludge from Pit Latrines

Another traditional sanitation method used by low-income communities is the pit latrine. The function of the pit latrine is to leach the liquid part of human waste and to decompose the solid parts. The pit latrine consists of a hand dug pit in the ground with a squatting slab on top. When necessary, the pit is lined with stones or bricks to prevent it from collapsing. A superstructure is built around it for privacy. The life of the pit varies from 4 to 15 years, when it has to be emptied for the first time or a new pit has to be dug (Bijlani & Rao, 1990; WASTE, 1993). In certain circumstances, (e.g. when the pit gets old, when the water table is high, or when there is a large number of users), pits have to be emptied more frequently. In Dar es Salaam, for example, there are pits that need regular emptying in less than 12 months. Pit latrines are the most common, but not necessarily the cheapest sanitation system. A large, deep pit with brick lining is

expensive, which is one reason for emptying and re-using a pit rather than constructing a new one. Nevertheless, pit latrines are widely used in urban areas in many developing countries. Major obstacles to latrine construction are: high population density and space requirements, a high water table, an inappropriate soil structure (rock, sand), and the danger of ground water contamination (Feachem & Cairncross, 1978).

Emptying of pit latrines can be done by manual or by mechanical methods. Manual methods, employing scoops and buckets, are applied to the more fluid type of waste, while thicker sludge have to be dug out by hand. This can involve hard work and almost total immersion in the sludge, as, for instance, by the "vyura" (frogmen) of Dar es Salaam. Twin-pit systems can overcome the unpleasantness and health hazards to the workers involved by allowing the excreta to digest and become virtually pathogen-free after one or more years of decomposition. Twin pits are designed to excavate the compost.

Mechanical methods revolve almost entirely around the use of vacuum trucks, where atmospheric pressure forces the pit contents along a hose pipe into a tank under vacuum. Again, the thicker sludge can present problems, such as blocking the hose pipe, so that in some cases addition of water and agitation of the contents may be necessary to increase viscosity and induce flow.

1.3 Emptying of Pit Latrines

At the user and the municipal level there has been general neglect of operation and maintenance of pit latrines, especially of ways to empty them (Etherton, 1980). Recognising this, the International Resource Centre for Wastes Disposal (IRCWD) has carried out a pit emptying programme to conduct field tests with vacuum trucks in Botswana (1986). And WASTE has also carried out comparative studies on pit emptying equipment, including vacuum trucks of different capacities and manual equipment (WASTE, 1992). The issue of latrine maintenance has recently been taken up again through a field study in several cities in India and Thailand (IHS/IRC, 1993).

In both urban and rural areas, pit latrines are usually relocated when they are full. This is uneconomic for the house owners, when they are well built. As urban land becomes scarce, plot sizes are reduced and it becomes both technically difficult and expensive to re-excavate pits and to move superstructures. Under these conditions, which are often found in fringe and urban low-income areas, it is necessary to empty the pit latrine (Etherton, 1980; Schertenleib & Hawkins, 1983; Muller and Rijnsburger, 1994). In many developing countries, pit emptying services using conventional vacuum trucks with a tank volume of 4-6 m³, developed in industrialized countries, have proved inappropriate. In particular this is because of: difficult access to old city slums and peri-urban squatter settlements, rapid wear, and high fuel consumption (Schertenleib & Hawkins, 1983). The operation of vacuum trucks also requires efficient human-equipment management which local authorities who are primarily responsible for sanitation, are unable to provide due to lack of resources. Pit emptying by conventional vacuum trucks is not included in this publication.

Experiments are being done, however, with intermediate technology, using smaller vacuum trucks with a tank volume of 1-3 m³. One such experience is in Kenya. In Kibera, a large, densely populated squatter settlement in Nairobi, a national NGO (KWAHO) has experimented with a pit latrine emptying service, using a special suction truck, managed by a 13-member community management team and operated by a crew of three persons (Hogrewe et al., 1993). MAPET, another example of intermediate,

mechanical technology, applying 0.2 m³ tanks, is one of the case studies included in this publication.

1.4 Transfer of Excreta to a Site for Disposal

The method of transportation of nightsoil and sludge varies greatly among countries. For bucket and pit latrines one speaks of a cartage system in which human wastes are transported by human or mechanical means, without the use of water for flushing. At its simplest, a cartage system is a man with buckets, often carried on a yoke, or a basket on his head which he fills from bucket latrines. The next stage is a hand-pushed cart or an animal-drawn cart. Beyond this, various forms of motorised cartage are possible, including a tanker/trailer and the vacuum truck system (Feachem & Cairncross, 1978).

1.5 Treatment and Disposal Methods

There is no point in having a transportation system unless there is somewhere for the waste to go. That is, treatment and disposal of sludge and nightsoil are the final part of the collection system. Some of the most common methods combine treatment with disposal, while others only dispose of the untreated excreta (Feachem & Cairncross, 1978; Blackett, 1994). Methods applied in urban areas that combine both treatment and disposal are:

- Burying on the site of the house in quantities of one cubic metre at a time. This is a customary method employed in both urban and rural areas.
- Trenching: nightsoil is buried in dug trenches in fenced areas outside of towns, covered with earth and left for at least two years to decompose and dry.
- Aerobic or anaerobic treatment in waste stabilization ponds.
- Co-composting with organic household garbage.
- Incineration of nightsoil together with other types of refuse.

The organisation Sanitation in Developing Countries (SANDEC) is currently carrying out a research programme on specific treatment methods for latrine pit sludge.

Methods that only dispose of the excreta without treatment are:

- Disposal of nightsoil directly into streams, rivers, lakes.
- Disposal directly into sewers. This can cause trouble in the sewerage system as the accumulated solids may result in blockage.
- Direct application on the land as an agricultural fertilizer.
- Throwing excreta on the general dump site for household garbage.

1.6 Similarities and Differences Between the Collection Services

An essential element of the collection service of both bucket and pit latrines is that each latrine must be emptied individually. Also, fairly small amounts of excreta are transferred over small distances to the disposal site, depending on the capacity of the means of transport. Often manual or animal-drawn means are used that can cover a few kilometres within the neighbourhood. As said before, the use of conventional vacuum trucks for the collection of excreta are not considered in this publication.

The complete removal of excreta from buckets and pit latrines depends, therefore, on the transfer of sludge up to a disposal site in the neighbourhood (primary service) and on subsequent transfer to another site for final disposal (secondary service). Coordination of these primary and secondary parts is thus a crucial element in an effective collection service. Several case studies bear this out.

The case studies also show that the removal of excreta from individual latrines can be combined with any one of the treatment and disposal methods mentioned.

The major difference between the two systems concerns the intervals and the regularity of sludge collection. Bucket latrines must be emptied daily or at least weekly, while pit latrines are emptied at intervals of three months to two years, when the need arises, depending on their sludge accumulation rate. The regularity of primary collection for bucket latrines facilitates coordination with the secondary collection. In contrast, the irregular demand for the emptying of pit latrines makes it more difficult to link up this primary service with the secondary service of transfer to a final disposal site. A strategy to improve the pit latrine collection service is, therefore, likely to involve attempts to organize a more regular primary demand for pit latrine emptying.

1.7 The Socio-economic Context of the Infrastructure Service

The previous paragraphs have focused on a broad outline of activities that make up this specific infrastructure service. It has become clear that the service has not only technical and sanitation dimensions, but also organisational, social, economic and environmental. Now attention will be paid to the context in which the service is carried out, in particular to the socio-economic environment of low-income communities.

This Introduction will not attempt to define low-income settlements and communities precisely (e.g. WASH Report no. 86, p.1), as the case studies in Accra and Ghaziabad concern settlements that are well-established inner-city slums, while the case study from Dar es Salaam concerns “unplanned areas, that are not squatter settlements”. And Yichang is an example of a city where bucket and pit latrines are common in both low-income and middle-income neighbourhoods. Nevertheless, the settlements and the communities do have some general characteristics in common that affect the level of sanitation service in these areas.

Some characteristics of low-income communities are that many of the residents are employed in the informal urban economy and have irregular and low levels of income. In a socio-economic sense, these communities have a heterogeneous composition in terms of ethnic background, income level, language and social norms. Usually a variety of social organisations and groups exists, which strengthen the social ties among the residents, but which also link the residents to groups outside the settlement, such as the larger family, the church, case organisation or the political party. In the absence of public services, some community-based organisations may focus on the improvement of living conditions in the settlement itself. Infrastructure, like water supply, roads and markets, and social services for education and health, may be obtained by community effort. Women play important roles in obtaining and managing the improvements in settlements. The low-income communities rarely have a permanent influence on political decision-making in their city. In a situation of scarcity of resources, politicians and city administrators respond to the pressure of the middle classes rather than to the demands

of the low-income communities. Poor and unreliable services to the latter are the result.

Whether the physical settlements of these low-income communities are old inner-city slums or are located at the periphery of the city, they have certain features in common. First, population growth and density is high compared with other parts of the city. Also, the poor physical site conditions often threaten a stable existence of the settlement (e.g. flooding), while complicated site layouts may make it impossible to construct modern water and sewerage infrastructure without demolishing a large number of buildings. Large-scale demolition would result in removing the low-income residents who depend on cheap, well-located housing. The legal land tenure situation of low-income settlements is often uncertain, as economic development pressures may lead to their demolition. Finally, these settlements are often located far from the main employment and administrative centres, and not served by the main transportation operations. Access to employment opportunities and to public services is thus made very difficult.

What do these characteristics mean for the demand for a service that collects human excreta? Several features can be listed (WASTE, 1993; WASTE, 1994).

- Where there is a scarcity of employment opportunities, providing a human waste collection service can be a chance of earning income, even if it is undesirable from the social and health points of view.
- Such a human waste collection service will be in operation as long as the waste collectors, whether they are self-employed scavengers, informal entrepreneurs, or owners of a formal enterprise, are satisfied with the income generated; and as long as the residents cannot obtain a more reliable, more effective, or cheaper service.
- The residents prefer to see a good service done before they pay, instead of paying in advance before the service is delivered.
- The costs should also fit in with the household expenditure pattern. With small irregular incomes, residents can only spend small, frequent amounts for the daily necessities, such as a daily bucket of water. Large expenditures are possible, but need special arrangements.
- The availability of household cash influences the decision to have the pit latrine emptied now or at a later time. This decision is taken in relation to other urgent household expenditures. Important in this respect is whether the man or the woman in the household controls this type of expenses.
- A “good” service is carried out in a hygienic manner, without spillage in the household yard or street. The service should be carried out completely, according to the agreed frequency or the agreed quantity. And the service should be performed at the time that it is required and agreed upon.
- The collection technology must be suitable to the physical conditions of the settlement. For example, it should fit the dimensions of houses and streets, move easily on unstable soil, and be able to turn around in complicated site layouts. Also, repairs should be easy and relatively inexpensive and rely on widely available skills. This will reduce dependence on technical workshops located in distant parts of the city.

- The point of contact for the service, that is the booking office, should be physically easily accessible, so that the residents do not have to spend time and money to go to an office located in another part of the city, to pay their user charges.
- The service should be socially accessible. Residents want to have influence on service delivery at the neighbourhood level, since they are not in a position to exercise political control at the central city level. Community influence is only possible if the service itself has characteristics that can be adjusted to suit the neighbourhood.

These features point to the desirability of a “neighbourhood based” collection service. This implies that the service is relevant to the neighbourhood concerned in social, economic and sanitation aspects. And that the service is available at the request of residents living in that neighbourhood. It also implies that local residents have the right to exercise control over the operation of the neighbourhood transfer or collection point. With the operation of suitable residents' committees the people have an opportunity to express their demands and influence the availability and performance of this service, including the setting of price levels.

1.8 The Social Status of the Cleaners of Latrines

The cleaners of latrines are often a special social or ethnic group. But there are significant differences in the economic position and social status of these people, as is shown in the following examples of Pakistan, India and China.

In Karachi, Pakistan, the street sweepers, latrine cleaners, excreta carriers etc. live together as a consolidated and well organized social group. The majority of these people are Christian Punjabis and Hindus isolated from other groups and considered as the lowest class of society. Because of this, however, the group has achieved a certain monopoly, putting them in a relatively strong economic position. There is a whole hierarchy and distribution of rights to clean a street, including latrines, with the more powerful and better paid jobs held by the big street owners muhaddams who supervise the “coolies” carrying out the work for them. Many private sweepers are also employed by the municipality. They pay the local authorities to get some hours off each day to clean “their street” (Streefland, 1979).

In India, the collection of nightsoil and the cleaning of latrines is the job of the Banghis, the lowest group within the caste of the “untouchables”. Many latrine cleaners or “scavengers” are employed by the municipal authorities. Their working conditions are bad and are characterized by low salaries, long working hours, and lack of work clothes (Schenk-Sandbergen, 1975). In contrast to the conditions in Pakistan, they are not only regarded as the lowest members of society, but are also the poorest people among the population in India. Their case also contradicts the observation made in the previous paragraph that the collection of human waste may be an acceptable source of income if nothing else is available. In India, the manual handling of excreta is only done by this particular class of people. And no other person will do this job. At present, the children of scavenger families tend to look for employment that is less polluting. This results in a shortage of scavenger personnel in some towns.

In some Indian cities, such as Ghaziabad, the scavengers are self-employed and belong to families who have the hereditary rights to perform this work for particular households

in particular streets. The Caste Council (Panchayat) sees to it that these rights are maintained. This also implies that the particular households are not at liberty to exchange one scavenger household for another. The particular type of relationship in which social responsibility and service are combined is well expressed in the manner of paying for the service. There is a daily payment consisting of one or two "roti" (Indian bread), which is a small, frequent expenditure for the owner of the latrine. At the end of the month the scavenger receives cash payment as well. Most of the self-employed latrine cleaners are women (70% in Ghaziabad). In contrast, it is the men who are employed by the Municipality in those towns where the municipal department provides the excreta collection service.

After the socialist revolution in 1949, the Government of the People's Republic of China made many endeavours to change the sanitary conditions in China. In conformity with the new ideology, the whole population became more involved. Now there are professional cleaning labourers, road sanitation committees, in which ordinary people participate periodically, and there is the Patriotic Sanitation Committee of which only high officials can be a member (Baumann & Karpe, 1980; Streefland, 1979; case study on China). In present-day China different categories of latrine cleaners exist in the cities. In Yichang, for example, both pit latrines and bucket latrines are a common form of private sanitation. The Municipality employs both permanent cleaners as well as temporary ones. In addition, there are self-employed cleaners and there are suburban farmers who have customary rights to collect nightsoil from particular streets.

The socio-cultural position of the latrine cleaners differs significantly between India and China. In India the cleaners are generally treated as a most abject group, because of their social status outside the caste system, and because the dirtiness of their work. Inspired by Mahatma Gandhi, however, a social movement to uplift the economic position of the cleaners is taking hold in many cities, supported by the government (see case study). In China, by contrast, the government yearly pays tribute to the sanitation workers, by holding festivals in their honour and inviting them on trips to beautiful holiday resorts. This is an official recognition of the importance of the sanitation workers for public health as well as for the agricultural economy.

Along the East African coast, where Islamic influence is strong, people are adverse 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, unless the work is performed without contact with the excreta.

Nevertheless, social esteem for the pit latrine emptiers is also related to the type of equipment they are utilizing. A MAPET pit latrine emptier in Dar es Salaam, for example, who uses mechanical equipment, has a higher social status than a traditional pit latrine emptier who only uses a hoe and a bucket borrowed from the house owner.

1.9 Aspects of Hygiene

One of the critical issues in the operation of bucket and pit latrines is their hygiene, both personal and environmental. The handling of fresh human excreta is a serious hazard to personal health when the workers empty the latrines with their bare hands, and carry the nightsoil on their head or shoulders without protective clothing. Surveys show that the incidence of parasitic diseases and skin infections is higher among these workers than among other categories of the urban population (see the

case study on China). These people are also more susceptible to disease as their living conditions and very low income undermine their health condition. Anaemia is common. Furthermore, the smell and touch of the excreta are a most unpleasant experience.

There is public concern about these hygiene aspects, particularly regarding nightsoil buckets. National committees, for example in India, have recommended that the emptying of buckets is made more hygienic through fitting the buckets with lids, introducing pushcarts for easier and cleaner cartage, providing the workers with boots and gloves, and making facilities for washing and bathing available. Others recommend that buckets are carried to a depot before being emptied, and that a clean, disinfected bucket then be substituted. At the depot they can be washed thoroughly and painted with a disinfectant and even a colour code to facilitate sanitary inspection. Yet implementation of these recommendations is always slow.

Public health officials and socially concerned NGOs, such as Sulabh International Social Service Organisation in India, therefore advocate a more fundamental approach. They press for the abolition of bucket latrines, out of concern for the health and the human dignity of the bucket collectors. In fact, the Government of India has enacted legislation to ban scavenging and is introducing programmes to convert the existing bucket latrines to sanitary toilets where scavenging or manual handling of human waste will not be needed. The Government is aware, however, that until all bucket latrines are converted, the present system of collection of human waste should be improved.

The health of residents and the environment is also affected. The hygienic quality of the latrines is determined by their being used properly, and by their reliable operation. When too many people use these latrines, their overuse has negative consequences for public hygiene. The same can be said when sludge or nightsoil is spilled during the collection or when the equipment is not cleaned properly. Also, when the sludge gets mixed with hazardous substances, such as batteries or paraffine that are thrown into the pit, this contributes to environmental pollution.

A social feature observed in many cities is that residents make a sharp distinction between private and public property. While they keep their own house, yard and toilet extremely clean, they care much less about the area outside their house. The streets often serve as the collectors of all kinds of refuse. Such a perspective can be modified by invoking the help of cultural and social leaders. Environmental education and social control among residents can be mobilised so that they themselves become aware of the possibilities to obtain a clean environment.

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II MAPET: A Service for the Collection of Latrine Sludge from Households in Dar es Salaam, Tanzania by Jasper Kirango¹ and Maria S. Muller²

2.1 Introduction

This chapter presents the Manual Pit latrine Emptying Technology (MAPET) project that was initiated in 1988 by WASTE at the request of the Dar es Salaam Sewerage and Sanitation Department (DSSD) in Tanzania.

The Dutch Ministry for International Cooperation financed the project, which included the input of a sanitation technician, a sanitation planner and a sociologist over a period of four years. The equipment that was developed during this period was donated to the DSSD.

The following features characterized the project approach:

- Participatory development and technology introduction through cooperation with local technicians, pit latrine emptiers, local leaders and residents
- Combining elements of technologies that are familiar to small workshops in Tanzania, such as vacuum and water pump technologies, and a traditional method of pit latrine emptying
- Pit emptying as self-employment that can provide adequate household incomes, but linked to public sector service operation

During the project period eight sets of equipment were developed and adjusted after field tests.

MAPET started as a local technology development project for emptying latrine pits, and became a pilot service to collect latrine sludge, as the transfer, disposal and treatment of sludge are part of its operations. MAPET is a neighbourhood based service with operational involvement of local leaders.

The general setting will be described, including the institutional position and responsibilities of the DSSD. This will provide the context for the MAPET project.

2.2 The Setting

Dar es Salaam, located on the east coast of Africa, is the largest city of Tanzania. The city is the former national capital and has the country's main harbour. It has a population of about two million people, with an estimated annual growth rate of 2.8%. The central part of the city, with its government buildings, private business offices, and international establishments, has a sewerage system. Major sections of the industrial area, as well as a few residential areas, are also connected to this system. A

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small percentage of the population has septic tanks. The large majority of the population (80%), however, relies on pit latrines. The majority of these residents belong to the low-income group.

The urban economy of Tanzania is experiencing growing unemployment in the formal sectors of the economy. This is due to a rapidly increasing population on the one hand, and to a structural adjustment programme that reduces the public sector on the other. Consequently, a steep rise in informal micro-enterprises has been observed by the ILO. These informal micro enterprises provide employment in many “niches” of the economy and in service provision. The MAPET service, operated by self-employed teams, is an example of this trend, in this case responding to a demand for basic services that the public sector cannot satisfy.

2.3 The Position and Role of DSSD

The Dar es Salaam Sewerage and Sanitation Department (DSSD) is a semi-autonomous department of the Dar es Salaam City Council, and is the only agency responsible for the operation and maintenance of the sewerage system, including the treatment ponds. Low-cost sanitation services fall under the responsibility of two municipal agencies, i.e. the DSSD and the City Department of Health. Several parastatals, such as the Port Authority, and private companies, such as commercial banks, also look after the sanitation facilities in their own buildings and housing estates. Each agency has its own fleet of vacuum tankers for desludging of septic tanks and emptying of pit latrines.

The City Council has jurisdiction over all the operational tasks, and has to approve all instructions and policy changes coming from the central government before they can be implemented. Starting from financial year 1991/92, DSSD operates as a parastatal body, although this is not yet legally enacted.

2.4 Regulation and Monitoring

DSSD has the authority to regulate and monitor pit emptying through the Sewerage and Drainage Act of the 1960's, and a subsequent sewerage and sanitation policy which names local government as implementing agent. DSSD monitors and enforces the regulation that latrine pits, filled up to one metre below ground level, must be emptied or closed. DSSD also regulates and monitors the discharging of pit emptying tankers into designated dumping sites. Institutions that operate sanitation tankers are given a permit for using the City's treatment plants. Conditions of the permit specify the area of operation, and the price to be charged by the City Council.

Monitoring is difficult as there are no specific standards. The national policy only states that sludge must be treated before disposal “to such a level that it cannot be a risk for public health.” Monitoring of environmental sanitation, including pit emptying, is done in cooperation with the Health Department. The Department has a Health Assistant with public health inspection duties in each of the local government wards of Dar es Salaam.

2.5 Financial Position of DSSD Regarding Pit Latrine Emptying

DSSD receives financial support from the Government to cover the personal emoluments for its whole staff and for some capital works. The costs of management and operation, however, are borne by the DSSD itself from its own sources of revenue, such as charges for pit emptying, and sewer use, sewer connection, sewer unblocking, and dumping of sludge charges.

The tariff structure concerning pit emptying, sewer user charges, and dumping fees does not aim at full cost recovery. A long, political decision making procedure takes place in the City Council for setting user charges, taking into account factors like customer affordability, the government's subsidy to DSSD, a certain inefficiency in service delivery, and political reasons.

2.6 The Position of MAPET in DSSD

The MAPET service has operated as a pilot project within DSSD, coordinated by the Head of Department and the Head of the Low Cost Sanitation Division. A MAPET Section, with its own account, was established in the Low Cost Sanitation Division with DSSD staff seconded for part-time duties with MAPET, i.e. two field assistants and three workshop technicians. The staff carried out construction and repair of equipment, training of the MAPET teams, performance monitoring, promotion of the service in the neighbourhoods, and communication between all parties concerned.

2.7 MAPET Pilot Project

At the beginning of the pilot project in 1988, two types of services for the emptying of pit latrines existed. They were the service with conventional vacuum tankers provided by the Dar es Salaam Sewerage and Sanitation Department, and the traditional method.

The service carried out by DSSD with vacuum tankers has great advantages. The modern technical equipment makes a service possible that is hygienic to both the emptying crews and the customers, and that disposes of the sludge in a controlled manner in the sewerage treatment plants. The tanker service also has its drawbacks in the conditions of Dar es Salaam:

- The tankers cannot provide service to many parts of the city, mainly because of the inaccessibility of the narrow, steep, muddy roads inside the low-income areas.
- Tankers are out of service for long periods due to maintenance and repair.
- The unit service price of emptying of one tanker load i.e. 5000 litres. Although this price is subsidised, poor people cannot afford the service fee instantly. In addition, "tipping" and payment of "incentives" to get the service delivered is a regular practice, increasing the price even more.
- Due to inaccessibility or unavailability of sufficient cash, latrine pits are overflowing, causing public health hazards.

The traditional method consists of scooping out or of flushing out the latrine sludge and burying it in a hole dug on the residential plot. The method necessitates breaking down

the superstructure of the latrine and the cement squatting slab. Local craftsmen, "fundi", who practise traditional pit emptying on a casual basis are available in Dar es Salaam. An important advantage of the traditional method is that customers and pit emptiers can agree personally the details of the service without bureaucratic regulations of a large government agency.

There are disadvantages as well. The emptying takes several days to complete and thus requires a high lump sum expenditure on labour. In addition, customers have to pay for the reconstruction of the pit slab and the latrine superstructure which are destroyed during the emptying process. The method is unhygienic because the emptiers manually empty the pits with buckets, sometimes even entering by the pit.

Summarizing the characteristics of the situation in Dar es Salaam, there is:

- a demand for pit emptying services, especially in areas that are inaccessible to conventional vacuum tankers.
- a demand for a type of service that is consistent with the social and economic preferences of the residents.

2.8 MAPET Equipment and the Sludge Collection Service

The MAPET equipment has two main components: a hand pump and a 200-litre vacuum tank, both mounted on pushcarts. Two flexible hose-pipes are a part of the equipment. They are a 3/4-inch hose-pipe, as air connection between the pump and the tank, and a 4-inch hose-pipe of 4 metres, to drain the sludge from the pit. A mixing rod to agitate the sludge before pumping is also part of the equipment. The collection service starts with personal contact between the customer and the MAPET team leader. At this stage, the MAPET emptier also visits the house of the customer to assess whether the space and the soil conditions are suitable for the most simple MAPET disposal and treatment method, that is burial on the residential plot. Then they negotiate over the service to be delivered and its price. At the agreed day and time, the MAPET team picks up the MAPET equipment from its parking place in the neighbourhood and take it to the customer's house. The equipment can be pushed over a distance of 2 kms at the most, because of its weight. The team then digs a large hole for sludge disposal. The latrine sludge is prepared for pumping by agitating it and by adding water and sometimes paraffine if necessary. After the hose-pipes have been connected the sludge pumping can start. It can take five to twenty minutes to fill up one 200-litre tank with sludge, depending on the sludge's viscosity and the pumping head.

When a tank is full, the hose-pipes are disconnected and the tank is manoeuvred next to the dug hole and tipped 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 hole is then covered with soil, a process which is repeated the next day when the sludge has settled. Finally, the equipment is cleaned and returned to the neighbourhood parking place.

At present, only on-site disposal can be practised, implying burying the sludge and covering it with a good layer of soil. It only takes place when the water table is low and when there is sufficient space on the plot.

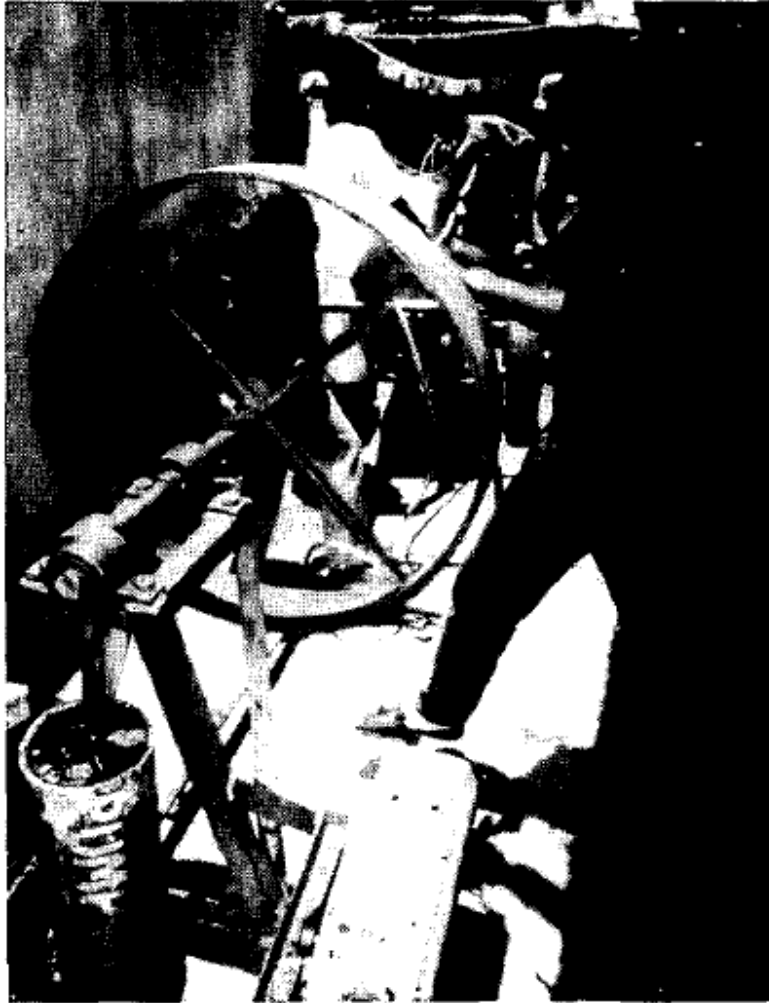


Figure II.1 A MAPET Team Member Operates the Flying Wheel of the System Manually.

2.9 Service Providers and the Institutional Setting

The MAPET service is provided by a team of three emptiers, each of whom is self-employed. The team leader selects his own team members. Together they decide on how to cooperate in the work and how to share the income they earn as a team. They depend on their own efforts to find work. Each team has its own set of equipment and its own service territory. The boundaries of each territory correspond to one or more administrative/ territorial units, called "Branches" in the former political system before 1995.

One team services on average one customer per day, provided there are good business

conditions. The first factor to determine good business conditions is to have a steady demand for service from customers. Customers are defined as people who have a full latrine pit and who have ready cash available. The second factor in good business conditions is to have easy access to repair facilities for the MAPET equipment.

To achieve these conditions, the MAPET teams depend on the cooperation of two other parties, i.e. the leaders of the neighbourhood, and the DSSD. Approval by the neighbourhood leaders is essential before any economic or service activity is carried out. In the case of MAPET, the leaders acknowledged that residents are facing great problems with full latrine pits. But they wanted a demonstration of the service before they agreed. In each neighbourhood, the leaders agreed that the neighbourhood "Branch" office be used as MAPET booking office. This is the central office in the neighbourhood known by everybody and easily accessible. And it is here that the MAPET equipment is guarded overnight. The leaders also assist with identifying customers.

The other essential party for the MAPET teams provides access to technology and its maintenance. DSSD has grown into this role, having staff and maintenance facilities for vacuum tankers and other vehicles. It gives direct enabling support to the MAPET teams in leasing or lending the equipment to them, and in carrying out major repairs. For minor repairs the MAPET teams turn to the informal mechanical workshops in their neighbourhoods for which they pay themselves. Replacement of essential components, such as a wheel, is, however, beyond the financial capacity of any MAPET team. DSSD also monitors the pit emptying performance, as part of its regular responsibility for sanitation.

MAPET teams rely on a support agency when starting services in a new neighbourhood in two more ways. DSSD gives training to new teams and issues a "diploma" to them. Training concerns proper ways of performing the pit emptying, assessing sites for safe burying of the sludge, cleaning the equipment after use, and carrying out basic repairs. While the diploma entitles the team to use the equipment. The Health Education Section of DSSD promotes MAPET in the neighbourhoods by emphasizing the importance of emptying latrine pits for public health reasons. This section also organizes the meetings with community leaders that are necessary to create public acceptance of MAPET.

2.10 Advantages of MAPET

The main advantage is that MAPET uses small equipment which enables the team to provide service in areas where conventional tankers have no access. This was, in fact, the purpose of developing additional pit emptying technology. However, residents of areas with access for tankers often demand MAPET service for several other reasons. First, the booking office is within easy walking distance in the neighbourhood, in contrast to the central DSSD offices. Secondly, customers can have direct influence on service performance, through their own negotiations with and supervision of the MAPET team they can also involve the neighbourhood leaders in case of disagreement.

Also in terms of cash outlay, customers like the MAPET service. They pay only after the service has been performed to their satisfaction. In contrast, they must pay DSSD in advance, while they have few means to complain, nor ways to demand better service from DSSD for their money spent. A crucial aspect of the MAPET service is, that the manner of payment is consistent with the expenditure patterns of low-income

households who have irregular incomes.

The manner of payment is related to the 200-litre tank as unit of service. Customers and pit emptiers negotiate about the number of tank loads of sludge to be removed. The small tank as a unit of service fits into the buying behaviour of low-income customers, who often buy small quantities of a commodity, such as one bucketful of water, or a cupful of sugar. A household that has small amounts of cash available at any one time may prefer to buy a "little bit of service" at frequent intervals in order to have its latrine function.

In 1992, the price charged per 200-litre tank load was circa US\$ 1. A survey in that period showed that 27% of the MAPET customers requested up to three tank loads of service, while another 27% of customers requested between three and five tank loads. The remainder demanded more tank loads of service.

Residents express their "feeling" that the informal, private MAPET service is inexpensive compared with the official, subsidised tanker service. They mean to say, that certain households may not have the large cash amount available to pay for a conventional tanker service which is more than US\$10 but can afford the lower lump sum for MAPET service, which is less than US\$5. However, in absolute terms, the unit price per volume for MAPET service is higher: that is \$5 per cubic metre, while for tankers this is \$2 to \$4 per cubic metre. Consequently, low-income households who have only access to MAPET services may be compelled to spend more on emptying their pit latrines, compared with those households that can make use of vacuum tanker services.

Another advantage is that the MAPET emptiers gain more public respect because they are using more advanced technology and apply a more hygienic operation, compared to traditional emptying methods. Wearing a MAPET overall uniform and carrying a DSSD diploma also increases their credibility.

2.11 Gender and MAPET Service

Questionnaire surveys analyzed by gender and discussions with women's groups confirmed that women hold themselves responsible for keeping the latrines in a clean condition. This mainly concerns keeping the surroundings clean, including the latrine slab, the floor, and the yard outside. Yet, neither women nor men consider the emptying of latrine pits as women's work.

Using the MAPET service allows women to complete their household task for the day because the booking office is in the neighbourhood. It is easy for women to make a booking for pit emptying, since the booking office is within walking distance and is often located in the building where public meetings are held or health care is given. In contrast, going to the centrally located DSSD office proves to be difficult for women, since it requires much time and transport costs.

Household decision making on whether to book the MAPET service and to pay, varies. In some households decision-making appears to be taken jointly by husband and wife, while in others the wives are not even allowed to hand over the payment to the pit emptiers.

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 expand and acquire a sound footing in the neighbourhoods.

2.12 Summary of the Characteristics of the MAPET Service

In summary the MAPET service has the following service characteristics:

- MAPET team provides a reliable service as it is performed without delay, and according to the agreement reached between customer and the MAPET team.
- MAPET is an effective sanitation service that can be performed where the conventional tankers have no access. However, it is only suitable for places where the traditional disposal method can be applied, that is in an area with a low water table.
- The MAPET service is physically accessible, as the booking office is located within walking distance.
- The MAPET service is socially accessible. The residents can immediately influence the reliability and effectiveness of the MAPET work, through direct observation and through complaints and withholding payment.
- MAPET provides an affordable service as the residents negotiate a price for a specified amount of service. The negotiated individual price falls within the general range of affordability of neighbourhood residents.

2.13 Improvement of the Service

To expand and improve the sludge collection service, a combination of different issues must be addressed.

At present, the sludge disposal method of MAPET is only feasible in locations with a housing density that allows for on-site disposal, and with a low water table. It is necessary to develop new disposal methods for implementation of MAPET in areas where space is limited and the water table is high. One such method will integrate the two existing pit emptying services in Dar es Salaam. The informal MAPET service will then transfer the sludge to a neighbourhood collection point, from where vacuum tankers will transfer it out of the neighbourhood to the city's treatment plants. Negative experience has already been gained with a fixed transfer station, constructed underground. Plans for a mobile sludge transfer station are ready to be tested, in the form of a tanker and trailer. However, there are still technical, operational, and planning solutions to be developed.

A further improvement lies in making the service more regular. The MAPET teams are faced with an irregular demand for pit latrine emptying. Pits are only emptied when full, and when the household has cash available for the service expenditure. Each household makes its own decisions in this respect, which causes great fluctuations in the total demand for the emptying service. One important consequence is a so-called "criss-cross" location of customers. Customers may be located at some distance from each other, which necessitates a team to spend unproductive time in moving the

equipment to the next customer. An important consequence is the irregularity of income for the members of the MAPET teams, who may be forced to look for secondary sources of income. A vicious circle may thus be set in motion, whereby MAPET becomes less easily available. This in turn threatens the business continuity of small enterprises, and reduces the positive impact of pit emptying on public health. MAPET could become a regular service if the neighbourhood community will organise it. Better organisation can only be achieved with extensive environmental health education and the cooperation of men and women residents and leaders.

Environmental health standards must be developed by the agencies responsible for environmental planning and those with experience in promoting community participation in neighbourhood development. Implementation requires training and supervision, as well as a legal framework to give DSSD the means to enforce public hygiene standards.

An important aspect to be improved is cost recovery for the depreciation of equipment. Currently, the labour costs of the MAPET teams are fully recovered as the fees negotiated with customers provide a basis for small business operation. However, cost recovery regarding the equipment itself has not been feasible. An informal MAPET team cannot afford the investment of about US\$2000 to purchase the equipment. DSSD has therefore made lease agreements with the teams. DSSD, however, has experienced difficulties in collecting the lease payments.

DSSD has until recently accepted responsibility for major maintenance and repair of the equipment. It is, however, not able to invest in new equipment for an expanded service nor continue with maintenance and repair without an adequate level of cost recovery.

In the pilot project phase of the MAPET service, DSSD has been the only agency with institutional linkages with the MAPET teams. When implementing the scaling up of MAPET services, it will be necessary to involve a new type of organisation to act as an intermediary between the MAPET teams and DSSD. Such type of organisation will identify and try out new forms of mobilizing capital and organising credit facilities. It will handle the issues of ownership and leasing of equipment to the MAPET teams. And this new type of organisation will strengthen the organisational capacity of neighbourhood communities in relation to public hygiene. And finally, an organisation is required that will provide professional expertise to DSSD for improving its regulatory and monitoring capacities regarding manual pit emptying services.

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III Scavengers and Scavenging in India: A Case Illustration from Ghaziabad by K.N. Gupta¹

3.1 Background

India is predominantly an agricultural country. According to the 1991 census, out of a population of 844 million, 74% live in nearly seven hundred thousand villages.

It has been assessed that hardly 20% of the urban population have access to water flush toilets connected to sewerage systems, 14% have water-borne toilets connected to septic tanks or leach pits, 33% have bucket or dry privies, and the remaining 33% do not have latrines of any type in their houses. The Task Force, constituted by the Planning Commission Government of India for tackling the problems of scavengers and suggesting measures to abolish scavenging, had assessed the number of bucket latrines in India as 7.64 million, of which 5.42 million existed in urban areas (1990-91). The number of scavengers engaged in manual handling of human waste was assessed as about four hundred thousand in the entire country.

The system of bucket latrines and the practice of open air defecation has wide spread effects: water sources get polluted, incidence of diseases rises affecting millions of people, labour force is affected, productivity of industry and agriculture falls. The debilitating effects of insanitary living conditions and deteriorating environment lower the productive potential of the very people who can least afford it. Among the poor, the women and children suffer the most.

3.2 Origin of Scavenging Practice in India

No authentic information is available to establish when and how the scavenging system (manual handling of human waste) came into vogue in India. However, sacred scriptures throw some light on the disposal of human waste which was done by slaves. It is interesting to observe that in Arthashastra (Economics) of Kautilya (320 BC) in the Maurya period, defecation in public places or near reservoirs etc. was prohibited and one had to pay a heavy fine for violation of the law.

With the advent of the Muslim era, during the mediaeval period when the Muslim women who used to observe "purdah" (veil) did not like to defecate in the open, bucket latrines were constructed to enable them to defecate in privacy. This made scavenging necessary. Those made captives by Muslim rulers were forced to clean the latrines and dispose of the human waste at distant places. After the captives were released, they were not accepted by the community; hence they formed a separate group called "Bhangies". These were renamed by Emperor Akbar as "Mehtars." Thus a separate class of people came into existence for disposal of human waste. This class became a hereditary occupational group with a fixed role and status in Indian society. The scavengers were placed at the lowest rung of the caste ladder, and because of the nature of their job called "untouchables." They did not get social justice nor human

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treatment. Being economically poor and almost illiterate, they could not revolt against the unjust sanctions nor could they obtain any work but scavenging.

3.3 Bucket Latrine

The most primitive version of collection and removal of human waste is referred to as the bucket latrine. The excreta which may or may not include urine are deposited directly in a receptacle placed below a platform with a hole. The excreta are removed periodically for disposal. This system has the advantage of minimal outlay on the part of the household. But it is unhygienic and offensive and is detrimental to environmental and health conditions.

3.4 Case Illustration of Ghaziabad

Ghaziabad is the district headquarters and is situated about 30 km east of Delhi. It is an important industrial town of Uttar Pradesh (a state in India). The town falls under the "National Capital Region" (NCR). The NCR is being developed in such a manner that excess population from Delhi can be accommodated in the smaller towns in the "NCR". The town is situated between latitude 28°-30' to 28°-5' and longitude 77°-15' to 77°-30' in the east. It is an important railway junction and well connected by roads to major towns. As per the 1991 census, the population of the town was 511,759 with 99,075 households. The old town is densely populated.

The topography of the town is almost flat terrain. River Hindon passes through the middle of the town and divides it into two distinct parts. The area to the east of the river is known as Cis-Hindon Area and the area to the west as Trans-Hindon Area.

Development of the town is the responsibility of Ghaziabad Development Authority (G.D.A.). In order to have a planned development of the city, a Master Plan was prepared by the State Town and Country Planning Department in the year 1960-61. In the year 1985, the Master Plan was revised to cover the period up to the year 2001. The total area of the town as per the revised Master Plan is about 22,000 acres.

3.4.1 Status of Sanitation and Water Supply

In Ghaziabad piped water supply was first introduced in 1955. Since then various schemes have been executed. The Master Plan for water supply was prepared in 1984-85 by U.P. Jal Nigam (Uttar Pradesh Water Supply and Sewerage Board) on the request of Ghaziabad Development Authority. The water supply is based on deep tubewells. The per capita water supply is about 180 litres per day.

The town is partially sewered. Part of untreated sewage is utilised for irrigation purposes and a part is treated in oxidation ponds or discharged into the river. No reliable data are available about the status of latrines in houses. A rough assessment is that about 28% houses have no latrines. They resort to open air defecation or use community toilets wherever available. There are nearly 15,000 houses with bucket latrines which are cleaned manually by privately employed scavengers. The roads and drains are cleaned by municipal workers "safai karamcharies", and solid waste is transported and disposed of as landfill outside the town.

3.4.2 Linkages between Scavengers and Households

When the local authorities were established in towns, the function of cleaning latrines and disposal of human waste was taken over by local bodies in a number of states and sanitation or scavenging tax was imposed for providing the service. Where scavenging is not municipalised, the latrines are cleaned by private scavengers and customary rights prevail. Scavenger families have acquired hereditary rights (customary rights) to clean the latrines of particular families. A customary relationship develops with the family members covering many areas of life.

As for the origin of customary rights of scavengers, it is generally believed that when landlords and chieftains migrated from rural areas to towns, they felt a need for latrines in their houses. They brought with them village sweepers who were made to clean the latrines. To meet the needs of other people in the neighbourhood, the scavengers extended their area of operation. Subsequently, with a growing number of households having latrines, it became necessary to have some sort of understanding amongst the scavengers and, therefore, the area of operation for individual scavenger family was demarcated by mutual consent. In those days there were no local authorities which could arrange cleaning of latrines. It was not considered worthwhile to employ a full time scavenger exclusively by one household for cleaning the latrine, so a number of persons jointly employed one scavenger.

In times of need the scavengers sell or mortgage their customary rights to other scavengers in the same manner as one does with one's property. However, deeds involving such transactions are not registered in the law courts. Nevertheless sale of customary rights is not very common. Such a sale or mortgage is more in the nature of an agreement within the community generally honoured through the sanction of the caste panchayat (council). Moreover, households, by customary rights to scavenger families, are unable to engage other scavengers, if they would desire that.

3.4.3 Collection of Nightsoil from Bucket Latrines and Disposal

The term "safai karmachari" is generally used in India for those engaged in cleaning roads and drains, as well as for those who are engaged in cleaning latrines and removal of human waste. In this report the term "scavenger" refers to those who are engaged in cleaning latrines, removal and transportation of human waste.

The scavengers remove human waste from bucket latrines in cane baskets or metal pans or drums after mixing it with ash or soil. They carry them on their shoulders or by hand. In earlier days the containers used to be carried as head-load. However, this practice is not in vogue now. In bigger towns municipal scavengers have been provided with wheel-barrows or hand carts fitted with drums to carry the human waste to municipality operated pail-depots or tankers standing at specified places. It is then transported outside the town by the local authority to trenching ground where, in some towns, it is mixed with solid waste. In smaller towns or where the number of bucket latrines is less, the human waste is collected in baskets along with solid waste. In some areas, collected human waste is sold to farmers by the scavengers. In such cases scavengers themselves dump it in fields to be used as a manure. Besides cleaning latrines and disposal of human waste, private scavengers clean the compounds of the houses, collect the solid waste of the households and carry it in baskets to municipal

garbage collection points.

In Ghaziabad the local authority has no role in collection of nightsoil. The bucket latrines are cleaned by private scavengers having customary rights. Each adult member of the family, including the women folk, work as scavengers or work as "safai karamcharies" in the municipality. The number of women working as scavengers constitutes nearly 70% of the entire work force engaged in scavenging. Members of the younger generation, who are educated, do not like to take up scavenging work.



Figure. III. 1 A Woman Scavenger Uses a Cane Basket to Transport the Waste from a Bucket Latrine after She Has Mixed the Excreta with Ash or Soil.

Private scavengers do not get any tools or equipments such as scrapers, metal pan, baskets, buckets, wheel barrows, hand gloves, gumboots, etc. from the local authorities or the households which they serve. The practice is that the collected human waste is put into the cane baskets on a layer of garbage and ash. Then the excreta are covered by garbage and carried to the intermediary garbage collection point operated by the

municipality and dumped there. Some scavengers use a wheel barrow, given to a family member employed in the municipal solid waste department, to carry the human waste. The scavengers do not have to pay anything to the municipality for disposing of the nightsoil and garbage at the intermediary collection point.

The scavengers walk less than half a km to the garbage collection point. The garbage collection points are places fixed by the Municipal Corporation. The municipal "safai karamcharies" also dump garbage there. From these collection points, the garbage is carried to main dumps fixed by the municipality by municipal "safai karamcharies" using wheel barrows. From there it is transported about 2 to 3 km away outside the town for final disposal as land-fill by the municipal trucks, tractor-trolleys, dumpers etc. Since human waste is not collected or transported separately at Ghaziabad, it is not used by anybody. It is disposed of along with the garbage and other solid waste of the town.

The municipal corporation has nearly 4000 "safai karmacharies" to clean the roads, drains and dispose of solid waste. Few of them are women. According to a rough assessment, there may be 1000 privately employed scavengers. The majority of whom are women.

3.4.4 Socio-economic, Living and Working Conditions of Scavengers

The employment of human beings of a particular class who make house-to-house collection of human excreta in buckets and baskets, and carry them on the head, shoulders or hand for disposal, is perhaps today the greatest stigma in the Indian society. The greatest weakness in the scavenging system is the employment of a particular class of people for such a demeaning task, which is looked down on even by those who derive benefit from their services. The stigma attached to this profession has passed down from generation to generation and the scavengers continue to carry out this work unwillingly. Thus the conservancy system is being handled by unhappy, grudging and sullen labourers. Many of the scavengers have lost their sensitiveness of human and social values, having been obliged to take up such profession since their childhood. This appears to have affected the mental attitude of the scavengers at work and at home, who are segregated from the rest of the community.

3.4.5 Economic Aspects of Collection of Nightsoil

About 30 years ago, private scavengers in small towns were generally paid in kind (a daily bread) and some perquisites like food, clothes etc. on special occasions like marriages, births, deaths etc., those supplements varying with the status of the householder. In bigger towns they were paid monthly, partially in cash, by each family served by them. In cities they were paid in cash only. Now the position has changed. In a majority of towns they are paid in cash per month by each household they serve. The payment is dependent upon the status of the household, amount of work, and number of persons in the household. Where the scavenging is municipalised, they are paid monthly salaries by the local authority. They are also entitled to the same retirement benefits in the form of provident fund, death-cum-retirement gratuity, pension, medical facilities etc. as are admissible to other municipal employees. They are also allowed weekly and other holidays, as well as time off, including maternity leave at par with other municipal employees. Private scavengers do not enjoy these benefits.

In Ghaziabad the scavengers are paid about Rs.5 to15 (US\$0.06 to 0.18) per month per family in addition to one or two roti (bread) per day. One scavenger services about 10 to 15 houses each day.

In Ghaziabad all scavengers are Hindus. Among the workers engaged in scavenging, female out-number males. The scavengers generally live in segregated slums in most unhygienic conditions. The local authorities, especially in major towns and cities, do provide housing facilities to some of them in order to improve their living conditions. In Ghaziabad the local authority has provided houses to only 8% of the "safai karamcharies." The study team on Social Welfare and Welfare of Backward Classes had laid stress on promoting integration by constructing houses for scavengers in colonies where people of other communities live. But in practice this is hardly followed. In major towns and cities community welfare centres are provided in "colonies" where large numbers of scavengers live. At some places creches are provided for the children of female workers.

3.4.6 Health and Hygiene Aspects of Nightsoil Collection

Scavenging is a potential hazard to health and hygiene. The All India Institute of Hygiene & Public Health, Calcutta, at the request of the Ministry of Health, Government of India, carried out a health survey of sweepers and scavengers in 1956-57 in and around Calcutta. The main findings were a significantly greater incidence of skin disease, anaemia and parasitic infestation of the alimentary tract mainly by hookworm.

3.4.7 Social Aspects of Scavengers

The scavengers in larger towns and cities are well organised. They have trade unions to settle their disputes by negotiation or by utilising the industrial relations machinery provided under the law. Unions play an important role, not only for protection and enhancement of the rights and privileges of their members but also in improving their social conditions by undertaking social activities for the welfare of their members. Due to the ignorance and backwardness of this section of society, trade union leaders often exploit them for their personal and political ends. In Ghaziabad municipal employed "safai karamcharies" have a strong trade union, but private scavengers are not covered by that union, nor have they their own union.

Scavenging communities and other "safai karmacharies" have strong community panchayats (councils) elected by them. This system has no legal sanction. These panchayats take decisions mainly on social issues. The system is now becoming non-existent in major towns and cities.

A large percentage of scavengers and their family members are illiterate, especially the women and girls. Although the government provides many incentives for education, only a small section takes advantage of these facilities.

3.4.8 Past Efforts to Improve Living and Working Conditions of Scavengers

The sweepers and scavengers are rendering a very essential service to the community, particularly in urban areas where the problem of sanitation and environmental hygiene has assumed a new dimension under the impact of rapid

urbanisation and growing congestion in the central areas. On account of the nature of their work, they have been the most despised section of the working class. Even though Mahatma Gandhi, the Father of Nation, endeavoured to awaken the social conscience of the people for ameliorating the working, service and living conditions of the scavenger class, not much has been achieved. The central and the state governments have been concerned, as is evident from the number of Committees and Commissions that have gone into the question of improving the living, service and working conditions of the scavengers. The recommendations of these Commissions/Committees were mainly confined to increases in wages, supply of uniforms, facilities for education, reduction in working hours, housing, and supply of equipment and tools. Although efforts have been made by state governments and local bodies towards improving their conditions, scavengers continue to suffer from various social and economic handicaps.

3.4.9 Present Efforts in Improving the Bucket Latrines

The Government of India and state governments are keen to eradicate scavenging from the country. The Government of India has passed legislation to ban scavenging. NGOs are active in assisting the government in achieving the target of eradication of scavenging as early as possible. Sulabh International Social Service Organisation is the largest non-profit NGO in India to promote sanitation and prevent environmental pollution by converting bucket latrines to twin pit pour-flush toilets and constructing pay and use community toilets with bath, washing and urinal facilities. Sulabh has also initiated social reforms without disruption of the existing social structure.

In Ghaziabad, the Municipal Corporation has entrusted Sulabh with the work of converting 10,255 bucket latrines to twin pit pour-flush toilets. Of these, 5,817 bucket latrines have already been converted. The sanitation facilities, provided by Sulabh in Ghaziabad, are being used by about 40,000 persons daily.

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Interaction with the officials of Health and Sanitation Section of Ghaziabad Municipal Corporation.

Interaction with the Officials of the Union of Safai Karmacharies, Ghaziabad Municipal Corporation (Union of Workers of Ghaziabad Municipal Corporation engaged in cleaning of roads, drains, disposal of solid waste etc.)

Interaction with the scavenger community leaders at Ghaziabad.

IV Collection and Disposal of Nightsoil from Nightsoil Buckets **Case Illustration from Accra, Ghana** *by James Gordon¹*

4.1 Background

Accra, the capital of Ghana, is the largest city in the country. It is estimated that the current population of Accra (1996) is 1.26 million.

The various types of latrines in use in the city are classified as follows:

	% of population
Water closet with septic tanks	70
Water closet connected to central sewer	5
Public toilets of various kinds such as WC, Aqua Privy, KVIP served	20
Bucket latrines	5

Of the various types of latrines listed above, the bucket latrine is the oldest. This type of latrine was introduced by the European colonialists in the 17th or 18th century. Traditionally, the people of Ghana used pit latrines, which were normally sited on the outskirts of the community at such distance that the smell or flies around the pit could not reach the houses in the community. The communities were also relatively small during that time.

When the European colonialists came and started building trading centres and other structures for the purpose of administration, they found it was necessary to build toilets in their homes or offices. Hence, Europeans introduced the bucket latrines which are emptied on a daily basis. Bucket latrines were built, along with every house, as the colonial administration expanded. When finally piped borne water and water flushed toilets were introduced, these new types became the standard for the outskirts of the city. Thus, as the city is growing, the system of water flushed toilets is also expanding.

The issue of what to do about the bucket latrines in the old parts of the city is important. It is a pressing question, as the continuing operation is cumbersome with some 4,000 conservancy labourers in the employment of the Accra Metropolitan Assembly (AMA) to carry out the work. The AMA, therefore, reached a policy decision in 1987 to immediately phase out bucket latrines and privatize what cannot be phased out. To implement this policy, house owners with bucket latrines were encouraged, with a soft

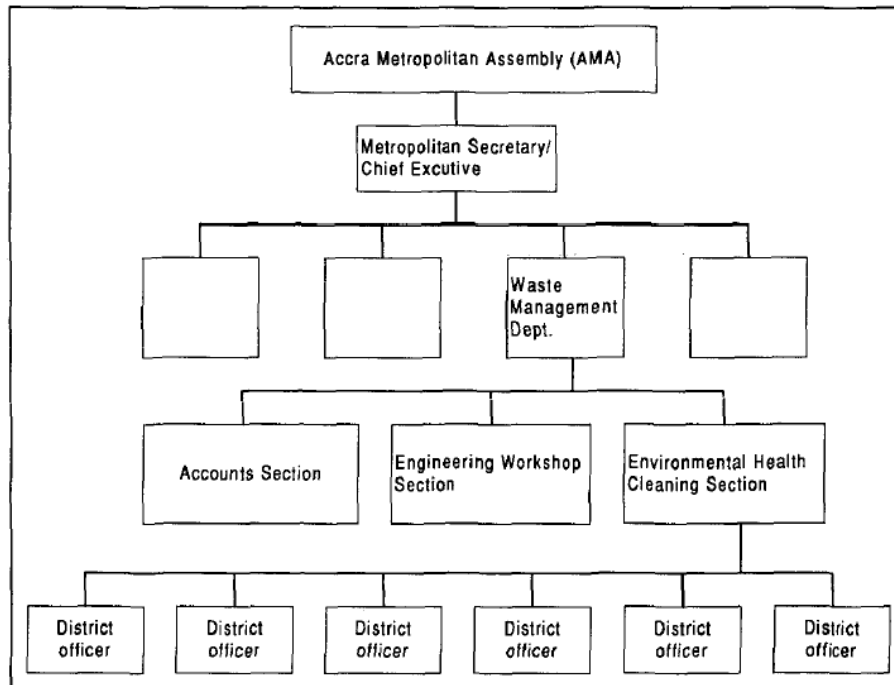
¹ James Gordon is a sanitation engineer working independently.

loan programme, to change to water flush toilets with septic tanks or to Kumasi Ventilated Improved Pit latrines (KVIP). The emptying of bucket latrines was then privatized by contracting out this work to private contractors. The Waste Management Department of the Accra Metropolitan Assembly remains responsible for the collection of containers and their transfer to the treatment plant.

4.2 Accra Metropolitan Assembly

The Accra Metropolitan Assembly (AMA) is the elected body which has both political and policy responsibility for the city of Accra.

The organisational structure through which the AMA carries out its various responsibilities is presented in Figure IV.1. The Waste Management Department (WMD) of the AMA is responsible for all aspects in connection with sanitation in the city and supervises all operational activities. The AMA is operating as the centralized organisation.



Note:

1. Accra Metropolitan Assembly is the elected political body. Assembly members represent the various wards of the city.
2. Metropolitan Secretary - Chief Executive. He is nominated by the president and approved by 2/3 majority of votes of the members of the AMA.
3. District Officer or District Environmental Health Officer.

Figure IV.1 Organisational Structure of the AMA.

Bucket latrines are in use in many high-density and low-income areas of the inner city. Emptying of these bucket latrines is carried out by contractors who have a contract with the Waste Management Department.

The areas with bucket latrines, serviced by each contractor, are located in a District headed by the District Officer, i.e. District Environmental Health Officer.

The emptying service operates only in very small sections of the city. Table IV.1 shows the list of companies currently operating the service under the supervision of Accra Metropolitan Assembly and their areas of operation.

4.3 Primary Collection of Nightsoil from Bucket Latrines

A conservancy labourer or collector makes his rounds with a 25-litre bucket, covered with a lid. This he carries on his head, in addition to a broom and a water can in his hand. At a bucket or pan latrine, which normally has an outlet door outside the house, he stops, opens the outlet door, and draws out the filled bucket or pan. Then he empties the pan/bucket into his large bucket and washes the inside of the pan/bucket in the street, he puts it back into its place and shuts the door. He lifts his large bucket on to his head, lifts the water can and broom and moves on to the next house.



Figure. IV.2 The Back of a House in Accra Showing Two Openings for Bucket Latrines.

Table IV.1 Companies Involved in Emptying of Bucket Latrines in the City of Accra

No.	Company	Area/Zone	No. of Containers	No. of Households	Rate of Removal /week	No. of Labourers
1.	Daben Cleansing Services	Teshie and Nungua	5	829	2	25
2.	Rock Do Ltd.	Laakoo La Wireless	2	506	1	19
3.	Abo Services Ltd.	Osu Market Osu Regal Junior Quarters, Adabraka Adabraka Market	4	640	1	20
4.	Sir Francis Pharmacy Ltd.	Farrah Avenue Bubuashie no.8 Kokomlemle Omane Darkuman Cable & Wireless	5	700	1	25
5.	Bogya No. 1 Services	Nima Highway Nima 5&6 Maamobi poly. Maamobi-robert Motors Nima-chief Kardo	5	780	2	21
6.	Bogya No. 2 Services	Newtown Market A.n.t. Experimental Shool Kotobabi Unit 3	3	568	1	24
7.	Bogya No. 3 Services	Kotobabi Powerlines Silk Cotton Tree Pig Farm Alajo	4	540	1	22
8.	Metro Towers	Freedom Market Camera Mamponseh Mamprobi	4	553	1	23
9.	Ajonesburg Ltd.	Kroo Quarter London Market	2	600	1	23

He goes through the emptying process from house to house until his large bucket is full. Then he carries the filled bucket to the nightsoil transfer container where he empties it. He then returns to service the buckets of other houses. When all pan/bucket latrines in his area are serviced or emptied, he washes his large bucket by the roadside and takes

it to his home for storage. This process is normally carried out at dawn and only a few people ever meet the conservancy labourer carrying out his assignment.

Each bucket is emptied every other day and the conservancy labourer normally goes on fixed routes as decided by a contractor. One labourer empties or services between 12 to 20 buckets per day depending on distances between buckets.

All transfer containers are placed at Sanitary Sites in the neighbourhood in such a manner that distances between the transfer container and the buckets in the area of operation, can be easily covered on foot. A transfer container is about 1.5 m high and is thus low enough so that the large buckets can be emptied into it by hand.

4.4 Collection of Nightsoil from Secondary Collection Points

The transfer containers are owned by the Waste Management Department (WMD) of the Accra Metropolitan Assembly (AMA). These are placed at Sanitary Sites which, are either open or enclosed spaces where a multilift truck can enter and pick up the containers. The containers have about 6m³ capacity.

A multilift truck leaves its base with a clean container and goes to a Sanitary Site. On arrival it drops the clean container and picks up the full one. The multilift truck carries the full container to a treatment plant designated for that purpose. Currently only two treatment plants, Achimota and Korle-Gonno, receive nightsoil. The truck empties the excreta into the sedimentation tank of the treatment plant. The containers are then washed and carried to the next Sanitary Site where the washed container replaces the full one. The process goes on until the last transfer container is serviced and the multilift truck returns to the depot with a washed container ready for service the next day.

The emptying operation is carried out at regular intervals, depending on the number of buckets in each locality. The longest time interval containers are left without emptying is seven days.

The containers as a rule are picked up only when full, since WMD charges the contractor for the lifting. Thus the contractor will wait as long as possible before having it picked up. When a container is full, the contractor goes to pay for the lifting before the lifting is performed.

The excreta treatment process as performed by the WMD is described in the following section.

4.5 The Treatment Process of Nightsoil

The container contents are emptied into a sedimentation tank. In this sedimentation tank, raw nightsoil from buckets is mixed with sludge from cesspit emptiers in the ratio of 1:4. Sedimentation takes place in the sedimentation tank and the liquid at the top is run off into a series of ponds where the liquid undergoes a treatment process before final discharge into a river.

When a sedimentation tank is full it is left standing for six weeks for the sludge to become pathogen-free, while the other sedimentation tank is filled. The sedimentation

tank is then emptied and the sludge heaped into a windrow using a wheel loader.

4.6 Windrow Processing of Nightsoil

The contents of a sedimentation tank heaped into a windrow is labelled and dated. The temperature of each windrow is recorded daily. Temperatures are taken in five or six places and the daily average recorded. Three or four weeks after the formation of a windrow, temperatures rise from an average of 40°C to 65°C. Turning them takes place using a wheel loader. During turning, temperature falls due to evaporation and aeration. After turning, temperature begins to rise again.

The temperature records (temperature-time graph), being plotted against times, show an increase with time until a maximum temperature is attained. This temperature rise is an indication of biological decomposition taking place inside the windrow. Each windrow is left in place for a period of five or six weeks for decomposition to take place between turnings. When any windrow attains constant ambient temperature, the sludge is said to be matured and can therefore be screened into compost. The windrow processing is illustrated in Figure IV.3.

Compost from windrows of solid waste and of liquid waste (faecal matter) are screened separately. They are then mixed in ratios 1:1 or 2:1. Packed in 25 Kil sack, they are sold at c 1,800 per sack (equivalent to US dollar \$1.20).

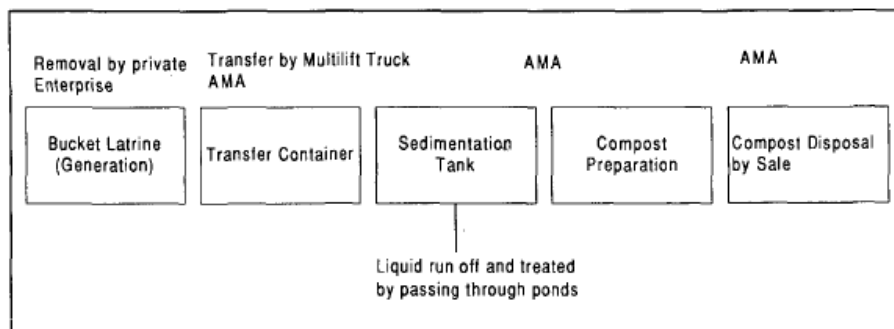


Figure IV.3 The Windrow Processing of Nightsoil in the AMA.

4.7 Some Financial Data on Nightsoil Collection Operation

The rates introduced in 1996 on various operations of nightsoil collection are as follows. The figures are averages based on different rates provided by contractors.

- Conservancy Labourer/Scavenger's pay per month
c 75,000 to c 90,000 per month (\$50 - \$60)
- Charge/bucket/month as paid by users - c 8,000 (\$5.33)
- Charge per lifting of transfer container - c 30,000 (\$20.00)

(Normally a transfer container of 6m³ capacity is allowed to fill only up to 4.8m³ prior to removing from its location.)

4.8 Licence Fees Charged by Waste Management Department (WMD) of Accra Metropolitan Assembly to Contractors

Introduced in 1996, fees were charged per bucket/month as follows:

- Charge paid by a contractor, from his income as fixed by WMD = c 1,500 (\$1.00)
- Income of contractor c 6,500 (\$4.33)/bucket/month
- Butte sale price of compost per 5 m³ = c 75,000 (\$50)
- Retail sale price of compost per 25 kg sack = c 1,800 (\$1.20)

4.9 Social Aspects of Nightsoil Collection

Nightsoil collectors or conservancy labourers live in their areas of operation or in adjacent neighbourhoods, since all their operations are carried out on foot and at night. There are no hereditary linkages between nightsoil collectors and households in contrast to what is the case in some Indian towns. Children of nightsoil collectors attend school with everybody else. The community being served may know the contractor of the nightsoil collection service or his supervisor. Complaints can be lodged with either of them or with the Accra Metropolitan Assembly District Officer, but not necessarily with the individual nightsoil collectors.

The collection system is not socially acceptable, hence efforts are being made in the city to completely phase out bucket latrines.

4.10 Conclusions

Conservancy labourers or nightsoil collectors came on the scene when the bucket latrine was first introduced. In the past, the collection of nightsoil buckets was carried out by workers from neighbouring countries who came to the Gold Coast (the colonial name for Ghana) to work.

Today there are only a few foreign workers left. Some hard-pressed Ghanaians have joined the ranks of nightsoil collectors. Nightsoil collection, although a very necessary and useful social service, has always been looked down upon.

It is understood that new methods are being practised in different parts of the world for collection and disposal of nightsoil in a more safe and hygienic manner. Therefore, every effort must be made through seminars, publications or other means of dissemination of information to bring to the attention of governments everywhere, how others have solved their sanitation problems.

V Collection and Disposal of Excreta from Public Dry Latrines, Household Dry Pit Latrines and Bucket Latrines in Yichang City China

by Jin Rulin Fout! Bladwijzer niet gedefinieerd.¹

5.1 Background

The Republic of China has a total of 1.2 billion population at present of which about 400 million live in 620 big, medium and small cities spread over the country. Collection, treatment and disposal of human excreta are a major problem in these cities, as considerable sections of the cities are not served with water borne sewerage systems. In big and medium-sized cities a large proportion of the population is served by water flush public latrines. The remaining areas in those cities have dry public latrines.

In areas where a water borne sewerage system is available, most of the city residents have individual house connections, while those in other areas rely on bucket or pit latrine or use public latrines available in the community. However, public latrines occupy a prominent place in the available sanitary facilities for city residents (Table V.1). Although it is evident from the above data, that a large number of public latrines are available in each of these cities, these toilets are insufficient to meet the demand created by inhabitants as well as the floating population who visit these cities.

Water flush public latrines are available primarily in city centers and dry public latrines are mostly found in suburban and peri-urban areas. These public latrines are built and maintained by the Sanitation Bureau of each cities which is known as Environmental Sanitation Administration (ESA).

In addition to these two types of latrines, in suburban and peripheral areas people use private dry bucket and pit latrines. Most of these latrines are built and maintained by the farmers in the area, who collect the excreta for farmyard use.

Public latrines in Chinese cities are planned and built based on the guidelines provided in a publication of the Ministry of Construction, known as "the Standards in Planning and Design for Urban Public Latrines (CJJ 27-89)".

At present most of the dry public latrines in cities are being converted to water flush toilets, under a programme known as "latrine revolution". Under this programme, 38 dry public latrines in the capital city of Beijing were converted to water flush latrines in 1994 at a cost of 13 million Yuan RMB (Renmin.bi - unit of Chinese currency), which is equivalent to 1.57 million US\$.

Another activity under the latrine revolution is installation of dry pit latrines with improved designs. The excreta accumulated in these buckets or tanks are taken away by farmers and after a period of fermentation used by them as fertilizer.

¹ Jin Rulin is a sanitation engineer working with the Wuhan Urban Construction Institute.

Table V.1 **Available Latrine Types in Selected Big, Medium and Small Cities in China**

City Scale	City	Present Population (10 ³)	Available Public Latrines				Total
			Water Flush		Dry Latrine		
			No.	%	No.	%	
Capital City	Beijing	1000	4760	70	2040	30	6800
Super	Shanghai	1300	828	75	276	25	1104
Big	Wuhan	353	804	82	175	18	929
Medium	Yichang	38.3	84	67	44	33	128
	Xiangfan	47	133	80	34	20	167
	Huanghi	5	59	53	51	47	110
Small	Huangpi	6	7	6	100	94	107
	Beiging	19.2	5	38	8	62	13

Although the above developments are taking place for the improvement of public and private latrines in Chinese cities, it has been found that a considerable proportion of the population is still using private or public dry pit or bucket latrines (Table V.2).

With the development of China's economy and the corresponding improvement of people's living standard, it is expected that most city residents and institutions will develop indoor toilets for their usage.

5.2 Yichang City: A Case Study

The City of Yichang, the case study, is located in Hubei Province of China. It has a population of 383,000 living in about 76,600 households spread over an area of 2902 km². Only 75% of the city population are served with a sewerage system, while the balance is using public dry latrines or bucket latrines.

5.2.1 Collection and Disposal of Nightsoil

The Environmental Sanitation Administration of the city is responsible for collection and disposal of excreta from public latrines which are located in the city core. In the city periphery the collection of nightsoil is mainly handled by the sub-urban farmers who use excreta for agricultural and aquaculture activities.

In 1995 the Environmental Sanitation Administration (ESA) employed about 656 people on a permanent basis and 417 on a contract basis. It is directly involved in collection, transportation and utilization of excreta collected from public latrines, household buckets and pit latrines. However, the collection and disposal methods of these three latrine types differ from one another.

Table V.2 **Population Using Private or Public Dry Pit or Bucket Latrines**

City	Population (10 ³)	Population using Private or Public Dry Pit or Bucket Latrines		
		No. of People	%	No. of Buckets
Shanghai	13000	N/A	N/A	300,000
Wuhan	353	11664	33	N/A
Yichang	38.3	964	25	6,400
Xiangfan	47	17401	36	N/A
Huanshi	53	18235	34.5	N/A
Beijing	19.2	10.2	53	N/A

i Public Latrines

Excreta are collected out of public latrines using vacuum trucks and transferred to storage tanks of the ESA. After digesting the excreta in the tanks for about one month, the excreta are sold to farmers.

ii Household Buckets

The employees of the ESA collect household buckets using carts, or in certain areas farmers are permitted to collect excreta directly from household buckets and public latrines. The farmers normally maintain a storage tank in which excreta are collected. Once the excreta are digested it is used in farmyards.

iii Pit Latrines

Normally pit latrines are constructed and managed by sub-urban farmers who collect, treat and utilize the excreta for farming purposes. When pit latrines are full, farmers collect the excreta and use it in farmyards.

5.2.2 Financial Aspects of the Collection of Excreta

As indicated above, the collection, treatment and disposal of excreta from public latrines, bucket and pit latrines are responsibilities of the Environmental Sanitation Administration (ESA). ESA has mainly two methods of collection of excreta. It uses vacuum tankers to empty public latrines in urban areas where a sewerage system is not available. In sub-urban and peri-urban areas it employs contract labourers who either use hand pushed carts or animal-pulled carts to collect excreta. In addition, the farmers also collect excreta as being permitted by the ESA.

According to a recent study it was found that a household in Yichang has to pay US\$3.6 per month to ESA for collection of excreta from each bucket available in the household. These collection charges support the ESA to meet part of its expenses incurred on labour and maintenance of equipments. However, when farmers are permitted to collect excreta from household latrines, the households do not make any payment as the farmer gets the benefit by using excreta as fertilizer. It is clear that the ESA will not be able to continue its services as it has to shoulder heavy financial losses every year on collection and disposal of excreta.

Therefore, alternative methods of collection and disposal of excreta have to be explored in order to ensure effective and efficient excreta collection.

5.2.3 Problems of the Existing Excreta Collection System

According to the UNDP/ World Bank assisted Hubei Urban Environmental Project (HUEP), carried out in 1994-95, several problems of the existing non-sewerage sanitation system have been identified. Some of them are indicated below.

- Inadequate treatment of excreta at storage tanks.
- Improper design of storage tanks for untreated nightsoil with a 30 days retention time requirement.
- Sludge from septic tanks and fresh nightsoil from dry latrines are often used by farmers without any treatment.

In addition, where septic tanks are used, they often do not function properly, due to improper design or lack of desludging. As a result the discharge of septic tanks creates pollution in non-sewered areas.

5.2.4 Health and Hygiene Aspects of Excreta Collection and Disposal

In addition to the technical problems connected with nightsoil collection, the health and hygiene aspects also indicate alarming signals in Chinese cities. Farmers, sanitary workers and children below the age of 10 have been identified as high risk groups for whom there is a greater chance of contracting diseases as a result of direct contact with excreta. The extent of the contraction of disease for those directly exposed to excreta, for example excreta-emptying workers and excreta-applying farmers and fishermen is: 98 to 643 out of every 100,000 people in terms of Hepatitis A. With the incidence higher than other professional groups: 93 to 700 out of 100,000 people for Dysentery. The incidence of Hepatitis A in people involved in excreta collection and disposal is 1.9 times higher than other workers in cities. Additionally, the incidence of

Hepatitis A for those who have not been initiated on hygiene is 5.6 times higher than the educated people. Therefore, improved hygiene behaviour and education on proper hygiene practices are necessary for these vulnerable groups.



Figure V.1 An Animal-pulled Cart for Nightsoil Transportation in Yichang.

5.2.5 Social Status of Nightsoil Collectors

In China, nightsoil has been used for farming for generations for over 2000 years. Therefore collection and disposal of nightsoil is not regarded as a job of an under-class section of the society. There is no such differentiation as most farmers in peri-urban and rural areas regularly collect and use nightsoil for agricultural purposes.

Even in cities, although the excreta collectors and scavengers have a lower income compared to other workers, their social status is equally respected. In fact, excreta collectors, scavengers and other cleaners are honoured as “city beautifiers”. Each year the Ministry of Construction selects some people from these groups to travel domestically and spend some time in tourist resorts as an indication of concern and respect from the government to their service. Thus, there are no specific social problems in respect to the collection of nightsoil.

5.3 Conclusion

Recently, the policy of the Chinese government has been to improve the system for treatment and disposal of excreta. For this purpose, expansion of sewerage networks and improvement of individual toilets, by converting bucket latrines into water flush toilets have been identified as key areas in connection with the collection and disposal of

excreta.

Furthermore, improvement in environmental sanitation and working conditions of excreta collectors, scavengers and cleaners, in safe and hygiene handling of excreta, are other aspects which receive consideration. Safe handling of excreta with proper equipment and precaution would greatly reduce the risks to those who are exposed to excreta. Thus, it should be mentioned that a comprehensive coverage of activities connected to excreta collection and disposal is required to ensure safe and hygiene handling of nightsoil, without disturbing the traditional use of human excreta for agricultural purposes.

VI Financial Analysis of the Manual Pit Emptying Technology and Service (MAPET) by Lex Hemelaar¹

6.1 Introduction

MAPET was introduced on a project basis in the city of Dar es Salaam, Tanzania, during the period 1988 - 1992. The project was sponsored by the Dutch Ministry for International Cooperation (DGIS) and executed by WASTE in collaboration with the Dar es Salaam Sewerage and Sanitation Department (DSSD). At present, the system is running independently under the management of DSSD. The data used in this analysis are taken from project documents and updated by recent research undertaken in Dar es Salaam. However, expert judgement was required, in some cases when the availability and accuracy of some data items were not satisfactory.

The information provided by the analysis can be used as input in the decision making process. Policy makers at the municipal level can use the financial information as one of the aspects which are relevant when deciding on feasible sanitation systems.

The objective of the financial analysis is to reveal under what conditions MAPET can be operated as a financially feasible service.

A methodology was developed to perform the financial analysis, based on financial practices. In this methodology, all the costs of the service and the revenues are computed. Subsequently, the profitability of the service is presented in a Profit & Loss Statement. This statement summarizes the cost and revenue of an entity over the period of one year. The cost is the money equivalent of the inputs used by the entity. These inputs, required to be able to render the services, consist of tangibles like labour, capital goods and land. Revenue refers to the money equivalent of the compensation given to the entity by users of the service or supporters of the entity. The balance between cost and revenue is either a profit or a loss, depending on whether the result is positive or negative. The profitability of the entity is the main issue in any financial analysis. If the entity generates losses, then it is likely to go broke sooner or later.

To conclude, it is emphasized that the financial data used in this analysis have a fair degree of uncertainty. The data were collected from project documents based on social surveys, interviews and the records kept by the MAPET teams (1988-1992). These were updated by the DSSD of the municipality of Dar es Salaam (1995). Expert judgements were used to enhance the reliability of the data.

6.2 Scope of the Analysis

The entity under research is a MAPET team, an independent and autonomous entity with an informal status, i.e. not a formal, legal organisation. The members of the MAPET teams are all self-employed. A team consists of one leader and two helpers. Costs, revenues and profits are shared among the members. None of them has the

¹ Lex Hemelaar is an environmental economist working with WASTE.

status of employee or contract labourer. MAPET could not be regarded as an enterprise yet, because it is not the principal activity of the members. The reason for this is that the number of customers is too small to have a permanent work load. Therefore MAPET has the characteristic of a survival activity rather than a business oriented activity.

The kind of service activities that a MAPET team renders is the emptying of pit latrines and final disposal of the sludge. The technology applied is operated manually. Emptying is done by using a vacuum hand pump which is connected with a hose-pipe to a 200-litre tank which is constructed on a push cart on bicycle wheels. Treatment and disposal are done by burying the sludge on the same or an adjacent plot.

The equipment used by the team was bought by the project and municipalized by the Dar es Salaam municipality. The municipality manages the service, takes care of repair and maintenance, and provides in-service training to trainees. Graduates of the training program are given a license to operate the service and may use the equipment free of charge. The license is withdrawn if the performance of the team is below standards.

6.3 The Service Area and the Service Level

The service area in which the MAPET team operates is determined by the geographical range of the push cart. One team mainly operates in an administrative neighbourhood.

The magnitude of the service can either be based on the standard or on the actual service level. The standard level refers to normal working conditions, for instance a preferable or an optimal situation. In such conditions, one MAPET team could handle on average 1.5 jobs per day. This presumes that there is a well established customer network and that the location of customer plots is not too dispersed. One job refers to the emptying of a pit latrine with an average volume of 1,800 litres. This requires 9 loads with the 200-litre tank cart. So the maximum workload could approximate 2,700 litres per day or 16,200 per week or 713 m³ of sludge annually. The annual volume is based on a six days working week and 44 working weeks per year (2 weeks off for social events, 2 weeks lost due to rainfall and 4 weeks for repair and maintenance). Taking this into account, the standard service level is 33 jobs per month (713,000 litres divided by 1,800 litres per job divided by 12 months).

However, to base an analysis on optimal conditions would be a rather hypothetical case which has little relevance for the actual situation. For instance, working conditions and working performance fluctuate from day to day and are seldom optimal. Therefore, the actual service level is a more interesting variable as it represents daily life.

The actual service is calculated by using several parametres which determine the extent of the service. The actual service level is much lower compared to the optimal conditions described above. Firstly, a team does seldom complete more than one job per day. Secondly, the demand pattern is very irregular and there is no daily continuity in rendering the service. This is due to matters like affordability, irregular patterns of liquidity and household priorities. Therefore the actual average service level for one MAPET team was 108 litres or 108 m³ of excreta collected and hauled in 1995. The result is a workload of on average five jobs per month or 60 jobs annually which is only 15% of the maximum capacity. It should be noted that this is an average; since a couple of teams perform better.

6.4 The Unit Cost Price of the MAPET Service

The cost of the MAPET service can be divided in running and capital costs. The running costs of the entity are also called the out-of-pocket expenses. The entity faces these costs regularly, i.e. daily, weekly and monthly. These costs are variable, which means that the entity, within a short period of time, can change the amount of these costs by reducing or increasing the service level. The running costs of a service consist of the costs of labour, materials, bought-in services, rent and taxes. The capital costs are also called the fixed costs. This means that the entity cannot, within a short period, change the amount of these costs by reducing or increasing the service level. Capital costs include the costs of depreciation and the costs on interest.

The running and the capital costs are calculated on an average basis and are related to the average actual service level, discussed in the previous section. This results in the unit cost per m³ of excreta handled. The prices used in the analysis all refer to the year 1995 and are given in Tanzanian Shillings (Tsh) and US dollars. The average exchange rate of the Tanzanian Shilling to the US dollar in 1995 was 600.

Viewed from a different perspective, the costs can be divided into actual, hidden and real costs. Actual costs are those costs that have actually been paid by the entity as compensation for an input. For instance, salaries paid by the entity to employees are actual costs. Hidden costs are the costs related to inputs for which no expenditure has been made by the entity. So these costs are not directly visible and some investigation is required to determine the level. For example, when the municipality provides support to the entity free of charge, the equivalent of this support in money terms is a hidden cost. As will be clear from the following pages, hidden costs are included in this analysis to give a complete picture of the total costs made by the society to render the service. Both the actual and hidden costs together form the real costs.

6.5 Summary of the Average Unit Cost Price of the Service

The section provides a summary overview of the costs of MAPET service. See also the annex (pp. 54-58) in this chapter "Details on the Cost of the MAPET Service" for detailed calculations on the running and capital costs.

Table VI.1 shows that the actual cost price per m³ of excreta are US\$6.80, i.e. the cost incurred by the MAPET team when operating the service. It should be noted that the actual cost of interest on working capital is not included, because a fair estimate could not be made at this moment. In addition, there is a substantial amount of hidden cost per m³ of excreta of US\$14.85. This cost is for the account of the municipality and not charged to the MAPET team. So the real cost price of the service provided, actual and hidden cost included, amounts to US\$21.65 per m³ excreta. The running costs are 82% of this total.

However, cost reduction could be achieved when the under-utilization of the system can be relieved. The average actual service level of 108 m³ of excreta handled is only 15% of the standard service level of 713 m³. Therefore the fixed costs, viz. the capital costs and the overhead labour costs per m³ of excreta are relatively high. When the utilization of the system could be increased to its maximum capacity, the capital costs would be US\$0.54 and the overhead costs would be US\$1.00. So the real cost price

would drop from US\$21.65 to US\$12.36 per m³.

Unfortunately, it is not possible in the scope of this paper to answer the question whether the MAPET cost level is in proportion to the costs of other excreta collection, treatment and disposal services. In order to make such a judgement, cost calculations of other services would need to be along similar lines as done here for MAPET.

Table VI.1 **Estimated Unit Cost Price Per m³ of Excreta, 1995**

Cost Item	Average Cost (US\$) per m ³ of Excreta		
	Actual cost	Hidden cost	Real cost
Cost of labour	3.10	6.90	10.00
Cost of materials	0.56	-	0.56
Cost of bought-in services	3.14	4.02	7.16
Cost of rent	-	-	-
Running cost	6.80	10.92	17.72
Cost of depreciation	-	1.57	1.57
Cost of financing	p.m.	2.36	2.36
Capital of cost	-	3.93	3.93
Cost price (tax excluded)	6.80	14.85	21.65
Cost of taxes	-	-	-
Cost price (tax included)	6.80	14.85	21.65

6.6 The Revenue of the MAPET Service

The revenue generated by the MAPET team consists of the user charge only. There are no revenue subsidies given by the municipality. The sludge is not sold for other uses like, for instance, co-composting, so there is no revenue from waste recovery. Contracts, e.g. with the municipality for frequent emptying, are not negotiated.

Before the MAPET team enters into pit-latrines emptying, the team leader negotiates the sales price with the customer. On average the sales price of the service (1995) amounts to Tsh 1,300 or US\$2.17 per 200-litre drum. So the revenue per m³ excreta are US\$10.83, and the average revenue per job is US\$19.50 (recall that one job equals, 1,800 litres handled). The customer pays the amount due on the spot immediately after the service is delivered, so the revenue collection efficiency is 100%. As discussed previously, the customer has to absorb expenses for water and paraffin which increases his cost by US\$0.56 per m³ of excreta. So the total price paid by the customer amounts to US\$ 11.39 per m³ of excreta.

6.7 The Profitability of the MAPET Service

The profitability of the service is presented in the Profit & Loss Statement in Table VI.2.

Table VI.2 shows that the service provided by MAPET makes a loss when all the real costs made are considered. The loss amounts to US\$10.82 per m³ of excreta handled. Nor is MAPET able to recover the real running cost. Table VI.6 shows that the real running costs are US\$17.72, still substantially higher than the revenue of US\$10.83.

Table VI.2 Profit and Loss Statement per m³ of Excreta in 1995

Item	Per m ³ of Excreta (US\$)	Per Year (US\$)
Revenue		
gross sales price	11.3	1,230
customer purchases (water and paraffin)	0.56	60
net sales price	<u>10.83</u>	<u>1,170</u>
Actual running cost (see Table VI.6)	6.80	734
Gross profit	4.03	436
Actual capital cost (see Table VI.6)	-	-
Net profit before tax	4.03	436
Cost of taxes	-	-
Actual net profit after tax	4.03	436
Hidden cost (see Table VI.6)	14.85	1,604
Real net loss after tax	-10.82	- 1,168

The reason MAPET is in operation is because of the subsidy given by the municipality. The municipality absorbs a considerable part of the costs into their account, the hidden costs, which are in the amount of US\$14.85 per m³. The MAPET team is charged with the actual costs, which are an amount of 6.80 m³. Therefore, the MAPET entrepreneurs are able to make a profit of US\$4.03 per m³ or US\$436 per year.

Considering the governmental contributions, it can be concluded that the subsidy is also partly a subsidy to the users of the MAPET service. This is obvious because MAPET is now offered at a net sales price of US\$10.83 per m³, whilst the real cost price is twice as high. As shown in the previous section, the real cost price could be reduced by an increased utilization of the capacity, even though the cost price would still be higher than the net sales price.

This can be compared with other municipal services, for instance sewerage, which also receives a large subsidy from central government, supporting personnel and investment costs. The amount is not reflected in cost statements and thus is a hidden cost. Therefore, for a valid assessment of the viability of services, the hidden costs of both the government and the informal services should be taken into account.

6.8 Conclusions

A financial analysis is commonly applied to entities which are business oriented and are called enterprises or businesses. They have a continuity objective, which means that they aim at generating sufficient income for the entity to stay alive. To reach this objective the entity has to generate at least a small profit as a buffer to be able to survive unexpected or unfavourable circumstances. At the same time, the enterprise should be able to pay its staff and employees sufficient income to meet their financial needs.

In the case of MAPET this is different because the MAPET entity is an informal sector activity. In such an activity the financial objectives deviate from formal enterprises. People working in informal sector activities seldom have a business orientation, but usually follow a survival strategy. They operate in an environment characterized by uncertain economic conditions. These can affect the demand for the service and, subsequently, jeopardize the survival of MAPET instantly and unexpectedly.

The high level of risk is the reason that entrepreneurs look at MAPET as just one source of income which contributes to their total daily income. The team members cannot afford to take the risk of depending completely on the income generated by the MAPET entity. This implies that they do not engage themselves into medium or long-term obligations like, for instance, making investments or contracting loans. The absence of a financial buffer to cope with unfavourable situations which last for a couple of days contributes to this vision that can be termed 'short-term' from an enterprise point of view, but which is sound practice from a personal survival point of view.

This setting results in a MAPET service which can be characterized as:

- Operating only at 15% of its standard capacity
- Requiring substantial financial support from the municipality

Any opportunities for improving the financial situation of the MAPET system lie in an increase in demand for the service. The entrepreneurs have insufficient financial means and a lack of confidence to invest in activities that would increase the service level and reduce the risk. Therefore the demand remains low and the service operates at a margin. The entrepreneurs themselves cannot reverse this situation on their own. One possibility to improve this situation is to establish working agreements with communities. This could both increase the level of demand and create more stability.

A final remark concerns the applicability of this type of financial analysis to an informal activity. Even if reliable data could be collected, the question of validity remains. Is it appropriate to analyse informal enterprises, which operate on the borderline of business and survival activity, by using an analytical technique which is developed for formal enterprises? What this exercise for the MAPET service demonstrates is that a very careful interpretation of the results is required.

Annex: Details on the Cost of MAPET Service

Cost of Labour

One MAPET team consists of three persons, one leader and two helpers, all participating in the emptying and disposal operations. The leader does the price negotiations with the customers. Small repair and maintenance jobs are executed and paid for by the municipal workshop.

In financial terms there are no labour costs present, as there is no contract labour. The income of the team members consists of the revenues collected from customers minus the cost made. However, this income could be split into a compensation for the labour input and a compensation for entrepreneurship, the latter also called profit. In this section the labour costs are estimated separately by taking the family subsistence income as a reference. In 1995, this was estimated at Tsh 30,000 per month or say Tsh 1,200 or US\$2 per working day.

Based on the average work load of five jobs per month, the team totals 10 working days per month (0.66 day per person per job). An additional 4 days per month are calculated for acquisition activities of the leader. This results annually in 168 working days for the whole team.

In addition, the MAPET team is backed-up by two governmental officials of the sanitation department. They spend part of their time in supervising and monitoring the activities of the team. This amounts to an estimated 280 working days annually, which can be regarded as indirect labour or overhead cost. This cost is not passed on to the MAPET team and is therefore labelled as hidden.

Table VI.3 Estimated Labour Costs per m³ of Excreta, 1995

Item	Unit	Amount	
		Actual	Hidden
Direct labourer working days	#/year	168	
Overhead working days	#/year		280
Subsistence wage rate	Tsh(1995)/day	1,200	
Supervising & Monitoring Salary	Tsh(1995)/day		1,600
Total amount of labourer cost	Tsh(1995)/year	201,600	448,000
	US\$/year	336	747
Average service level	m ³ /year	108	
Labour costs	US\$/m ³	3.10	6.90

Cost of Materials

Operation of the MAPET service requires three types of materials:

- Paraffin (on average 5 litres), an additive which is said to kill the bacteria and reduce the bad smells
- Water (on average 40 litres), required to make the sludge more suitable for pumping
- Spare parts and maintenance materials

Both paraffin and water are provided and paid by the customer and therefore do not accrue to the cost of the MAPET team. However, they are included here in order to have a complete overview of the cost of the service. Later on a correction will be made on the revenue side to balance this cost item. Spare parts and maintenance materials are not bought by the MAPET team, but by the municipal workshop that does the repairs. So this is dealt with under the heading “ Cost of Bought-in Services” in the next section.

Table VI.4 **Estimated Material Costs per m³ of Excreta, 1995**

Item	Unit	Actual Amount
Paraffin and water	Tsh(1995)/job US\$/job	605 1
Total material cost	US\$/year	60
Average service level	m ³ /year	108
Material costs	US\$/m ³	0.56

Cost of Bought-in Services

As the MAPET team is restricted to emptying and disposing of sludge, there are a number of bought-in services in order to facilitate the operation. These comprise the following six items:

- Large repair and maintenance, done by the municipal workshop
- Transport, provided by a municipal pick-up vehicle in case the push cart breaks down
- Small repairs, done by commercial workshops
- Parking and guarding fee
- Acquisition costs
- Incentives to speed-up or smoothen the execution of services

The cost of repair and maintenance in the municipal workshop comprises the cost of spare parts, materials and the labour cost of technicians. The MAPET team pays only for the labour cost, the municipality provides the spare parts and materials free of charge. Therefore, the cost of the latter is labelled as hidden. The transportation service

is provided by the municipality in case of major maintenance and break down. The transport is required because the location of the workshop is often kilometres away from the place where the break down occurs. The MAPET team pays for the cost of petrol, the other costs are for the account of the municipality and are regarded as hidden cost. On average about 10 round trips were needed in 1995.

Table VI.5 **Estimated Costs of Bought-in Services per m³ of Excreta, 1995**

Item	Unit	Amount	
		Actual	Hidden
Municipal repair and maintenance	Tsh(1995)/year	11,500	27,500
Municipal transport	Tsh(1995)/year	67,000	233,000
Small repair	Tsh(1995)/year	5,000	
Parking and guarding fee	Tsh(1995)/year	40,000	
Acquisition	Tsh(1995)/year	60,000	
Incentives	Tsh(1995)/year	20,000	
Total cost	Tsh/year US\$/year	203,500 339	260,500 434
Average service level	m ³ /year	108	
Bought-in services cost	US\$/m ³	3.14	4.02

For the other items, the data collected are not sufficient to make a sound cost estimate. Instead, estimates are made. Small repairs are done by commercial workshops and directly paid by the MAPET team. The acquisition costs comprise the direct costs of the team leader, mainly transportation costs. They do not include incentives to key persons. Incentives is an euphemism for the money that is required to 'have things getting done' at the end of the municipality. It refers to the two services mentioned above. The amount spent on this should be considered as a good guess.

Costs of Depreciation

The investment for a MAPET team comprises of equipment only, i.e. one pump cart, one push cart with a 200-litre drum, 5 metres of flexible hosepipe, a mixing rod, a spade and a hoe. All the components can be locally constructed by using detailed drawings and specifications. However, for economic reasons the piston was imported, because it cannot be produced locally in small numbers due to high mould costs. The investment expenditure amounts to about Tsh (1995) 1,000,000 or say US\$1,700. This amount is based on local manufacturing by commercial workshops of one unit at the time.

The MAPET team does not bear any investment cost. The equipment was produced by the municipality and the expenditure was covered by donor funds. Afterwards the

equipment was handed over to the MAPET team free of charge. This means that the cost of depreciation should be regarded as a hidden cost (i.e. \$1.57). The cost of depreciation can be computed by using the asset register.

Table VI.6 **Estimated Cost of Depreciation per m³ of Excreta, 1995**

Name of Asset	Year of Purchase	Estimated Total Life Time (yrs)	Price and Value of the Asset (US\$)				Average Annual Occupation Rate (m ³)	Depreciation Cost per m ³ of Excreta	
			Historical Purchase Price (1995)	Replacement Value (1995)	Hidden Value	Residual Value		Actual Cost	Hidden Cost
1	2	3	4	5	6=5-4	7	8	9=[(4-7)/3]/8	10=[6/3]/8
All equipments	1992	10	0	1,700	1,700	0	108	0	1.57

Financing Costs

The financing costs relate to the capital invested in the MAPET team. Firstly, there is the investment capital, dealt with in the previous section. The costs of interest are not on the account of the MAPET team, but for the donor who provided the grant money. Therefore, this is a hidden cost, of which the level is calculated by multiplying the average book value of the investment ($1,700/2=850$) with an interest rate of 30% annually for the year 1995 (see Table VI.5).

Secondly, there is an investment in working capital. Working capital is required to pre-finance expenditure, eg. to cover the cost of repair and maintenance or transportation. It could be financed by reserves which are fed by profits generated. This is not applied by the MAPET team. All profits generated are directly spent on either private consumption or repayment of debts. There is no allocation to a reserve fund which could be used to cover future expenses.

Cost of Taxes

The MAPET team is an informal organisation and is not part of the formal sector to which government legislation applies. Therefore the MAPET team is not subject to tax legislation.

Table VI.7 **Estimated Financing Cost per m³ of Excreta, 1995**

Item	Unit	Amount	
		Actual	Hidden
Investment capital	US\$	-	1,700
Working capital	US\$	p.m.	-
Average capital invested	US\$/year	p.m.	850
Market interest rate	%/year	30	
Total cost	US\$/year	p.m.	255
Average service level	m ³	108	
Cost of financing	US\$/m ³	p.m.	2.36

VII Understanding the Collection of Human Excreta as Part of Urban Waste Management *by Maria S. Muller*

7.1 The Collection of Human Excreta: a Framework of Activities and Linkages

The collection of human excreta from private latrines in urban low-income neighbourhoods is an infrastructure service that consists of several activities for which various organisations are responsible. These activities are:

- Storing the excreta
- Removing the excreta (nightsoil or sludge) from the latrines
- Transferring the excreta to the place of disposal
- Treatment of the excreta
- Final disposal of treated excreta

The organisations responsible for these activities can be private households, local communities, informal private sector enterprises or waste collectors, formal private contractors, municipal departments, NGOs, CBOs, or farmers. In fact, any organisation that exists in the urban setting can be responsible for any of these activities, depending on local customs and institutional patterns. There is no uniform pattern about the allocation of responsibilities. The case studies in this publication, for example, show that the removal of human excreta can be carried out by either the private informal sector or the private formal sector or the municipal administration: or even by suburban farmers.

The provision of a facility to hold human excreta are a precondition for the collection service. The type of facility constructed by private households, whether pit latrine or bucket, determines the type of collection service required. This publication gives attention to the role of private households in having the excreta removed. They pay for the collection service. Further, as individuals and communities, they have an interest in making sure that the work is hygienically performed.

Figure VII.1 depicts the activities which are part of human excreta collection and indicates the organisations that play a role in these activities on the neighbourhood and urban level.

The distinction between activities and between organisations facilitates the analysis of the operations of the collection service itself. Questions can be directed to specific organisations. One can ask which tasks and activities each organisation has to carry out in order to perform its main activity. A private contractor, for example, may see it as his main activity to collect and transfer human excreta to a collection point in the neighbourhood. In addition, however, he must employ and pay his workers, pay a fee to the municipality, collect charges from customers, repair his equipment, comply with municipal public health regulations, provide satisfactory service to customers. The private contractor must combine all these tasks as well as make a profit for his enterprise.

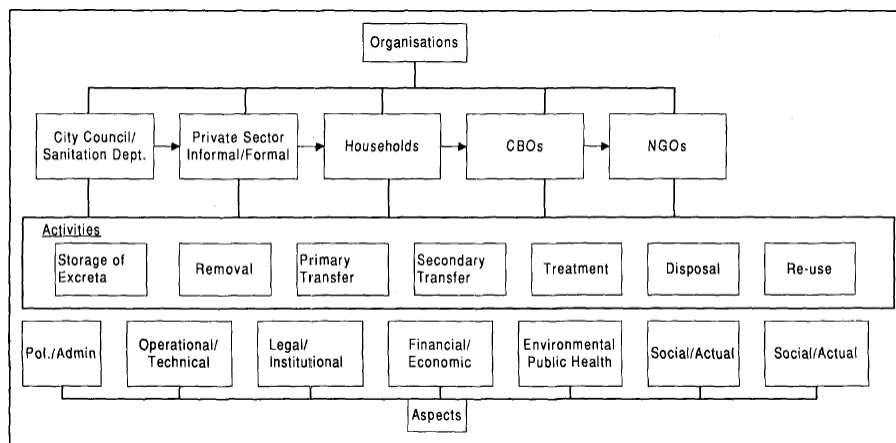


Figure VII.1 **Activities and Organisations in Human Excreta Collection.**

This schematic presentation of excreta collection as a complex of activities and organisations makes it clear that the collection of human excreta are not an isolated activity. First, each organisation must fulfill several tasks in order to make each collection activity possible. Secondly, together these organisations perform a sanitation service that is integrated in the urban institutional system. The collection service forms part of the city-wide sanitation system (WASTE 1993, 1994). All case studies in this publication illustrate that an adequate performance of their own main activity, for example, removal of excreta from latrines, depends on the adequate performance of other organisations responsible, for example, for their transfer to the disposal site. In this way one can say that an adequate collection service depends on the efficiency and effectiveness of certain organisations throughout the urban and even the national system.

The case studies not only provide examples of interlinkages between organisations, they also point to problems experienced because of inadequate operation of these linked organisations.

7.2 The Institutional Setting

It is useful to distinguish the organisations that carry out these activities. The municipal authority has final responsibility for this infrastructure service, but it can leave the operation of parts of the service to the private sector, ranging from informal, self-employed workers to formal private enterprises.

The distinction between private formal and private informal enterprises must be recognized. Private formal enterprises are characterized by a higher level of capital investment, a larger scale of operation, and easier access to influential officials in the government and economic sectors, compared with informal enterprises.

The informal enterprises usually have a much smaller scale of operation than the formal enterprises. They are confined to a smaller service area, and the entrepreneur and his/her assistants often live in the same area as their customers. Therefore, the informal

enterprises are more dependent on good working relationships with the residents and can be more influenced by community demands for good service than the formal sector enterprises. Thus community-based supervision and performance control are more feasible with informal enterprises.

This distinction between formal and informal enterprises is applicable to a service that deals with individual sanitation facilities, such as buckets and pit latrines. Small, informal enterprises are likely to use inexpensive, manual equipment. When large trucks or trailers are used involving high investment and recurrent costs, only the public sector or financially strong formal enterprises can own and operate them. A picture emerges of a collection service that is operated by a combination of different types of organisations. Small, informal enterprises take care of the removal and first transfer of human excreta, while either the municipal department or a private contractor provides the secondary transfer and the disposal service.

The role of informal private enterprises or waste collectors as partners in a public-private partnership for sanitation services is not yet recognized. In such a partnership the public authorities will be expected to stimulate and enable the informal enterprises to carry out their activities in similar ways as they enable formal enterprises to operate, for example through licensing, leasing, contracting, or capital borrowing facilities.

7.3 The Excreta Collection Service in the Four Case Study Cities

The table on the next page shows the variety of organisations that carry out the major activities in the excreta collection service, as exemplified in the four cities Accra, Dar es Salaam, Ghaziabad, Yichang.

The practical situations studied made adjustments in the analytical framework necessary. Analytically, removal of excreta and their transfer to the neighbourhood collection point are separate activities. In reality, however, these activities are always carried out by one and the same organisation or by the same pit emptiers. The scavengers in Ghaziabad carry the excreta away in a small basket. The employees of the private enterprise in Accra collect the excreta from several bucket latrines into a large, 25-litre container and carry this to the neighbourhood container positioned at the road side. The MAPET pit latrine emptiers in Dar es Salaam use equipment that can "suck up" the excreta into a 200-litre tank, and push this tank to the disposal site.

In Yichang several methods are in operation. The Environmental Sanitation Administration (ESA, a public sector agency) employs workers to empty the buckets into small carts and transport the excreta to the nearest public latrine (septic tank). From there, the ESA transfers it by vacuum tanker. Also housewives carry buckets to the public latrine. Another system is that private farmers remove the nightsoil from buckets and transfer it to the small storage tanks on their own farms. After one month they use the nightsoil as a fertilizer.

The table distinguishes transfer to a neighbourhood collection point and further transfer to a site outside the neighbourhood. Further transfer is always done by the organisation that is responsible for final treatment and disposal. In two cases this is the municipal department, in the case of Yichang this is either done by the private farmers of the ESA, the public agency that empties the public latrines. MAPET is a case on its own, since the method of disposal and treatment consists of burial on the residential plot of the latrine owner. Transfer takes place over a few metres.

Distinctions regarding treatment and disposal are also necessary on the basis of the real services carried out in the four cities. Disposal without treatment is the practice in Ghaziabad, where the municipal department deposits nightsoil together with solid waste on a dump site outside the town. In Accra, however, the Municipality treats and disposes of the sludge and sells part of the treated sludge for re-use by farmers. The municipal department in Dar es Salaam treats latrine sludge in treatment plants which primarily treat the sewage of the city. The treated sewage is disposed of in surface water flowing into the sea. The city of Yichang operates its own system whereby the nightsoil collected from public latrines is treated in treatment plants located at the outskirts of the city. After about one month the health risks associated with the use of nightsoil for farming purposes are considered to be reduced sufficiently. The city then sells the sludge to farmers.

Table VII.1 **The Latrine Sludge Collection Service: Activities and Organisations**

Town	Storage	Removal/ primary transfer to neighbourhood collection point	Secondary transfer	Treatment	Disposal	Re-use as fertilizer
Accra	Buckets	Private formal enterprise	Municipal department	Municipal department	Municipal department	Yes
Dar es Salaam		Private informal enterprise	--	Private informal waste collectors	--	--
Ghaziabad	Buckets	Private informal enterprise	Municipal department	--	Municipal department	--
Yichang	Buckets	Public Sector	Public Sector	Public Sector	--	Yes
	Buckets	Housewives	Private farmers	Private farmers	--	Yes
	Buckets	Private farmers		Private farmers	--	Yes
	Vaults	Private farmers		Private farmers	--	Yes

Note:

1. The term "waste collectors" includes scavengers (Ghaziabad) and MAPET emptiers (Dar es Salaam)
2. The Environmental Sanitation Administration (ESA) is an agency under the municipal government.
3. A vault is a large underground container holding fresh nightsoil for several days or weeks

7.4 Tasks of Organisations

Each organisation with responsibility for operating the collection service has to carry out several tasks in order to continue performing its main activity in the service. Table VII.2 on the following page lists the tasks of municipal departments and informal private enterprises.

The case studies provide examples of some of the tasks outlined in Table VII.2.

7.4.1 Service Provision

A public sector department is duty bound to respond to the real service demands of the citizens. Yet a centralized, bureaucratic organisation is easily isolated from the differentiated demands for better service by its customers. This can lead to extreme frustration among the residents who pay for, yet are unable to obtain the required service. To make a department more accountable to the public, decentralization of political responsibility to districts within the Metropolitan area has been implemented in Accra. The positive effects of such an institutional change is, however, limited when control over operational decision remains centralized with the metropolitan authorities.

In Dar es Salaam, in contrast, there is a direct relationship between service provision and demand for service. The informal private MAPET teams must satisfy their customers in order to safeguard their own source of income. The informal scavengers in Ghaziabad, however, have a different relationship with their households as both parties are bound to each other by hereditary rights and duties concerning cleaning duties and social considerations.

7.4.2 Tariffs and Charges

The municipal government decides on its own tariffs and charges, taking into account various political and financial factors, as mentioned in the case study of Dar es Salaam. The municipality also influences the charges levied by private companies through the conditions of the contracts concluded with the private sector, as in Accra.

The negotiations between the informal MAPET teams and their customers are based on a different set of considerations, as the team wants to earn a minimum income and as the customers pay what they are prepared to pay. These negotiations, set within definite limits, result in a certain amount of service for a certain price. The financial analysis of the MAPET service makes clear, however, that there may be a contradiction between the wish to provide a service on cost recovery basis and the preparedness and ability of customers to pay for it.

7.4.3 Land Provision

It is the task of the municipal government to provide sites for the handling of sludge, such as the neighbourhood collection point and land for treatment and disposal facilities. The neighbourhood sites required for the transfer of sludge, though relatively small, may cause complicated political and planning problems, as these sites are located inside residential areas. There is competition for space and general fear for nuisance and pollution. The planning conditions attached to urban land in Dar es Salaam have been a reason to develop a mobile sludge transfer station instead of a fixed transfer station.

7.4.4 Coordination of Transfer

The case studies provide only examples of coordination regarding the primary and secondary transfer of sludge. It focuses, in fact, on the operation of the neighbourhood collection points, where sludge is temporarily deposited by one organisation, such as a private enterprise or informal collectors and from where the public agency hauls it to the final site. Work schedules have to be coordinated: agreements made about the amounts of sludge to be handled at specific times; and about responsibilities for cleaning the collection point and its surroundings. In Accra and Yichang work schedules are apparently well adhered to. In Dar es Salaam a system for the operation of the sludge transfer point, involving both the Sanitation Department and the informal enterprises, still has to be worked out.

Table VI.7 Tasks of Municipal Sanitation Department and Informal Private Enterprises in the Operation of Collection Services

	Municipal Department	Informal Enterprises
Operational/ Technical	service provision maintenance/repair large equipment	serve customers repair of small equipment
Financial/economical	determine tariffs/charges collect charges large investment	negotiate charges no investment
Legal/institutional	enforcement of bye-laws issue permits coordination of all excreta collection activities	comply with regulations obtain permit/rights for operation
Political/administration	manpower management	social organisation among excreta collectors
Environment/public health	land provision for transfer points, treatment and disposal performance monitoring	utilize allocated sites comply with standards
Social/cultural	awareness raising community mobilization recognition of norms/ideas	awareness raising community consultation recognition of norms/ideas

Note: This list of tasks was composed by the participants of the workshop "the Collection of Human Excreta from Household Latrines in Urban Low-income Settlements", held in Colombo, Sri Lanka, 7-9 February 1996.

7.4.5 Performance Monitoring

Setting the standards for performance monitoring is another task of the municipal government. The case studies do not provide examples of how monitoring is carried out in practice, although all mention its importance.

A specialized environmental agency may give advice regarding general and operational standards to be adhered to as well as the specific measures to assess performance. They concern, for example: emptying of the latrine pit before it starts overflowing; dumping of waste in legally designated areas; transfer of excreta without spillage. The assessment measures have to be suitable for monitoring the services in low-income neighbourhoods, where many private workers remove and transfer excreta from individual latrines.

Public health officials may be assisted by residents in supervising performance monitoring and environmental cleanliness in general. For this to happen effectively, general environmental health education is required, as well as the development of means for enforcement through sanctions such as the withholding of service payment. Such neighbourhood level monitoring regarding environmental sanitation is already taking place in many settlement improvement projects, for example in Colombo, Sri Lanka.

VIII. CONCLUSIONS

8.1 Background

The participants of the workshop held in Colombo, Sri Lanka, to discuss the case studies, were concerned about how to provide hygienic and sustainable excreta collection services. They stressed that nightsoil buckets and pit latrines should be abolished, as they are unhygienic in operation. However, taking into account the problem of poverty, lack of resources, and practical difficulties in providing water borne sewerage systems to low-income areas, the participants considered that improvement of the existing latrine systems must be recognised as a necessary intermediary step. Three main issues stood out in the discussions, i.e. the interlinkages between the neighbourhood and the city systems, the economic value of excreta collection services, and the role of neighbourhood communities.

8.2 Interlinkages between the Neighbourhood and the City

The primary collection of excreta from large numbers of latrines can be very suitably organized on neighbourhood level. The relatively simple equipment makes such a decentralized operation feasible. Nevertheless, primary collection must be linked to a larger sanitation system that operates facilities for treatment and disposal of excreta. Or, seen in a wider perspective, excreta collection is an integral part of an urban waste management system in which collection, recycling of excreta and solid waste and their final treatment and disposal take place in an environmentally sound and sustainable manner.

Many different social actors may carry out the primary collection service, including informal small enterprises, self-employed scavengers, formal private enterprises with contract labour, and even the municipal department with its own labourers. Which actors are actually involved in primary service provision depends upon developments in each city.

The responsibilities of the municipal sanitation department regarding primary and secondary service vary in the different case study cities. It is clear, however, that the position of the department in the institutional framework as well as its internal functioning have an influence on its relations with the other social actors in service provision. The degree of dependence and accountability of the municipal sanitation department vis-à-vis the national ministry or the municipal council influences its powers to support and regulate the private sector actors. Similarly, the department's own capacities to manage its personnel, equipment, and finance can influence its ability to be effective vis-à-vis the other actors.

The neighbourhood transfer point, from where the secondary service transports the collected excreta to another site for treatment, provides a concrete example of the technical and operational interlinkages between the municipal sanitation department and private actors.

8.3 Economic Sustainability of Excreta Collection Services

The collection of excreta are often merely considered a service for the well-being of the public, with direct financial costs to the public sector, but without direct public benefits. The case studies, however, provided interesting examples of the economic value of excreta collection, which can be increased if the right policy perspective is adopted. Moreover, if the potential economic value can be captured, both public authorities and private enterprises are likely to develop methods to increase the coverage of residential areas by excreta collection services.

In the first place a collection service creates employment in the private informal and formal sectors of the economy. This is a positive aspect in the urban economy, even if it is for many people a source of daily income rather than the basis for a stable enterprise. It is a labour-intensive form of service which can cover a large part of the city, provided the pricing responds to the demand of customers and the resulting income and profit are satisfactory to owners and waste collectors.

The re-use of nightsoil as organic manure in agriculture is another economic benefit. Urban authorities both in China and Ghana derive revenue from the sale of treated nightsoil, while farmers obtain high-quality fertilizer. The available technological processes and the inherent cost aspects need to be well investigated.

The financial viability of excreta collection services is important information for decision makers. It is necessary, therefore, that analytical methods are applied to both private and public sector enterprises. Various models of financial and economic analysis are feasible, taking into account the direct benefits as well as the wider effects on the urban economy.

8.4 The Role of Communities

There is a diversity of cultural norms and practices regarding the handling of human excreta, ranging from the intense dislike common in India to the public praise in China for sanitation workers who contribute so much to the national economy. These norms also affect the degree of public attention given to the improvement of environmental sanitation.

The social status of the collectors of human excreta, such as scavengers, pit latrine emptiers, and sanitation labourers, should be improved by recognising the essential nature of their service. They should also receive official recognition, through licenses and badges, and their operational problems and health concerns should be addressed.

Creating awareness about the hygienic and health aspects of sanitation is important. Community awareness programmes should address men, women and children about the safe handling of human excreta by community members. It will improve the living conditions in neighbourhoods when residents are concerned about the cleanliness of both their own court yards and the streets and public places outside their houses. Mobilization for organizing and supervising excreta collection services or even on a wider scale, for waste management services may then be possible.

A basic requirement is that a larger section of the urban community becomes interested in the subject of removal, transfer, treatment and disposal of human excreta including politicians and professionals. Efforts must be made to increase their appreciation of the

positive and negative aspects of excreta collection. Also the initiatives of the informal sector of the economy to earn an income from a service for which there is a real demand, deserve greater appreciation. Finally, this may lead to a greater recognition of the institutional complexity of providing effective and sustainable excreta collection services for urban low-income households.

Collection and disposal of human excreta form a serious sanitation problem in most of the cities in developing countries. This is especially felt in low-income urban settlements and unplanned areas, where pit and bucket latrines are a common sanitation facility. If not well maintained and operated, they pose a risk to public health. In this respect it is important to see what services exist for the collection and disposal of human excreta from these latrines.

The Collection of Household Excreta documents excreta collection practices in four urban areas in the South. Cases are taken from Dar es Salaam in Tanzania, Ghaziabad in India, Accra in Ghana and Yichang in China. Together they provide a cross-section of different cultural and socio-economic conditions influencing different methods for collection of human excreta from pit and bucket latrines.

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Dar es Salaam	Leaching pits	Private informal waste collectors	--	Private informal waste collectors	--	--
Ghaziabad	Buckets	Private informal waste collectors	Municipal department	--	Municipal department	--
Yichang	Buckets	Public sector	Public sector	Public sector	--	yes
	Buckets	Housewives	Private farmers	Private farmers	--	yes
	Buckets	Private farmers	Private farmers	Private farmers	--	yes
	Vaults	Private farmers	Private farmers	Private farmers	--	yes

Note:

1. The term "waste collectors" includes scavengers (Ghaziabad) and MAPET emptiers (Dar es Salaam).
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