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"L'amélioration des services de la ville de Moshi,Tanzanie.
Analyse de la demande et régulation du secteur."

# THE MANAGEMENT OF SANITATION SERVICES: THE CASE OF MOSHI URBAN

## ENVIRONMENTAL REGULATION


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# INTRODUCTION

## 1.1 Background

Most urban centres in developing world, and in Tanzania in particular, have over recent years experienced sanitation and health related problems. These problems have recently been compounded not only by growing rural-urban migration, urban population growth rates but also by the combination of poverty, illiteracy and lack of adequate and appropriate urban management thus poor sanitation is not only a problem in unplanned areas, it is also a problem in planned areas. Indeed, it is so much a problem in urban areas, in planned or not planned areas.

According to Wright (1977), the urban poor, the largest group lacking sanitation services, make up more than half the population in many cities of the developing world.

The percentage of people without access to sanitation services continues to increase. In 1990, at the end of the International Drinking Water & Sanitation Decade, 453 million urban people (or 33% of the urban population in developing countries) had no sanitation services. In the following four years, investment programs brought new or improved sanitation to 70 million city dwellers. But in the same four years the urban population in developing countries rose from 1.4 billion to nearly 1.6 billion people. By 1994 the number of unserved people had risen to 589 million or 37 percent of urban population. (Wright 1997).

The urban poor are often not taken into account in municipal programs to improve or extend services such as water, sanitation, garbage collection, roads, health care and education. And this is very evident in Tanzania and Moshi Urban is no exception.

Cramped and precariously constructed housing also creates physical problems in infrastructure development. For example construction of latrines or conventional sewers is much more difficult in the congested narrow streets and alleys of many of these settlements.

According to Kironde 1996, high density in urban areas necessitates advanced sanitation arrangements to minimise the risk of epidemics. Pointing out that the sanitation situation in Tanzania still leaves a lot to be desired. He adds that this is especially so in the densely occupied areas in unplanned settlements. Only a minority of urbanites is connected to central sewer networks or to septic tanks. By far, the majority rely on pit latrines.

Health indicators such as infant mortality and the incidence of diarrhoea have been shown to be much worse in crowded tenements and squatter settlements than in other an areas. The Moshi District Medical Officer confirms this situation by saying that communicable diseases are most common in the low-income areas of Urban Moshi.

Human and domestic waste from any area has the potential to contaminate not just the local environment but also ground water, lakes and rivers used by many others for supplies of fresh water. Thus the sanitary crisis can take its toll on all city residents and on the national freshwater resources of developing countries (Wright, 1997).

Planning for the best management of sanitation is essentially a process of arbitration weighing up a wide variety of factors before deciding whether or not to promote a particular development or to go ahead with maintenance program. One of the factors that is of increasing significance in weighing up the advantages and disadvantages in understanding the impact of such management on the environment.

Management of the environment is closely linked to sustainable development, i.e. the use of renewable and non-renewable resources for present needs without jeopardizing future/long term needs of the other biotic components.

Therefore to insure sustainability in any kind of development, the environment becomes a major concern that needs special guidance in managing. The focus of this study is therefore; on environmental regulations seeking to find out to what extent they are reflected in sanitary practices in Urban Moshi especially with the growing population densities.

### 1.2 Study objectives

This study is looking at the environmental aspects of sanitation management in Moshi Urban. It has been conducted with the objective of:

- Evaluating the capacity of areas to absorb waste and refuse in the context of high demographic growth

### 1.3 Questions to be asked include

- What is the impact of sanitation practices in localities?
- Does the data available allow the establishment of state of matters in the localities and to chart out the volume of refuse and the absorption capacities of the soils?
- What information is necessary in the light of evolution of urban densities, to allow the monitoring of zones in which autonomous sanitation is possible?
- How can one create a system of information, which can be shared by different actors in order to give greater attention to the environmental quality of localities?

### 1.4 Hypothesis

The study is guided by the following hypothesis.

- The impact of sanitation practices is not well known especially because of insufficient data available

## 1.5 Methodology

The environmental study was conducted through the use of questionnaires and interviews, which were conducted with officials of Moshi Urban Water Supply and Sanitation Authority (MUWSA), the Municipal leaders (especially the Health Officers) the drilling and dam construction company, the Pangani River Basin Project, (Moshi and Tanga offices), and the Urban Planning Department in Moshi.

Physical surveys and observations were made to various localities within the Municipalities to examine sanitary practices in the areas. The major focus was on the high population density areas of Njoro, Kaloleni, Mji Mpya, Pasua and Majengo. Shantytown was also observed to represent a medium/ low density unplanned area. This selection was made considering the fact that poor sanitary practices, if present, would have more environmental and hygienic impacts on high-density areas than elsewhere.

Observation included methods of liquid waste management, solid waste and sewerage disposal in these different localities. Moreover the income status of the people in different localities was assessed, in order to understand how their income influenced the type of or access to sanitation services.

Visits were made to the MUWSA waste stabilization ponds, the Municipal dumpsite and some water sources such as Njoro spring so as to assess the situations in these areas.

Various documents were also used as well in order to get background information on Moshi Urban and sanitation management in general. Literature was also reviewed with the view to get data that is relevant to this study.

## ENVIRONMENTAL REGULATIONS

Like many other developing countries Tanzania has recently realised the importance of environmental management in all sectors be they profit making or service providers. To ensure that there is effectiveness in achieving this goal, there are a set of policies, laws, by-laws and regulations that have been put forward to guide the process.

Sanitation is one of the areas, which have been given some consideration in policy statements, laws, regulations and the like. The only concern is to what extent these policy statements; laws and regulations are actually being implemented on the ground. This section highlights some policy statements, laws and regulations focusing specifically on sanitation practices and the environment.

### 2.1 Policy

**The National Environmental Policy (1997)** has stipulated policy objectives which incorporate sanitary practices in the following areas:-

**Technology**: "The primary policy objective shall be the promotion of the use of environmentally sound technologies, that is, technologies that protect the environment, **are less polluting**, use all resources in a more sustainable manner, **recycle more of their wastes and products, and handle residue wastes in a more acceptable manner** for which they are substitutes."

This objective is meant for the industries and how they should take care of their waste.

**Health**: "The main objective here is to protect public health, not in the narrow though indispensable sense of airing diseases, but in the broad sense of promoting human well-being and informed participation in primary environmental care. The policy objectives to be pursued are: -

a) Provision of community needs for environmental infrastructure, **such as safe and efficient water supplies, sewage treatment and waste disposal services**; and

**b)** Promotion of other health-related programmes such as food hygiene, **separation of toxic/hazardous wastes and pollution control at the household level.**

These policy objectives reflect on the health sector or in this case the Municipal council where by the health department would be responsible to ensure that these objectives are met. Unfortunately., the Moshi municipal council has not been able to achieve these objectives mainly due to lack of resources, but efforts are still in progress.

## 2.2 Laws, Acts and ordinance

### 2.2.1 The Local Government (urban authorities) Act No.8 of 1982.

Functions and Duties of Urban Authorities

**54 (1)** It shall be the responsibility of each urban authority as a local government authority, subject to this Act-

a) to promote the social welfare and economic well-being of all persons within its area of jurisdiction;
b) Subject to the national policy and plans for rural and urban development, to further the social and economic development of its area of jurisdiction.

**55 (g)**:- "To keep and maintain, in good order and repair all public latrines, urinals, cesspits, dustbins and other receptacles for the temporary deposit and collection of rubbish, and public bathing and washing places, and to provide for the removal of all refuse and filth from any public or private place, and provide for the removal of night soil and the disposal of sewage from all premises and houses in its areas, so as to prevent injury to health.

This concerns the Moshi Municipal Council but through observation this is not being effected (at least not sufficiently). Apart from not being able to provide exhaustive and proper sanitary services to all private places (residential ones inclusive), the public places are not well maintained either. This was evidenced at the Njoro market place whereby the latrines were full and according the market traders the situation had been that way for some time and they were not sure when it would be dealt with.

**2.2.2** Sewerage services for Moshi Municipality was handed over to Moshi Water Supply and Sewerage Authority (MUWSA) in 1st July 1998 following amendment and enactment of **Urban Water Supply Act No 8 of 1997** and **Water Ordinance Cap 281 by the government of Tanzania** .The primary objectives for the provision of services by MUWSA are:

- To safeguard the health of Municipal residents and neighbouring villages and
- To maintain the environmental status of the Municipality against the effect of unsafe disposal of wastewater from domestic, commercial and industries. (MUWSA 2002).

**2.2.3 Ward Development Committees Act, 1969 No.6 revised 1996.**

The Function of Ward Committees among others is:

1. Committee may:-

a) subject to the approval of the minister, initiate schemes for development of the area constituting the ward;

b) do such other acts and things as the minister may direct

2. For the purposes of subsection (1) a scheme for the development of the area constituting a ward includes a scheme:-

c) For the construction of works or buildings for the social welfare of the people residing within such areas.

e) For the construction of any work of public utility.

**Powers of the committee**

Every committee shall have power to make an order requiring all adult citizens of the United Republic resident within the area constituting the ward for which the committee is established to participate in the implementation of any development scheme and to require persons who are liable to so participate and who fail to participate and who fail to participate without reasonable excuse, to make such contribution either by payment to the committee of such sum of money being in excess of the maximum sum prescribed by regulations made under this Act or by delivery to committee of such goods or other property as may be so prescribed may be so prescribed.

With these functions and powers vested on the committees, it means the committees are in a position to effect schemes focussing on proper sanitation practices and environmental management with full participation of the people.

### 2.2.4 The Public Health (sewerage and drainage) CAP 336 of the laws annual–Supplement 1955

Under **protection of public sewers** states that:

1. No person shall construct or cause to be constructed any building over a public sewer save with the written consent of the authority first obtained.

2. The authority may give written consent to the construction of a building over a public sewer provided that such sewer is constructed of cast iron or steel or if of stoneware, concrete or asbestos cement the sewer is encased all round and throughout the length of sewer which may be under the proposed building in not less than 6 inches of 1:3:6 concrete; consent shall not at any time be given to erect a building over a man-hole or other means of access to a sewer.

Under part VIII **offences** it states that:

3. Any person who pollutes the water in any rive, stream or watercourse or in any body of surface water to such extent as to be likely to cause injury

directly or indirectly to public health, to livestock or fish, to crops, orchards or gardens which are irrigated by such water or to any product in the processing of which such water is used shall be guilty of an offence and liable upon convection to a fine not exceeding one thousand shillings or to imprisonment for a period not exceeding six months or to both such fine and such imprisonment or in the case of a second or subsequent conviction to a fine not exceeding two thousand shillings or to imprisonment for a period not exceeding one year or to both such fine and such imprisonment and in every case where the offence is a continuing one to an additional fine not exceeding one hundred shillings in respect of every day during which the offence has continued.

These laws clearly state that waters should be protected from pollutive acts hence sanitation inclusive. With the kind of river and stream pollution present within the Moshi Municipal, it means someone should take responsibility. The question would remain whether it is the individuals carrying out these pollutive practices that should be held accountable, or the responsible authorities who are vested with the responsibility of ensuring that these improper practices do not exist to begin with.

Other sectoral legislations responsible for improvement of specific aspects of the environment that could be applied include :

- The Water Utilization Act No. 42 of 1974 with amendments e.g. No. 10 of 1981, and 1998 governing water resources.

- The Land Act No.4 of 1999 and the village Land Act No. 5 of 1999 controlling land development in urban and rural areas respectively.

- The National Environment Management (NEM) Act No. 19 of 1983.

- Water Utilization (Miscellaneous Amendments) 1997.

- The Urban Water Supply Act, 1981.

- The Water Act. No. 8 of 1959

## MOSHI MUNICIPALITY

### 3.1.Location

Moshi has an area of 58kms2, it lies approximately $3^{o}$18'S and $38^{o}$20' E on the Southern slopes of Mt. Kilimanjaro. It is the administrative, commercial and tourist centre of Kilimanjaro Region and the entire Northeast Tanzania. (Moshi Environmental Profile 1999).

### 3.2 Population

The population of Moshi has grown from 8,048 inhabitants in 1948, to a projected 216.375 in 2001. The annual population growth rate is 6.2% and doubling every decade (Ibid 1999). The estimated number of households is 21.600, with an average of five people per house. The population density is estimated at 3.275 people per sq. km (Moshi Municipality 2002).

### 3.3 Socio-economic activities

The main activity sectors in Moshi include, housing of which 51% are built on planned areas and the rest in unplanned areas the unchecked rate of rural urban migration has led to higher residential densities in unplanned areas. Other sectors include, water supply, industry, solid waste management, liquid waste management, tourism recreation and forestry, Transport and communication, commerce and finance, energy supply, urban agriculture, health services and education.

## SANITARY PRACTICES

### 4.1 Sewerage services in Moshi Municipality.

Moshi town has an advantageous topography that provides a necessary gradient for natural drainage into Karanga, Rau and Kiladeda Rivers and ultimately the Indian Ocean. Njoro juu stream also drains into Rau River after collection of run off from a number of natural gullies. Of the total cubic metres discharged daily only about half is disposed through the central sewerage system (Moshi Environmental Profile1999.

Moshi urban has 4 types of sewerage sanitation systems:

1. Sewage system
2. Septic tanks
3. VIP latrines (ventilated improved pit latrines)
4. Soil pits

The most dominant sanitation systems are the use of septic tanks, VIP latrines and soil pits. The soil pit is just a hole without lining. The durability of the soil pit latrines depends very much on the geology of an area it is located. It is important that the toilet is not built on a rock to allow waste to filter through.

### 4.1.1 The Municipal sewerage system

The Moshi Authority is also running a conventional system of collection, treatment and disposal of sewage from domestic, commercial, institutional and industrial centres within the Moshi Municipality.

In 1999 improvements were made to the central sewerage system. This involved two central lines passing Kiusa and Kilima, followed by extension of new system around Majengo area also in the same year. Later on there was construction of conventional waste stabilisation ponds hence leaving the trickling filter system, which was used at the time. The rehabilitation was partial focusing on just 2 lines that were not functioning properly and which were seriously blocked and leaking. The general the performance of sewer line was poor.

A MUWSA official pointed out that the remaining (un-rehabilitated) system is not very bad, but some parts are still not functioning well due to poor design and material. He said the increase in population is resulting to frequent cases of leakages and blockages. The MUWSA official gave examples of such areas being ; Mission Street- Bondeni Ward, Mbuyuni Street- Bondeni Ward, Lenguo-Mawenzi Ward and Njoro Street, also in – Bondeni Ward. He said problems in these areas are caused by the old age of the pipes, which have now grown weak, revealing that the original system was established in 1954. He also attributed these problems to population growth, and poor planning, which has led to haphazard construction of residential units done on top of sewerage pipes and even worse, on top of manholes (an offence under The Public Health (sewerage and drainage) CAP 336 of the laws annual–Supplement 1955). Thus, it is difficult to trace a leak or blockage in such cases. The situation is very dangerous in term of ground water and soil contamination and people's health status in general.

The sewerage network coverage is about 4.06 out of the total 58 square km. of Moshi Municipality. This coverage is realised after the support from The Urban Sector Rehabilitation Project (USRP) for rehabilitation of 5000m of the existing network and construction of new network of about 8411m that aimed at improving the status of services provided and increasing the number of customers connected to the services. Following its expansion, the population that is served with sewerage services in Moshi Municipality, has increased from 7% to 37%, which is about 65% of the total area covered by the sewerage network within the Central Business District (CBD).

The system is directed southward of the town to stabilization ponds in Mabogini area where the effluent enters river Rau into the Pangani basin ending up in the Indian Ocean. There is no treatment, but rather natural stabilization of wastewater. (Plate 1)

The treatment plant is designed to receive 4,500 mq3 per day but it is now receiving only 2,592-3,456 mq3 per day depending on season. During the rainy season or when there is high consumption of water, the amount it receives increases. Septic tanks are disludged by cesspits, which is the responsibility of the Municipal Council. The cesspit tanks/or trucks make about 90-100 trips per month.

**Plate 1 Mabogini wastewater treatment ponds**

According to MUWSA, a regular quality control and monitoring is done considering the amount of suspended solids. The parameters tested are according to the, (WHO) and Tanzania Temporary Standards (TTS). Unfortunately not all recommended parameters are measured due to lack of laboratory apparatus. Moreover the Municipal health department is also

responsible for testing the effluent quality. According to the health officer this is conducted every after three months.

**Table 1 showing some of the tested parameters of effluent at the end point of the waste stabilization ponds according to WHO standards. (Jan.2002)**

| | | WHO | Effluent actual (January 2002) |
|---|---|---|---|
| 1) | Suspended solids ……..... | 100 – 800 | …….. 92 |
| 2) | Temperature effluent …… | 5$^{o}$C | …….. 22$^{o}$C |
| 3) | PH …… | 6.5 – 8 | …….. 8.9 |
| 4) | Electroconductivity …… | 300 – 1,200 | …….. 3.7 |
| 5) | Biological oxygen demand …….. | 100 – 600 | …….. 35mg /l |
| 6) | Nitrate ……. | 0 – 30 | …….. 8.2mg/l |
| 7) | Sulphide mg/l… ……. | NIL | …….. 0.105 |
| 8) | Herminth eggs ……... | NIL | …..No reagents |

**----->Source :-** MUWSA January 2002

. The missing measurements are many if compared to the effluent standards (see appendix 1). This indicates that the quality of the effluent could in fact be acceptable in relation to the tested parameters but we are not sure whether the degree of acceptability would still be the same were other parameters also tested. The uncertainty of this alone, poses a threat to the users of the receiving rivers and streams, and to the environment in general.

Although there has been some improvement in the coverage of the sewerage system, still it is very small, and even in the area where the network is available, very few households have been connected. Before these improvements only 195 households were connected to the system, however, after the improvement in 1999-2002 about 1,561 households were connected to the system. According, to

MUWSA, the main reasons for the hesitations on connecting are basically financial and lack of understanding or information about the system. The effectiveness of the system may still not be very clear.

This being the case, most of the households are using simple systems such as septic tanks, VIP latrines and soil pits for disposal of sewerage since these are more economical and convenient to them. But the main concern is that there is a large number of houses that have opted for this type of sewerage disposal while its reliability in terms of the environment is not well understood.

Some of the areas visited e.g. Njoro have revealed very threatening realities in relation to sanitation practices. The area has high population density and is dominated by a low-income population that uses pit latrines and soil pits as a common disposal system. Due to the fact that a considerable part of the area is located on top of a rock, the pit latrines are shallow in nature and hence experience a lot of over flowing especially during rainy seasons.

River Njoro is running through the area, and as a result, it is highly polluted from these over flows and other domestic waste that flows into it. This has resulted in health problems for the people living in the areas as they use this river water for domestic purposes.

### 4.1.2 Industrial wastewater and sewerage disposal

There are about 6 industries on the Western part of the Municipal namely Kibo Match and Kibo Paper, which release their effluent into the Njoro stream; Bonite bottlers and Kibo Breweries, that release into Karanga river and Moshi Leather industry that releases into Njoro stream. On the South, there is the Municipal treatment plant, which is relatively not very pollutive compared to the past when the tricking filter was in use.

The Coffee curing industry is the only industry that is connected to the sewerage network. According to the MUWSA Office, the remaining industries have their own treatment plant (or rather disposal mechanisms) and make pre treatment of the effluent.. e.g., these industries include among others, Kibo Match, Bonite Bottlers, and Kibo Breweries. According to the Pangani River Basin official responsible for water quality, these industries have private ponds of which during rainy season they over flow into the streams, thus causing pollution.

According to the municipal health officer, Kibo Match industry is producing very little water and that the affluent is treated through sedimentation tanks, slow sand filter and 2 ponds, which are exposed to evaporation. She pointed out that the industry had not had problems of sludge. On the other hand an officer responsible for water quality in the Pangani Basin revealed that the same industry was responsible for discharging raw flows into the river. This is probably the reason why the health officer pointed out that in 2001the tested parameters for effluent had exceeded Tanzanian Temporary Standards (TTS). In this, case the Industry was advised to use supplementary material.

The health officer revealed that two industries, Kibo breweries (seized production this year (2002) and Bonite Bottlers are permitted to release water / effluent into the rivers. The data provided by Pangani River Basin on quality of wastewater produced by the industries in Moshi (table 2) reveal that the standards are in some cases extremely exceeded, which is an indication that the industrial wastewater is not safe. The data reveals that on this particular occasion Kibo match , Kibo Paper and Kibo breweries had some parameters which were way above the acceptable standards (table 2).

Like the wastewater treatment ponds, the health officer explained that industrial effluent is also checked after every three months adding that surprise visits are made when the office feels there is a problem as a strategy to keep the industries

in check all the time. She added that after the tests / measurements are made; the results are communicated to the council and community.

**Table 2 Wastewater analysis results for Moshi industries (18/3/2002)**

| **Sampling position/ Sample source ( )** | **Kibo Match** last evaporating pond (waste water) | **Kibo Paper** outlet to paddy fields (waste water) | **Kibo breweries** discharge point Karanga River (waste water) | **Moshi wastewater stabilization ponds.** (Wastewater) | **Maximum permissible value, water utilization Act, Amendment 1981** | **NEMC proposal 1997** | **World Bank, general guidelines 1998** |
|---|---|---|---|---|---|---|---|
| **Ec. µs/cm** | 2270 | 434 | 1516 | 339 | - | - | **-** |
| **Temp.°C** | 27.0 | 28.0 | 29.0 | 30.0 | See appendix 1 | | |
| **pH** | 6.60 | 6.50 | 4.47 | **10.3** | 6.5 - 8.5 | 6.5 - 8.5 | 6 - 9 |
| **DO mg/1** | 1.3 | 0.1 | 0.0 | 9.7 | - | - | - |
| **BOD5 mg/1** | **80.0** | **180.0** | **235.0** | **45.0** | 30 – 40 | 30 | 50 |
| **Phosphates mg/1** | 6.5 | **21.0** | **10.5** | 3.3 | 6.0 | - | - |
| **Ammonia mg/1** | **48.5** | **38.5** | **13.5** | 8.5 | 10 | - | 10 |
| **Zinc Mg/1** | **56.5** | - | - | - | 1.0 | 5.0 | 2 |
| **Cr VI mg/1** | **6.25** | | | | * | 0.1 | 0.1 |
| **Cu mg/1** | 0.19 | - | - | - | 1.0 | 2.0 | 0.5 |
| **AL mg/1** | - | 0.11 | - | - | - | - | - |

**Source:** Pangani River Basin Tanga 2002 / Ministry of Water river basin Management (see Appendix 1) .

The following table (3) gives the sewerage production estimates for industries not connected to the sewer. (some are not operating at present)

**Table 3 Sewerage production (own disposal)**

| Industry | Daily Average Flow | BOD (mg/l) | PH |
|---|---|---|---|
| Kibo Paper Mill | 2,700$m^3$ | 2400 | 6.71 |
| Tanzania Malting | 1,500$m^3$ | 2000 | 6.84 |
| Moshi Textile | 52$m^3$ | - | - |
| Bonite Bottlers | 120$m^3$ | - | - |
| Tanzania Bag Corp. | 52$m^3$ | - | - |

**Source:-** Urban sector engineering project (1995)
Final preliminary engineering design. Page (7/5)

Apart from the industries that release their effluents into the Njoro stream, the stream also receives all surface runoffs from the town. The stream is also the main source of water for lower Moshi irrigation scheme. The unfortunate fact is that people in Mabogini and elsewhere along the stream path also use this same stream. With the realisation that there is overflow of waste water from the waste water ponds from the industries, and town surface runoff, it is no surprise that there are frequent outbreaks of water born diseases such as dysentery and cholera in the down stream.

According to the 2001 environmental profile at ward level for Moshi West Division among others, the pollution of River Karanga results from effluents from Kibo Pulp and Paper Factory and Bon Bosco limestone industry. Also building of houses close to the river, bathing and disposing human waste in the river

contributes to pollution. Hence causing down stream users to be affected by water borne diseases.

### 4.2 Solid waste services in Moshi Municipaliy

#### 4.2.1 Waste collection

According to the Director of Moshi Municipal Council, one of the biggest problems facing Moshi Municipal is solid waste management. A Municipal health officer pointed out that a total of 200 tons were being generated daily but the council manages only 100 tons and out of which only 60 tons are collected daily (table 3).

Another official from the Health Department within the municipality revealed that 145 tons of solid wastes were being produced per day as domestic and commercial waste (.table 3) This shows an increase of 45 tons compared to the estimated 100 tones which was recorded in the 1999 environmental profile. And while in 1999 the amount of solid waste collected was about 55 tones daily the officer said at present only 60 tons out of the total waste is collected by the municipal and most of this is being produced in the CBD.

This means that about of 85 tones of waste is un-disposed of and this is only for the CBD.and other areas, which are provided with the service. If one is to add the amount of waste generated from the unplanned or unserved areas, than it would mean that an alarming figure of uncollected waste is generated. This is very hazardous both environmentally and hygienically as the 1999 environmental profile indicated that an average 47 tones of estimated solid waste per-day were left uncollected. However out that 30% was used as animal feed and compost while 20% was either burned or buried leaving a daily estimated 24 tones uncollected or unmanaged. These alternative practices are still being used to date and the rates may have increased in terms of numbers but the problem is growing even worse due to population growth. If in 1999 uncollected waste was

47 tones per day and at present it is 85 tones, then it means the situation is getting worse. While the estimated waste produced has risen by 45 tones from 1999 – 2001/2, the amount collected by the Municipal has only increased by 7 tones.

**Table 3 Estimations and distribution of waste generation in the Moshi Municipal**

| | |
|---|---|
| Total generation | 200 tones daily |
| Domestic and commercial: | 145 tones |
| Institutions: | 8 tones |
| Industries: | 47 tones |

| | High income | Medium income | Low income |
|---|---|---|---|
| Total population (2001) | 54.899 | 90.217 | 71.216 |
| Generation per capital (kg/day) | 1 | 0.6 | 0.5 |
| Quantity / day tones | 55 | 54 | 36 |

**Source: -** Moshi Municipal councils collection inventory year 2000

This situation is worsened by the fact that the town's terrain slopes towards the south hence during the rainy season the heaps of uncollected waste are washed away by rain water, thus blocking drainage systems and polluting streams. Likewise the flooding aggravates seepage from the disposal site into the nearby river. (Sustainable Moshi Programme 1999).

Matters are even worse in the unplanned and squatter areas where due to inaccessibility and shortage of trucks, uncollected piles of garbage are building up. This is not only unattractive for the eye but the longer the piles remain, the more hazardous they become as leaching takes place hence affecting the underground and surface water. Moreover, the decaying garbage produces fault

smell, which attracts flies, rodents and other insects that accelerate the spreading of diseases in an already poor hygiene area.

### 4.2.2 Dumping site

Haphazard waste disposal has been observed at the dumping site at Kaloleni, no separation of different categories of waste is done hence one would find metals, plastics, food stuffs, papers etc all piled up into the some are. Even some industrial waste is found in the area. This is a very dangerous method of waste disposal as observed also by the Moshi Environmental Profile of 1999. The report indicated that uncontrolled dumping leads to seepage, water contamination and the spread of water-borne diseases. Also incidental fires at the dumping site are likely to cause Upper Respiratory Tract (URT) and carcinogenic infections.
(Plate 2)

The dumping site is located near a residential area although the Health Municipal Officer pointed out that the dumpsite has been there for the past 30 years and that the people and the industries have encroached into the area much later. This situation creates risks to those who live near-by because scavenger birds tend to move from the dumpsite to the peoples' homes hence carrying along some items or garbage to the settlements. This causes the spread on diseases and if the scavenger is to land near or in a stream, for a drink then the water will also be contaminated.

The Municipal director pointed out that there is a crude dumping site in Kaloleni, which is now full, and in desperate need of replacement. The Municipal Director revealed that after trying unsuccessfully to secure land within the Municipal area, the Municipal finally was allowed to use a 4 hector piece of land ear marked as a dumping field at Bomang'ombe about 30 km away from Moshi. Preparations for this project though, are still underway.

**Plate 2 Kaloleni dumpsite**

### 4.2.3 Initiatives to improve situation

According to the municipal health officer, the plans to sustain the new Bomang'ombe landfill include:

- Increasing the present fleet of 2 skip loaders to three.

- To increase the number of buckets from the present 30 to 60 in five years time

- To increase revenue towards solid waste management. This will be in accordance to the current Bylaw amendments in process, which is geared towards enabling the council to collect fees and charges in areas which are not contributing towards solid waste management expenses these include households in peri-urban areas, markets, bus stands and institutions.

- To privatize refuse collection to CBOs in peri-urban areas. Reducing the current workload to the department.
- To improve enforcement of the principal legislation and Bylaws governing management of solid waste.
- To sensitize the public on waste separation and recycling.
- To prepare a sustainable council's waste management policy by June 2003.

### 4.2.4 Industrial waste disposal

According to the Municipal Health Official, all industries are responsible for the collection and transport of solid waste to the dumpsite at their own costs. Where the Municipal finds it necessary then the Municipal collects the waste and the industries pay for the number of trips, the digging and burying of the waste within the dumpsite. This was done for the leather industry (now not operating) because of the nature of the waste produced, in order to ensure proper disposal.

With this self-service kind of management, it is not easy to control and to ensure that these industries are really following the proper procedures of industrial waste disposal. This is dangerous especially if there are industries, which produce hazardous wastes. The 1999 environmental profile for Moshi confirms this argument as it says: - **"**There is grave danger of ground water contamination due to crude dumping of untreated wastes and lack of necessary expertise and equipment to monitor the qualify of industrial discharges.**"**

The profile goes on to highlight the possible impacts on human health for those using the water both for domestic and agriculture. It mentions the contraction of debilitating intestinal and skin diseases as being among the health impacts resulting from intake or external use of the contaminated water, food etc.

### 4.2.5 Hospital waste disposal

According to the Municipal health department, KCMC and Mawenzi hospitals wastes are incinerated in respective hospitals. The Municipal Health Officer said that there was an idea of using the old trickling filter plant site for hospital waste incineration. If this is to be done then there is a need for a lot of precaution on how this hospital waste is going to be transported to the site as the site is locate some distance from the town centre. Any leakages or outlets from the containers could be catastrophic to those living along the path taken by the carrier and the nearby population. Likewise, even more consideration should be given to those located near the proposed site. This decision need not be rushed. A comprehensive Environmental Impact Assessment (EIA) needs to be conducted before anything is put in place.

Hospital waste such as needles are supposed to be disposed of in containers, and protected in pits that are lined and tightly sealed. The health officer though, expressed that with the growing numbers of private health facilities, it is not easy to monitor or to ensure that all practitioners are following the proper procedure of hospital waste disposal. This situation is very discomforting as far as human health and the environment is concerned.

## 4.3 The Relationship between Income Status, Sanitation and Environment in Urban Moshi

Observation made have revealed that there is a close link between the income status of the people, the type of environment they live in, as well as their sanitary practices.

These observations involved seven areas within the Municipal being both planned and unplanned areas, and of high, medium and low-income status. The income status was purely from observation of the type and quality of houses (i.e.

materials used in construction, whether temporary or permanent the size and other aesthetic factors) found in the area. The areas in which the houses were situated were also used as an indication. Referring to whether the area was easily accessible, organised, squatter, availability of services such as water, roads, electricity ect, and whether or not it is a marginal area.

Areas of poor economic status such as Njoro are characterised by temporary building materials such as mud and wood. Also the environment proved to be very poor as solid waste collection seems to be very minimal if at all present. Most residents are practicing autonomous sanitary management i.e. in sewerage and domestic waste disposal. (Plate 3).

Moreover it is a squatter area to a great extent established on marginal land. Not all parts of Njoro are accessible due to the overcrowding and haphazard construction of low quality houses and also due to the character of the terrain in the area. The area has suffered great erosion resulting from rain water flowing towards the area from the town into the Njoro stream hence causing gullies and exposure of the wider lying rocks.

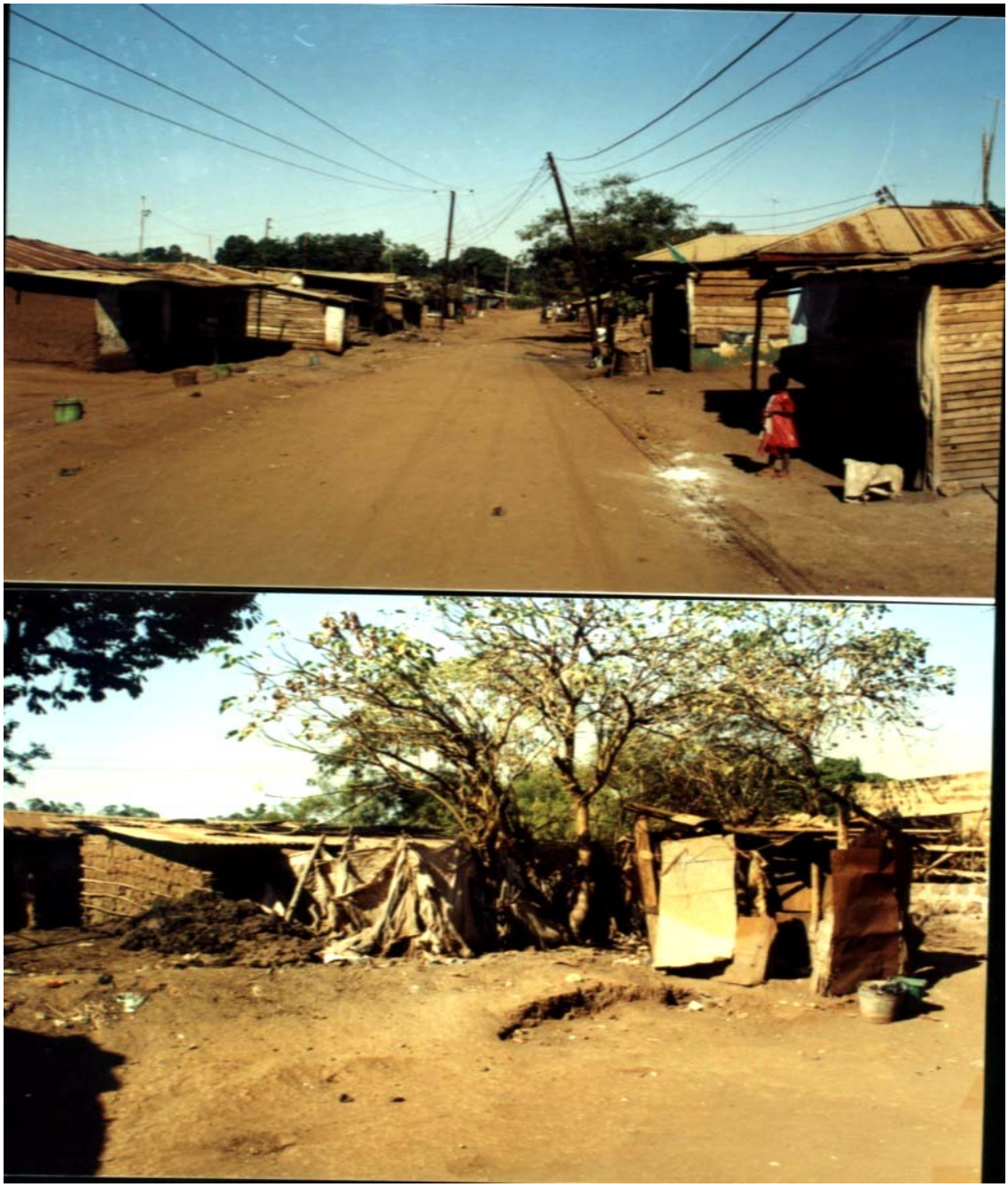

**Plate 3 Njoro low economic status characterized by poor, temporary structures.**

The level of income of most people in these areas results to poor handling of both solid and liquid waste (human excreta inclusive) as they are not able to afford the construction of proper sanitary facilities. Most of the people living in these areas depend on very small scale informal activities such as selling food stuffs, either in the market place or on the road sides others especially women sell baked foods such as donuts and the like or vegetables and fruits by caring them around or putting them on the front of their homes. Many seem not to have permanent employment. None of these activities really could enable these people to afford to have a decent life in terms of material wealth. Therefore these people tend to do whatever basic practice will pull them through with the little resources they have the main target being to survive.

Making matters worse, the Njoro area is on top of a rock, which makes it impossible (with the resources available) for the people in the area to dig deep latrines, septic tanks or even solid waste disposal pits. This being the case most pit latrines in this areas are built with the depth being established by elevating the latrines but in some cases even that is not affordable so the latrines are very shallow.(Plate 4)

**Plate 4 at the background- an elevated pit latrine in the Njoro area**

The result of this practice is overflowing of these pit latrines especially during the rainy season. The overflow may also result from the fact that the latrines are filled up. This is dangerous health wise as it leads to outbreak of diseases such as diarrhoea, dysentery etc. But more dangerous is the fact too that once the outbreak takes pace people are not economically in a position to protect or treat themselves and with their already poor diet, recovery is also very difficult.

What is even more critical is the fact that some of these pit latrines/ soil pits once full, are emptied manually by human means e.g. use of a bucket and rope. This threatens the health of those carrying out the exercise, as they have no protective gear. Also, another matter of concern is the dumping site/destination of this liquid waste. The point of destination will not only be experiencing excessive organic material disposal in the soils ,but this material could easily be carried into a river or spring, hence causing water contamination and pollution.

Moreover children tend to walk and play bare foot and even bath in the contaminated water (of course not only contacting the contaminated water but adding to it as well), which result to diseases such as worms and skin diseases.(Plate 5).

Solid waste disposal in areas like Njoro, include throwing garbage on the banks or within the river Njoro and even a greater portion of the solid waste is dragged into the river from the surrounding settlements especially during the rain season. (Plate 6) This, plus the overflowed latrines create a very dangerous health hazard to those using the water of this and any other river, experiencing the same situation. This situation is a result of not having waste collecting services in these areas the one municipal skip basket was spotted at the Njoro market but due to the in accessibility of the more interior parts (where the situation is critical) this services is not available letting the people use autonomous alternatives.

The unfortunate fact is that the people who use these rivers are the same ones who are responsible for this contamination. The rivers provide water for domestic use and to some extent small-scale agriculture. But this could be more a result of lack of clean water supply (tap water) as MUWSA has not been able to cover all areas with this service. It could also be a result of inability to pay for the service large part of urban Moshi has functioning water-meters for every customer.

**Plate 5 washing and bathing taking place in the Njoro spring along Njoro river. (viewed in the back ground is a shut down water pump.)**

Also observation reveals that areas with medium to high income status, such as, Shanty town have a much different approach to sanitary management. In some cases those which are near to the CBD are connected to the central sewerage system (these are very few) but for those who have to connected, or are living in the unplanned areas of the municipality, they tend to use more decent or favourable kinds of sanitary practices including construction of septic and seepage tanks which indicates that even their toilets are more modern, such as flush toilets and the like. These are in most cases facilitated by Municipal Cesspit trucks, which are responsible for the emptying of these septic tanks. The individual pays for the service. (Plate 7)

**Plate 6 waste disposal along and within The  Njoro River**

Also being well of economically, it is probably easier to educate and make aware this category of individuals on the importance of connecting to the sewerage system than it is to those living in more or less poor economic situation.

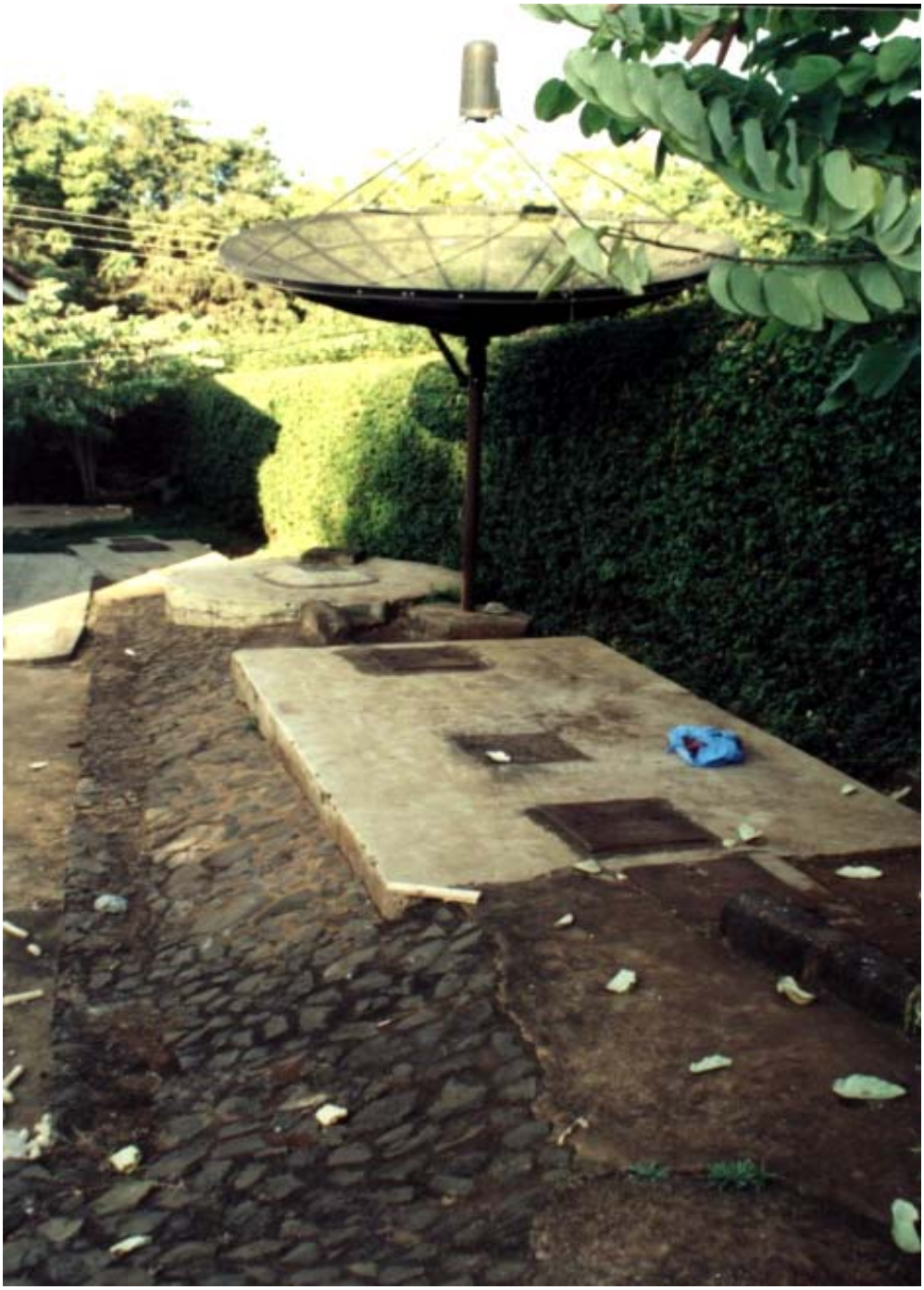

**plate 7 septic at a house in shanty town .the satellite dish is a sign wealth**

Other areas experience a mixture of both high and low income characteristics and sanitation practices hence become mixed e.g. Pasua Majengo Mapya,

Majengo and the like. These areas tend to have very well built houses and modern toilet facilities using septic tanks or in cases such as the Majengo area some are even connected to the main sewerage system. On the other hand there are those with not so attractive houses, permanent, but poorly built or even those with day houses these tend to have either pit latrines some VIP's and others can only afford to use the most basic means which is the soil pit. With this kind of mix, diseases are likely to affect all economic categories regardless the practices used by others in the area.

These improper autonomous sanitary practices are of great concern especially environmentally because large part of Moshi urban is not planned and that being the case, Municipal authorities are not in a position to advise on the construction of septic tanks or pit latrines, as these are not official sites. As a result, the people have to a great extent depended on autonomous builders who may not be well informed on the designs and environmental precautions to be taken into consideration during construction.

Hence, these autonomous builders tend to build through experience or in other worse cases such as construction of soil pits no experience is even considered. It is just a matter of digging a hole (depth of choice or convenience) and constructing a shed over it and covering the hole with materials such as wooden boards, iron sheets and any other materials that may seem suitable. This is not only dangerous environmentally and hygienically, but could also be catastrophic to life if the covering materials are not stable enough.(Plate 8).

**plate 8 A soil pit built from a mixture of available materials.**

Environmentally, This haphazard habit of construction of autonomous sanitary facilities could lead to the contamination of underground water, out break of diseases. According to the District Medical officer communicable diseases are most common in the low-income areas. Revealing that in the year 2000 there were 2,702 reported cases of diarrhoea and 3,354 cases of intestinal warms. be this being the case, this situation needs to be seriously considered as always this impact has far more reaching effect, Wright (1997) clearly explains this phenomenon by pointing out that, “human and domestic waste from any area has the potential to contaminate not just the local environment, but also groundwater, lakes, and rivers used by many others for supplies of fresh water. Thus the sanitary crisis cant take a toll on all city residents, on the national freshwater resources of developing countries.”

This means ignoring the improper practices that are being used by the poor who have no assistance in improving their economic situation, could actually jeopardize the whole community poor and rich.

**4.4 The Impacts of improper sanitation practices.**

According to Winbald et.al. (1985), Many infections of human beings are spread through inadequate sanitation. Viruses, bacteria, protozoa and worms may spread through direct contact, indirectly via food, water and soil or via carriers and vectors. He adds that infection from taking in food or drink contaminated with faeces may lead to viral diseases like poliomyelitis, infectious hepatitis and gastroenteritis; bacterial diseases like cholera, typhoid, paratyphoid and bacillary dysentry; protozoal disease like amoebic dysentry and giardiasis; and worm infections like ascariasis, trichuriasis and pinworm are passed on when people touch faeces and then food or drink.

According to the Municipal Health Officer, common health problem in Moshi Municipal, include malaria, dysentry and diarrhoea. According to the Health Officer, poor sanitation practices contribute more than 60% of all health problems mentioned above. These diseases may be transmitted through –

- Contamination of water sources
- Improper use of water sources
- Poor disposal of liquid and solid water
- The prevailing of vectors that carry disease pathogens

Unfortunately ground water has not actually been tested for sanitary pollution.

According to the Municipal Health Office, the environmental threats that may result from sanitation systems include over-flowed pit latrines, odour/foul smell from pit latrines (due to poorly constructed), sewerage water from domestic houses to the streets and old age of the system and uncontrolled dumping site. The officer also confirmed that there have been several reports of these

problems to the office. The health officer though, explained that a greater percent of these problems is reported from the outskirts of the Municipal due to probably poor infrastructure including water supply, roads, housing etc.

According to the MUWSA sanitation engineer, traditional pit latrines/ soil pits cause 100% pollution. According to him, this is in terms of producing odour that results from lack of oxygen, as there are no significant processes taking place inside the pit latrine. Secondly he pointed out the danger of underground water pollution/contamination. The engineer also added that VIPs, septic tanks and especially seepage pits were also not very safe environmentally as they allow seepage of wastewater. He argued that the way to remove the pollution, for people to connect to the central sewerage system. The problem with this suggestion though, is the fact that the coverage of the system is still very small and still the issue of poverty is a major hindrance.

### 4.4.1 Solutions / efforts made

Winbald et.al. (1985), explains that for all the diseases mentioned above, the most important measure is to dispose of faeces in a sanitary way and to protest food and water supplies.

To deal with such problems brought about by improper sanitation practices, the health office said, that her office insures that there is no environmental damage through enforcement of environmental sanitation by-laws. She also explained that her office provides advice on:-

- Proper handling of refuse to the general public,
- Proper sanitation practices to women and NGO groups, and
- Water sanitation to women and other groups

This advice is given several times during meetings, health education programmes, Ward Development Committees ( WDCs) meetings, seminars etc. the officer claims that there has been some success in this.

### 5.1 Data / information availability

The data available is very minimal and does not reveal the state of matters in the localities. For instance there is no information on the soil types nor seepage or absorption capacities of Moshi soils in specific localities. Secondly the exact depths of the water table in specific localities is not established hence no precaution taken especially during the construction of autonomous pit latrines/soil pits.

Likewise there is no exact estimate of solid waste produced on daily basis since not all areas within the Municipal (for example Njoro) are served with skip baskets so estimations made are from the areas with such services.

Furthermore data/information on groundwater and surface water contamination resulting from sanitary practices is not well established. For example data on parameters such as faecal coliforms is not readily available. For instance the drilling and dam construction company only measures such parameters as PH, salinity, alkalinity etc but no biological test or measurements are made. This is dangerous to those who utilise water from these wells and dams. Reasons most commonly given both by MUWSA and the drilling company, are that, the test is expensive and they do not have the proper facilities (laboratories) to conduct such testing. Also adding that the test is very time sensitive as a delay in testing by hours may lead to faults result hence even testing this parameter in Arusha or Tanga may not give proper results if a delay is to occur. They pointed out that the tests could be conducted at the KCMC but it would be very expensive.

Nevertheless, the sanitary engineer strongly pointed out that bacteriological, chemical and physical analysis was very necessary and important. He said the office used to test hermnith eggs but this does not give direct numbers of faecal coliform (which goes against the standard guidelines for bacteriological examination. Box 1). He also emphasised that testing faecal coliform was very

important and though it was not being tested in the past, arrangements are now in progress to ensure the testing of this parameter.

Guidelines on water quality seem to put great emphasis on this parameter (box 1), and explaining the presence of organisms of coliform group to indicate pollution in the widest sense. Although the stream and river waters in which the effluents are released may not be conventional sources of water, they still need to meet these standards as a great number of people in Moshi urban depend very much on them.

The implication of not having bacteriological testing is very serious. One needs to weigh the cost of measuring or testing such parameters and taking action soon, against allowing the parameters to go untested and incurring more expenses in form of drugs and other medical services. What makes the latter outweigh the other is the fact that a greater price, which cannot be converted into monetary terms, is also paid and that is the loss of human life.

What is even more worrying though, is whether the information / data that is being obtained is accurate. This is due to certain data on BOD5 analysis (figure 1) provided by the MUWSA where there are cases of such extreme abnormalities in measurements that one would have to wonder if the information is correct.

**Box 1. Examination of Water Quality**

**Bacteriological Examination**

It is essential to check periodically during the operation .

| SUBSTANCE | UNIT | W.H.O | | STANDARD FOR RURAL WATER SUPPY IN TANZANIA |
|---|---|---|---|---|
| | | ACCEPTABLE | ALLOWABLE | |
| 1. Coliform count per 100ml at 37$^{o}$C | Each | - | 16-3 | 1-3 |
| 2. E. Coli. Count per 100ml at 44 $^{o}$C | Each | NIL | NIL | NIL |

1. 98% samples should not contain any coliform organism in 100ml
2. up to 3 contain is allowed in Occasional Samples but not consecutive samples.
3. not occurring repeatedly of which improvement to sanitary protection should be sort, or alternative source should be found.
4. No sample should contain E.Coli in 100ml.

Bacteriological examination should include colony counts of micro-organisms on non-selective media, and examination for faecal streptococci and possibly for costridium per fringes as well as for coliforms organisms and Escherichia

**Organisms Indicative of Faecal Pollution**

Organisms used as an indicators of pollution are E. Coli and the coliform group.E. Coli is of feacal origin. The Coliform group may be of faecal origin and should be assumed that they are all of faecal unless a non-faecal origin can be proved. **Organisms of coliform group are all foreign to water and their presence should be an indicative of pollution in the widest sense.**

Faecal streptococci (streptococcus faecal, can be a help when confirming mature pollution in water) Faecal streptococci occur in faeces and are smaller than of E. Coli their presence in water supply indicate faecal nature of pollution.

**Sourc**e: MUWSA 2001

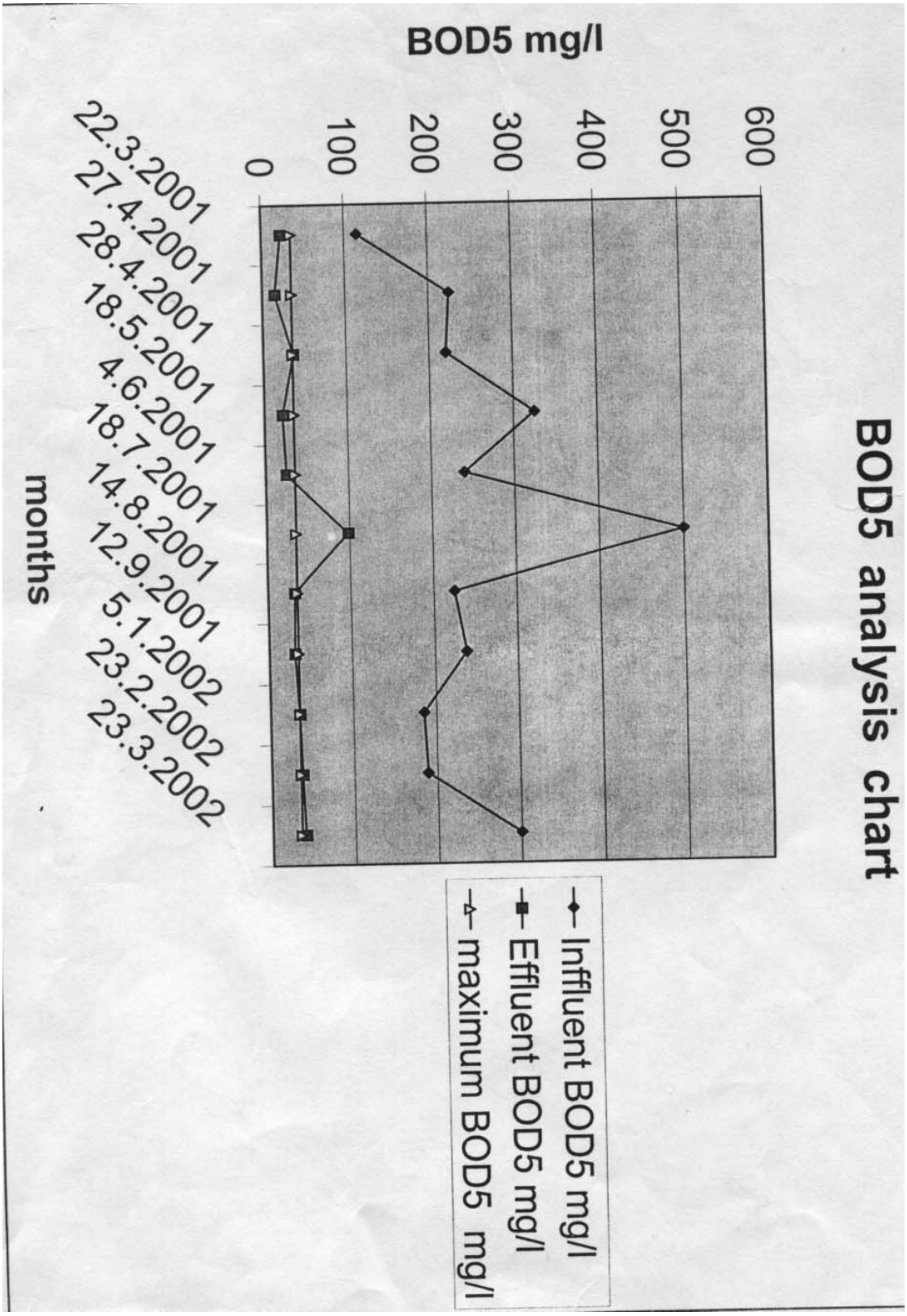


**Figure1 BOD analysis chart 22/3/2001 – 23/3/2002**. **Source:** MUWSA 2002

Bacteriological analysis report prepared for a particular association (private) on 11/03/1999, from Karanga spring intake (Njoro) revealed that the water was contaminated by faecal coliforms, (thus unsatisfactory) recommending treatment by chlorine before use or boiling as an initial action to be taken. The bacteriological data collected from down stream (River Karanga) in the village (on the same date) indicated the number of faecal coliforms as being too numerous to count (TNTC) meaning the water was highly contaminated by faecal coliforms and other materials, therefore full treatment was recommended before use. The test was also conducted along the river and from water in a container from a home in the village and the results were 243 faecal coliform/100ml in the first instance and TNTC in the latter (Regional Water Engineer's Office Arusha 13/03/99).

With this kind of data it is evident that River Karanga was facing contamination resulting from sanitary practices, but this analysis was done on request therefore, there is no information on the trend of the bacteriological status of the river and streams so long as there is no private request or intention of installing a water pump in the area for supplying water.

According a hydrologist in Moshi – no hydrological study has been done in Moshi that would provide information such as how connected the aquifers are, flow, direction and velocity of water and the like. He said soil analysis was important as that would provide information on the absorption/seepage capacity of the soil and the ability of the soils of specific localities to perform natural cleansing depending on the soil composition etc.

This being the case it means no exact information or data on the seriousness of ground water pollution caused by sanitary practices can clearly be determined or realised. Bearing in mind that the drilling and dam constructing company does not do bacteriological tests. The chemical tests could help to find out the extent of heavy metal pollution resulting from leaching taking place at the dump site but

even that can not be easily associated unless it is with in the vicinity of the dump site.

The sanitary engineer from MUWSA also said that his office does not have the necessary data for sewerage expansion for the specific localities and for charting out the volume of sewerage. He listed that the data needed includes: estimation of waste water generation, the geological formation so that if there is a rock then there will be need for excursion, soil type, level of water table, ground water recharge, flow results from per capital consumption of water.

He pointed out that because of lack of data (in the office) this responsibility is usually given to a consultant who collects the data together with a contractor who will be responsible for the construction but then it seems the information is not surrendered to the office.

### 5.2 Information necessary in light of evolution of urban densities

With an annual population growth rate of 6.2%, Moshi urban is experiencing pressure especially on the provision of social services. In-migrants (from within and outside Moshi), in most cases tend to occupy the marginal areas. This is mostly the case with rural urban migrants who are usually in search of greener pastures and do not have the financial means to occupy more suitable areas. Since these marginal areas are treated as free zones, the migrants become autonomous in their ways of living as well, and this includes even their sanitary practices.

The danger of this is that in most if not all cases, the practices are without due consideration of the environment, as these people do not have the financial

means of providing themselves with even the basic necessities for living. With the rapid trend of population growth therefore, and expansion of the town, there is a need to have in place mitigation measures so as to reduce if not do away completely with the environmental implications of these practices. This can only be done, where there is accurate and reliable information that covers every corner of the Moshi municipal.

Municipal health office suggested that there is a need to have environmental profile data from each ward**.** If that idea is to be taken on board, then the information that would probably be necessary may include among others:

- Population density, and growth rates resulting from natural increase and migration into the wards would help in forecasting future needs for sanitary infrastructure in the respective wards. It will also provide projections for the number of autonomous facilities to be expected in the future and hence ensure that proper control mechanisms are put in place.
- Population quality in every ward especially in terms of employment and education levels. This will assist in targeting the unemployed and uneducated in sanitary education and proper sanitary facilities as it is this group, which more often than not, practices improper sanitation.
- The social services available in every ward and their sufficiency as compared to the population growth such as garbage collection and disposal facilities, clean water, sewerage disposal facilities,

- There is need to find out the common disease outbreaks in the wards and whether they relate to improper sanitary practices.
- The dominant sanitary practices in the wards e.g. number of V.I.P latrines, soil pits, seepage pits and septic tanks and their conditions.
- The present environmental problems facing the wards, their causes and effects on the people.

### 6.1 Recommendations

- There is a need for all actors and stakeholders to come together or be involved in the planning, development establishment, monitoring and evaluation of sanitation practices in the localities.

These stakeholders should include:

- The MUWSA
- The Moshi Municipal
- All urban Moshi residents (representative at ward level)
- Local government leaders
- Sustainable Moshi project
- Pangani River Basin
- The Drilling and dam construction company

The MUWSA establishes and controls urban water supplies, imposes water rates and prevents water pollution (Environmental Profile, 1999). Ii is in a position to provide data on the amount and quality of water supplied, the coverage of conventional water supply in the municipal, main pollutants of the water sources etc.

The Urban Water Board is responsible for the operation and maintenance of water supply systems (Moshi Environmental Profile 1999).

The Municipal Council through the Council Department of public health and social welfare is supposed to maintain public latrines and the central sewer while the works Department caters for surface water drainage. (Moshi Environmental Profile 1999).

The drilling and dam construction company is an independent ground water facilitator to individuals and institutions it is in a better position to provide information on ground water quality.

Pangani River Basin is responsible for all information concerning rivers, springs and streams passing connected or in relation to the Pangani Basin from source of the water, passage, soil etc and testing quality of the water passing through urban areas, from industries etc into agricultural plots and main river channels.

The local government has a responsibility of ensuring the well being of its community in general.

The Moshi residents are the ones who use the resources and hence need to know about their well-being and how to best manage them for sustainable development.

This being the case then, it can clearly be seen that there is an overlap in either the responsibilities or interest in particular resources in this case water seems to have many actor all with different or overlapping intentions but each actor playing an isolated role.

- The Municipal should use the power vested in it by law to provide for private practitioners in the area of sanitation management but with a

strong monitoring role on how it is handled to ensure that there is no environmental damage.

- Ward development committees should develop schemes that would improve the economic and hence environmental well-being of its people. These schemes should be the initiative of the people themselves and the people should be willing to participate fully in the planning implementation, monitoring and evaluation stages of the scheme.

- The Municipal Health Office suggests that a working group in sustainable Moshi Programme be established to work on information system. If this is so, then there is a need to establish a permanent database concerning sanitation management that is frequently updated and revised. The data available should be shared among the stakeholders to ensure that all are well and equally informed. Changes reported should be communicated to all stakeholders.

For instance the type of information should include: the number of connections to the main sewer, number of pit latrines and average depth, ground water quality, type of diseases and causes of outbreaks, as well as data on environmental issue collected by different actors.

- There is need to fill the existing information gaps because the information is non continuous. For instance, there are cases where certain data is only available for several years then there is a huge leap in between before more data is available. Furthermore, storage and handling of this information once acquired is also very important.

- Causes and solutions to environmental degradation or distribution in localities should be discussed collectively and not through instructions and orders to the residents. The residents need to be made a part of the

campaign in sanitation management in that way they will be more willing to cooperate in improving the environment in which they live in.

- Education on safe and environmental friendly sanitary practices needs to be given to the masses. There is a need to have practical demonstrations on how best to construct and use the proper sanitary facilities.

- There needs to be a clear demarcation between MUWSA and the Municipal in their responsibilities and roles in sanitation management. the consequence is that there are areas which have serious environmental problems but no one seems to be responsible.

- The urban planners need to plan for the residential areas so as to avoid haphazard construction of houses and hence sanitary facilities.

- There is a need to create a monitoring mechanism that will ensure safe and proper disposal of both solid and liquid industrial and hospital waste. If possible the disposal of such waste should be done under strong supervision of the Municipality, to ensure that proper care and procedures have been taken.

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## Effluent standards in Tanzania

Effluent standards as they are given in Water Utilization Act and in a proposal from National Environmental Management Council as well as general guidelines given in Pollution Prevention and Abatement Handbook 1998, from the World Bank, are given in the table below.

| Substance | Maximum permissible value, Water Utilization Act, Amendment 1981 | | NEMC, proposal 1997 | World Bank, general guidelines, 1998 |
|---|---|---|---|---|
| | *Direct discharge into receiving waters* | *Indirect discharge, via municipal sewage treatment plant* | | |
| Suspended solids | Not to form sludge or scum in the receiving water | - | - | - |
| Colour | Not to cause any change in the natural colour | 100 Pt-Co | - | - |
| Taste and odour | Not to cause any change in the natural taste or odour | | - | - |
| Temperature | Not to cause any increase of the water by more than 5°C | 35°C or not more than 5°C above ambient temp. of the supplied water | - | Max. 3°C above ambient temperature of receiving water |
| Total dissolved | 3000 mg/l; no restrictions for discharge to the sea | 7500 | - | - |
| Total suspended solids | - | - | 100 mg/l | 50 mg/l |
| pH | 6.5 – 8.5 | | 6.5 – 8.5 | 6-9 |
| BOD, 5 days , 20°C | 30 mg/l | | 30 mg/l | 50 mg/l (BOD) |
| BOD, 5 days , 25°C | 34 mg/l | No limit | - | |
| BOD, 5 days , 30°C | 37 mg/l | No limit | - | |
| BOD, 5 days , 35°C | 40 mg/l | No limit | - | |
| COD | - | - | 60 mg/l dichromate | 250 mg/l |
| rmanganate value | 80 mg/l | No limit | - | - |
| Total Kjeldahl nitrogen | - | - | 15 mg/l as N | - |
| Ammonia | 10 mg/l | No limit | - | 10 mg/l |
| Nitrates | 50 mg/l | 80 mg/l | - | - |
| Nitrite | 1.0 mg/l | 10 mg/l | - | - |
| Total phosphorous | 6.0 mg/l | * | 6 mg/l | 2 mg/l |
| Fluoride | - | - | - | 20 mg/l |
| Chloride | 800 mg/l | 800 mg/l | - | - |
| Chlorine, total residual | 1.0 mg/l | 5 mg/l | - | 0.2 mg/l |
| Sulphate | 600 mg/l | 600 mg/l | - | - |
| Sulphide | 0.5 mg/l | 1.0 mg/l | - | 1.0 mg/l |
| Cyanide, free | - | - | - | 0.1 mg/l |
| Cyanide, total | 0.1mg/l | 0.2mg/l | - | 1.0 mg/l |
| Aluminium | 2.0 mg/l | 5.0 mg/l | 2.0 mg/l | - |
| Arsenic | 0.1 mg/l | 0.1 mg/l | 0.2 mg/l | 0.1 mg/l |
| Barium | 1.5 mg/l | 3.0 mg/l | 1.5 mg/l | - |
| Cadmium | 0.1 mg/l | 0.1 mg/l | 0.1 mg/l | 0.1 mg/l |
| Chromium (VI) | * | * | 0.1 mg/l | 0.1 mg/l |
| Total chromium | * | * | 1.0 mg/l | 0.5 mg/l |
| Cobalt | 1.0 mg/l | 1.0mg/l | 1.0 mg/l | - |
| Copper | 1.0mg/l | 1.0 mg/l | 2.0 mg/l | 0.5 mg/l |
| Iron | 3.0mg/l | 5.0 mg/l | - | 3.5 mg/l |
| Lead | 0.2 mg/l | 0.2 mg/l | 0.1 mg/l | 0.1 mg/l |

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| Substance | Maximum permissible value, Water Utilization Act, Amendment 1981 | | NEMC, proposal 1997 | World Bank, general guidelines, 1998 |
|---|---|---|---|---|
| Manganese | 3.0 mg/l | 5.0 mg/l | - | - |
| Mercury | 0.005 mg/l | 0.005mg/l | 0.005 mg/l | 0.01 mg/l |
| Nickel | 0.2 mg/l | 0.5 mg/l | 0.5 mg/l | 0.5 mg/l |
| Selenium | 0.5 mg/l | 1.0 mg/l | - | 0.1 mg/l |
| Silver | 0.1 mg/l | 0.1 mg/l | - | 0.5 mg/l |
| Tin | 2.0 mg/l | 2.0 mg/l | - | - |
| Vanadium | 1.0 mg/l | 1.0 mg/l | - | - |
| Zinc | 1.0 mg/l | 1.0 mg/l | 5.0 mg/l | 2 mg/l |
| Alkylbenzyl sulphonate | 2.0 mg/l | 5.0 mg/l | - | - |
| Aromatic and aliphatic hydrocarbons | 1.0 mg/l | 5.0 mg/l | - | - |
| Aromatic nitrogen containing compounds | 0.05 mg/l | 0.05 mg/l | - | - |
| Chloroform extract | * | 10 mg/l | - | - |
| Formaldehyde | 1.0 mg/l | 1.0 mg/l | - | - |
| Grease and oils | 5 mg/l | 10 mg/l | - | 10 |
| Non-volatile chlorinated compounds | 0.05 mg/l | 0.05 mg/l | - | - |
| Organochlorine pesticides (Cl) | 0.005 mg/l | 0.005 mg/l | - | - |
| Other pesticides | 0.01 mg/l | 0.01 mg/l | - | - |
| Resins, tar, etc. | 2.0 mg/l | 5.0 mg/l | - | - |
| Volatile chlorinated hydrocarbons (Cl) | 0.05 mg/l | 0.05 mg/l | - | - |
| Phenols | 0.2 mg/l | 1.0 mg/l | - | 0.5 mg/l |
| Coliform Bacteria | - | - | - | < 400 MPN/100 ml |

- = No limit set or proposed
* = Difficult to read

Faecal Coliform < 1000 per 100 ml – WHO (1989)