THE UNITED REPUBLIC OF TANZANIA

MUNICIPAL WASTEWATER MANAGEMENT IN TANZANIA

A National Report Compiled

by

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A National Report compiled for UNEP-GEF WIO-LaB PROJECT

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EXECUTIVE SUMMARY

Introduction

In most urban centers in Tanzania, few households are served with central sewerage system. The greater proportion of the population relies on on-site sewerage disposal systems. In Tanzania about 90% of the urban population depend on on-site sanitation systems: pit latrines (80%) and septic tanks (10%) as their excreta disposal facility. However, most of the facilities in place are sub-standard, illegal or delimited and are likely to collapse and/or overflow during rainy season. Poor handling and improper disposal of sludge from on-site sanitation facilities result into spread of pathogenic micro-organisms and breeding of disease-transmitting insects. The lack of formal stormwater drainage system has been found to lead into mixing of raw sewage and stormwater streams and clogging of stormwater drainage systems due to poor disposal of solid wastes.

The main objective of this review study was to carry out an inventory of the status of Municipal Wastewater Management (MWW) management in Tanzanian coastal areas. The review was undertaken under the auspices of UNEP-GEF WIO-LaB Project-an initiative of UNEP/Nairobi Convention that aims at addressing the growing challenges of managing municipal wastewater in the Western Indian Oceab (WIO)_sub-region. In addition, this study also involved the national level review of the municipal wastewater management guidelines prepared by the UNEP Global Programme of Action for the protection of the marine environment from land-based activities (GPA).

The study identifies key issues for national action with regard to MWW management in the coastal zone of Tanzania. The report provides a framework to promote the use of alternative solutions, including low cost and environmentally sound sanitation and wastewater treatment technologies, viable financial mechanisms, appropriate institutional, policy and legal frameworks, and creation of enabling environment for action. Furthermore, the report together with the UNEP/GPA Guidelines on Municipal Wastewater Management offer a linkage between water supply and sanitation to facilitate and promote holistic MWW management as part of the implementation of the GPA.

Policy Framework and Institutional Framework

The existing polices and strategies have potential (strength and opportunity) to bring positive changes in Tanzania. However, wastewater management in Tanzania is hampered by weak institutional capacity, inadequate coordination and collaboration. The current institutional framework for the provision of water supply and sanitation services is based on a separation between urban water supply and sewerage services, and rural water supply services. The ultimate responsibility for the provision of these services rests largely with the Ministry of Water. Currently, there is lack of an effective institutional framework for integrated water supply and sanitation services in Tanzania.

Legal Framework and Stakeholder Involvement

The existing legal and regulatory framework for water supply and sanitation management do not reflect the institutional and organisational changes necessary to implement the National Water Policy (2002). Inadequate stakeholder involvement in planning and operation of water supply

and sanitation systems has led to a lack of appreciation of problems faced by water and sanitation service.

Financing Mechanisms

All Municipal Councils need to operate more commercially with increasing responsibility for meeting all their own costs, including capital investment. Actions necessary to achieve this goal, are proposed in the following areas: tariff setting**,** billing system, control of operating cost*,* and funding of investments.

Inventory of MWW Treatment Infrastructures

The inventory of MWWM infrastructure in Tanzania shows that 7 coastal towns/districts out of 19 have a sewerage system. Except in Tanga, Zanzibar and part of Dar es Salaam City, that discharge untreated wastewater to the sea, all municipal wastewater is treated in waste stabilization ponds. Wastewater treatment does not always meet the prescribed standards despite the fact that the treatment plants are not fully loaded. Sewer networks often do not extend to industrial areas to collect industrial wastewater. The immediate requirement with regard to the existing system appears to be (i) identification of areas where the demand for connections is greatest and (ii) construction of more lateral sewers to maximize the number of new customers. There is no regular monitoring of quality of the receiving water bodies thus the trend is not known.

A sanitation study is recommended for all coastal towns where there has not been such a study. This should assess the total cost of providing sewerage services and identify areas where the provision of sewers may have economic benefits.

Assessment of MWW Management Practices and Methods

Investment in water supply and sanitation, either for rehabilitation or expansion, has been very low and totally inadequate in improving the levels of service and coverage of these services to the population. At present, all Authorities are essentially operating units, with capital investments made largely by the Ministry of Water or Development Partners.

About 70% of diseases treated in health units in Tanzania are reported to be water, sanitation and hygiene related. The identified existing constraints in MWW management practices and methods includes: Low priority accorded to sanitation and hygiene improvement; fragmented planning; inadequate investment financial resources; Low tariff levels; Inadequate skilled human resource base; environmental degradation and pollution of water sources; Lack of an effective institutional framework; Inadequate availability of effective sewerage and sanitation systems; limited participation of beneficiaries and other stakeholders; lack of attention on selecting the most appropriate technology; and general low public awareness.

In order to improve MWW Management Practices in Tanzania, the role of Government needs to change from that of a service provider to that of a co-ordination, policy and guideline formulation and regulation. There is also a need for the involvement of private sector in the financing and provision of water supply and sanitation services in Tanzania.

Review of Existing Technologies Used for MWW Management

A range of on-site technologies are currently used in Tanzania, including: traditional pit latrines, ventilated improved pit (VIP) latrines, composting latrines, septic tanks followed by soak way pit and sea outfall pipe. Existing off-site technologies include: aerated lagoons; Waste Stabilization Ponds; and constructed wetlands. The existing constraints in MWW technologies relates to capital investment; availability of water; poor urban planning; attitudinal barrier and social-cultural aspects; poor institutional frameworks to support infrastructure development; ineffective promotion of MWW management technologies and low public awareness; and limited attention in selecting appropriate MWW management technology.
Lessons Learnt from other Projects include;

- Participatory approach is critical for creating community ownership of projects;
- Capacity building is worth investing into;
- Demonstration schemes or pilot projects provide testing ground and a means of initiating collaboration among various partners;
- Regional and sub-regional cooperation may facilitate mobilization of necessary resources, and;
- Targeting poor communities has a much greater overall impact in improving the quality of living

With regard to application of appropriate technology, developing countries such as Tanzania should strive to make use of natural and artificial wetlands. Constructed wetlands are potentially good, low-cost, appropriate technological systems for domestic wastewater for both household and institutional/communal levels.

Applicability of the GPA/UNEP Guidelines

The UNEP/GPA Guidelines could include institutional arrangement and social participation models outlining their advantages, disadvantages and experience in their application in different parts of the world. In Tanzania, most of the industries were established without Environmental Impact Assessment (EIA) and as a result, most of them lack wastewater treatment facilities. It would be helpful for the UNEP/GPA Guidelines to provide guidance on low-cost technologies at least to selected industrial sub-sectors that are more prominent in the WIO region.

In Tanzania, the selection of sustainable and cost-effective technologies is influenced by emergence of unplanned squatter settlements particularly in urban areas such as Dar es Salaam.

The Guidelines should also include the following in the list: textile industries, breweries, leather industry, sugar industry, fish processing and pulp and paper industry. Due to the fact that provision of water and sewerage services has been as a social service, resulting in low willingness to pay, making revenue collection very difficult, the UNEP/GPA Guidelines should include illustrative guidance on different approaches of setting up tariffs.

Mechanisms for Domestication of Regional Guidelines

Mechanisms for Domestication

a) Mainstreaming the Guidelines in the implementation of existing national plans, strategies and programmes;

b) Information exchange and experience sharing through professional and scientific Forums, Conference and Associations, and;

c) Incorporating the Guidelines in the existing media and awareness initiatives.

Opportunities for Domestication

a) Finalization and enactment of the Water Supply and Sanitation Bill (2005).

b) Supporting development and dissemination of public information and awareness materials on GPA Guidelines in a common and simple language preferably 'swahili'.

c) Supporting awareness activities of institutions with related programs such as National Environment Management Council (NEMC), Prime Minister's Office – Regional Administration and Local Government (PMO-RALG), Association of Local Authorities of Tanzania (ALAT), Association of Tanzania Water Suppliers (ATWAS), Institute of Engineers Tanzania (IET), Engineers Registration Board (ERB) and Local Authorities.

d) Facilitating participation of national experts as well as policy and decision makers in international meetings and conference focused on MWW management.

e) Organizing study tours for Municipal and Sector Ministry technical staff as a way of enhancing institutional capacity and mainstreaming the Guidelines in the planning process in MWW management.

f) Mainstreaming the municipal wastewater management in formal educational curriculum

Impediments to Domestication

a) Lack of financial resources to support human resource capacity building, and improving coordination and dissemination of information on best practices and appropriate technologies;

b) Low awareness among different sectors and the general public may interfere internalization of the Guidelines;

c) Existing information dissemination pathways lack focus on MWW management and there is deficiency of MWW technical expertise in the media;

d) No priority on MWW daily planning; and

e) Weak enforcement capacity among relevant national authorities.

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ACRONYMS AND ABBREVIATIONS

ABS	Alkyl Benzyl Sulphonates
ALAF	Aluminium Africa
ALAT	Association of Local Authorities of Tanzania
ASP	Africa Stockpiles Programme
ATWAS	Association of Tanzania Water Suppliers
BICO	Bureau for Industrial Cooperation (University of Dar es Salaam)
BOD	Biological Oxygen Demand
CBD	Central Business District
CBO	Community Based Organization
CCC	Consumer Consultative Council
COWSO	Community Owned Water Supply Organization
COD	Chemical Oxygen Demand
CIUP	Community Infrastructure Upgrading Programme
CPCT	Cleaner Production of Tanzania
CWSSA	Clustered Water Supply and Sanitation Authority
DAWASA	Dar es Salaam Water and Sewerage Authority
DAWASCO	Dar es Salaam Water Supply Company
DCC	Dar es Salaam City Council
DMI	Dar es Salaam Maritime Institute
DUWSA	District Urban Water Supply Authority
EEZ	Economic Exclusive Zone
EIA	Environmental Impact Assessment
EMA	Environmental Management Act
EPM	Environmental Planning management
ERB	Engineers Registration Board
EWURA	Energy and Water Utilities Regulatory Authority
GDP	Gross Domestic Product
GPA	Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP)
ICM	Integrated Coastal Management
IET	Institution of Engineers of Tanzania
IMS	Institute of Marine Science (Zanzibar)
IPL	Industrial Packaging Limited
IPM	Integrated Pest Management
KTM	Karibu Textile Mills Limited
LGA	Local Government Authority
LGRP	Local Government Reform Programme
MAPET	Manual Pit Emptying Technology
MoW	Ministry of Water
MWW	Municipal Wastewater
NBS	National Bureau of Statistics
NEHHSS	National Environmental Health, Hygiene and Sanitation Strategy
NEMC	National Environment Management Council
NERA	National Environment Research Agenda

NGO	Non-Governmental organization
NSGRP	National Strategy for Growth and Reduction of Poverty
NUWSSP	National Urban Water and Sewerage Strategic Programme
NWSDS	National water Sector Development Strategy
OSHA	Occupational Safety and Health Authority
PHAST	Participatory Health and Sanitation Transformation
PPTL	Pee Pee (T) Limited
PMO-RALG	Prime Minister's Office – Regional Administration and Local Government
PUMPSEA	Peri-Urban Mangrove Forests as Filters and Potential Phytoremediators of Domestic Sewage in East Africa
SCP	Sustainable Cities Programme
SDL	Sabuni Detergents Limited
SDP	Sustainable Dar es Salaam Programme
SIDO	Small Industries Development Organization
SIDP	Sustainable Industrial Development Policy
SWAP	Sector Wide Approach
TBL	Tanzania Breweries Limited
TBS	Tanzania Bureau of Standards
TCC	Tanzania Cigarette Company
TCMP	Tanzania Coastal Management Partnership
TIRDO	Tanzania Industrial Research and Development Organization
TPCC	Tanzania Portland Cement Company
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational and Scientific Organization
USD	United States Dollar
UWSA	Urban Water Supply Authority
VIP	Ventilated Pit Latrine
VGT	Vetiver Grass Technology
WSP	Waste Stabilization Pond
WIO-LaB	West Indian Ocean – Land Based Activity GEF Project

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1.0 INTRODUCTION

1.1 Wastewater Management in Tanzania

Sewerage System

In most urban centers in Tanzania, few households are served with central sewerage system while greater proportion of the population relies on on-site sewerage disposal systems. The wastewater collection, treatment and disposal utilities in urban areas have not been accorded due priority. It is lagging behind water supply development. Out of 18 towns, only 8 have sewerage systems. Currently, the percentage of population covered by sewerage system in these towns is as follows:- Arusha is only 9%, Tanga 15%, Mwanza 13%, Moshi 7%, Dar es Salaam 13%, Mbeya 4%, Tabora 3% and Iringa 3% (Ministry of Water and Livestock, 2005). Provision of other related facilities e.g. cess vans is inadequate. The condition is exacerbated by inadequate and outdated treatment facilities.

Observed impacts associated with sewage pollution of the coastal environment in Tanzania

- Eutrophication of coastal waters
- Contamination of sea food
- Pollution of surface and groundwater
- Decreased marine productivity
- Public health risks (outbreak of cholera and typhoid, etc)
- Loss of recreational sites

There are a number of industries (e.g. tanneries and textiles) whose pollution effects are already being felt in waste receiving environmental media (air, lakes, rivers and the ocean) in Tanzania. Most industries lack treatment facilities for their effluents and emissions. They discharge their grey water directly into receiving water bodies or the few available un-operational wastewater stabilisation ponds.

Many small-scale industrial establishments/enterprises, particularly in the large informal sector are not served by municipal sewerage and waste disposal systems. Arguably, all urban settlements interfacing water bodies are potential major sources of water pollution, particularly for the tributary rivers, lakes and coastal waters.

On-site sanitation

Due to low coverage of sewerage systems, overflows of untreated sewage are a common sight on streets in most towns in the country. The problem is more serious in squatter settlements, where large population resides. Significant proportion of households discharge sewage in storm-water drains and streams particularly during rainy seasons.

About 90% of the urban population in Tanzania depends on on-site sanitation systems: pit latrines (80%) and septic tanks (10%) as their excreta disposal facility (Vice President's Office, 2007). However, most of them are sub-standard and offensive and are likely to collapse and/or overflow during rainy season. Due to these problems, pit

latrines have become one of the major sources of faecal related diseases. Current health data show that 40% of diseases most common in Tanzania are faecal related.

Problem associated with the on-site sanitation facilities is mainly caused by operational constraints due to lack of accessibility, high ground water table and periodic flooding of many areas of the coastal towns. In addition, lack of guidelines for construction and operation of the on-site facilities is another cause of environmental problems. Majority of people in urban coastal towns in the densely populated areas depend on pit latrines but lack of access by emptying trucks makes the management of these facilities more difficult.

Sludge management

Poor handling and improper disposal of sludge from on-site sanitation facilities result into spread of pathogenic micro-organisms and breeding of diseases transmitting insects.

Stormwater drainage

The lack of formal storm water drainage system has been found to lead into mixing of raw sewage and stormwater streams. Another problem is caused by clogging of stormwater drainage systems due to poor disposal of solid wastes. This leads into overflowing of stormwater into the environment, creating health hazard to road users and residents leaving close to the existing roads, flooding of the surrounding areas and destruction of adjacent properties and land use.

1.2 The WIO-LaB Project in the Context of the Nairobi Convention

Since the adoption of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) in 1995, UNEP has pioneered the development of tools addressing marine pollution originating from land-based activities. One of the problems the GPA addresses is the uncontrolled discharge of wastewater into the fresh water and coastal environment. This is a priority identified by UNEP and reconfirmed at the 2002 Millennium Summit and the World Summit on Sustainable Development.

The marine and coastal environment, and the goods and services it provides, are under threat in many regions of the world, including Tanzania. Some of the world's most valuable coastal and marine ecosystems are to be found in the Western Indian Ocean (WIO) region. The Government of Tanzania including other WIO States recognizes the urgent need for better and more effective management of coastal and marine resources for the purpose of improving the quality of life of people, sustaining economies of the countries of the region, and maintaining the productivity and diversity of the ecosystems. It is on this basis that Tanzania and other countries in the WIO region adopted the Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region and the Protocol

concerning Protected Areas and Wild Fauna and Flora (SPAW Protocol) in the Eastern African Region and the Protocol concerning Co-operation in Combating Marine Pollution in Cases of Emergency (Emergency Protocol) in the Eastern African Region. This convention that was enacted in Nairobi on 21 June 1985, constitutes the current regional legal framework for the protection and conservation of the marine and coastal environment of the Eastern African region. Parties to the Nairobi Convention includes the mainland countries of Somalia, Kenya, Tanzania, Mozambique and South Africa and the island states of Seychelles, Reunion (France), Madagascar, the Comoros and Mauritius. The Convention and its Protocols came into force in 1996 and each of the countries has ratified the instruments.

Based on the decision reached by the Contracting Parties (at the First Meeting of the Contracting Parties to the Nairobi Convention in March 1997) to prepare the Strategic Action Programme (SAP) for the region, the preparation of the project "Addressing Land-based Activities in the Western Indian ocean" (WIO-LaB) was facilitated by the Global Environment Facility (GEF) through a GEF Project Development Facility Block-B grant. Subsequently, a full-scale project was developed and approved by the Focal Points of the Nairobi Convention at a meeting held in Mauritius in February 2002. The broad goal of the WIO-LaB project is to contribute to the environmentally sustainable management and development of the WIO region by addressing the land-based sources of pollution that have adverse impacts on rivers, estuaries and coastal waters, as well as their biological resources. The WIO-LaB Project is designed to serve as a demonstration project of the UNEP's Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), and aims to achieve three major objectives:

- Reduce stress to the ecosystem by improving water and sediment quality;
- Strengthen regional legal basis for preventing land-based sources of pollution, including implementation of GPA; and
- Develop regional capacity and strengthen institutions in the Western Indian Ocean Region for sustainable, less polluting development including the implementation of the Nairobi Convention.

1.3 Objectives of the Study

The main objective of this review study was to undertake a detailed review of the status of Municipal Wastewater (MWW) management in Tanzania with a view of identifying the current trends and approaches as well as the policy, regulatory, legal and institutional frameworks that governs wastewater management in Tanzania. The study was part of a greater regional initiative that is aimed at addressing the growing challenge of MWW management in the Western Indian sub-region. The study also involved the review of the applicability of the UNEP/GPA MWWM Guidelines in Tanzania.

The specific objectives of the study were as follows:

i) Review of the UNEP/GPA Guidelines, key principles, and checklist on MWW management and establish the extent to which they can be adopted in Tanzania, taking into consideration the existing socio-economic conditions;

ii) Review the existing policy, regulatory and institutional arrangements in Tanzania with regard to the management of MWW;

iii) Undertake an inventory of MWW treatment infrastructure in the coastal catchment area including available MWW treatment facility;

iv) Examine MWW management practices and methods in Tanzania across stakeholder groups and geographic areas;

v) Review existing technologies in MWW management and suggest the appropriate technologies that could be adopted in Tanzania taking into consideration the existing socio-economic conditions;

vi) Review lessons learnt (positive and negative) from WIO-LaB demonstration projects on MWW management including other wastewater management projects in Tanzania, and;

vii) Review the existing national mechanisms that can be used to internalize the Regional MWW Guidelines on Municipal Waste Management in Tanzania.

The study identifies key issues that are necessary for initiation of national action with regard to MWW management in the coastal zone of Tanzania. The report also provides framework for promoting the use of alternative solutions, including low cost and environmentally sound sanitation and wastewater treatment technologies, viable financial mechanisms, appropriate institutional, policy and legal frameworks, and creation of enabling environment for action. Furthermore, this national report and the UNEP/GPA Guidelines on Municipal Wastewater Management offer a linkage between water supply and sanitation. This linkage is crucial for facilitating and promoting holistic MWW management in developing countries such as Tanzania.

1.4 Significance of the Coastal Marine Environment

Coastal and marine environment (including the critical ecosystems) provides myriad ecological services and activities whose values are not easily quantifiable. These services includes storm surge protection, water filtration, fisheries nursery, scenic and cultural amenities, waste discharge and dispersal, industrial and power plant cooling, to name but a few. In addition, the coastal zone supports a diversity of natural systems including coral reefs, beaches, estuaries, seagrass beds and mangrove forests. Coastal communities rely on these coastal natural systems for provision of resources for their livelihood. In general terms, the socio-economic livelihood of the coastal communities

depends mainly on smallholder farming, subsistence forestry, artisanal fishing, lime and salt production, seaweed farming and small-scale trade handicrafts.

1.5 The Tanzania Coastline

1.5.1 Geographical Landscape

The Tanzania coastline stretching from Tanga to Mtwara is 800 km long (Figure 1). The surface area of the coastal zone of the Tanzania mainland is approximated to be 30,000 km^2 and its continental shelf adds a further 17,500 km^2. The mainland Tanzania encompasses 14 coastal administrative districts, namely Muheza, Kilindi, Tanga, Pangani, Bagamoyo, Kinondoni, Ilala, Temeke, Mkuranga, Rufiji, Kilwa, Mafia, Lindi and Mtwara. These coastal districts are in five coastal regions of Tanga, Coast, Dar es Salaam, Lindi and Mtwara regions. The Tanzania coast also includes three islands: Unguja, Pemba and Mafia as well as numerous small islands and reefs, such as Latham, Tutia and Songosongo. Zanzibar has five administrative coastal regions making a total of ten coastal administrative regions in Tanzania. The approximate surface area of the Economic Exclusive Zone (EEZ) for Tanzania is 223,000 km^2.

Tanzania experiences a variety of climatic conditions ranging from coastal to alpine deserts on top slopes of Mount Kilimanjaro permanently covered by snow. The coastal area and islands are tropical, while most of the rest of the country is sub-tropical except at higher altitudes. The coastal area is also influenced by two monsoon winds which are the north-east monsoon blowing southward from December to March and bringing the hottest temperatures of the year; and the south-east monsoon blowing northwards from March to September and bringing heavy intermittent rains. June and July are the coolest months. The temperature variations are influenced by altitude: mean annual temperatures range from 21^oC in the high montane areas to 29^oC at the sea level. The average annual rainfall for the coastal area range from 800 mm to 1,200 mm per year

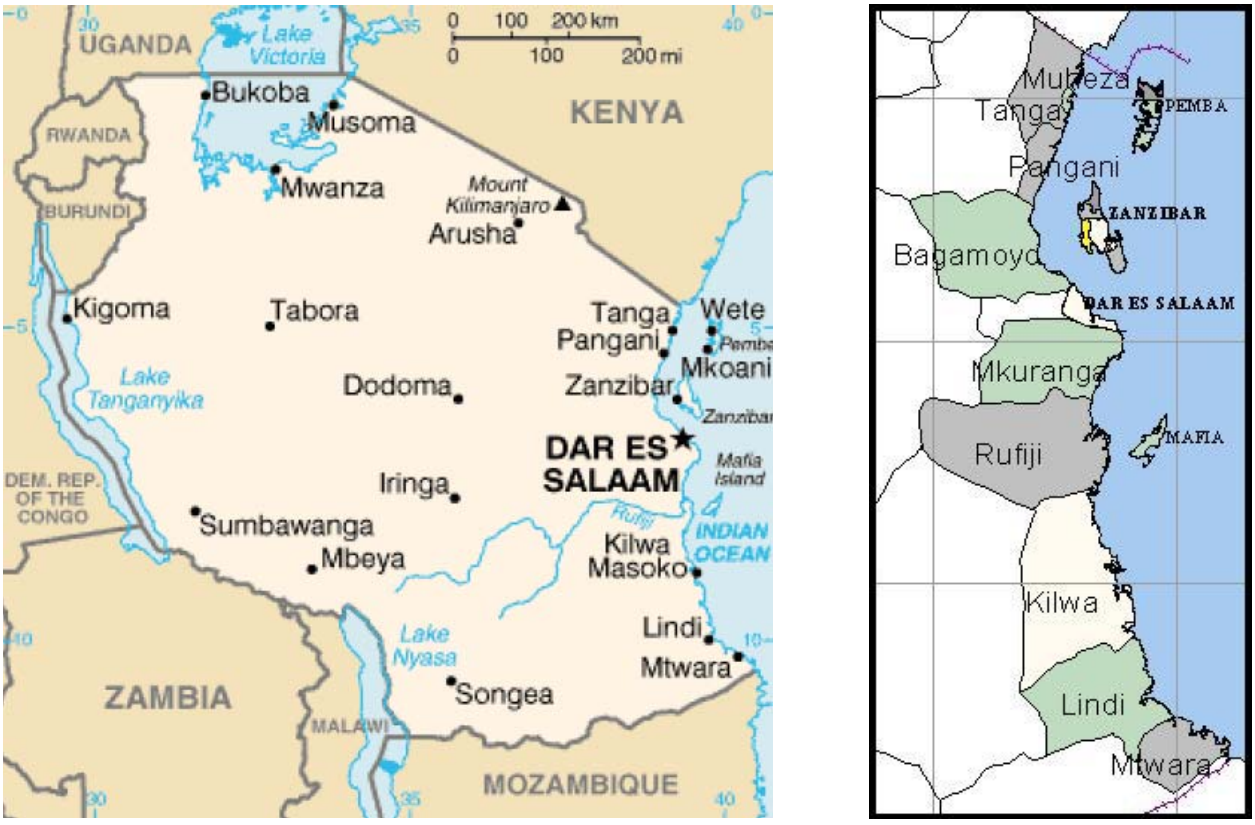


Figure 1: Map of Tanzania showing the coastal urban centers and coastal districts

1.5.2 Demography and Socio-economic Profile

The socio-economic and ecological importance of the Tanzanian coastal zone cannot be overemphasized. The five mainland coastal regions encompass about 15% of the country's land area. The coastline is home to about 25% of the country's population and 75% of country's industrial segment of the economy is located in the coastal zone (TCMP, 2001). The population profile of the coastal regions is indicated in Table 1. The total population on the coastal region of Tanzania is estimated to be 8 million which is roughly 25% of the total population in Tanzania.

Table 1: Population and population density by coastal region

Region	Land area (km^2)	Total population	Population density per km^2
Coast	32, 407	885,017	27
Dar es Salaam	1,393	2,487,288	1,793
Lindi	66, 046	787,624	12
Mtwara	16,707	1,124,481	68
Tanga	27,348	1,636,280	61
Zanzibar	2,460	981,754	353
TANZANIA	945,234	34,569,232	36

Source: Tanzania National Website (2003)

The abundance of natural resources and economic opportunities in coastal areas has led to high rates of migration and urbanization over the past 30 years. Consequently, coastal areas are facing a multitude of problems stemming from existing resource exploitation practices. In some areas, pollution levels are also threatening human health, directly through exposure to contaminants in coastal waters, and indirectly through accumulation of toxins in seafood. This pattern of over-extraction and overloading with wastes is likely to continue, if not intensify, in future.

High rates of mineral exploitation in the coastal zone including sand, salt, natural gas and building materials are causing widespread degradation of coastal areas. In addition, poorly planned coastal development is leading to increased degradation and pollution of the coastal zone. Coastal development is also the dominant cause of the accelerating loss of many natural ecosystems with significant but often unrecognized amenity values. Being important economically, socially and biophysically, the coastal area is indeed a national asset that deserves priority in its conservation and management.

1.5.3 Hydrological Characteristics of the Coastal region

Several rivers on Tanzania Mainland discharge into the Indian Ocean. The major ones are the Pangani, Wami, Ruvu, Rufiji and Ruvuma. Most of these rivers carry large quantity of water, sediment, nutrients and pollutants and these are discharged into the coastal waters. For example, the Rufiji in southern Tanzania, which comprises four major tributaries (The Great Ruaha, Kilombero, Luwengu and Rufiji) has a mean discharge rate of 820 m^3/sec. The surface area of Rufiji drainage basin is 156,600 km^2 extending into the southern highlands of Tanzania Pangani river basin has a total surface area of about 42,200 km^2 of which 2,320 km^2 is in Kenya.. Pangani river rises from the slopes of Mount Kilimanjaro and discharges into the Indian Ocean through Tanga region. The total length of the river inside Tanga region is approximately 260 km. Table 2 shows the key hydrological characteristics of major rivers in Tanzania.

Table 2: Hydrological features of the major rivers discharging into the Indian Ocean

River	**Length (km)**	**Mean Annual Runoff (Million m^3)**	**Catchment Area ('000 km^2)**	**Suspended Sediment load (tons/year)**
Pangani (and others)	440	627 (at Hale)	42.1	0.15 million
Wami	-	3,280 (at Mandera)	46.4	-
Ruvu	-	1,370 (at Morogoro Bridge)	18.4	-
Rufiji: The Great Ruaha	750	-	-	-
Rufiji	640	22,250 (at Stiegler's Gorge)	177.4	17.09
Ruvuma	640	-	52.1	-

The country as a whole has a good potential of groundwater resources. With the exception of the Pangani river basin, groundwater development has mainly

concentrated on shallow wells for domestic purposes. On the coast, the Pangani basin has a good potential and adequate supplies that can be obtained for domestic, industrial and irrigation purposes. Adequate supplies can therefore, be extracted for Tanga municipal water supply. At present, 88% of groundwater extracted in the Pangani basin is used for irrigation, 4% for industrial use and 8% for domestic use (refs?).

1.6 Preparation of the Report

The report was prepared through a number of methods including the following:

a) Literature review of relevant documents including national policies, legislation, regulations, strategies, programmes, projects and international/regional documents. This included visits to different libraries, Government Ministries and institutions;

b) Physical survey of selected sites including waste stabilization ponds, constructed wetlands, drainage/sewage systems;

c) Consultation with experts in wastewater management within the country;

d) Review of the draft national report by the National Municipal Wastewater Taskforce established under the auspices of the WIO-Lab Project in Tanzania. The Taskforce met twice to discuss on the draft report on 14th July and 24th August 2007;

e) The revised report was then reviewed by the Project Management Unit (PMU), WIO-Lab Project based in Nairobi as well as the Regional MWW Expert.

1.7 Organization of the Report

This national report on Municipal Wastewater (MWW) management in Tanzania places a particular emphasis on the situation within the coastal zone of Tanzania. The preparation of the report was based on the Terms of Reference and Guidelines that were prepared by the WIO-LaB Project Management Unit. The following is an outline of the key chapters of the report:-

Chapter 1 introduces the context within which the study was undertaken and outlines its objectives and usefulness in Tanzania.

Chapter 2 reviews the institutional, policy and regulatory framework for MWW management in the country including stakeholders' involvement and financing mechanisms.

Chapter 3 provides a summary of inventory of MWW treatment infrastructure for domestic and industrial wastewater including MWW treatment facility, the nature of the

technology use, their general state as well as the collection of data with regard to the actual efficiency of such facilities.

Chapter 4 offers an assessment of MWW management practices and methods in Tanzania.

Chapter 5 highlights existing technologies used in the country for MWW management including lessons learnt from other related infrastructure.

Chapter 6 reviews the applicability of the UNEP/GPA Guidelines, key principles, and checklist on MWW management and establish the extent to which they can be adopted in Tanzania, taking into consideration the existing socio-economic conditions;

Chapter 7 reviews the existing national mechanisms that can be used to internalize the Regional MWW Guidelines on Municipal Waste Management in Tanzania and in particular establish factors that could compromise the domestication of the GPA/UNEP Guidelines in the country

2.0 REVIEW OF ENABLING POLICY, REGULATORY AND INSTITUTIONAL ENVIRONMENT FOR MWW MANAGEMENT

2.1 Assessment of Existing Policy Framework

It is estimated that globally, 90% of sewage in Cities in developing countries is discharged untreated polluting water bodies, soil and air as well as affecting public health. Similar situation exists in Tanzania. It is generally argued that wastewater related policies have rarely been designed to meet society's demand.

Wastewater management in Tanzania is principally addressed under the National Water Policy (2002) as well as other related sectoral policies. The major emphasis is on active participation of communities, private sector and Local Governments as the role of Central Government in services provision diminishes. Changes in management for improving wastewater services such as decentralization, privatization, public-private partnership are typical institutional arrangements being advocated in Tanzania in order to bring changes in wastewater management and enhance performance.

A quick scan of the sectoral policies is provided in Table 3. These policies reflect common themes that respond to the 1992 United Nations Conference on Environment and Development's ("The Rio Summit") "Agenda 21," by supporting "integrated resource management" and "balance between sustainable development and environmental protection." The existing policies and strategies have potential (strength and opportunity) to bring positive changes and enhance public health and the environment. In addition, there is a complementing and supportive linkage among the relevant policies as well as other national development strategies and plans including Tanzania Development Vision 2025, National Strategy for Growth and Reduction of poverty (2004), and Local Government Reforms. They include indicators that can be monitored such as raising sewerage service coverage from 17% in 2004 to 25% by 2006 and to 30% by 2009. In addition, these policies devise various instruments of implementation. Some of the common instruments are Environmental Impact Assessment (EIA) of development projects including water supply and sewerage projects; cost recovery; and legal and regulatory regime.

However, wastewater management is hampered by weak institutional capacity, inadequate coordination and collaboration and unclear demarcation of responsibilities among various actors and low public awareness on the policies.

Table 3: Rapid Assessment of the Existing Policy Framework for Water Supply and Sanitation Services

POLICY	Objectives Relevant to Water and Sanitation Sector	Policy Instruments	Windows of opportunity	Limitation/Gaps
1. National Environmental Policy (1997)	• The Policy objectives in the water and sanitation sector are geared towards achieving the planning and implementation of water resources and other developments in integrated manner and in a way that protects water catchment areas and their vegetation. • The Policy identifies six major environmental problems including land degradation, lack of access to good quality water for both urban and rural habitants, environmental pollution, loss of wildlife habitat and biodiversity, deterioration of aquatic systems and deforestation.	• Environment Impact Assessment (EIAs) • Economic instruments. • Legal and regulatory regime • Precautionary principle • International cooperation	• Existence of the Environmental Management Act (2004) that clearly stipulates responsibilities among different actors in relation to provision of water supply and sanitation services • Integrated Coastal Management Strategy • Environmental standards • Cleaner production initiatives since 1994 • International cooperation and cooperation	• Inadequate institutional capacity
2. National Water Policy (2002)	• The goal of the National Water Policy, 2002, is to develop a comprehensive framework of sustainable development and management of the nation's water resources, in which an effective legal and institutional framework for its implementation will be put in place.	• The polluter pays principle • Cost recovery • Environmental impact assessment (EIA) • Strengthening of legislation enforcement mechanisms • Legal and regulatory regime • International cooperation	• National Water Sector Development Strategy (2004) • Water Supply and Sanitation Bill (2005) • On-going institutional reforms for water supply and sanitation services	• Inadequate institutional capacity and coordination
3. National Health Policy(1990)	• The Policy emphasises the need for adequate supply of water and basic sanitation for minimising water borne diseases, which are among the	• Several policy guidelines on waste management, environmental health, Participatory Health and	• On-going health sector reforms • Provision of environmental health services is a priority and is one among the five	• Inadequate institutional capacity, collaboration and coordination

POLICY	Objectives Relevant to Water and Sanitation Sector	Policy Instruments	Windows of opportunity	Limitation/Gaps
	major health problems in the country. • It also recognises that public health is dependent on the availability of safe water supply, basic sanitation and improved hygiene practices.	Sanitation Transformation (PHAST) and health care waste management have been developed. • Legal and regulatory regime • Cost sharing	essential health packages. • Communities and private sector participation are being encouraged to deliver sanitation services. • Promotion of low-cost sanitation technologies	
4. Local Government Reform Policy (LGRP)	• The overall objective of the Local Government Reform Policy (LGRP) is to improve service delivery by making local authorities more autonomous. • The Policy identifies provision and facilitation of water services as an important responsibility of Local Government.	• The Policy also envisages that the future magnitude of grants to local government will depend on performance of the authorities, the state of the economy, and on the financial consequences of reducing the role of ministries in implementation through decentralisation and privatisation.	• The reforms are intended to create viable entities, develop required local government/central government relations, establish the necessary legal framework, and develop the necessary capacities for effective performance by Local Government organisations. • Reforms will not only confirm the legitimacy of local authorities, but will help them generate more revenues, reduce costs, and operate water services more efficiently.	• Inadequate fiscal decentralization (financial constraints) • Weak institutional capacity and coordination
5. National Land Policy (1995)	• To facilitate socio-economic development and environmental protection; • To promote and ensure secure land tenure system; • To encourage optimal use of land	• Land Use Master Plan • Land charges • Gender mainstreaming • Legal and regulatory regime .	• Existence of Land Use Commission • Project on 20,000 surveyed plots in Dar es Salaam	• Inadequate enforcement of Land Use Master Plans

POLICY	Objectives Relevant to Water and Sanitation Sector	Policy Instruments	Windows of opportunity	Limitation/Gaps
6. National Human Settlements Development Policy(2000)	• The Policy aims to improve provision of infrastructure and social services such as water, roads, energy, schools, health services, drainage, sewerage system, solid waste management that are functional, healthy, aesthetically pleasant and environmental friendly	• Building Permit/ Environmental Impact Assessment (EIA) • Environmental education; • Gender mainstreaming • Property charges • Legal and regulatory regime	• Sustainable Cities Programme (SCP) • Projects on upgrading of infrastructures in squatter areas • Promotion of low-cost sanitation technologies	• Inadequate enforcement of Urban Development Master Plans • Inadequate funding • Inadequate participation of urban communities in planning and decision making
7. Agriculture and Livestock Policy (1997);	The Policy aims to promote integrated and sustainable use and management of natural resources such as land, soil, water and vegetation in order to conserve the environment.	• Control of quality, hygienic and sanitary standards • Control of vermin, epidemic pests and diseases • Taxes and subsidies • Legal and regulatory regime	• Integrated Pest Management (IPM) programme resulting in reduced use of pesticides. • Provision of agricultural extension services. • Africa Stockpile Programme (ASP) that would dispose of obsolete stocks of pesticides and veterinary chemicals	• Inadequate institutional capacity
8. The National Energy Policy (2003)	• To provide an input into the development process by establishing efficient energy production, procurement, transportation, distribution and end-user system in an environmentally sound and sustainable manner.	• Environmental Impact Assessment (EIA) • Energy efficiency and conservation • User charges • Energy education and gender mainstreaming • Legal and regulatory regime	• Promotion of renewable energy technologies such as solar power, wind power	• Inadequate dissemination of low-cost renewable technologies • Financial constraints
9. National Forest Policy (1998)	• The main objective of the Policy is to enhance the contribution of the forest sector to sustainable development and conservation of and management o natural resources for the benefit of present and future generations.	• Environmental Impact Assessment (EIA) • Royalties and other fees. • Legal and regulatory regime	• On-going efforts in conservation of natural ecosystems	• Inadequate enforcement of regulatory regime
10. Sustainable Industry	• One of the main objectives of the Policy is to promote	• Environmental Impact Assessment	• Existence of Environmental Management Act (2004)	• Inadequate enforcement of

POLICY	Objectives Relevant to Water and Sanitation Sector	Policy Instruments	Windows of opportunity	Limitation/Gaps
Development Policy- SIDP (1996-2020)	environmentally friendly practices, technologies and products;	(EIA)/Building Permit • Licensing and other certification schemes such as occupational health and safety certificate • Polluter pays principle • Legal and regulatory regime	where EIA and Environmental Auditing are mandatory • Availability of technical consultancy services through the Tanzania Industrial Research Development Organization (TIRDO) and Cleaner Production Center of Tanzania (CPCT) • Industrial effluent standards by the Tanzania Bureau of Standards (TBS)	regulatory regime • Weak institutional collaboration and coordination (Licensing Vs EIA requirements)
11. The Mineral Policy of Tanzania (1997)	To ensure sustainable and social development and minimize or eliminate social and environmental impacts due to mining activities.	• Environmental Impact Assessment (EIA) • Licensing • Royalties and other fees • Legal and regulatory regime	• Promotion of environmental friendly mining technologies	• Inadequate enforcement of regulatory regime
12. National Tourism Policy (1999)	• The Policy aims to assist in promoting the economy and livelihood of the people through encouraging the development of sustainable and quality tourism that is culturally and socially acceptable, environmentally sustainable and economically viable.	• Environmental Impact Assessment (EIA) • User charges/Fees • Legal and regulatory regime	• Promotion of environmental friendly tourism (eco-tourism)	• Inadequate enforcement of regulatory regime
13. National Fisheries Sector Policy and Strategy Statement (1997)	The overall goal of the National Fisheries Policy is to promote conservation, development and sustainable management of the Fisheries Resources for the benefit of present and future generations.	• Legal and regulatory regime • Licensing • Environmental Impact Assessment (EIA) • Applied research	• Water quality requirements	• Inadequate enforcement of the regulatory regime including surveillance and monitoring • Financial constraints

2.2 Assessment of Existing Legal and Regulatory Framework

Constitutional Framework

Under the Constitution of the United Republic of Tanzania of 1977, policies and laws respecting natural resource management, including coastal and marine resources, are established and implemented by the central government. Parliament has exercised its constitutional authority to make laws concerning coastal lands, resources and the environment, but, as discussed below, local governments have been delegated specific powers of implementation and enforcement that differ depending on the particular resources and laws involved.

Zanzibar, although a part of Tanzania, has a unique legal status. According to Article 2(1) of the Constitution, the territory of the United Republic consists of the whole area of mainland Tanzania and the whole of the area of Tanzania Zanzibar, and includes the territorial waters. One mainland Tanzania law (the Fisheries Act of 1970) does not cover the territorial waters of Zanzibar, and Zanzibar has its own fisheries legislation.

National Regulatory Framework

Water supply and sanitation in Tanzania is governed by:

- The Laws of Tanganyika 1947 – 1950, Cap 281, as amended by:
  - Waterworks Ordinance, 1949, Cap 281-Supp. 62
  - Urban Water Supply Act, No.7 of 1981 (amended by Act No 8 of 1997 to DAWASA Act)
  - Waterworks (Water Supply) (Designated and Declared Areas) Rules, 1997, G.N. 369
  - Waterworks Regulations, 1997, G.N. 371
  - Water Laws (Miscellaneous Amendments) Act No.8 of 1997
  - Operational Guidelines, 1998
- Public Health (Sewerage and Drainage) Ordinance, 1955, Cap 336
- National Investment (Promotion and Protection) Act 1990
- The Energy and Water Utilities Regulatory Act No 11 of 2001
- The Local Government (District Authorities) Act, 1982 as amended to 30th June 2000
- The Local Authorities (Urban Authorities) Act, 1982 as amended to 30th December 2000
- Environmental Management Act (EMA) No. 20 of 2004.
- Industrial and Chemicals (Management and Control) Act (2003)
- OSHA Act (2003)

Provision of water supply and sanitation services in Tanzania resides primarily in Cap 281 of The Laws of Tanganyika 1947 – 1950 and subsequent amendments, regulations and ordinances. The Urban Water Supply Act, No 7 of 1981 established the National Urban Water Authority.

However, the most significant amendments to the original legislation are the Waterworks Regulations, 1997 and the Water Laws (Miscellaneous Amendments) Act, No 8 of 1997. Under the former Regulations, the Minister may designate certain areas to become a Water Supply and Sewerage Authority, which may be managed as an autonomous body, a public or private company, a Water User Association, a Co-operative Society or a NGO. The areas excluded are villages, village or minor settlements which are more than 400 metres from an existing distribution network. The Regulations also provide for the three categories of Water and Sewerage Authority, i.e. A, B and C, based on ability to cover costs.

Water Laws (Miscellaneous Amendments) Act No. 8 of 1997, replaces the National Urban Water Authority with the Dar es Salaam Water and Sewerage Authority (DAWASA) and gives powers to the Minister to declare any area to be a Water Supply and Sewerage Board / Authority and to transfer facilities and infrastructure to such a Water Supply and Sewerage Board / Authority. It is this Act which is recognised as leading to the establishment of the Urban Water and Sewerage Authorities, although the legislation does not limit the establishment of Authorities to urban areas.

The Public Health (Sewerage and Drainage) Ordinance, 1955 gives custodianship of public health issues to the Ministry of Health. Meanwhile the Ministry of Health is updating and consolidating health laws into the Public Health Act for easier application. The aim of the Public Health Bill is to provide for the consolidation of various laws regarding the promotion, prevention and maintenance of Public Health, and to ensure comprehensive, functional and sustainable Public Health Services.

The National Investment (Promotion and Protection) Act, 1990 states that the provision of public water for domestic and industrial purposes is reserved for exclusive investment by the public sector and that private sector investment can only be made through the granting of a special license.

The Energy and Water Utilities Regulatory Act, No 11 of 2001, provides for regulation of service providers by Energy and Water Utilities Regulatory Authority (EWURA) where this is specified in sector legislation. However, the current water sector legislation does not provide for regulation of any water service providers by EWURA, other than as specifically prescribed in the DAWASA Act (2001).

The Local Government Acts of 1982 for both District and Urban Authorities state that the respective authorities may perform the following functions in respect of water supply and sanitation:

- establish, maintain, operate and control drainage and sewerage works;
- establish, provide maintain and control public water supplies and impose water rates; and
- prevent the pollution of water in any river, stream, water course, well or other water supply in the area, and for this purpose prohibit, regulate or control the use of such water supply.

In addition, Township Authorities may provide and maintain supplies of water and, for that purpose, to establish and maintain water works and water mains.

The Environmental Management Act (2004) demands sustainable utilization of resources and water being one of them. The Act assigns responsibility to Local Authorities to ensure that any person (including factories and industries) treat water before it is being discharged into any water body. EIA is mandatory to any development projects or undertaking.

Industrial and Chemicals (Management and Control) Act (2003) provides for the management and control of the production, importation, transportation, exportation, storage, dealing, and disposal of chemicals and for matter connected therewith.

Occupation Health and Safety Authority (OSHA) Act (2003) deals with the protection of human health from occupational hazards. Among other provisions, it requires the employer to ensure safety of workers by providing safety gears at work place. Part V of the Act emphasizes on provision of adequate clean, safe and wholesome drinking water, sufficient and suitable sanitary conveniences and washing facilities.

Standards for Monitoring of Wastewater Discharges

The National Environmental Standards Committee of the Tanzania Bureau of Standards (TBS) develops, reviews and submits to the Minister responsible for environmental management proposals for environmental standards. The National Environment Management Council (NEMC) is mandated to enforce environmental quality standards.

Tanzania has set standards for wastewater discharges in accordance to the requirements of the Environmental Management Act (2004) (Section 140-150). The standards define effluents as those, which are flowing out or fluid material, including wastewaters, (treated or untreated) discharges from domestic or industrial wastewater systems. They also include wastewaters or other pollutants from pens, commercial establishments, as well as cooling waters and wastes from energy or power plants and storm runoffs, which due to their qualities, quantities and/or characteristics, might adversely affect the natural state, and impair the beneficial use of receiving waters.

The effluent standards apply to all treated and untreated domestic and industrial wastewater. The receiving water standards apply to any water body into which any effluent is discharged. Both standards operate simultaneously. The effluent standards give an indication of pollution load of individual institutions, agencies or individuals; whereas the receiving water standards serve as an indicator for pollution load of the water body for the particular category for which the water is ultimately intended (Table 4).

Table 4: Environmental Quality Standards for Effluents

Substance/ Characteristics	Unit	Maximum permissible value	
		Effluent meant for direct discharge into receiving waters	**Trade and industrial effluents meant for indirect discharge into receiving waters e.g. via municipal sewage treatment plant**
a) General			
Suspended Solids	mg/l	Not to cause formation	No limit
Colour	Number (Pt-Co)	Not to cause any change in the natural colour of the receiving Water	100
Taste and odour		Not to cause any change in the natural taste or odour of the receiving water	No limit
Temperature	ºC	Not to cause any increase of the receiving water by more than 5º C	35ºC or not more than 5ºC above ambient temperature of the supplied water, which-ever is great
Total Dissolved Solids	mg/l	3,000; No restrictions for discharge into the sea	7,500
pH		6.5 – 8.5	No limit
B.O.D. 5 days, 20ºC	mg/l	30	No limit
B.O.D. 5 days, 25ºC	mg/l	34	No limit
B.O.D. 5 days, 30ºC	mg/l	37	No limit
B.O.D. 5 days, 35ºC	mg/l	40	No limit
Permanganate value	mg/l	80	No limit
b) Selected inorganic substances			
Arsenic (As)	mg/l	2.0	5.0
Cadmium (Cd)	mg/l	0.1	0.1
Chromium (Cr)	mg/l	0.1	0.2
Iron (Fe)	mg/l	3.0	5.0
Lead (Pb)	mg/l	0.2	0.2
Mercury (Hg)	mg/l	0.005	0.005
Ammonia + Ammonium (NH + 3NH4)	mg/l	10	No limit
Chlorides (Cl)	mg/l	800	800
Free chlorine	mg/l	1.0	5.0
Cyanides (CN-)	mg/l	0.1	0.2
Nitrates (NO3)	mg/l	50	80
Phosphates (PO4)	mg/l	6.0	15?
Sulphates (SO4)	mg/l	600	600
Sulphides	mg/l	0.5	1.0
c) Selected organic substrates			
Alykyl benzeyl sulfonates (ABS)	mg/l	2.0	5.0
Grease and oils (petroleum ether extract)	mg/l	5	10
Organochlorine pesticides	mg/l	0.005	0.005
Volatile chlorinated	mg/l	0.05	0.05

hydrocarbons (CI)			

Synthesis

The existing legislation related to the provision of water supply and sanitation services management has developed over time through amendments to the original primary law. As the result, the current legislative provisions:

- lack clarity and, in some cases, lead to contradiction of intent;
- have led to a differentiation between service provision in large urban areas, other population centres, and rural areas;
- are not harmonised with the provisions of local government legislation; and
- do not reflect the institutional and organisational changes necessary to implement the National Water Policy (2002).

Zanzibar Islands

In Zanzibar Islands, there is a deficiency in legislation guiding water supply and sewerage services development. Therefore, there is an urgent need to review the legislation in order to address the current and emerging issues.

Table 5: The key legislation relevant to marine and coastal environment of Zanzibar Islands

Aspect	Policies/Plans/Legislation
Natural Resources	▪ The Fisheries Legislation (Revised 1988) ▪ Forest Reserve Decree (Cap. 120) and Wood Cutting Decree (Cap. 121) ▪ Wild Animals Protection Decree (Cap. 128) ▪ The Wild Birds Protection Decree (Cap. 129)
Land Use	▪ The Land (Distribution) Decree, 1966 ▪ Town and Country Planning Decree (Cap. 85) ▪ Public Land Decree (Cap. 93) Removal of Natural Produce Rules
Cross-cutting	▪ Commission of Lands and Environment Act,1988 ▪ The Investment Promotion Act, 1986 ▪ Administrative Authorities Act, 1981 ▪ Local Government Act, 1986 ▪ The Public Health Act (Cap.73) ▪ Dangerous Goods Act (Cap. 160) ▪ The Petroleum Act of 1980 ▪ The Mining Act of 1979

2.3 Assessment of existing institutional mechanisms

Tanzania Mainland

The current institutional framework for the provision of water supply and sanitation services is based on a separation between urban water supply and sewerage services, and rural water supply services. The ultimate responsibility for the provision of these services rests largely with the Ministry of Water.

However, a number of different central and local government departments or organizations have a mandate or legal requirement to be involved in various aspects of the provision of these services. In particular, local government, be it at the city, municipal, town, district, or township authority level, have varying levels of responsibility for providing water supply and sanitation services to the population in their areas, and the Ministry of Health has an overall responsibility for protecting public health through ensuring the provision of adequate sanitation and hygiene education by the local authorities. In the following sections, the key institutions involved are discussed.

a) *Ministry of Water (MoW) Responsibilities*

Under current legislation (The Waterworks Regulations, 1997, and the Water Laws (Miscellaneous Amendments) Act, 1997), the Minister responsible for Water may designate and declare a Water Supply and Sewerage Authority for certain areas. This legal provision has been used to establish 19 Urban Water Supply and Sewerage Authorities (UWSA) in the areas of municipal councils throughout the country, and for town councils where these are also regional centres.

In addition, the Minister has declared 37 District Urban Water and Sewerage Authorities (DUWSAs) for towns which are also district headquarters, and 27 of these have been established. All these UWSAs and DUWSAs are accountable to, and monitored by, MoW although the respective Local Authority has representation on the Board. However, the UWSAs and DUWSAs are not responsible for on-site sanitation, which remains with the respective Local Government Authority.

Both UWSAs and DUWSAs are defined in three categories dependent on their ability to meet all or part of their operation and maintenance costs. The organizations are encouraged to improve their performance so as to achieve a higher category status. Where the organisations are still reliant on the Government for part of their costs, annual budgets are subject to endorsement by MoW.

MoW is also responsible for assessing the need for and securing capital investment finance for water supply and sewerage schemes irrespective of whether they are run by UWSAs, DUWSAs or the Local Government Authority.

In the area of rural water supply, MoW has constructed and continues to operate six major rural water supply schemes: Handeni Trunk Main, Makondeko, Waging'ombe,

Maswa, Mugango/Kiabakari, and Chalinze. In addition, under the same legislation mentioned above, the Minister responsible for Water may approve the formation of Water User Associations for specified areas. To date around 50 Water User Associations and two Trusts have been established. Where these Associations have been established, MoW is responsible for performance monitoring and support.

MoW is also responsible for securing investment finance for rural water supply schemes where it is responsible, or where it has approved the establishment of Water User Associations. Where investment is required for new rural schemes, MoW may react to requests from the relevant District Council.

b) *Local Government Authorities*

The local government authorities are ultimately accountable to the Prime Minister's Office, Regional Administration and Local Government (PMO-RALG). The Local Government Acts of 1982 for both District and Urban Authorities give the respective authorities, and Township Authorities, powers to establish, maintain, operate and control public water supplies drainage and sewerage works. The Local Government Authority levels and differing responsibilities for the provision of water and sewerage services are shown Table 6.

Table 6: Responsibilities for Water Supply, Sewerage and Sanitation

Local Authority Level	Number	Responsibility for Water Supply and Sewerage	Responsibility for Sanitation
City	1	UWSA	City Council
Municipality	9	UWSA	Municipal Council
District	92	DUWSA or District Council	District Council Town Council
Towns	11	DUWSA or Town Council	Town Council
Small Towns	88	District Council	District Council

Notes:

1. This Table excludes Dar es Salaam, which is a special case with three municipalities making up a city council, and for which water supply and sewerage services are provided by the Dar es Salaam Water Supply and Sewerage Authority (DAWASA). DAWASA has been established by separate legislation and has entered into a lease contract with a private operator.
2. The number of District councils will increase to 99 as a result of seven new Districts which are in the process of being declared.
3. The Small Towns are being considered for declaration as Townships.

In rural areas where Water User Associations or Trusts have not been established under the auspices of MoW, responsibility for water supply rests with the district councils.

c) *Energy and Water Utilities Regulatory Authority (EWURA)*

The EWURA was established under the EWURA Act, 2001, with responsibility *inter alia* for regulation of the distribution of water and sewerage. The extent of the regulatory functions conferred on EWURA in respect of water supply and sewerage services is to be determined by sector legislation, which has not yet been promulgated. Therefore, although EWURA exists for other utility sectors, as far as the WSS sector is concerned, EWURA has yet to have its functions determined so that it becomes operational. As a consequence, regulation of the WSS sector effectively remains with MoW.

Synthesis

The current institutional framework in Tanzania has a central focus in the Ministry of Water (MoW). There are a number of overlapping responsibilities. Furthermore, the mechanisms for effective consultation, consensus building, and participation of stakeholders in the decision-making process are not adequately defined and implemented.

In rural areas, the Government, External Support Agencies, and NGOs have been planning and constructing water supply schemes at village level, with little involvement or participation of the benefiting communities. The Government has also been the owner and operator of a number of these schemes. These approaches have led to a lack of commitment by the beneficiaries to safeguard the facilities, and an unwillingness to contribute to the cost of operation and maintenance.

The lack of an effective institutional framework for integrated water supply and sanitation in Tanzania has led to:

- overlapping roles and responsibilities between various institutions leading to inefficient use of human and financial resources, duplication of effort, and gaps in effective provision of services;
- inadequate co-ordination between various government institutions;
- inadequate communication and awareness building between these institutions and local organisations and water users; and
- Responsibility for regulation and performance monitoring of the provision of WSS services is being vested in the same organisation that is responsible for service delivery and investment financing, thus creating a potential conflict of interest.

The lack of active participation of beneficiaries in the execution of water supply and sanitation schemes in rural areas in Tanzania, has led to:

- poor performance of the schemes;
- lack of proper management of the schemes;
- lack of ownership; and
- Poor delivery of the service.

In view of the above identified gaps, the institutional framework for water supply and sanitation in Tanzania need to be clarified and streamlined to meet the challenges of efficient and cost-effective provision of services. Also, the roles and responsibilities of the different stakeholders have to be clearly defined so as to ensure the participation of stakeholders. The framework should also encourage the participation of the private sector where such involvement results in greater efficiencies and cost-effectiveness.

Under the Policy Paper on Local Government Reform, local governments will have the future responsibility for public service provision including water; Local Authority staff will be de-linked from their respective ministries; and line ministries will change their role into policy making, support and capacity building, monitoring and quality assurance, and regulation.

With the role of Government, through the Ministry responsible for Water, changing to that of coordination, policy and guideline formulation, and regulation, current responsibilities for the provision of water supply and sanitation services will need to be transferred to successor organisations.

Taking into account of these facts, the Draft National Water Sector Development Strategy (2005) proposes future institutions for the provision of water supply and sanitation services to be of three main types: Clustered Water Supply and Sanitation Authorities (CWSSAs); Service Providers; and Community Owned Water Supply Organisations (COWSOs). Regulation of the CWSSAs will be by the Energy and Water Utilities Regulatory Authority (EWURA), while regulation of the COWSOs will be by the Ministry responsible for Water.

Clustered Water Supply and Sanitation Authorities

The Clustered Water Supply and Sanitation Authorities (CWSSAs) will be financially autonomous statutory organisations, to be established based on the clustering of water supply and sanitation responsibilities across a number of Local Government Authority areas so as to promote and achieve commercial viability. Therefore, regulation would only be required for a limited number of CWSSAs, each of which having been established based on potentially commercial viability.

Water supply and sanitation assets would be transferred to the CWSSAs in order to provide balance sheet equity as a guarantee for loans from the Government and External Support Agencies. To protect these assets from possible sequestration, each authority would not provide the services themselves but would contract a Service Provider (public or private) to provide the services. Clustering of water supply and sanitation authority responsibilities can be based either on regional and local government boundaries, or on river basins, depending on criteria such as the number of local government authorities involved, potential viability, social or cultural factors, and geographical proximity.

Service Providers

Service Providers will be responsible for providing water supply and sanitation services on behalf of the CWSSAs under varying contractual arrangements, such as service, management or lease contracts. More than one Service Provider may be engaged by each CWSSA, depending on the circumstances.

A Service Provider may be a company established by one or more LGAs for this purpose, which would be in line with the principle of decentralisation under the Local Government Reform Policy, or may be from the private sector, or may be a Non-government or Community Based Organisation.

Community Owned Water Supply Organisations
Community Owned Water Supply Organisations (COWSOs) will be bodies legally constituted by a community to own, manage, operate and maintain the water supply systems on behalf of the community. These bodies may take various legal forms, such as Water Consumer Associations or Water Consumer Trusts, and establishment of the COWSOs will be promoted through the local government framework of district and village councils.

The COWSOs will be expected to meet all the costs of operating and maintaining their water supply systems through charges levied on water consumers, and to contribute to the capital cost of their systems. The main source of capital investment will be through the system of block grants to district councils.

The COWSOs may contract part or all of their operation and maintenance responsibilities to private companies or individuals, or to Non-government Organisations. Performance monitoring and regulation of COWSOs will be by the Ministry responsible for Water.

Energy and Water Utilities Regulatory Authority (EWURA)

EWURA has been established under the Energy and Water Utilities Regulatory Act, 2001, to regulate *inter alia* the provision of water services. EWURA will be responsible for issuing licenses to CWSSAs, based on the submission of business plans, and for monitoring and regulating performance of the CWSSAs against these business plans. This will include the approval of tariffs for water and sanitation services based on the performance of the CWSSAs in delivering services to consumers.

As the business plans of the CWSSAs will be required to include the performance related contractual arrangements with their Service Providers, the CWSSAs will have responsibility for the management of these contracts and EWURA will not be required to separately regulate the Service Providers.

Functions and Responsibilities of Future Organisations

Table 7 indicates the main functions and responsibilities of each organisation of the proposed institutional framework. In addition, the proposed institutional framework and coordination for the provision of water supply and sanitation services as indicated in the Draft National Water Sector Development Strategy (2004) is presented in Figure 2.

Table 7: Main functions and responsibilities of proposed institutional arrangement in the provision of water supply and sanitation services

Organization	Functions and responsibilities
1. Ministry responsible for Water	• Policy and strategy development • Advises EWURA in formulation of technical guidelines and standards • Coordinates planning for projects of national importance • Secures finance for projects of national importance • Monitors performance and regulates COWSOs • Provides technical guidance to Councils
2. Clustered Water Supply and Sanitation Authorities	• Own, manage and develop water supply and sanitation assets • Prepare business plans to provide water supply and sanitation services including capital investment plans • Secures finance for capital investment and relevant subsidies • Contract and manage Service Providers • Provide services not contracted out • Formulates by-laws for service provision
3. Service Providers	• Provide water supply and sanitation services in accordance with contractual obligations • Collect revenues for services
4. Community Owned Water Supply Organizations	• Own and manage water supply assets • Operate and maintain water supply assets • Determine consumer tariffs • Collect revenue for the provision of services • Contract and manage Service Providers
5. Energy and Water Utilities Regulatory Authority	• Approves business plans of CWSSAs • Issues operating licenses to CWSSAs • Approve service tariffs • Publishes technical guidelines and standards • Monitors water quality and performance of CWSSAs • Collects and publishes comparative performance data
6. Prime Minister's Office – Regional Administration and Local Government (PMO-RALG)	• Coordinates planning of projects from Local Government Authorities • Coordinates Local Government Authority budgets • Coordinates capacity building for Local Government Authorities
7. Regional Secretariat	• Representation on CWSSA Board

	• Provides technical advice to Local Government Authorities
8. Municipal and District Councils	• Representation on CWSSA Boards • Coordinate CWSSA budgets within Council Budgets • Disburses block grant funds to CWSSAs • Coordinate physical planning with CWSSAs
9. Village Councils	• Promote establishment of COWSOs • Representation on COWSO management body • Coordinate COWSO budgets within Council budgets • Resolve conflicts within and between communities

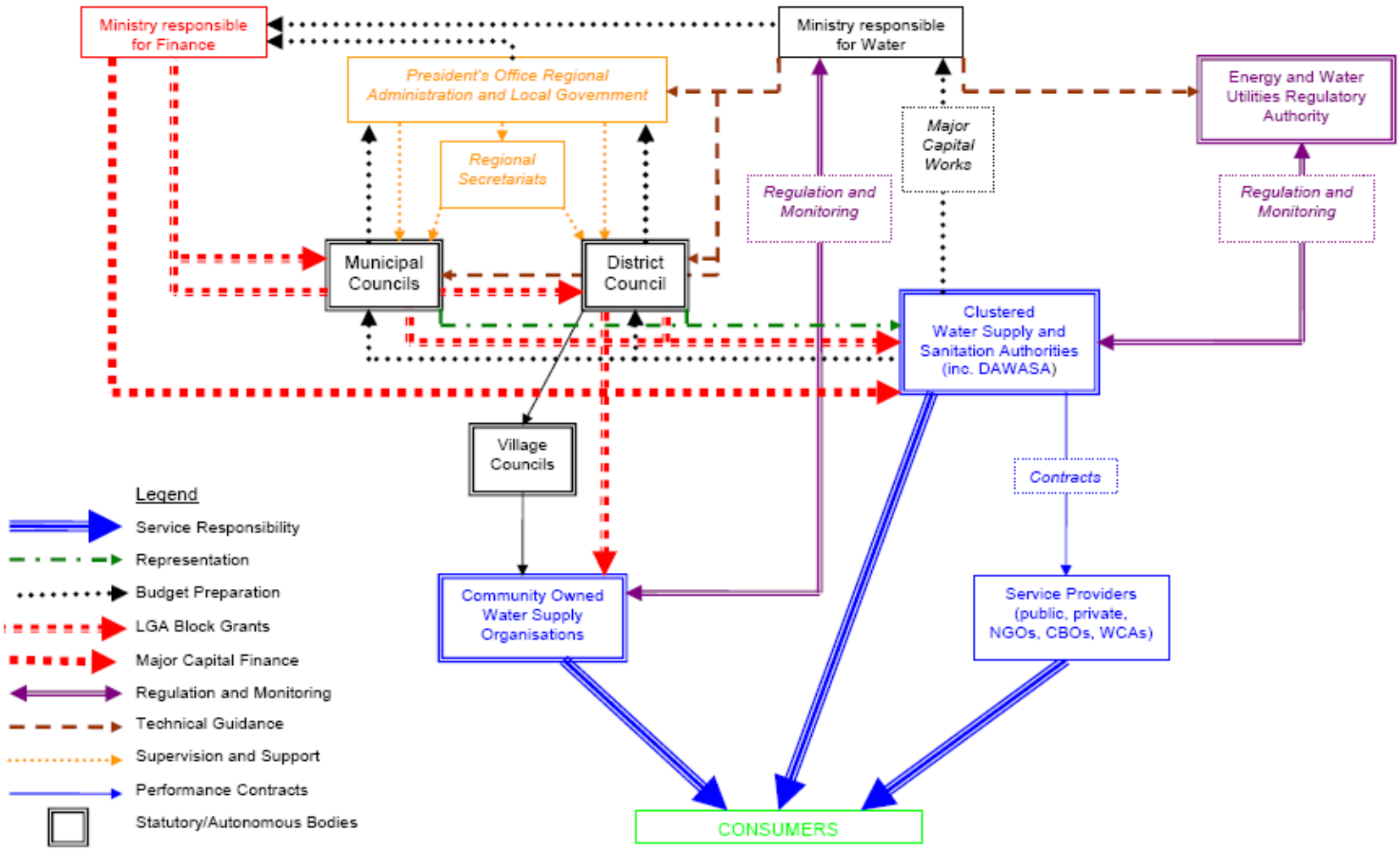


Figure 2: Proposed institutional arrangement for water supply and sanitation

2.4 Assessment for mechanisms for stakeholder involvement in MWW management

In the past water supply projects in Tanzania were implemented without the active participation of the stakeholders in planning, construction and management. As a result, the projects were not properly operated and maintained and thus became unsustainable. Ownership of facilities was not legally vested in stakeholders, which has led to a lack of commitment of ownership, operation and maintenance. The Government was the sole implementer and operator and supplied free water to stakeholders since it was regarded as a freely supplied commodity.

Failure to involve all stakeholders in planning and operation of water supply and sanitation systems has led to a lack of appreciation of problems faced by water and sanitation service deliverer in operating and maintaining the system. In turn, this has led to complaints from customers and nonpayment for the services.

In rural areas, inadequate involvement of communities in the development of water supply schemes has led a lack of acceptance of responsibility for the schemes and their on-going operation and maintenance. Consequently, schemes have not been sustainable.

The strategy for stakeholder participation could be to:

- establish appropriate mechanisms for involving stakeholders in the planning and provision of services;
- increase stakeholder awareness of their new participatory roles and responsibilities; and
- encourage dialogue between stakeholders including Non-government Organisations and Community Based Organisations.

Private Sector Participation

Water supply development and service delivery in Tanzania has been dominated by the public sector and very little attention has been given to participation of the private sector. Prior to the publication of the National Water Policy (2002), private sector participation had not been considered appropriate to what was seen as a government service. As a consequence, there has been a lack of a historical involvement of the private sector in the provision of water supply and sanitation services in Tanzania and, therefore, there is no readily available market on which to draw.

Failure to involve the private sector in water supply and sanitation service delivery has led to a number of problems:

- Little local experience of the private sector in providing water supply and sanitation services;

- Financial resources for developing the local private sector are not readily available;
- Many of the schemes are likely to be too small to attract international private sector participation;
- Many water schemes have not been functioning properly and will require rehabilitation before becoming commercially viable; and
- Water and sewerage services as an essential commodity was previously termed as a free service because the public sector had assumed all roles and responsibilities.

Involvement of the private sector in the financing and provision of water supply and sanitation services in Tanzania should be encouraged where this would result in a more efficient and cost-effective level of service to consumers. The strategy for private sector participation (PSP) will be to:

- Increase consumer awareness of the objectives and potential benefits of PSP;
- Create an enabling environment for increased PSP, including incentives and legal recognition;
- Promote local private sector participation; and
- Cluster schemes to achieve economies of scale and enhance prospects for PSP.

2.5 Assessment of existing financing mechanisms

Water supply and sanitation recurrent costs

The Government of Tanzania has been disbursing recurrent budgetary allocations to the Ministry of Water, the Regional Secretariats and Local Government Authorities to finance water supply and sanitation recurrent activities such as personal emoluments and operations and maintenance costs. However, the mechanisms for determining the beneficial utilisation of these allocations to maintaining water supply and sanitation services are weak. In addition, funding from Government to support recurrent costs has continued to diminish over the years.

The performance in collection of water supply and sewerage service revenues from consumers by service providers is generally poor with many consumers not being metered, and the level of unaccounted for water is unacceptably high. The combination of reduced government allocations and poor revenue collection has resulted in a shortfall in funds necessary to carry out operation and maintenance, which, in turn, has resulted in deterioration of infrastructure for both rural and urban water services. Furthermore, the non-separation of water accounts from other services in Local Government Authorities has led to obfuscation regarding the use to which these revenues are being put.

The constraint of inadequate recurrent financial resources from both consumer revenues and the Government, together with an absence of financial guidelines for re-allocation of recurrent financing to the water supply and sanitation sector and inadequate transparency in the use of funds, has resulted into poor performance in service delivery at all sector levels.

Sustainable operation and maintenance of water supply and sanitation schemes should be based on financial mechanisms that ensure adequate levels and appropriate channeling of financial resources. The source of funds for recurrent costs in urban areas should be from consumers, based on **cost recovery tariff principles**, while in rural areas communities will be required to pay full operation and maintenance costs and costs of higher service levels as well as to manage their schemes. This will as well require effective and transparent mechanisms for covering recurrent costs based on defined performance standards which take into account the level of service and ability to pay, supported by targeted subsidies in cases of need.

The resources allocated to sewerage services delivery have been inadequate to meet investment and even basic operation and maintenance requirements. Most Municipal Councils are unable to operate commercially and therefore do not attract private investment.

Tariff Structures

The approach to tariff structures differs according to the organisation responsible for provision of water and sewerage services. In urban areas, UWSAs determine their tariff structures and charges according to their particular operational and capital funding requirements, and the category in which they operate:

- Category A: Authorities are expected to meet all direct and indirect operational costs;
- Category B: Authorities are expected to meet all direct and indirect operational costs except personal emoluments for permanent staff; and
- Category C: Authorities are expected to meet all direct and indirect costs except personal emoluments for permanent staff and electricity costs.

In water supply and sanitation schemes run by Local Authorities, tariff structures and levels are determined by the District Council, but without specific targets of cost coverage. Provision of water and sewerage services has been seen as a social service, resulting in low willingness to pay, making revenue collection very difficult. In determining tariffs, affordability is given more weight than cost recovery, although no meaningful studies have been carried out on affordability.

The tariff structure applied by most Municipalities is principally fixed charges for varying customer categories (domestic, institutions, commercial and industrial)

due to lack of water consumption measuring devices (meters), which are often low, and therefore, the inability to apply a tariff structure system of **rising block tariffs**, charges are not equitable and revenues do not reflect actual cost of services.

The charge for the sewerage service varies according to the customer category and is applied to 50-80% of the billed water consumption. Other categories of consumers are levied tariff on 80% of their water consumption and these categories include institutional connections, commercial connections and industrial connections, including the bulk connections. Typical tariff levels for the coastal regions in indicated in Table 8.

Table 8: Comparative sewerage tariff levels

Region	Domestic sewerage tariff (Tshs) per month		Institutional tariff (Tshs/m^3)	Commercial tariff (Tshs/m^3)	Industrial tariff (Tshs/m^3)
	High density (poorer)	Low density (richer)			
1. Tanga	1,080	1,600	64	160	220
2. Dar es Salaam	3,300	8,300	-	-	-

Tariff levels and structures should be controlled and regulated based on the levels of service to be provided, the cost-efficient provision of these services, and the cost-recovery targets to be achieved. A minimum or **life-line tariff** can be introduced to protect poor and disadvantaged groups, the cost of subsidising which will be met through internal cross-subsidisation. Government subsidies will be aimed at encouraging efficiency improvements by Service Providers.

2.6 Conclusions and Recommendations

Policy Framework

The existing polices and strategies have potential (strength and opportunity) to bring positive changes and enhance public health and the environment. They include indicators that can be monitored. However, wastewater management is hampered by weak institutional capacity, inadequate coordination and collaboration and unclear demarcation of responsibilities among various actors and low public awareness on the targeted communities. Efforts to address these challenges need to be sustained.

Institutional Framework

The current institutional framework for the provision of water supply and sanitation services is based on a separation between urban water supply and sewerage services, and rural water supply services. The ultimate responsibility

for the provision of these services rests largely with the Ministry of Water. However, both Central and Local Government Authorities have a mandate or legal requirement to be involved in various aspects of the provision of these services. Currently, there is lack of an effective institutional framework for integrated water supply and sanitation services.

Taking into account of these facts, the Draft National Water Sector Development Strategy (2005) proposes future institutions for the provision of water supply and sanitation services to be of three main types: Clustered Water Supply and Sanitation Authorities (CWSSAs); Service Providers; and Community Owned Water Supply Organisations (COWSOs). Regulation of the CWSSAs will be by the Energy and Water Utilities Regulatory Authority (EWURA), while regulation of the COWSOs will be by the Ministry responsible for Water.

Legal Framework

The existing legal and regulatory framework for water supply and sanitation management do not reflect the institutional and organisational changes necessary to implement the National Water Policy (2002). In this regard, it becomes necessary to promulgate new legislation and regulations to provide for the future provision of water supply and sanitation services, including clearly defining the roles, responsibilities and powers of subsector institutions and organisations. It may be worth mentioning of the Water Supply and Sanitation Bill (2005) that addresses most of the identified gaps.

Stakeholder Involvement

Failure to involve all stakeholders in planning and operation of water supply and sanitation systems has led to a lack of appreciation of problems faced by water and sanitation service deliverer in operating and maintaining the system. In turn, this has led to complaints from customers and non-payment for the services.

Involvement of the private sector in the financing and provision of water supply and sanitation services should be encouraged where this would result in a more efficient and cost-effective level of service to consumers.

Financing Mechanisms

All Municipal Councils need to operate more commercially with increasing responsibility for meeting all their own costs, including capital investment. Actions necessary to achieve this goal are proposed in the following areas:

a) **Tariff Setting:** Willingness to pay surveys should be undertaken in few of the towns to provide realistic guidance to the charges that people are able and willing to pay for different levels of services under different

circumstances. A set of guidelines on tariffs should be prepared after the surveys have been completed. Tariffs should be approved by EWURA.

b) **Billing system:** All Authorities should use modern proven computerized billing systems. Management should check that overall billing levels are consistent with water consumption data.

c) **Control of operating costs:** All Authorities should review their operating costs especially personnel, administrative and overhead costs, and reduce them wherever they are significantly above the average for the size of the Authority.

d) **Funding of Investments:** Although it is expected that much investment will come from grants in the immediate future, wherever possible Authorities should be expected to fund investments from their own resources. The Water Supply and Sanitation Bill (2005) incorporates provision for the establishment of National Water Fund, to which other donors may contribute. The Fund would offer a mechanism for the Authorities to borrow funds at reasonable interest rates.

3.0 INVENTORY OF MWW TREATMENT INFRASTRUCTURES

3.1 Background

This chapter provides an overview on the sanitation facilities providing services for sewage and excreta disposal, and storm water drainage for the residents of the Tanzania coastal regions. Figure 3 presents main drainage rivers in Tanzania.

Figure 3: Map showing the main Tanzanian rivers draining into the India Ocean

The provision of sanitation services, including sewerage, has not kept pace with population growth in the coastal urban areas of Tanzania. According to the World Bank, “the greatest challenge in the water and sanitation sector over the next two decades will be the implementation of low cost sewage treatment that will at the same time permit selective reuse of treated effluents for agricultural and industrial purposes”.

The majority of coastal communities use pit latrines for sewage disposal (Table 9). In urban areas a small proportion of residents have access to modern toilet facilities but some have no means of disposal other than their immediate surrounding beach or bush. In rural areas, an even greater proportion have no toilet facilities.

Table 9: Percentage distribution of private household by type of toilet in the coastal regions

Region	RURAL			URBAN		
	Flush	Pit latrine	none	flush	Pit latrine	none
Tanga	0.8	80.8	18.3	16.2	79.2	4.5
Coast	0.9	76.1	23.0	4.8	88.3	6.7
Dar es Salaam	3.8	80.9	15.2	15.9	83.1	1.0
Lindi	0.6	77.2	22.2	4.7	85.0	10.3
Mtwara	1.0	84.2	14.8	7.4	86.1	6.6

Source: Tanzania 2002 Population Census

The health consequences of the service shortfalls are enormous and fall most heavily on the urban poor. In most municipalities in the country, sewage is rarely treated. There is also the problem of uncontrolled industrial discharges into municipal sewers, increasing organic loads and introducing a range of chemical contaminants that can damage sewers, interrupt treatment processes, and create toxic and other hazards.

The National Strategy for Growth and Reduction of Poverty (NSGRP) (2004) targets raising sewerage service coverage from 17% in 2004 to 25% by 2006 and to 30% by 2009. It is argued that it might not be practical to reach the target for sewerage (measured as the percentage of households with a connection), because the number of houses with the requisite internal plumbing facilities to make such a connection practicable is generally no more than 20% of the total.

3.2 Domestic wastewater

3.2.1 Muheza District

*Socio-economic and Demographic Condition*s

Muheza District, situated in Tanga Region, covers an area of 4,922 km^2 with a population of about 300,000. The population growth rate stands at 1.5% per annum. According to the 2002 National Census, the district had a total of 62,921 private households, of these 55,124 were in rural areas and 7,796 were in urban areas. The population density is 56 persons per km^2.

About 84% of the population depends on subsistence agriculture while only over 1% relies on fishing (NBS, 2004)

Water Supply Facilities

Water supply sources include bore-holes and natural springs. The current piped water supply scheme serves about 18% of the population. However, during dry seasons, some of the sources dry up leading to scarcity in water supplied. The distribution of households by location and main source of water supply are indicated in Table 10.

Table 10: Main water supply sources in Muheza district

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected	River/ stream	Pond/ dam	Lake	rainwater	Water vendors	Total
Total	18.05	9.23	38.16	4.68	2.90	22.07	2.78	1.16	0.04	0.94	100
Rural	8.83	10.03	42.20	5.34	3.31	24.94	24.94	1.32	0.04	0.82	100
Urban	83.25	3.55	9.61	0.04	0.03	1.72	1.74	0.00	0.40	1.72	100

Sewerage Networks

There is no sewerage system and all people depend on on-site sanitation facilities.

On-site Sanitation

According to the 2002 National Census, about 82% of the population have access to on-site sanitation facilities implying about 18% have no toilet facility. About 80% of the population use traditional pit latrine whereas 1% use flush toilets with soakage pits. The percentage distribution of households by location and type of toilet facility is indicated in Table 11.

Table 11: Percentage distribution of on-site sanitation facilities in Muheza District

	Flush toilet	Traditional pit latrine	Ventilated pit latrine	Others	No facility	Total
Total	1.16	80.02	0.75	0.03	18.04	100
Rural	0.24	78.87	0.55	0.03	20.31	100
Urban	7.70	88.15	2.17	0.03	1.98	100

Stormwater Drainage

There exists no constructed storm water drains. Natural drainage channels drains stormwater leading into the Indian Ocean.

Sludge management

Upon accumulation of sludge in septic tanks, owners/tenants have to pay for the service of acquiring a tanker to withdraw waste/sludge from the septic tanks which is transported to Tanga City about 20km from Muheza. This creates concerns that at times, the tankers could discharge the septage in forests to increase profit margin.

Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

The District extends along the coast with flat coastal plain with clay and sand soils, rising inland to undulating slopes with sand and loamy-clay soils.

3.2.2 Tanga City

Socio-economic and Demographic Conditions

Tanga City covers an area of 536 km^2 and is the country's third largest town and second largest port located on the coast of the Indian Ocean in the north east of Tanzania just 65 km south of the border with Kenya. It is a large sprawling settlement with the inner areas around the port and central business district (CBD) built in a grid pattern. Tanga has a population of about 250,000 people and a total of 53,454 private households, of which 14,410 are in rural area and 39,459 are in urban area. The average size of household is about 4.45 persons per household.

Some unplanned settlements have developed on marginal lands which are liable to flooding and very difficult or very expensive to improve. In general these areas lack basic services such as water, sewerage, drainage, etc.

Water Supply Facilities

The Tanga water supply system takes water from Mabayane Resevoir on the River Sigi serving about 80% of the population. The storage capacity of the reservoir is 5,000,000 m^3. The actual production is about 24,931 m^3/d of which more than 30% are estimated to be lost through leakage, illegal use and excessive use. The distribution of households by location and main source of water supply are indicated in Table 12.

Table 12: Main water supply sources in Tanga City

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	84.82	3.80	9.19	0.07	0.23	1.48	0.17	0.01	0.27	100
Rural	54.21	11.90	30.21	0.28	0.86	1.83	0.65	0.03	0.03	100
Urban	96.00	0.84	1.52	0.00	0.00	1.36	0.00	0.00	0.28	100

On-site Sanitation

It is estimated that about 89% of the population have access to on-site sanitation facilities implying that about 11% of them do not have any toilet facility. About 68% of the population use traditional pit latrine whereas 20% use flush toilets with soakage pits. The percentage distribution of households by location and type of toilet facility is indicated in Table 13.

Table 13: Percentage distribution of on-site sanitation facilities in Tanga City

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	20.18	68.05	0.84	0.04	10.88	100
Rural	2.49	67.92	0.98	0.03	28.58	100
Urban	26.64	68.10	0.80	0.05	4.42	100

The Sustainable Tanga Programme in 2006 constructed about 480 community low-cost latrines in a bid to improve the City's environmental sanitation. Recipients contributed USD 10-15 (Tshs 15,000 – 20,000) for one latrine. The latrines have been constructed at Kiomoni, Kwanjeka Nyota, Kichangani Mafuriko, Magaoni and Mwarongo.

Sewerage Networks

The sewerage system serves a minority of households. A sewerage system was first built for the central area of Tanga before 1950. It was rehabilitated and expanded between 1991 and 1994, when new concrete main sewers and a sea outfall were installed. The total length of sewers is now about 33 km, comprising clay, concrete and PVC pipes with diameters up to 600mm. Many of the pipes are old and suffer from frequent blockages and collapses. The system covers about 17% of the urban area. There are 2,238 connections to the sewerage system, of which 2017 are to households, 144 commercial premises, 66 to institutions, and 11 to industries.

Peak discharge into the sea is 80 litres per second with BOD of 1200 mg/l. Bombo hospital is not connected to the central sewer because of its location at a lower level than the main sewer. It therefore empties its untreated waste (contaminated) directly into the sea near the harbour. Likewise some industries such as Foma Detergent Factory discharge untreated effluent into storm water drains or streams which lead the effluent into the ocean at Sahare.

Wastewater Treatment Scheme

There is no treatment of the wastewater collected in the municipal network other than the screening and grit removal. The waste water is pumped into a collection tank from which it gravitates through the outfall and is discharged to the sea about 500m from the shore. The measure BOD of the effluent at the inlet to the outfall in 2003/04 varied between 112 and 760 mg/L. Complaints of pollution of the shoreline are received from people living nearby.

Stormwater drainage

The City has a open-channel stormwater drainage system with about 5.6 km in length. The canals whose construction was supported by the Sustainable Tanga Programme (STP) are in Kwanjeka Nyota (1.2 km), Duga (0.47 km), Makorora (0.885 km), Mabawa (2.280 km) and Mwanzage (0.227 km), Ngamiani and Kiomoni.

Sludge Management

Emptying of septic tanks is carried out by the City Council through leasing of trucks to private sector operators who are supposed to empty their loads at Ras Kazone. Some trucks empty their loads into sewer manholes before reaching the said emptying point. Septage is discharged to the sewerage system for sea disposal at no charge to the City.

The City lacks wastewater treatment system, and therefore the municipal wastewater is discharged directly into the Indian Ocean.

Sludge from pit latrines is either emptied using tankers, though only practiced by fewer households and majority opt digging new pits on a different locations.

Topography and Drainage

Tanga Region is part of the largest Indian Ocean drainage basin and it drains mainly through the Pangani River and its tributaries (e.g. Mkomazi, Soni River and Lwengera). The extreme northern parts of the region are drained by the Umba river, whereas drainage in the coastal belt is made possible by a number of short coastal rivers e.g. Sigi river, most of them with seasonal discharge only.

3.2.3 Pangani District

*Socio-economic and Demographic Condition*s

Pangani district is among the six districts that constitute the Tanga region occupying 1,803 km^2 or 6.6% of the total regional area. According to the 2002 Population Census, the District had a population of about 45,000, of whom 50.6% are males and 49.3 are females. The District had a total of 11,434 private households, of these 9,735 were in rural areas and 1,699 were in urban areas. The population grows at about 1.3% per annum. The population density is about 25 persons per km^2. The census revealed that 35% of the district population lived in the hinterland while 65% stay along the coast.

Fishing and agriculture are the major occupations for the district residents, however, honey and beeswax production and livestock keeping is undertaken in small scale and in traditional way.

Water Supply Facilities

The main sources of water are by piped water and shallow wells. Other sources of water are rain water harvesting, dug wells and ponds. Siltation poses a threat to these water sources. The current district water supply coverage stands at 87.7%. However, due to the fact that most of the schemes operates at low capacity level and others are not operating due to lack of funds to make periodic preventive maintenance services, only about 46% of the district population have regular access to water supply. The distribution of households by location and main source of water supply are indicated in Table 14 below.

Table 14: Main water supply sources in Pangani District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	Lake	rainwater	Water vendors	Total
Total	45.37	6.13	20.33	13.12	3.65	8.96	2.10	0.19	0.04	0.01	100
Rural	36.32	7.07	23.53	15.52	4.28	10.53	2.47	0.23	0.05	0.00	100
Urban	97.23	0.77	1.94	0.00	0.00	0.00	0.00	0.00	0.00	0.06	100

Sewerage Networks

There is no sewerage system and all people depend on on-site sanitation facilities.

On-site Sanitation

The majority of the District population relies on on-site sanitation with 24% of the population having no sanitation facility. The sanitation facility being used includes traditional pit latrines (67.3%) and flush toilets with soakage pits (6.2%). The percentage distribution of households by location and type of toilet facility is indicated in Table 15.

Table 15: Percentage distribution of on-site sanitation facilities in Pangani District

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	6.24	67.28	2.67	0.03	23.79	100
Rural	5.50	64.73	2.56	0.00	27.22	100
Urban	10.48	81.93	3.24	0.18	4.18	100

Stormwater Drainage

There are permanent structures of stone ditches constructed for storm water drainage. However, they do not meet demand especially during rainy seasons and during high tides.

Sludge management

Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

Sludge from pit latrines is either emptied using tankers, though only practiced by fewer households, and majority opt digging new pits on a different locations.

Topography and Drainage

The district extends along the coast with flat coastal plain with clay and sand soils, rising inland to undulating slopes with sand and loamy-clay soils. This structure is parallel to the coast is disrupted by two rivers of Pangani and Msangasi and several tributaries in the valleys of which alluvial soils with brackish water prevails. The altitude range from 0-188 m above sea level.

North Pangani has brown loamy sands along the coast, black clays in low lying areas and dark reddish-brown loams elsewhere. South Pangani on the other hand is composed of dark reddish-brown loam with black clays in lower areas.

3.2.4 Bagamoyo District

Socio-economic and Demographic Conditions

Bagamoyo District is located in the Coast region covering an area of approximately 10,000 km^2 having a population of about 230,000 people with an annual growth of about 2.4% per annum. The District has a total of 51,063 households. The average household size is 4.48 persons per household according to the 2002 National Census. The District coastline extends 60 km from Buyuni in the north to Mpiji River in the South.

Once a center for the East African slave trade, Bagamoyo literally means, “lay your heart” (*Bwaga* = lay and *Moyo* = heart in Swahili). The name came from the despair felt by those who had been captured inland and transported to Bagamoyo where they waited to be shipped to Zanzibar and the Far East.

Water Supply Facilities

The main water supply source is the Lower Ruvu river. The coverage of the water supply network is about 25%. The distribution of households by location and main source of water supply are indicated in Table 16.

Table 16: Main water supply sources in Bagamoyo District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	25.41	4.97	31.72	0.11	1.03	4.03	30.84	0.05	0.64	100
Rural	16.16	5.68	37.57	0.13	2.01	5.70	31.97	0.04	0.74	100
Urban	65.02	1.93	6.05	0.00	0.00	0.08	26.01	0.08	0.23	100

Sewerage Networks

There is no piped sewerage system.

On-site Sanitation

According to the 2002 National Census, about 86.5% of the population has access to toilet facility implying that about 13.5% of the population have no toilet facility. About 85% of the population use traditional pit latrines and 0.88% of the population use flush toilets with soakage pits. The percentage distribution of households by location and type of toilet facility is indicated in Table 17.

Table 17: Percentage distribution of on-site sanitation facilities in Bagamoyo District

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	0.88	84.82	0.61	0.14	13.5	100
Rural	0.34	82.76	0.57	0.00	16.33	100
Urban	3.19	93.64	0.81	0.72	1.64	100

Stormwater Drainage

There is no piped storm water drainage system

Sludge Management

Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

Sludge from pit latrines is either emptied using tankers, though only practiced by fewer households and majority opt digging new pits on a different locations.

Topography and Drainage

The Bagamoyo District rises from 0-100 m above sea level which is dominated by sandy loam and sandy clay soils.

The Bagamoyo District has two major rivers on the northern part, namely Wami and Ruvu and both of them discharge into the Indian Ocean. Topographically, this district is characterized by gently undulating plains covered with low sparse vegetation. The northern and eastern parts are covered by natural forests.

3.2.5 Dar es Salaam City

Socio-economic and Demographic Conditions

The population of Dar es Salaam City is projected to be about 3.5 million. Population density per square kilometer as per 2002 population census report stands at 1,787 per square kilometer. The city had a total of 604,969 private households, of these 37,076 were in rural areas and 567,894 were in urban areas. The migration rate for permanent dwellers is considered to be 10% annually and for transient population, the rate is about 1,000,000 per annum. The city's rapid population growth is estimated to be 7% per annum. The outcome of this growth has been the proliferation of unplanned and unserviced areas. It is estimated that 75% of residents live in squatter areas, and 65% of new housing is being built in these areas. Key squatter areas of high population density include Manzese, Temeke, Mbagala, Buguruni and Vingunguti, to mention a few.

It is estimated that about 95 % of City residents are working in the informal sector, while the remaining 5 % are employed in the formal sector including the government and public cooperation. Based on statistics for 2002, unemployment in the City of Dar es Salaam was 46.5% while in other urban areas it was 25.5% and in rural areas it was 18% (DCC, 2004).

Water Supply Facilities

The water supply in Dar es salaam amount to 270,000 m^3/d of which more than 50% are estimated to be lost through leakage, illegal use and excessive use. The current piped water supply scheme is estimated to serve about 73% of the population. The distribution of households by location and main source of water supply are indicated in Table 18.

Table 18: Main water supply sources in Dar es Salaam City

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected	River/ stream	Pond/ dam	Lake	rainwater	Water vendors	Total
Total	72.64	15.29	7.31	0.28	0.41	0.18	0.03	0.00	0.04	3.83	100
Rural	21.83	13.00	62.39	0.46	0.68	1.07	0.35	0.01	-	0.08	100
Urban	75.95	15.44	3.71	0.27	0.39	0.13	0.01	-	0.03	4.07	100

Sanitation Facilities

The existing sanitation network originally was built in 1950 aiming to serve the city center and parts of the peri-urban areas. According to DAWASA records,the provision of excreta disposal facilities is summarized in Table 19.

Table 19: Percentage distribution of on-site sanitation facilities in Dar es Salaam City

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	14.27	82.92	1.32	0.12	1.37	100
Rural	1.09	87.34	1.19	1.03	9.34	100
Urban	15.13	82.63	1.33	0.06	0.85	100

On-site sanitation

The city of Dar es salaam is estimated to have about 75% of her residents living in squatter areas and 65% of new housing is being built in these areas (Mgana, 2003). Presently most of the residential areas in Dar es salaam are served by onsite disposal systems in the form of pit latrines or septic tanks with soak pits. According to the 2002 National census, about 99% of the population use on-site

sanitation systems, of which 83% use pit latrines with about 1% of the population without sanitation facility. About 15% use septic tanks with soak pits system to treat wastewater. The current pit emptying charges range between US$ 25 – 35 per trip. The fact that Dar es Salaam has over than 120,000 pit latrines, there is a need to focus on their sustainable function.

Ground water table influences the construction and the rate of sludge/solids withdrawal from the latrines. It is not uncommon to find that a portion of the latrines were built higher than ground level with access stairs in order to extend the period between dislodging which also is beneficial for groundwater quality.

Ventilated pit latrine is one sort of accepted enhanced sanitation facility in the community. Others are double vault latrines, pour flush system, etc; however, higher cost may be associated with the construction of some of these systems.

Soil condition also has influence on the configuration of the pit latrine used as soft soils introduces a requirement that some sort of lining (using concrete rings or bricks) be used to prevent soil collapse with deeper excavation. The higher the soil permeability, the higher the potential of suing larger amounts of water depending on the infiltration allowed at these areas. Areas experiencing high ground water table are the most subject to frequent de-sludging.

Private wells may be constructed within residential areas, abstracting groundwater sometimes through wells that risk being subject to pollution from leaching pit latrines thus resulting in serious outbreaks of water borne diseases.

Domestic sewage waste is one of the leading sources of marine pollution in the city with indicative pollution loads presented in Table 20. High faecal and total coliform levels are a result of this sewage pollution. The situation is made worse by broken sewer pipes which discharge untreated sewage on mud flats near the harbour. This is now threatening invertebrates and fish resources in those areas. Seaweed blooms are a regular feature in the waters off the northern end of the beach of Ocean Road in Dar es Salaam.

Table 20: Pollution loads from pit latrines and septic tanks to water resources in Dar es Salaam City

Type of pollution load	Industrial effluent	Pollution loads quantities discharged from pit latrines and septic tanks to identified water resources (kg/day)			
		Surface water resources		Groundwater resources	
		Pit latrines	Septic tanks	Pit latrines	Septic tanks
BOD	28,330	15,282	3,275	15,282	7,641
COD	29,904	16,131	3,457	16,131	8,068
Suspended solids	47,216	25,470	5,458	6,116	3,832
Dissolved solids	83,940	45,280	9,830	97,857	61,128
Total N	4,145	2,236	479	4,829	3,018
Total P	787	425	91	915	572

Sources: Mohamed *et al*, 2005

It is estimated that about **22 million litres of wastewater** is managed through conventional sewerage system and about **0.6 million litres** is managed through on-site sanitation schemes.

Sewerage networks

The existing sewerage system provides services to about 15% of the City's population. The sewerage system is based on a separate system (i.e. excluding storm water) with a combination of gravity and pumped flows, comprising of 15 pumping stations, a total sewer length of 170 km of with pipe diameter ranging between 100 millimeters for arterials and up to 1000 millimeters for trunk sewers covering a total area of 1,717 hectares, with access for servicing via over 2,967 manholes (Mgana, 2003). The sewerage system serving the city centre disposes of the sewage untreated via a 1-km long, 1,000 mm diameter asbestos-cement sea outfall. Drainage areas and existing sewers are indicated in Table 21.

Table 21: Drainage areas and existing sewerage system in Dar es Salaam

Area	Total Length (Km)	Manholes No	Sewers (m) per Manhole
City Center Kariakoo, Upanga (R & C)	67.8	745	91
Mikocheni (R)	7.4	163	45
Regent Estate (R)	3.7	66	56
Kijitonyama (R)	10.2	154	66
Buguruni (R)	4.2	136	31

Pugu Road (I)	3.5	44	79
Tazara	5.5	103	53
Ubungo	9.1	164	55
Lugalo	17.2	610	28
Airwing & Airport	4.4	145	30
Ukonga	2.2	58	38
Mgulani	9.2	236	39
University	11.2	343	33
Assorting Pumping main	11.9		
Total	**167**	**2,967**	

Source: DAWASA (2002)

The Dar es Salaam sewerage system is a collection of small independent drainage areas rather than a fully integrated network. Apart from the city centre, other sewered areas are mainly institutional: airport, military barracks and the University of Dar es salaam. There are 10 sewerage systems, 9 systems discharging into waste stabilization ponds and the remaining is serving the city center, Kariakoo Upanga and Muhimbili discharges directly into the Indian Ocean through a sea outfall.

The existing sewerage system in Dar es Salaam may be sub-divided into the following drainage classifications:

a) **Residential & Commercial (R & C),** including; City centre, Kariakoo & Upanga.

b) **Residential (R)**, including Mikocheni, Regent Estate, Kijitonyama, Buguruni.

c) **Industrial (I),** including; vingunguti, Tanzania Zambia Railways (Tazara), and Ubungo,

d) **Institutional (T)** including; Lugalo Barracks, Ukonga, Air wing, Airport Mgulani police line and the University College.

From existing data, the estimated average sewage flows generated from various areas served by the existing pumping stations are indicated in Table 22. There are 15 pumping stations serving Dar es Salaam sewerage system with flow rates ranging form 14 to 216L/S and head ranging form 5 to 29m. The force main diameters range from 150 to 300mm. Pipe materials are UPVC and Ductile Iron.

Table 22: Sewage Discharge from Pumping Stations

Area	Pump station	Flow (L/S)	Head (m)	Pumping Main Diam (mm)	Length (m)
City Center Kariakoo, Upanga (R & C)	Muhimbili Gymkhana	75 216	8 9	300 – DI 450 – DI	740 420
Mikocheni (R)	Mikocheni	35	27	200 - uPVC	1805
Regent Estate (R)	Msasani	35	29	200 - uPVC	1600
Kijitonyama (R)	Gravity				
Buguruni (R)	Gravity				
Pugu Road (I)	Gravity				
Tazara (I)	Tazara 1	17	10	150 - uPVC	526
	Tazara 2	24	24	150 - DI	1008
	Tazara 3	14	24	150 - uPVC	1337
Ubungo	Gravity				
Lugalo	Lugalo 1	58	16	200 - uPVC	295
Air wing & Airport (T)	Lugalo 2	89	5	300 – DI	10
	Airport 1	17	14	150 - uPVC	900
	Airport 2	17	3	150 - DI	295
	Air wing 2	44	10	250 - DI	1160
Ukonga (T)	Gravity				
Mgulani (T)	Mgulani 1	59	10	200 - uPVC	218
	Mgulani 2	14	10	150 - uPVC	672
University (T)	University	14	21	150 - DI	920

Out of the 15 pumping stations, only three are currently operational, the flows of the non working pumping stations are diverted to surface water drains or ditches which ultimately discharge to the sea via rivers or streams. However, there are projects that are aimed at rehabilitating these pumping stations.

Wastewater treatment scheme

a) Waste stabilization ponds

A total of 9-sets of waste stabilization ponds are used in treating sewage from these independent drainage area based sewerage systems. The 9-sets of waste stabilization ponds have a total area of 23.2 hectares and overall volume of 304,376 m^3 with a total design hydraulic retention time of 160 days (Mgana, 2003). The nine sets of waste stabilization ponds exist in the City of Dar es Salaam, with the following major problems:

a) The pond floors are not sealed and hence loose wastewater through seepage.
b) Variable influent flows and losses allow littoral weed growth.
c) Embankment damage due to erosion and soil slips.
d) Insufficient capacity to achieve bacteriological effluent standards.
e) Lack of routine monitoring and analysis of performance data.

f) Non-frequent dislodging.
g) Treatment sites are not secured with boundary fences and many are encroached by squatter housing leaving no room for future expansion.
h) No control over the discharge of toxic matter or inhibiting industrial effluents.

Currently rehabilitation project by DAWASA is carried out to restore the original capacities of selected ponds.

b) Constructed wetlands

Constructed wetlands for treatment of wastewater have been introduced in Tanzania. In the coastal area, practical systems have been constructed at the University of Dar es Salaam which is mostly used for research purposes. Other constructed wetlands are found in two (2) households in Dar es Salaam and in Kibaha, Coast region (1). Other existing constructed wetlands outside the coastal zone are situated in Iringa region (2), Shinyanga region (4) and Moshi municipality (2).

c) Peri-urban mangrove wetland

There exists a pilot peri-urban mangrove wetland in Kunduchi, Dar es Salaam which serves as a natural wastewater treatment system under the auspices of the PUMPSEA Project.

Storm water drainage

The city also has 1,100 km of open lined ditches and 600 km of piped storm water drainage. Lack of regular maintenance and the dumping of refuse into the drains causes blockage leading to seasonal flooding in parts of the city. In addition, many industries that are not connected to the sewerage system or do not have waste treatment plants, indiscriminately discharge their waste into stormwater drains and watercourses in areas adjoining their factories. These areas are often close to or within low-income settlements.

Sludge management

Sludge, representing the solids portion encountered from excreta disposal – is interchangeably used to address solids accumulated in the wastewater stabilization ponds, concentrated discharge from the septic tanks and the content of the pit-latrines (or other forms of onsite sanitation) after reaching their full capacity. By this, the generated sludge is dealt with in different ways as follows:

i) Sludge from existing wastewater stabilization ponds – though accumulated for years without proper desludging – shall now be periodically discharged due to the current rehabilitation projects that aim at providing adequate drying beds or other means of solids drying for final disposal (possibly into sanitary landfills). DAWASCO is responsible for operating the sewerage system and the wastewater stabilization ponds.

ii) Sludge from septic tanks originates mainly from middle income households and institutional establishments not connected to sewerage system and that can afford adequate house connections for water supply and construction of suitable septic tanks. Upon accumulation of sludge, tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks and convey them to the nearby wastewater stabilization ponds.

iii) Sludge from pit latrines is also a major component requiring adequate management due to several reasons among which are:
    a) Weak accessibility represented in very narrow pathways in the informal areas;
    b) Restricted areas within households property inhibiting the construction of new latrines which is not a sustainable solution by itself;
    c) The need to manage the handling and disposal of sludge in an environmentally sound manner taking into consideration the type of hazards such sludge can result in.

Private excavators are currently widely used to dig the contents of the pit latrines then either coordinating with the City Council for final disposal or disposing the sludge themselves in a random way into dug pits.

Topography and Drainage

Dar es Salaam is built on low lying terrain with increasing altitude of about 20 m a.s.l around City Centre to about 260 m a.s.l on the Pugu/Kisarawe Hills to the south west.

The City is drained by three main river systems:

i) Mpiji River forms the northern boundary of the City;

ii) Msimbazi River flows to the North of the City Centre

Msimbazi river runs through the heart of the City of Dar es Salaam is polluted in terms of high organic and nutrient concentrations, low dissolved oxygen, and high counts of indicator organisms. Biochemical

oxygen demand (BOD5) concentration range from 27 to 340 mg/L, dissolved oxygen in the river is as low as 0.9 mg O^2/L. Bacteriological pollution increase with distance downstream of the river, a trend attributable to an increase in the catchment of pollution sources, which are mostly on-site sanitation systems (IMS, 2006).

iii) Kizinga and Mzinga Rivers flow into the harbour area of the City

There are also small water courses such as Nyakasangwe, Tegeta, Mbezi, Sinza, Tabata and Minerva.

3.2.6 Mkuranga District

Socio-economic and Demographic Conditions

Mkuranga district is one of the six districts that form the Coast Region covering 2,432 km^2 and a population of about 190,000 people. According to the 2002, National Census, the district had a total of 43,511 private households, of these 38,162 were in rural areas and 5,349 were in urban areas. The District has about 90 kilometers of coastline, extending from the Temeke to the Rufiji district.

Agriculture is the principal economic activity, with over 90% of the households engaged in farming. The most common food crops are cassava, rice and beans. Major cash crops are cashew nuts, coconut, pineapple and orange.

Water Supply Facilities

The Mkuranga District is rich in water resources, but water contamination is common and so is water and sanitation-related diseases. In fact, with only 9% of the households accessing potable water, Mkuranga is one of the worst districts in Tanzania in terms of access to piped or protected water sources. The distribution of households by location and main source of water supply are indicated in Table 23.

Table 23: Main water supply sources in Mkuranga District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	0.63	8.03	90.93	0.04	0.07	0.08	0.00	0.00	0.22	100
Rural	0.11	6.67	93.02	0.03	0.07	0.08	0.00	0.00	0.02	100
Urban	4.28	17.72	76.00	0.09	0.07	0.09	0.02	0.04	1.68	100

Sewerage Networks

There is no piped sewerage system.

On-site Sanitation

According to the 2002 National census, about 88% of the population use on-site sanitation systems, of which 89% use pit latrines with about 12% of the population without sanitation facility. About 1% use septic tanks with soak pits system to treat wastewater.

The sandy collapsible soil makes latrine construction difficult for poor households and in 2002, less than 40% of the households had a latrine. A District Integrated Coastal Management (ICM) Action Plan, adopted in 2002, recognizes that a major concern is that people use the beach as a toilet and garbage-dumping area. The percentage distribution of households by location and type of toilet facility is indicated in Table 24.

Table 24: Percentage distribution of on-site sanitation facilities in Mkuranga District

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	0.07	88.75	0.07	0.10	12.07	100
Rural	1.12	96.26	0.69	0.20	1.91	100
Urban	0.20	88.75	0.14	0.09	10.82	100

Sludge Management

Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

The Coast region is drained by Rufiji river (the largest), Ruvu 'B' river, Wami river and smaller rivers like Muhoro, Ruboi and Luhule rivers. The rivers discharge their waters into Indian Ocean.

3.2.7 Rufiji District

Socio-economic and Demographic Conditions

The Rufiji District is located on the southern coast of Tanzania covering an area of 8,300 km^2 and almost half of the district is within the Selous game Reserve.

According to the 2002 Population Census, Rufiji District had a total population of 202,001 growing at 1.9 % per annum, therefore projected to 219, 139 in 2006. in 2002, the district had a total of 44,880 private households, of these 34,624 were in rual areas and 10,256 were in urban areas. The population density is about 16 people per km^2. The headquarter of Rufiji District is at Utete, located about 200 km south of Dar es Salaam. The district also has one of the lowest male-to-female ratios in the country as a result of out-migration.

The economy of Rufiji District is predominantly based on natural resource related activities mainly subsistence agriculture, fishing and forest harvesting which account for approximately 60% of household cash income. Rufiji is an important harvest site for many fish species including prawn fisheries. Catches in the Rufiji area account for approximately 80 of the national industrial prawn catch.

Water Supply Facilities

The District has as many as 35 water sources which include Rufiji River and its tributaries. These include water supply scheme, hand pump tube wells and shallow wells with hand pumps. However, out of them, only 8 are operational which are found in Utete, Mkongo, Mtanza/Msona, Ikwiriri, Nyamisati, Mjawa, Kilimani and Kingupira villages.

According to the 2002 National Census, about 30% of the total district population has access to clean water. The demand for clean water supply stands at 5,478.5 m^3, however, currently only 3,396.7 m^3 are supplied equivalent to 62% of the actual demand. The distribution of households by location and main source of water supply are indicated Table 25.

Table 25: Main water supply sources in Rufiji District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	3.03	18.05	62.21	0.10	1.01	11.33	2.54	0.07	1.68	100
Rural	0.78	7.67	72.97	0.10	0.68	14.50	3.24	0.05	0.00	100
Urban	10.60	53.07	25.86	0.13	2.12	0.61	0.16	0.13	7.34	100

On-site Sanitation

It is estimated that about 87% of the population has access to on-site sanitation facilities implying that about 13% have no toilet facility. About 87% of the population use traditional pit latrine and 0.2% use flush toilets with soakage pits. The percentage distribution of households by location and type of toilet facility is indicated Table 26.

Table 26: Percentage distribution of on-site sanitation facilities in Rufiji District

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	0.20	86.54	0.55	0.02	12.68	100
Rural	0.05	83.43	0.51	0.03	15.98	100
Urban	0.71	97.05	0.71	0.00	1.53	100

Sewerage Networks

There is no piped sewerage system.

Stormwater Drainage

The District is divided into three main geographical zones namely, flood plain, coast and highland. The flood plain zone is situated along the Rufiji River with an area of about 130 km^2. During floods especially high ones, the river channel changes its course leading to creation of meanders, ox-bow lakes, lagoons and old river remnants. The Rufiji delta and coastal zone extends north to south about 75 km of the coast and stretches inland around 25 kms in a roughly deltaic shaped caused by the interaction of the river floods and the tides. The Plateaua (hill area) zone is between the Rufiji flood plain and Kilwa/Liwale Districts, this is known as Matumbi Mountains

Sludge Management

The generated sludge is dealt with in different ways as follows:

i) Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

ii) Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

The flood plain is composed of alluvial deposit consisting of sands, silt and clays often highly stratified. The delta/coastal zone soils are sandy, sandy clay and sandy silt loam. The plateau (hill/highland) zone soils are sandy and sand clay loam.

3.2.8 Kilwa District

Socio-economic and Demographic Conditions

The Kilwa District located in the Lindi region, covers an area of 13,920 km^2 and a coastline of 150 km. According to the 2002 National Census, the population of Kilwa was about 171,057 and a total of 36,549 private households, of these 32,979 were in rural areas and 3,570 were in urban areas. The population density is 10.8 persons per km^2. Kilwa can be generally characterized as having poor infrastructure and poor road access, particularly during the rainy season.

Similar to other coastal communities in Tanzania, poverty in Kilwa's coastal villages is high and livelihoods are highly dependent on activities such as subsistence agriculture and artisanal fishing, as well as lime and salt production, seaweed farming, livestock husbandry and small-scale trade. Subsistence agriculture employs approximately 90% of the working population and contributes approximately 80% of the district GDP. Only about 47% of the population are literate.

Kilwa has a number of unique cultural and historical sites over 500 years old, which are of interest for rehabilitation. The ancient ruins found in Kilwa District are quite extensive and unique, which is why UNESCO named them as a World Heritage Site in 1981.

Water Supply Facilities

The coverage of water supply is about 80% of the urban population. The distribution of households by location and main source of water supply are indicated in Table 27.

Table 27: Main water supply sources in Kilwa District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	8.33	11.65	62.07	2.01	4.24	11.02	0.61	0.02	0.05	100
Rural	0.62	11.42	68.15	2.22	4.70	12.21	0.67	0.02	0.00	100
Urban	79.64	13.84	5.97	0.03	0.03	0.00	0.00	0.00	0.50	100

On-site Sanitation

It is estimated that about 94% of the population have access to on-site sanitation facilities implying that 6% have no toilet facility. About 90% of the population use traditional pit latrines whereas 0.4% use flush toilets with soakage pits. The

percentage distribution of households by location and type of toilet facility is indicated in Table 28.

Table 28: Percentage distribution of on-site sanitation facilities in Kilwa District

	Flush toilet	Traditional pit latrine	Ventilated pit latrine	Others	No facility	Total
Total	0.41	90.20	0.34	2.86	6.19	100
Rural	0.02	90.01	0.22	3.13	6.62	100
Urban	4.03	91.96	1.51	0.31	2.18	100

Sewerage Networks

There is no piped sewerage system.

Stormwater Drainage
There is no constructed storm water drainage system

Sludge Management

The generated sludge is dealt with in different ways as follows:

iii) Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

iv) Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

Most of the Kilwa District is well drained sedimentary sandstone of low fertility and with low-moisture holding capacity. Three of the four main rivers of the Lindi region, neamly the Metandu, Mbwemkuru and Maniji Rivers, eastwards run through the district into the Indian Ocean.

3.2.9 Lindi Urban District

*Socio-economic and Demographic Conditio*ns

Lindi urban is a small town located on the coast in the south east of the country. It is a depressed area with poor communication to the rest of the country. The town is a sea port. The main economic activities include the growing, processing

and packing of cashew nuts, processing of and trading in timber, and petty trading and retailing. In 2002, Lindi urban had a population of 41,075 and a total of 10,985 private households, of these 3,391 were in rural areas and 7,593 were in urban areas. The lack of employment opportunities appears to have encouraged a steady outward migration of young people.

Water Supply Facilities

Water supplies comes from pumped springs and well fields. The water production is estimated at 1,547 m^3/d of which 86% are estimated to be lost through leakage, illegal use and excessive use. The present system serves about 63% of the population of the town. The distribution of households by location and main source of water supply are indicated in Table 29.

Table 29: Main water supply facilities in Lindi District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	47.97	19.37	23.90	3.65	2.98	0.80	0.00	0.03	1.24	100
Rural	14.07	9.97	57.18	11.27	4.84	2.60	0.00	0.03	0.00	100
Urban	63.12	23.58	9.03	0.25	2.15	0.00	0.00	0.08	1.79	100

On-site Sanitation

According to the 2002 National Census, about 97% of the population has access to on-site sanitation facilities. About 91% use traditional pit latrines whereas 3% have no toilet facility. About 5% of the population have flush toilets. The percentage distribution of households by location and type of toilet facility is indicated in Table 30.

Table 30: Percentage distribution of on-site sanitation facilities in Lindi District

	Flush toilet	Traditional pit latrine	Ventilated pit latrine	Others	No facility	Total
Total	4.79	90.54	1.23	0.00	3.44	100
Rural	0.12	92.07	0.06	0.00	7.73	100
Urban	6.86	89.86	1.75	0.00	1.53	100

Sewerage Networks

There is no sewerage system and all people depend on on-site sanitation facilities.

Stormwater Drainage

There is no constructed storm water drainage system

Sludge management

The Town Council does not have a tanker for emptying septic tanks and latrines. There is a need for a sanitation study to address the problem of human waste and wastewater disposal, and what is best way to protect the environment as well as the health of the population.

The generated sludge is dealt with in different ways as follows:

i) Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

ii) Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

The Lindi Urban District is situated on coastal low land with elevation and relief increasing a few metres above sea level along the coast.
There are four major rivers – Matandu, Mbwemkuru, Mavuji and lukuledi. These rivers run parallel to each other discharging into the Indian Ocean.

3.2.10 Mtwara Urban District

Socio-economic and Demographic Conditions

Mtwara is the southern-most coastal district in Tanzania and covers an area of 16,707 km^2 about 40 km from the border with Mozambique. According to the 2002 population census, the district has a population of 92, 156. The district has a total of 23,175 private households, of these 3,221 are rural areas and 19,954 are in rural areas. The average household size 3.9 persons/ household. Mtwara Coastline stretches from the Ruvuma River in the South to the Lindi region border, a distance of about 125 km.

The town is very extensive, with large open spaces surrounding the government offices and other institutional buildings in the centre. The peri-urban areas contain more compact communities in low cost housing, although there are modern houses in various parts of the town, often quite isolated from other buildings. The area is economically depressed, being dependent primarily on the production of cashew nuts, the price for which has been low in recent years.

Communities in Mtwara rely primarily on subsistence fishing and agriculture for their survival. The largest cash crop is cashew nuts, which are sold locally and exported. Other activities include evaporative solar slat pans, lime production, bivalve collection and limited mariculture.

Water Supply Facilities

Water supplies come from a small well-field, which is located on the south of the town and has six presently operational boreholes. Water is delivered to central collecting tank with a capacity of 400m3. The distribution network covers 87% of the population. Water production is estimated at 6,337 m^3/d out of which 48% is unaccounted for, assumed to be lost through leakage, illegal use and excessive use. The distribution of households by location and main source of water supply are indicated in Table 31.

Table 31: Main water supply sources in Mtwara Urban District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	87.21	7.43	3.68	0.86	0.71	0.01	0.06	0.02	0.02	100
Rural	47.75	30.46	15.59	0.87	4.75	0.06	0.43	0.12	0.00	100
Urban	93.58	3.71	1.76	0.86	0.06	0.00	0.00	0.00	0.02	100

Sewerage Networks

There is no piped sewerage system.

On-site Sanitation Facilities

The town is low lying and, in areas liable to flooding, surface water may be polluted by existing sanitary facilities. However, the low density of development prevents major problems arising and the limited use of flush toilets means that a sewerage system would not solve most of the existing problems.

The 2002 census revealed that about 92% of the district's population had access to traditional pit latrine facilities with about % of the population having no toilet facility. It is also indicated that 4% of the households have flush toilets (see Table 32). There are some privately operated public toilets. The Council is responsible for emptying septic tanks. At present, there is only one tanker.

Table 32: Percentage distribution of on-site sanitation facilities in Mtwara Urban District

	Flush toilet	Traditional pit latrine	VIP	Others	No facility	Total
Total	4.16	91.64	0.80	0.02	3.39	100
Rural	2.48	91.12	0.28	0.02	6.12	100
Urban	4.43	91.75	0.88	0.00	2.95	100

Stormwater drainage
There is no constructed storm water drainage system

Sludge Management

The generated sludge is dealt with in different ways as follows:

i) Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

ii) Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

The area is characterised by a narrow continental shelf extending to no more than 8 km offshore. The District landscape consists of a coastal plain with complex land for ms with soils of alluvial origin.

The major rivers include Ruvuma River and Maombi and Mbuo rivers.

3.2.11 Mafia District

*Socio-economic and Demographic Condition*s

Mafia is situated off the coast of Mainland Tanzania, approximately 120 km South of Dar es Salaam. Mafia is an island district made up of Mafia Main Island approximately 407 km^2 area of land masses and 565 km^2 area covered by water. The District has also several small islands and islets scattered to the west and south. These small islands include Chole, Juani, Jibondo and Bwejuu.

According to the 2002 Population Census, Mafia District had a total population of 40,557 and 9,913 private households, of these 7,569 households are in rural areas and 2,344 households in urban areas. The population growth is about 3.6% per annum. The population density is 64 persons per km^2. The majority of

the population are engaged in fishing, small scale agriculture and animal husbandry.

Water Supply Facilities

The current piped water supply scheme serves about 12% of the population. The distribution of households by location and main source of water supply are indicated Table 33. There are 14 shallow wells, 70 boreholes and 4 rainwater harvesting tanks for Juani, Jibondo an Bwejuu islands (Rubens and Kazimoto, 2003).

Table 33: Main water supply sources in Mafia District

	Piped water	Protected well	Unprotected well	Protected spring	Unprotected spring	River/ stream	Pond/ dam	rainwater	Water vendors	Total
Total	12.32	4.44	76.20	0.53	0.04	0.06	6.33	0.00	0.09	100
Rural	0.25	2.30	88.32	0.70	0.05	0.08	8.28	0.00	0.01	100
Urban	51.28	11.35	37.07	0.00	0.00	0.00	0.00	0.00	0.30	100

Sewerage Networks

There is no sewerage system and all people depend on on-site sanitation facilities.

On-site Sanitation

It is estimated that 60% of the district's population have access to onsite sanitation facilities whereas about 40% of the population have no toilet facility. About 58% of the population use traditional pit latrine while 1.2% use flush toilets and soakage pits. The percentage distribution of households by location and type of toilet facility is indicated in Table 34.

Table 34: Percentage distribution of on-site sanitation facilities in Mafia District

	Flush toilet	Traditional pit latrine	Ventilated pit latrine	Others	No facility	Total
Total	1.23	58.40	0.29	0.05	40.04	100
Rural	0.25	48.91	0.25	0.01	50.56	100
Urban	4.35	89.04	0.43	0.13	6.10	100

Stormwater Drainage

There is no constructed storm water drainage system

Sludge management

The generated sludge is dealt with in different ways as follows:

i) Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

ii) Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location.

Topography and Drainage

Mafia sland is a raised portion of the continental shelf, and not a coral island. The soil of Mafia is mostly sand and the terrain very flat. There is a ridge forming a backbone to the northern end but at its highest point it does not eceed 200 feet above sea level. Along this ridge, there is firm and fertile clay soil (about 60% of the island soil) where cultivation of annual crops is possible. On the eastern shores, there is some coral rock, making cultivation impossible.

3.2.12 Zanzibar – Unguja Island

Zanzibar is in the Western Indian Ocean with an area of 2,450 km^2 and is a state of the United Republic of Tanzania. The state is made of Unguja and Pemba islands. In the last census in 2002, the population of Zanzibar was 985,000 with estimated growth rate of 3.1% per annum |(NBS, 2004).

Socio-economic and Demographic Conditions

Unguja Island is approximately 85 km long and 39 km wide, with a total area of 1,660 km2. Located 40km east of Mainland Tanzania, it is the largest of the islands making the archipelago of Zanzibar. The total population of Unguja island in 622,459. About 40% of the population on the island live within the urban area around Stone Town, and approximately 35% live in coastal areas. The island has a large urban and economic centre located around Stone Town, on the west coast of the island.

In the last decade, tourism industry has grown to be a central part of the economic and social fabric of the Zanzibar. In addition, coastal villages in Unguja are highly dependent on fishing for economic and subsistence needs.

For a long time, cloves served as the main cash crop and foreign exchange earner. However, following fall of clove prices in the world market, more emphasis is now placed on tourism, aquaculture, semi-processing industries and diversification in agriculture.

Water Supply Facilities

The existing water supply of Zanzibar Municipality is served by two separate pressure complexes; one low pressure and one high pressure, respectively.The low pressure system covers reticulation from Saateni water works including that from Bububu and Mtoni springs and from Saateni to the Harbour. The high pressure system servies the rest of the town.

The estimated daily consumption for the Stone Town is in the order of 68-105 L per capita per day based on the production capacity of 13,000 – 20,000 m^3/d and a population of 200,000. Unaccounted-for-water is estimated to be around 30% of the production figure.

On-site Sanitation

About 78% of the population of Unguja is served by pit latrines whereas those using septic tanks is about 3%.There is however no easy access for trucks to empty the tanks, resulting in overflows and contamination.Currently, the sewage and stormwater drains into the sea through various outfalls (about 27 mixed outfalls in total for Stone Town and new Town). Table 33 gives indicative contribution of domestic wastewater to pollution load in Unguja Island.

Table 35: Estimated contribution of domestic wastewater to pollution load in Unguja Island

	BOD	**COD**	**SS**	**N**	**P**
People connected to sewers	*Ton/year*				
Kilimani	59	132	60	10	1.2
Stone Town	362	809	368	61	7.4
Kikwajuni	48	106	48	8	1.0
Michenzani	43	96	44	7	1.0
Population not connected to sewers	2,595	5,795	2,634	435	53
Total	**3,107**	**6,938**	**3,154**	**521**	**63.6**

Source: Mohamed *et al*, 2005

Sewerage Networks

It is estimated that Unguja island generates about 9 million m^3 of liquid waste per year. The only sewerage system in Zanzibar is in the Zanzibar Stone Town serving 19% of the population and dates back to 1920s. The rest of Zanzibar town and its suburbs are served by pit latrines (78.5%), cesspits and soakpits

(2.7%). Centralized waste water systems cover only some areas such as part of the Stone Town, Kikwajuni and Kilimani housing schemes.

Most sewers drain by gravity to various outfalls except the main sewer drain from Kikwajuni flats which has a pump station that lifts the collected sewage to the ocean outfall. The main sewer and drainage collector pipe draining sewer and stormwater from Stone Town underpasses Creek Road (the divide between Stone Town and New Town). Several drain pipes from New Town are also connected into this main collector pipe.

The existing combined system has open channel drains with occasional slab covers and closed conduit pipes buried underground. Some open drains are of formal construction with channel linings whilst others are naturally shaped channels without any lining. The closed drains mostly comprise buried concrete pipes with inspection manholes located at intermediate locations along the drainpipe.

The length of the different sewers within the existing sewerage system is shown in Table 34.

Table 36: Length of existing different sewers in Unguja Island

Type of drain	**Length (m)**
Existing Closed sewer pipe	12,690
Existing Open combined drains	4,880
Existing Closed combined drains	2,480
Total	**20,050**

Wastewater Treatment Scheme

Wastewater is discharged untreated into the nearby coastal water via the sewer network off Zanzibar town and through seepage from pit latrines and septic tanks.

Zanzibar town waters have alarming levels of coliform bacteria - several hundred-fold above the internationally accepted levels for safe bathing. Nutrient levels are also higher than normal for tropical seawaters indicating inputs from human related activities.

Stormwater Drainage

The existing stormwater drainage system mainly comprises open drain channels, with some closed drainpipes. Several storm drains also serve as sewer drains, but is almost a state of disuse through lack of maintenance. The main catchment areas of the rivers are Mpepo, Mwera and Mkele Rivers.

The existing stormwater drains comprise of 7,700 m of open storm drains and 1,960 m of closed storm drains, totaling to 9,730 m. However, the existing stormwater drainage does not meet the demand especially during rainy season.

Certain areas of drainage concern comprise of low lying basin-like areas such as Kikwajuni, Mnazi Mmoja playgrounds, Jangwani, Uwanja wa Farasi, Government Printer, Amani and Jang'ombe. These areas are prone to flooding as illustrated by flood watermarks and suitable drains depending on topographical survey need to be considered to alleviate or mitigate flooding problems.

Sludge Management

Septic tanks are desludged by Municipality tankers at the cost to the owner which is about USD 10 (Tsh 15,000) for domestic and USD 15 (Tsh 20,000) for commercial.

No standard design is used for pit latrines and their locations are not controlled. Desludging of pit latrines is done either by the Municipality or by local latrine cleaners (*'wazamia lulu'*) who perform this task by using a bucket and no health protection equipment. The cost of desluding by the Municipality of pit latrines is around USD 8 (Tsh 10,000). Also, others discharge sludge from pit latrines and septic tanks either in onsite pits dug near houses or on a mangrove stand situated a few kilometers outside the municipality.

Topography and Drainage

The Unguja island is relatively flat in the west and rises gently from the Coast towards the East. The mean coast elevation is 6.6 m above sea level, whilst to the East the Masingini ridge climbs to the highest point of 100m in elevation. The topography can be separated into three distinct landforms, which relate directly to the geology:

- The undulating and elevated precipitous and broken Miocene country rock;
- The channel country; and
- The flat coastal periphery or "coral rag" country.

The soils throughout the area of the Unguja comprise brown quartzite silty sands, with topsoil limited to 120-300 mm. The natural vegetative cover is a coarse grass and scrub.

In Unguja, there are four semi-permanent streams in the town area. All of these are located on the north eastern side of the island. These are Mto Bububu, Mto Pepo, Mto Upepo an Mkele. The flow direction is generally westerly from the Masingirini ridges, which rise to about 100m from sea level. These streams (with exception of Bububu) are seasonal and dry shortly after the rains. Importantly, they all serve as storm water drainage for the areas they pass.

3.2.13 Zanzibar – Pemba Island

Socio-economic and Demographic Conditions

Pemba Island lies north of Unguja Island and approximately 50 km east of Mainland Tanzania. The island is 67 km long and 23 km wide, with a total area of 985 km^2. In 2002, the population of Pemba was 362, 166. The population density is 324 persons/km^2 in the north and 532 in the south.

Much of the island, which is hillier and more fertile than Unguja island, is dominated by small-scale farming and cash crop activity for cloves and cashew nuts. The island's two largest towns are Chake Chake and Wete.

Fishing is one of the main activities for coastal communities on Pemba Island. Over 60% of resident's in Pemba are dependent on marine resources.

Figure 4: Map showing road network of Pemba Island

Water Supply Facilities

Waster supply sources in Pemba island includes 78 boreholes and four springs in Gawani and Bungumi in Wete and Kwapweza and Miembeni in Chackechake.

On-site Sanitation

A greater proportion of the population use pit latrines with a relatively smaller segment using septic tanks and soakage pits.

Sewerage Networks

There is very old non-functioning sewerage system built over 30 years ago in both Wete and Chake Chake towns. During rainy season, sewage overflows along the roadside accentuating public health risk. The system drains untreated sewage into the Indian Ocean.

Stormwater Drainage

Natural drains are used for draining stormwater as well as raw sewerage into the Indian Ocean. These drains are also used for dumping solid waste thus posing public health risk.

Sludge Management

The generated sludge is dealt with in different ways as follows:

i) Upon accumulation of sludge from septic tanks, owners/tenants have to pay for the service of acquiring tankers to withdraw waste/sludge from the septic tanks.

ii) Due to relatively adequate land space availability, once pit latrines are full, most of the people prefer digging new pit latrines on a different location

Topography and Drainage

Topographically, Pemba island is a single ridge and watershed with a raised east coast. It is dissected by hills and ridges and has a mantled indented wastern coastline with low-lying shore and numerous marine inlets and dense mangrove forests.

3.3 Industrial wastewater

3.3.1 Overview

Untreated municipal and industrial wastes are currently the main threats to the quality of Tanzania's coastal waters in the urban areas of Tanga, Zanzibar and Dar es Salaam (see Table 37). Other coastal areas of Tanzania outside these major cities, though largely free from domestic wastes, do suffer from run-off of agricultural wastes, including pesticides and fertilizers, via rivers and streams. Most major rivers in the country drain agricultural lands and deposit their waste loads into coastal waters.

In addition to the transport of pollutants into the coastal waters of Tanzania, rivers also carry large quantities of sediments to the coast. Though such inputs can be a result of natural events such as heavy rains in upland areas, poor agricultural practices upstream have been known to play a leading role in degradation of coastal waters due to sedimentation. High sediment levels in rivers are often linked to deforestation and soil erosion. A direct consequence of this is the smothering of corals and other organisms, as well as the reduction of aesthetic value of the water, making it less attractive for activities such as tourism and general recreation.

Table 37: A Sample of Coastal industries and their pollutants

Type of industry	Example of companies	location	Pollution
Food processing	DARBREW Ltd, Tanzania Breweries Ltd., Diaries and Flour mills	Dsm	Organic matters, detergents, suspended solids, nitrogen and phosphorus compounds and bacteria
Textile	Urafiki Textiles, Karibu Textile Mills Coastal Industrial Combined Ltd	Dsm Tanga	Organic matter, dyes
Metals	NECO, Steel cast, ALAF, Bicycle company, steel rolling mills	DSM Tanga	Solid wastes, suspended solids, zinc, chromium, iron, copper, acids and alkalis
Petroleum	Tanzania Zambia pipeline, storage tanks at ports	Lindi Tanga DSM	Sludge, petroleum hydrocarbons, oils, greases, suspended solids, degradable matter
Soap and detergents	SDL, Several factories	DSM, Tanga	Wastewater, organic matter, phosphates, suspended solids, oils and zinc
Sisal	Amboni Ltd, Kikwetu Sisal Estate, Kigombe estate	Tanga	Organic matters, wastewater, sisal organic wastes

Plastics	Amboni plastic, Simba plastics, Saafa Plastics, CENTAZA, Omar Packaging, COTEX	DSM Tanga	Solid wastes
Cement	Tanzania Portland Cement, Tanga Portland Cement	DSM Tanga	Dust and fumes
Cigarettes	Tanzania Cigarette company	DSM	Dust and fumes

3.3.2 Muheza District

There is at present very little industrial activities going on in the district apart from some small scale industries.

3.3.3 Tanga City

Following a transition period of economic reforms including privatization, the industrial base of Tanga is in a gradual recovery in terms of increasing production trends, increase in net production and increase in types and number of industries. Major industrial establishments in Tanga Municipality are presented in Table 38.

Table 38: A list of major manufacturing industrial establishments in Tanga City

Industrial classification	Industry	Product(s)
Cement, lime and quarrying	Tanga Cement Company Ltd.	Cement
	Shell Craft	silica
	Simba Lime Factory	Lime
	Athi River Manufacturing (T) Ltd	Factory lime products
Food and beverages	Sea Products Ltd	Fish processing
	Sabuni Detergents Ltd (SDL)	Detergents and toothpaste
	Tanga Fresh Ltd	Diary products
	Pembe Flour Mills	Wheat flour
	International Food Packers Ltd	tea and spice packers
	Anjari Soda Factory	Soft drinks
Textile	Majestic Theatres (T) Ltd	Blankets
	AFRITEX Ltd	Textiles
	Kilimanjaro Blankets Corporation Ltd	blankets
	Amboni spinning	sisal ropes and twine
Cosmetics	Mamujee Products Ltd	Cosmetics
Oil and soap	Tip Soap Industries Ltd	Laundry soap
Wood Products	Sikh Saw Mills (MASCO)	Wood products
	Burhani Saw Mills	Wood products
	Sandali Wood Industries	Wood products

	Pallet Manufacturers Ltd	Wooden pallets
Plastics	Essri Enterprises	Plastic bags
	Bajaber Packaging Ltd	Poly bags
	PEE PEE (T) LTD (PPTL)	Plastic/polyethylene bags
	Tanga Pharmaceuticals and Plastics Ltd	Water bottling
Iron and Steel	Unique Steel Rolling Mills	Nails

Most industries are situated in specially designed industrial areas which include Gofu, Duga and SIDO industrial estates. It is estimated that the industrial area covers about 10% of total Tanga urban land area. There are mainly four (4) industries in the Gofu industrial area which discharge significant amount of wastewater from their processes, these are AFRITEX, TIP SOAP, AHA and Fish processing located in SIDO estate. Duga area covers an area of about 40 km^2. Industrial activities in this area is mainly garages and woodworks.

Most of the industries discharge untreated or partially treated wastewater into storm water drains and streams which lead the effluent into the ocean. Bombo hospital discharges its untreated wastewater directly to the ocean. Wastes from the slaughterhouse were reported to be similarly discharged. In 1999, the total pollution load to sea contributed by industries in Tanga was estimated to be in excess of 2.2 tonnes/year (BOD) and 4.2 tonnes/year for suspended solids. (UNEP, 1999).

The industries in the Gofu area that discharge their effluent into a channel that leads to the ocean include Sabuni Detergents Ltd (SDL), Tip Soap Industry, Sea Products Ltd and AFRITEX Ltd. A brief description of each of the industry is presented in Table 39.

Table 39: Brief description of major industrial establishments discharging untreated or partially treated wastewater in Tanga municipality

Industry	Products	Production capacity	Water consumption	Amount of wastewater	Wastewater treatment and its Quality
1. Sabuni Detergents Ltd (SDL) - 1966	Detergent powder Laundry bar soap liquid detergent scouring powder; and toothpaste	• Detergent powder: 3 t/h • Bar soap: 2.5 t/h • Liquid detergent: 125 L/h • Toothpaste: NA	• Production process: 25,000 L/d • Domestic activities: 2,000 L/d • Total: 27,000 L/d	• 1,500 L/d • Flow rate: 28.8 m^3/d	Wastewater from production process passes through a skimming tank for oil removal before it is discharged into a stormwater drain pH: 8.69; TDS: 686mg/L; TKN: 23.1; BOD_5: 90mg/L; COD: 407.4 mg/L; Total P: 10.36 mg/L (BICO, 2006)
2. Tip Soap Industries Ltd	• Bar soap *'Mbuni'* • Laundry soap *'Gardenia'*	20 tonnes/day of soap	• Production process: 20-21 m^3/day • Domestic purposes: 2.5 m^3/d • Total: 22.5-23.5 m^3/d	• Water used for production is recycled • Amount of water recycled: 10,000 L/h	Domestic wastewater is discharged into a septic tank
3. Sea Products Ltd - 1994	Processed frozen fish: *octopus (pweza), lobsters (kambakochi), cuttlefish (dome), squids (ngisi), crabs (kaa), slipper lobsters (kambamti), finfish and prawn*.		• Production process: 19,000 L/d • Domestic purposes: 1,000 L/d • Total: 20,000 L/d	14,000 L/day	Wastewater is screened and then flows to treatment tanks where anaerobic treatment takes place. The treatment scheme is not functioning properly resulting into a foul smell pH: 6.93; TDS: 1,511mg/L; TKN: 43.9mg/L; BOD_5: 250mg/L COD: 504mg/L; Total-P: 4.52mg/L (BICO, 2006)
4. AFRITEX Ltd	textiles		275,350 m^3/d	0.043m^3/s (154.8 m^3/h)	Wastewater is discharged into a stormwater drain without any pretreatment pH: 9.69; TDS: 739mg/L; TKN: 38.6mg/L; BOD_5: 58.6mg/L; COD: 1,590mg/L; Total-P: 0.44mg/L (BICO, 2006)

Rapid assessment of industries in Tanga city established that about 67% of the large industries contribute to water pollution. The Tanga region has major waterways, such as the Pangani, Soni, Mkulumuzi, Mnyuzi and Vuga rivers. Most of the rural sisal estates discharge industrial effluents into these rivers. The direct discharge of untreated industrial effluents through rivers is of socio-economic and health concern. The sludge from the septic tanks as well as 60% of the pit latrines are assumed to be de-sludged and emptied into the Indian Ocean either directly or indirectly

3.3.4 Pangani District

There are two sisal estates at Mwera and Bago. Both have decortication plants and therefore generate effluent that are discharged into Ushongo river and finally into the sea. There has been reports of fish kills along beach areas that are suspected to be caused by the effluents from the sisal decortication plants.

3.3.5 Bagamoyo District

There is at present very little industrial activities going on in the district apart from some small scale industries.

3.3.6 Dar es Salaam City

It is estimated that waste output from the paint and plastics, pharmaceuticals, chemical, metal and petroleum industries comprises some 850 tonnes of solid waste, and more than 2,900 tonnes of sludges annually (DAWASA, 2002). Although a high proportion of solid waste generated by these industries is either recycled or transported to the disposal site at Vingunguti, the disposal route for sludges is not identified. The processes undertaken in the above industrial sectors are associated with the generation of a range of pollutants including chromium, copper, cadmium, lead and zinc compounds, hydrocarbons, and halogenated solvents. A significant proportion of these sludges and/or wastewater are either disposed of through the existing sewerage network, directly to stabilisation ponds, or through discharge to surface water bodies.

The Industrial development that has taken place in Dar es Salaam is mainly light industries manufacturing a variety of goods for both domestic as well as export markets. Majority of the industrial establishments (64%) are located in Temeke Municipality, 29% are in Kinondoni Municipality and 7% in Ilala. In terms of ownership, 64% are privately owned, 19% public owned and 14% are joint ventures.

The type of industries located in Dar es Salaam City include: textiles, breweries, distilleries, beverages, bags, cigarettes, cement, paints, pharmaceuticals, plastic, metal products, steel, grain milling, chemicals, timber and wood products, confectionery, food products, petroleum products, edible oil, dairy products, domestic utensils, tea blenders, batteries, radiators, body building, printing and publishing, paper products, garments, electricity generation and glass (see Table 40).

Most industries in Dar es Salaam discharge untreated or partially treated wastewater into neighbouring surface water bodies such as rivers and ocean (see Table 41). In 1999, the total pollution load to sea contributed by industries in Dar es Salaam was estimated to be in excess of 2,700 tonnes/year (BOD) and 15,500 tonnes/year for suspended solids. Nutrients load from industries in Dar es Salaam was estimated at 10,000 tonnes/year of Nitrates and 8,000 tonnes of phosphates per annum (UNEP, 1999).

Table 40: A list of major industrial establishments located in Dar es Salaam and their associated pollutants

Category	Company / Location	Products	Pollutants generated and waste management
1. Textile Manufacturing	Urafiki Textile Mills	Khanga, kitenge, bedsheets, linen, drill, khaki	• Highly coloured and alkaline effluents (dyes, bleaching agents, alkalis, and organic matter) • Discharge their untreated effluents into rivers and eventually into the Indian Ocean
	Karibu Textile Mills (KTM)	Khanga, kitenge, bedsheets, linen, drill, khaki	
	Blanket Manufacturing Ltd	Blankets	
	Nida Textile Mills (T) Ltd	Khanga, kitenge, bedsheets, linen, drill, khaki	
2. Beverages	Tanzania Breweries Ltd (TBL)	Beer	• Organic compounds, suspended solids, Nitrogen, Phosphorus compounds and bacteria • Untreated effluents are released directly to river or through waste stabilization ponds
	Serengeti Breweries	Beer	
	Coca Cola Kwanza	Soft drinks	
	SBC (T) Ltd (Pepsi Cola)	Soft drinks	
	DARBREW	Kibuku drink	
	Bakharesa Food Products	Food products	
	Royal Diary Products	Diaries	
	Tropical Food Processing	Mineral water, fruit juice and others	
3. Cigarette	Tanzania Cigarette Company (TCC)	Cigarette	• Organic matter, dust and fumes
4. Cement	Tanzania Portland Cement Co. ltd (TPCC)	Cement	• Dust and noise • Land degradation from quarrying activities
5. Pharmaceuticals and Hospitals	Keko Pharmaceuticals	Pharmaceutical products	• Chemical contaminated effluents • Have effluent treatment plants
	Ely's Chemicals	Pharmaceutical products	
	Mansoor Daya Chemicals	Pharmaceutical products	
6. Hospitals	Muhimbili National Hospital	health services	• Hazardous/Infectious Clinical waste • Have no waste treatment
	Bombo Regional Hospital	health services	

Category	Company / Location	Products	Pollutants generated and waste management
			plants, combine with general municipal wastes
7. Plastic Manufacture	Simba Plastics Ltd	Plastic pipes, fittings and containers,	• Solid waste • Air emissions • Limited effluents • Lack corporate consciousness in establishing plastic recycling schemes that would help avoid related environmental pollution by plastic materials (such as littering, blockage of sewage and stormwater systems)
	COTEX Industries	Plastic chairs, containers, pipes and packaging	
	Saafa Plastics Ltd	Plastic bags, containers and packaging	
	CENTAZA Plastics Ltd	Plastic containers and packaging	
	Industrial Packaging Ltd (IPL)	Plastic packaging	
8. Garages, car washing, workshops, metallic and electroplating industries	TAZARA Workshop	Engineering works	• Suspended solids, petroleum hydrocarbons, oils, greases, phenols, acids, alkalis, chromium, sulphur, zinc, manganese, lead, mercury and others • Lack waste treatment facilities, untreated effluents are discharged directly into water bodies
	Jangwani truck terminal	Cargo transport services	
	Ubungo Bus terminal	Travel services	
	YUASA Batteries Ltd	Batteries	
	Matsushita Electrical Co. Ltd	Dry cell Batteries, radios	
9. Paint industries	Begger Paints (T) Ltd	Paints	• Solid waste is sent to dump sites while liquid waste is mostly discharged into septic tanks
	Gold Start Paints	Paints	
	Noble Chemical & Packaging	Metal containers, paints	
	Sadolin Paint (T) Ltd	Paints	
	Rajifa Enterprises	Automotive paints	
10. Oil and Soap industries	Murzah Oil & Soap Mill	Soap and edible oil	• Suspended solids and colloidal matters. Oil emulsion, organic matter, unpleasant smell and high temperature waters • Partially or totally untreated effluent is discharged directly into water bodies
	Trans Tech	Vegetable edible oil and soap/detergents	
	TRADECO Oil Industries	Edible oil	
	Coastal Oil Industry	Edible oil	
	BIDCO Oil & Soap Industries Ltd	Soap and edible oil	
	Mpishi Food Products	Edible oil	
11. Solid waste dump sites	Vingunguti old solid waste dump site (along Msimbazi River)	Crude Solid waste disposal	• Leachate not contained and contaminated surface runoff goes directly into
	Tabata old dump solid	Crude Solid waste	

Category	Company / Location	Products	Pollutants generated and waste management
	waste site (along Msimbazi River)	disposal	water bodies
	Mtoni old solid waste dump site (adjacent to the Indian Ocean)	Crude Solid waste disposal	
12. Waste Stabilization Ponds	Vingunguti WSP	Wastewater treatment including domestic and industrial wastewater	• Partially or totally untreated mixed (domestic and industrial) wastewater is discharged directly into water bodies
	Mabibo WSP		
	Buguruni WSP		
	Keko WSP		
	Kurasini WSP		
	Msasani WSP		
	Lugalo WSP		
	University of Dar es Salaam WSP		
	Ukonga (Air Wing) WSP		
13. Abattoirs and slaughter house	Vingunguti abattoir	Meat	• Effluent containing blood, manure, fats, nutrients (e.g. nitrogen and phosphorus) • Untreated effluent is discharged directly into Msimbazi River
	Kimara slaughter house	Meat	
14. Urban farms	Sukita complex	Vegetables, livestock	• Manure/fertilizer, pesticide, fungicides and insecticides • Runoff leads to pollution of adjacent water bodies
	Individual gardening (along river basins)	Vegetables, maize, rice	

Table 41: Brief description of major industrial establishments discharging untreated or partially treated wastewater in Dar es Salaam City

Industry	Products	Production capacity	Water consumption	Amount of wastewater	Wastewater treatment and its Quality
1. Karibu Textile Mills (KTM) – 1998	Khanga kitenge Bedsheets Linen Drill khaki	18-20 million running metres per annum	Production process: 3,000 m^3/d	2,400 m^3/day	Wastewater is discharged directly into Kizinga river BOD_5: 636 mg/L; Mercury: 0.04 ppm (NEMC, 2001)
2. Tanzania China Friendship Textile Co. Ltd (Urafiki) - 1966	Khanga kitenge Bedsheets Linen Drill khaki	• Installed Capacity: 30 million running metres per annum • Production capacity: 12-15 million running metres per annum	Approx. 25 million L/month	20 million L/ month	Wastewater is discharged directly into Mabibo waste stabilization ponds BOD_5: 540mg/L; Mercury: 0.165 ppm (NEMC, 2001)
3. Tanzania Breweries Ltd (TBL)	Assorted beer products		Approx 2,500 m^3/day	2,000 m^3/day	Wastewater is discharged directly into a stormwater channel that leads into Msimbazi river pH: 11.76; TSS: 160 mg/L; TDS: 5,170 mg/L; BOD_5: 240 mg/L; TKN: 86mg/L; TP: 0.92mg/L; Sulphate: 180mg/L; Sodium: 1,216 mg/L (NEMC, 2001)
4. BIDCO Oil & Soap Industry -	Cooking oil Bar soap	• 500 tonnes per day of cooking oil • 250 tonnes per day of bar soap	720 m^3/day	430 m^3/day	Wastewater is discharged untreated directly into Nyirenda River through a closed channel leading into the Indian Ocean
5. Sabuni Detergents	Detergents Toilet soap	• The detergent installed capacity is 2 tons/hour			

Industry	Products	Production capacity	Water consumption	Amount of wastewater	Wastewater treatment and its Quality
Ltd (SDL)		• Production capacity for detergents is 800 – 1000 kg/hour. • The installed capacity for toilet soap is 1 ton/hour • Production capacity for toilet soap is only 50% of the installed capacity due to aging machinery and equipment.			
6. TANPACK Factory	Toilet tissues and MG papers	• Toilet tissues: Installed capacity is 8 tonnes/day while the actual production is 7tonnes/day • MG papers: installed capacity is 9 tonnes per day while the actual production is 8 tonnes/day	180 m^3/day	170 m^3/day	The industry discharges raw wastewater containing dyes to the Nyirenda River, through a closed conduit, leading into the Indian Ocean BOD5: 201 mg/L; COD: 3,328mg/L; pH: 7.56 (Kayombo, 2006)

3.3.7 Mkuranga District

There is at present very little industrial activities going on in the district apart from some small scale industries.

3.3.8 Rufiji District

In the absence of reliable electricity, this has partly discouraged industrial development in the District. There are 6 timber factories, of which 2 are located at Utete and 4 located at Ikwiriri ward. There is also fishing processing factory at Nyamisati.

3.3.9 Kilwa District

There is at present very little industrial activities going on in the district apart from some small scale industries.

3.3.10 Lindi Urban Disrict

There is at present very little industrial activities going on in the district apart from some small scale industries.

3.3.11 Mtwara District

There is at present very little industrial activities going on in the district apart from some small scale industries. The one time operating industries all being agro-based industries are faced with enormous operating problems. These are the five cashew nut processing and two sisal processing industries. The cashew nut industries were established in the late 1970's but hardly any one performed as expected mainly because of capital liquidity. These cashew nut industries are in the process of being privatised. However, the sisal processing plants are operating though at below capacities. The low price of sisal fibre in the world market is the main reason behind poor performance of the sisal industry in general.

3.3.12 Mafia District

Mafia is highly pronounced for supplying variety of species of fish at the Dar es Salaam fish market. These include finfish, octopus, prawns and lobster to mention a few. An average of 11,000 tones of various species of fish is obtained annually. Of this amount, 75% is sold outside of Mafia District including Tanga, Dares Salaam, Mtwara and Lindi.

About 739 tones of fish are processed and exported by 3 fish processing industries namely, TANSPECA, SHAMEZ and PRIME OCEAN. TANSPECA was established in 2002 processing about 120-190 tonnes/month of frozen shrimps,nile perch and other marine products. The industry discharges about 25,000 – 30,000 L/d of untreated wastewater directly into the ocean.

3.3.13 Zanzibar - Unguja Island

In Unguja Island, most industrial production units are located at Saateni, Maruhubi and Mtoni areas. Given the low industrial development in Zanzibar, industrial contribution to overall pollution in the country is still minimal. Main pollution is of organic nature originating from industries such as soap making, bakeries, milk processing, soft drinks, flour milling, fish processing and edible oil production. These contribute organic matter, biochemical oxygen demand, suspended solids, phosphorus and nitrogen to the total pollution load. Vehicle repair workshops contribute oils, grease and heavy metals. Table 43 presents indicative pollution loads from major industrial establishments operating in Unguja Island.

Discharge of industrial effluents to the coastal waters for example from fertilizer factories leads to excess nutrient loading which can results into the proliferation of macroalgae which once they die results into an anoxic environment. Table 44 presents a summary description of major industrial establishments discharging untreated or partially treated wastewater in Zanzibar Municipality.

Table 42: Contribution of industrial waste (kg/yr) to pollution load in Unguja Island

Industry	BOD	SS	Oil	N	P
	kg/yr				
Slaughter houses	13,512	12,611.2	4,729.2	1,576.4	112.6
Milk processing	7,633.06	2,160.3	-	446.46	97.93
Butter production	252.32	345.28	-	14.82	3.19
Coconut oil production	44.32	43.79	50.02		
Soap manufacturing	3,256	814	18.45		
Production of soft drinks	303	101.01			

Source: Mohamed *et al*, 2005

Table 43: Brief description of major industrial establishments discharging untreated or partially treated wastewater in Zanzibar Municipality

Industry	Products	Production capacity	Water consumption	Amount of wastewater	Wastewater treatment and its Quality
1. Zanzibar Soft Drink Factory – 1977	Soft drink	8,600 L per day of soft drinks	20 m^3/day	13 m^3/day	Wastewater is lead into soakage pits before being disposed of through a sea outfall The present wastewater treatment is inadequate as most of the organic and inorganic matter is lead to the ocean without any treatment.
2. Diary Factory - 1978	Fresh and sour Milk and yoghurt	• 6,000 L/day of fresh and sour milk and variety of diary products	10,000 L/day	6,000 L/day	Typically wastewater contains milk, milk fractions, fats, proteins, casein, fermentation products including lactic acid and sugar and alkaline washing agents. The BOD of the effluent is between 1,000 and 2,000 mg/L The wastewater is treated through soakway pit and lead to a non-functional septic tank (due to deficiency in design). The septic tank has one chamber with no facilities for scam and/or sludge removal. The standard partition wall is missing and the inlet/outlet pipes are badly installed. Eventually the wastewater is discharged directly into the Indian Ocean.
3. Government Central Workshop - 1984	Repairing government and private vehicles		2,500 L/d	2,000 L/d	The wastewater contains oils, greases and acids. Most of the used oil is given to individuals for other purposes and the little which is spilled is drained away into stormwater channel. The current treatment arrangement is

Industry	Products	Production capacity	Water consumption	Amount of wastewater	Wastewater treatment and its Quality
					inadequate, an oil separator should be installed to recover some of the spilt oil. Also a septic tank/soak pit treatment scheme should be installed.
4. Mbweni Tractor Factory - 1966	Repairs state owned tractors		The Factory has its own water supply from a nearby borehole	2,000 L/day	The wastewater contains oils, greases and acids. Most of the used oil is given to individuals for other purposes and the little which is spilled is drained away into stormwater channel. The current treatment arrangement is inadequate, an oil separator should be installed to recover some of the spilt oil. Also a septic tank/soak pit treatment scheme should be installed.

3.3.14 Zanzibar - Pemba Island

There is at present very little industrial activities going on in the island apart from the Clove Oil Distillery and small scale industries.

3.4 Conclusions

The results of this study shows that 7 coastal towns/districts in Tanzania out of 19 have a sewerage system that collects wastewater from the central area of the towns. The sewerage schemes are generally limited to the central business district. There is little doubt that there is a significant potential for increasing the number of connections for those coastal towns with sewerage systems, and that the trunk sewers and treatment facilities have the capability of carrying the additional load.

Except in Tanga, Zanzibar and part of Dar es Salaam City, which discharge untreated wastewater to the sea, all municipal wastewater is treated in wastewater stabilization ponds. Wastewater treatment does not always meet the prescribed standards despite the fact that the treatment plants are not fully loaded. The effectiveness of the treatment is variable. Most treatment works are operating well under their original design capacity, so there is a need to review the reasons for failing to provide an effluent that meets to the Tanzanian standards and take appropriate action.

Nearly all sewer networks are simple gravity systems and there is minimal mechanical equipment at any of the treatment plants. Therefore, the schemes have low operating costs and few maintenance requirements, except for the need to remove blockages in the sewer networks.

It does not appear that most existing sewerage schemes have been designed as part of the overall sanitation plan for the towns. Therefore, the immediate requirement with an existing system appears to identify where the demand for connections is greatest and focus on constructing more lateral sewers to maximize the number of new customers. A sanitation study is recommended for all coastal towns where there has not been such a study. This should assess the total cost of providing sewerage and identify areas where the provision of sewers may have economic benefits.

Sewer networks often do not extend to industrial areas to collect industrial wastewater. The collection of wastewater from industrial premises needs careful consideration. Where sewerage services are provided, it is expected that they will be limited to the central parts of the town, whereas major industries are often on the outskirts of the town and extending the public sewerage system is likely to require substantial investment. Therefore, major industries that are outside the central area covered by the sewer network should generally be expected to treat and dispose of their wastewater in accordance with Tanzanian standards. For industrial estates, separate wastewater collection and disposal systems may be provided that are independent of any municipal system. Industries should be liable for any costs incurred by the Municipal/City

Councils where industrial effluents that do not comply with the standards damage the sewers or the treatment process.

There is no regular monitoring of quality of the receiving water bodies thus the trend is not known.

4.0 ASSESSMENT OF MWW MANAGEMENT PRACTICES AND METHODS

4.1 Overview of Existing MWW Management Practices and Methods

Political commitment and financing

The MWW development and management in urban coastal areas of Tanzania have not been accorded due priority. It is lagging behind water supply development. Investment in water supply and sanitation, either for rehabilitation or expansion, has been very low and totally inadequate in improving the levels of service and coverage of these services to the population.

At present, all Authorities are essentially operating units, with capital investments made largely by the Ministry of Water or Development Partners. Historically, investment has not been prioritized or targeted on the basis of a rational plan, but has been reactive to the availability of finance, principally from development partners, or to an ad hoc decision-making process. Furthermore, the cost-benefits of alternative technologies to increase coverage have not been given due consideration. In the provision of MWW services, peri-urban and rural areas have been neglected in favour of larger urban centres where the scale of economic activities is relatively higher.

Despite the significant investments made in the sector during 1970s and 1980s, sector development generally remains inadequate. Factors which have contributed to this unsatisfactory situation were the absence of a holistic and integrated approach to the planning and financing of investments in the sector. Financing has been provided through multiple approaches used by financiers (by both Government and Development Partners). Earlier experiences in trying to attract international investment in Tanzania water sector have not been encouraging. It is anticipated that until there is a significant change in attitude of the private sector to investing in the water sector. Central Government will continue to be the main source or channel for investment funds.

Institutional capacity
Most of the UWSAs have little experience in planning and implementation of major projects and lack many skills needed to take responsibility for their own development. The present staffing situation in most UWSAs is characterized by vacant post, acting appointments, shortage of key skills and experience particularly in the commercial and financials areas, surplus workers, underemployment, differing conditions of employment (Ministry of Water and Livestock, 2005).

Few UWSAs are generating significant funds to replace worn-out equipment and most depend on foreign funded projects or grants from the Ministry of Water for refurbishment of pumping stations and sewerage treatment plants. In addition, many of the water supply and sewerage systems suffer from poor quality materials and workmanship, which necessitates much earlier replacement than would normally be expected.

Many authorities do not have readily accessible good quality information on their water and sewerage systems. For instance, none of the authorities has a model of its water or sewerage network.

Planning approach

It is widely accepted that the provision of sanitation facilities is linked to the provision of water – where water is readily available the range of sanitation options is wide; where water is not available or not affordable the range of sanitation options is limited. About 70% of disease treated in health units in the country are reported to be water, sanitation and hygiene related. Lack of access to safe water, and the related sanitation service provision and hygiene education, is one of the causes of poverty.

In the past, water supply and sanitation schemes have been developed with more consideration being given to water supply services, while sanitation and hygiene is being given little attention.

The planning processes for water supply and water water/sanitation services are highly characterized by top-down planning and are fragmented. The lack of a holistic and integrated approach in planning for the whole sector (Sector Wide Approach to Planning), that is agreed by stakeholders, including Development Partners, has led to:

- Fragmented results that are difficult even to monitor for implementation impacts;
- Water supply/wastewater infrastructure is constructed without adequate consideration of the ultimate uses and economic benefits;
- A persistence of regional, district and even intra-urban inequalities regarding water supply/sewerage/sanitation services, and the lack of a priority basis for financial allocations.

Physical planning

The outcome of the high population growth in major urban areas is a proliferation of unplanned and un-serviced areas. Under these circumstances the sanitation situation in urban areas get worsened particularly in congested unplanned settlements. The pit latrines and septic tanks become too numerous to manage, apart from the question whether they follow good guidelines for operation and maintenance of these systems. Consequently they pose an increasing environmental pollution problem.

Historically, the Water supply and MWW services technology chosen in any particular situation has not always taken appropriateness, affordability and sustainability as the main criteria. For example, the introduction of sewerage systems is not going to be sustainable where the water supply to the properties serviced is insufficient to ensure the transport mechanism for the wastes.

The lack of attention to selecting the most appropriate technology in providing water supply and sanitation services has led to:

- higher capital and operation and maintenance costs;

- higher charges to consumers;
- limited sustainability; and
- lack of consumer or community acceptability.

There has been limited dissemination of appropriate low cost sanitation technologies such as *ecosan* toilets in some parts of Dar es Salaam and Tanga along the coastline.

Involvement and participation of key stakeholders .

Historically, the provision of water services in rural areas has been led by the central government, in many cases with the support of Development Partners. Beneficiary communities have only become involved at the point at which these schemes have become operational, and have been expected to play a major role in maintaining the schemes and collecting the revenues necessary to meet operations and maintenance costs. The lack of involvement of communities in decisions in the design and construction of the schemes, combined with a lack of awareness raising of the communities' responsibilities has led to may schemes failing to be maintained at the level necessary to sustain even basic service levels.

In recent years, various forms of community involvement and responsibility for rural water supply have been implemented, such as community owned companies, trusts, and user associations, which have led to increased sustainability. Intensifying community involvement in rural water supply will increase the sustainability of investment. The provision of rural water supply/sewerage schemes without the active participation and support of the beneficiary communities has led to:

- ineffective awareness raising of the communities' role as beneficiaries;
- lack of acceptance by the communities of their responsibilities for the sustainability of the rural water supply schemes;
- use of inappropriate technologies, locations of service points, and levels of service;
- failure of communities to appreciate the need to pay for water supply/sewerage services;
- lack of maintenance of facilities by communities; and
- poor state of facilities.

4.2 Assessment of Existing Constraints in MWW Management Practices and Methods.

Some of the major constraints with regard to MWW management practices in the country include the following:

a) Low priority accorded to sanitation and hygiene improvement

The on-going Local Government Reforms devolves the responsibilities of provision and facilitation of water and sanitation services to the LGAs. The reforms empower the

communities through their LGAs to prioritise areas of interventions, plan and implement their sanitation and hygiene promotion activities. However, in reality this devolution of responsibility and authority has been progressing at a low pace, therefore, LGAs have yet to sufficiently assume their assigned roles. In addition, where resources have been available a greater proportion is usually spent on constructing water infrastructure and not enough on promotion, planning and support of sanitation initiatives. Furthermore, there is low awareness among policy and decision makers and/or politicians at all levels on the significance and the relationship between water supply and sanitation.

The low priority accorded to sanitation and hygiene improvement in rural and urban areas and the failure to provide pre-defined minimum sanitation standards has led to:

- Continuous existence of nuisance and unsightliness in the environment, which can lead to contamination of water sources, damage of aquatic life, spread of communicable diseases, including cholera outbreaks, breeding of vectors and other health and environmental hazards; and

- Existence of dental malformation, stained enamel, skeletal fluorosis and, in some cases, crippling fluorosis.

b) Fragmented planning

Sanitation and hygiene sub-sector in the country has over the years suffered from weak coordination amongst the actors leading to poor sharing of available information and unclear sanitation implementation guidelines at the level of LGAs; and duplication of work and hence wasteful of the scarce resources available. It is until recently when working committees and/or teams at central and local government levels to coordinate sanitation and hygiene activities have been established. In addition, poor physical planning due to rapid rate of urbanization in relation to the capacity of LGAs has led to mushrooming of squatter areas whose accessibility is difficulty and therefore hindering provision of water and sanitation services.

Fragmented planning without adequate consideration of cross-sectoral water management issues and challenges has led to:

- The perception of alienation of smaller but widespread users of water that they are primary losers in basin management efforts, and water resources planning is urban biased and fosters rural inequity;
- In the Pangani and Rufiji Basins, this perception stems from the fact that the production of hydroelectric power is located downstream of major irrigated areas and that water for hydropower production is subtractable from upstream water uses in irrigation fields; and
- Threats to the integrity of the environment, ecosystems and biodiversity.

c) Inadequate investment and financial resources

Generally speaking, sanitation and hygiene promotion are not among the priority areas as they usually receive little attention in funding as compared to Malaria, HIV/AIDS and immunisation despite of high rate of diarrhoeal diseases and cholera outbreaks occurring in different parts of Tanzania (Binamungu, 2007). The largest funding for sanitation and hygiene is currently available through the MoW - which prioritizes water supply actions over sanitation and hygiene promotion.

The inability of the Authorities responsible for water supply and sanitation systems to adequately plan and satisfy their investment requirements has led to:

- failure to deliver satisfactory levels of service;
- failure to increase coverage of water supply and sanitation services;
- failure to expand water and sanitation services, particularly into peri-urban and rural areas;
- a lack of confidence amongst consumers and an unwillingness to pay for services; and
- an inequitable distribution of available capital investment between sub-sectors and geographical locations;
- insufficient attention being paid to the need for investment in water resources management;
- the use of inappropriate technologies; and
- over reliance on external support.

d) Low tariff levels

In general, tariffs for water supply and sanitation services are low as the provision of these services was seen in the past as a social service. Setting of tariffs, and the tariff structure involved, is done without considering:

- the real cost of providing the services;
- the need to improve efficiency levels, particularly in revenue collection and expenditure control;
- the need to provide affordable minimum levels of service to the poor and disadvantaged groups;
- the use of internal cross-subsidisation and external subsidisation; and
- control and regulation of tariff levels to ensure value for money for consumers.

e) Inadequate skilled human resource base

The water supply and sanitation services sector has problems associated with human resources in terms of availability and capability of employees. One of the root causes of the present situation is the way in which workers have been appointed to the UWSAs. When the majority of the UWSAs were formed in1998, those Government employees directly in the administration and provision of urban water

supplies at the time were seconded to the new Authorities. This secondment was intended to be a transitional arrangement, however, the transfer of workers did not happen as quickly as hoped and, even today, many employees are still employed by Central Government and are effectively on secondment to the authorities. Although some of the UWSAs have re-skilled some of the inherited technical staff through training, the Authorities still do not have the manpower required to operate commercially.

f) Environmental degradation and pollution of water sources

Inadequate water quality management and pollution control practices, and weak enforcement due to weak institutional capacity, has led to deterioration of the quality of water resources and limited their use, or made treatment costly. Environmental degradation and pollution of water sources from increasing human activities has led to:

- increased scarcity and vulnerability of water resources; and
- deterioration of the integrity of ecosystems, which perform valuable services to society, including moderating floods and droughts, purifying water and sustaining fisheries and other aquatic resources.

g) Lack of an effective institutional framework

overlapping roles and responsibilities between various institutions has ledi to inefficient use of human and financial resources, duplication of effort, and gaps in effective provision of services. It has also led to;

- inadequate co-ordination between various government institutions;
- inadequate communication and awareness building between these institutions and local organizations and water users; and
- responsibility for regulation and performance monitoring of the provision of water supply and sanitation services is being vested in the same organization that is also responsible for service delivery and investment financing, thus creating a potential conflict of interest.

h) Inadequate availability of effective sewerage and sanitation systems

Most of the existing sewerage schemes have inadequate coverage of the population and are aged, with some of them being built over 50 years ago. This has implication on their operation and maintenance as it is often more expensive to continue maintaining aging sewerage systems. The inadequate availability of effective sewerage and sanitation systems has led to:

- increased risk of waterborne diseases;
- uncontrolled dumping of sewage and sanitation sludges; and
- environmental degradation.

i) Limited participation of beneficiaries and other stakeholders

The provision of water supply and sanitation schemes without the active participation and support of the beneficiary communities has led to:

- ineffective awareness raising of the communities' role as beneficiaries;
- lack of acceptance by the communities of their responsibilities for the sustainability of the rural water supply schemes;
- use of inappropriate technologies, locations of service points, and levels of service;
- failure of communities to appreciate the need to pay for water;
- lack of maintenance of facilities by communities; and
- poor state of facilities.

In addition, failure to involve the private sector in water supply and sanitation service delivery has led to a number of problems:

- little local experience of the private sector in water supply and sanitation services;
- financial resources for developing the local private sector are not readily available;
- many of the schemes are likely to be too small to attract international private sector participation;
- many water schemes have not been functioning properly and will require rehabilitation before becoming commercially viable; and
- water as an essential commodity was previously termed as a free service because the public sector has assumed all roles and responsibilities.

j) Lack of attention given to the selection of the most appropriate technology

The lack of attention to selecting the most appropriate technology in providing water supply and sanitation services has led to:

- higher capital and operation and maintenance costs;
- higher charges to consumers;
- limited sustainability; and
- lack of consumer or community acceptability.

k) Low public awareness

The previous and current communications and advocacy instruments were weak and did not facilitate imparting of information from the national level down through all levels to the community, and vice versa.

4.3 Recommendations for Improved MWW Management Practices

On the basis of the review of the status of municipal wastewater management in coastal areas of Tanzania, including the constraints faced, the following recommendations are put forward.

1. Investment in rehabilitation and expansion of water supply and sanitation infrastructure should be based on a prioritized investment plan which aims at providing some form of safe water supply and adequate sanitation service to the most number of people. This will favour rehabilitation of existing schemes and the provision of schemes in previously un-served areas, before expansion of existing schemes.

2. The role of Government needs to change from that of a service provider to that of a co-ordination, policy and guideline formulation and regulation. Consequently, the institutional framework will involve new organizations at different levels and re-structuring existing organizations. The framework will also broaden stakeholder participation at the different levels.

3. In order to contribute to the improvement the health and living conditions of people in coastal rural and urban areas, emphasis should be placed on integrating systematic monitoring and assessment of the status of water quality, sanitation, waste management and hygiene education.

4. On the water supply and wastewater/sanitation side, a holistic and Sector Wide Approach to Planning (SWAP) should be promoted in order to ensure efficient allocation of public financial resources, thus reducing regional and district inequalities, and facilitating communities to take the lead in the planning, implementation and management of water/sewerage/sanitation schemes.

5. Service Providers should provide water supply and sanitation services using the most cost effective technology available which is suitable to the area and the socio-economic circumstances of the users. In rural areas, communities who will e responsible for operation and maintenance, should be empowered and facilitated to make appropriate technology choices that will suit their own capabilities, particularly in those which require low investment costs and are operated and maintained at least cost.

6. Mechanisms for effective and appropriate stakeholder participation in the provision of water supply and sanitation services should be instituted to ensure that all stakeholders understand and meet their obligations, and are actively involved in the planning and design and development of schemes.

7. Communities should be empowered to initiate, own, manage, operate and maintain their water schemes, including responsibility for coverage of operation and maintenance costs, so as to improve the sustainability of rural water sustainability of rural water supply systems. Eventually communities will be responsible for letting and supervising design, construction and operational contracts for their water supply systems.

8. Involvement of the private sector in the financing and provision of water supply and sanitation services should be encouraged where this would result in a more efficient and cost-effective level of service to consumers.

9. Tariff levels and structures need be controlled and regulated based on the levels of service to be provided, the cost-efficient provision of these services, and the cost-recovery targets to be achieved. A minimum or life-line tariff should be introduced to protect poor and disadvantaged groups, the cost of subsidizing which will be met through internal cross-subsidisation. Government subsidies should be aimed at encouraging efficiency improvements by Service Providers.

10. Communications and advocacy mechanisms should be established to enhance information and experience sharing to keep stakeholders aware of sector problems, successes and needs, so as to facilitate knowledge of the sector and its reforms by the general public and provide mechanisms for joint action.

11. Low cost wastewater treatment technologies such as constructed wetlands need to be promoted widely, particularly for application in institutional setup such as schools, colleges/universities, hospitals and tourist hotels.

12. Capacity building including training programmes and provision of necessary equipment is necessary, particularly for technical/professional staff responsible for the management, operation and maintenance of wastewater treatment systems.

5.0 REVIEW OF EXISTING TECHNOLOGIES USED FOR MWW MANAGEMENT

5.1 Overview of Existing Technologies

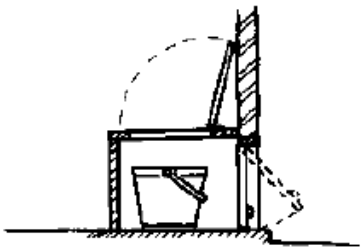
In this sub-section, various sanitation systems are introduced with a brief indication of their suitability for particular situations, the constraints on their use, and their disadvantages.

5.1.1 On-site technologies

A range of on-site technologies are currently used in Tanzania, including: traditional pit latrines, ventilated improved pit (VIP) latrines, composting latrines, septic tanks followed by soak way pit and sea outfall pipe.

Bucket latrine

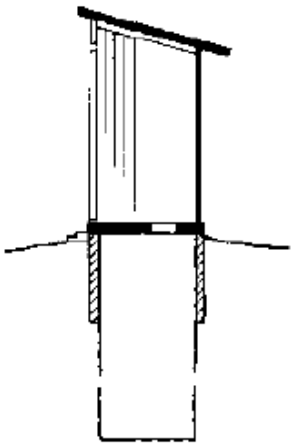
This latrine has a bucket or other container for the retention of faeces (and sometimes urine and anal cleaning material), which is periodically removed for disposal. Although it has low initial cost, it stinks, creates fly nuisance, presents potential health risk to those who collect and generally speaking the collection is aesthetically undesirable.



These are mostly used in prisons in Tanzania.

Traditional pit latrines

Traditional latrines usually consist of a single pit covered by a slab with a drop hole and a superstructure. The slab may be made of wood (sometimes covered with mud) or reinforced concrete. The superstructure provides shelter and privacy for the user. The pits can be square, rectangular or circular, usually 1.0–1.5 m wide. The depth (usually 3–5 m) depends on the soil and groundwater conditions. This type of latrine does not require water to function, though a small amount of water may be used occasionally to clean the squat-plate.



Indiscriminate de-sludging of pit latrines in Dar es Salaam

Pit latrines reduce likelihood of open contact with excreta and therefore promotes better public health. The capital

cost ranges from US$ 90 to US$ 220 for its construction. However, most of the construction materials required are available from scrap materials within the dwellings and therefore, in many occasions the actual cash requirement for construction of this latrine is minimal. The life span of the pit latrine is about 3 - 4 years, depending on number of users and the pit size.

Some of the disadvantages of the pit latrines include:

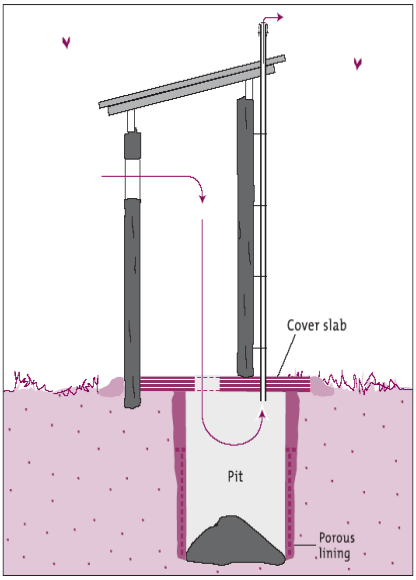
- Unpleasant smell;
- attracts flies.
- risks of contamination of groundwater.
- Does not fully eliminate the chances for transmission of excreta related diseases since excreta are exposed to flies and thus can be transmitted to food.
- Children may feel unsafe to use the latrine.

As settlement densities rise in a finite area, households increasingly share facilities, and loading per latrine climbs. Pits fill faster, while in many areas there is no longer space to dig new pits and build a replacement latrine, nor to bury the contents of an emptied pit on-site. Accordingly latrine waste in urban areas must increasingly be removed and taken away.

It is estimated that over 90% of the population in Tanzania use pit latrines, however, over 80% of the latrines are considered substandard and offensive due to poor design considerations.

Ventilated improved pit (VIP)

Ventilated Improved Pit (VIP) latrines are designed to reduce two problems frequently encountered with traditional latrine systems - bad odours and insect proliferation. For the Ventilated improved pit (VIP) latrines, waste drops into the pit where organic material decomposes and liquids percolate into the surrounding soil. Continuous airflow through the top-structure and above the vent pipe removes smells and vents gases to the atmosphere. A darkened interior is maintained causing insects entering the pit to be attracted towards the light at the top of the vent pipe and trapped by the fly screen. A separate hand washing facility is required.



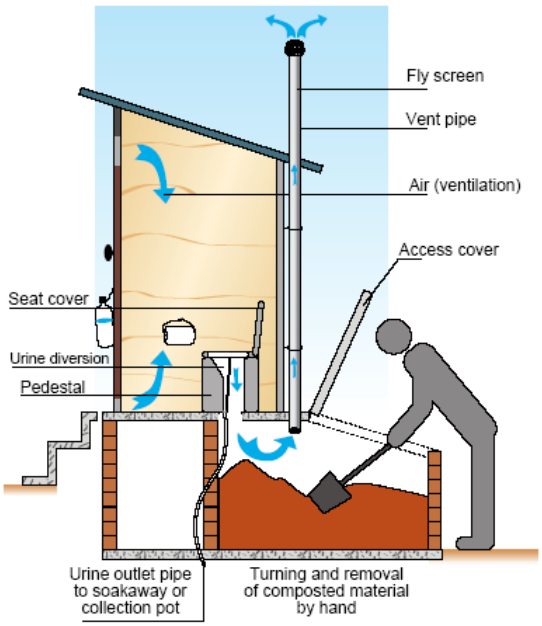
The VIP latrine does not accept domestic wastewater, lid should not be used and it cannot be placed inside a house. However, it allows access for mechanical pit-emptying and availability of sludge treatment and disposal where required. It is almost odorless and greatly reduces the risk of excreta related and fly-borne disease transmission. The cost for constructing the VIP latrine

ranges from US$ 110 - US$ 220 depending on choice of materials. The life span of the VIP latrine is about 3 to 4 years, depending on number of users and pit size.

These toilets have been introduced to limited communities in Dar es Salaam and Tanga.

Urine diverting toilets (Composting latrines-ecosan toilets)

For the urine diverting latrines**,** waste is deposited in the chamber and dry absorbent organic material, such as wood ash, straw or vegetable matter is added after each use to deodorise decomposing faeces and/or control moisture and facilitate biological breakdown (composting). Urine is diverted through use of specially adapted pedestals. This may be collected and used as a fertiliser. In desiccation systems. Ventilation encourages the evaporation of moisture. The capital needed for this latrine ranges between USD 300-400 depending on the choice of material and size.



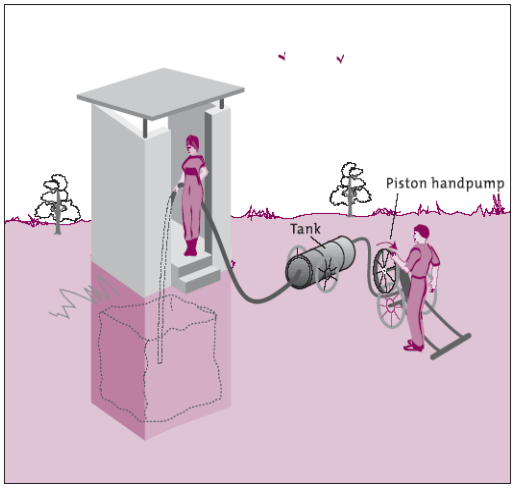
Some of the advantages of urine diverting latrines include: being environmentally sound as it does not contaminate ground or surface water, and also does not use scarce water resources for flushing of the toilet. It creates humus, a resource that can be productively recycled back into the environment. This latrine is most suitable for places where high ground water exists. After using the latrine (defecation), ash or dry soil is added on the top of excreta to reduce odor and prevent flies from coming in contact with excreta and also changes the pH of the excreta therefore limiting the proliferation of disease causing microbes/pathogens.

A number of these composting toilets have been introduced in Ukonga Majumba Sita area in Dar es Salaam including schools (see Figure 5). It is estimated that there are about 10,000 ecosan toilets that have been introduced in Tanzania. Two types of urine diversion toilets have been applied, the seat pan and squatting pan, the later being more preferred to the community.However, some form of subsidy was used to promote or support widespread use of new technology. The use of unsustainable subsidies may have achieved some short term gains but appear to militate against long term affordable solutions.

Figure 5: Ecosan toilet at Karakata Primary School in Dar es Salaam

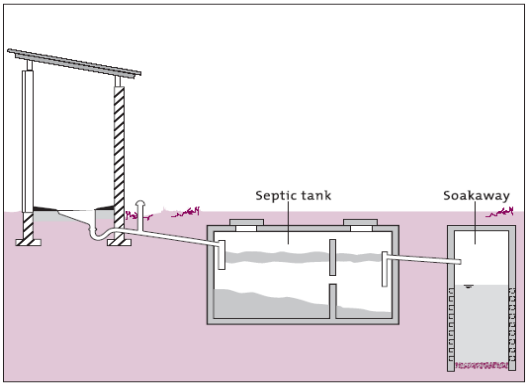
The Manual Pit Emptying Technology (MAPET)

The Manual Pit Emptying Technology (MAPET) uses manually operated equipment to empty the latrine pit. The sludge is usually buried in a hole close to the pit, or taken to a nearby disposal point (e.g. a disposal field, or sludge transfer station). The equipment is small and hand-operated, and is therefore particularly suitable for high-density settlements (squatter areas) with narrow streets, where conventional vacuum tankers have no access. The maximum width of the MAPET, for example, is 0.8 m. The initial cost is about USD 3,000. A pilot project operating from 1988-1992 disseminated the MAPET technology in unplanned areas of Mburahati in Dar es Salaam city. A total of seven teams were active with equipment in Dar es Salaam, and one team in Morogoro. By March 1994, five teams were still operational. However, the current status of the remaining equipment could not be established.



Septic Tank and Soakway

A septic tank is a water-filled box designed to collect and partially treat black water (feaces and urine). When the toilet is flushed, the wastes flow through a pipe into the top of the septic tank. Water needed per flush is about 3–5 litres. Heavy solids, such as feces, settle to the bottom of the tank, while liquids pass through before overflowing into a soakaway. Over time, bacteria within the septic tank break down some of the organic matter, thus the larger the tank is, and the more chambers it has, the better the treatment provided. Nevertheless, however well the septic tank functions, both the solids within the tank and the liquid that overflows from it contain harmful pathogens, hence are a potential source of infection and disease.



Settled solids gradually accumulate at the bottom of the septic tank. When this sludge, or septage, occupies two-thirds of the depth of the tank, it needs to be removed, otherwise there is a risk that excreta will pass directly through the tank and overflow into the soakaway pit. The accumulated sludge in the tank must be removed regularly, usually once every 1–5 years, depending on the size of the tank, number of users, and kind of use. The sludge is smelly, wet and highly pathogenic, so should always be removed by mechanical means (e.g. using a vacuum tanker) before being taken to an approved sludge treatment and disposal site. The initial cost for septic tank ranges from US$ 90–400 (including labour and materials).

A soakaway is a pit for collecting the liquid effluent from a septic tank, which is then allowed to infiltrate the ground. The capacity of the pit should be at least equal to that of the septic tank. The pit may be filled with stones, broken bricks, etc., in which case no lining is required, or it may be lined with open-jointed masonry (often with a filling of sand or gravel between the lining and the soil to improve infiltration). The top 0.5 m of the pit is lined solidly, to provide firm support for the reinforced concrete cover. The cover is sometimes buried by 0.2–0.3 m of soil to keep insects out of the pit. The size of the soakaway is determined mainly by the volume of liquid effluents produced, and by local soil conditions. With large effluent flows, drainage trenches may be more economical than soakaways. Planting trees adjacent to, or over, a soakaway can improve both transpiration and permeability.

5.1.2 Off-site technologies

Start by stating that wastewater is conveyed to the treatment system through a sewerage network. Also, state where it is used in Tanzania.

a) **Preliminary treatment:** Preliminary treatment includes *grit chambers* to screen out or separate debris is the first step in wastewater treatment. Sticks, rags, large food

particles, sand, gravel, toys, etc., are removed at this stage to protect the pumping and other equipment in the treatment plant. The collected debris is usually disposed of in a landfill. *Skimming* is also practiced particularly in manufacturing industries to remove oil and grease.

b) **Primary treatment:** The objective of primary treatment is the removal of settleable organic and inorganic solids by sedimentation, and the removal of materials that will float (scum) by skimming. Approximately 25 to 50% of the incoming biochemical oxygen demand (BOD), 50 to 70% of the total suspended solids (SS), and 65% of the oil and grease are removed during primary treatment. Some organic nitrogen, organic phosphorus, and heavy metals associated with solids colloidal and dissolved constituents are not affected.

c) Secondary Treatment

The objective of secondary treatment is the removal of biodegradable organic matter (in solution or suspension) and suspended solids. The systems applied includes;

i) Aerated lagoon

Aerated lagoons are mostly used in Tanzania by manufacturing industries including tannery industry in Kibaha. Such systems were used in the past in some institutions but they were abandoned due to higher operational cost.

In aerated lagoons, oxygen is supplied mainly through mechanical or diffused aeration rather than by algal photosynthesis. Aerated lagoons typically are classified by the amount of mixing provided. A partial mix system provides only enough aeration to satisfy the oxygen requirements of the system and does not provide energy to keep all total suspended solids (TSS) in suspension.

ii) Vetiver Grass Technology (VGT)

Vetiver Grass Technology, now popularly known as Vetiver System (VS) is being introduced in Tanzania through a demonstration pilot project located within Msimbazi River Basin in Dar es Salaam. Vetiver grass, which has strong, deep (at least 3 meters), profuse roots, is:

- native to hydro-environment such as wetland, lagoon and bog.
- extremely tolerant to drought as well as waterlogged/submergence conditions.
- effective for soil and water conservation, and,
- endowed with excellent biological features to ameliorate wastewater and pollution mitigation.

Vetiver grass presents a low cost option for wastewater treatment though its potential is yet to be realized in the country.

d) Primary-Secondary-Tertiary combined treatment

i) Waste Stabilization ponds

Waste stabilization ponds are in used Dar es Salaam for treatment of domestic wastewater. This is a low-technology treatment process; basically a shallow body of wastewater contained in an earthen basin (lagoon). It usually has 4 or 5 ponds of different depths with different biological activities taking place in each, hence their names- anaerobic, facultative and maturation ponds. The first pond, *anaerobic pond*, is mainly a pre treatment step acting as settling tanks with anaerobic degradation of organic matter, like faeces. In *the facultative ponds*, organic matter is further broken down to carbon dioxide, nitrogen and phosphorous by using oxygen produced by algae in the pond. *Maturation ponds* are aerobic systems used as post treatment to facultative ponds, to further reduce organic matter and pathogenic microorganisms before disposal into natural water bodies.

ii) Constructed Wetlands

Constructed Wetland technology for wastewater treatment has been introduced in Tanzania. Practical systems in the coastal zone have been constructed in Kibaha and Dar es Salaam. There is also a mangrove demonstration constructed wetland at a beach hotel in Dare s Salaam. The use of constructed wetlands for wastewater treatment from urban areas is gaining increasing attention and these have been identified as a much more cost-effective option than sewage treatment plants. Constructed wetlands are natural wastewater treatment systems that typically have lower construction and operation and maintenance costs than conventional mechanical treatment systems.

Mangrove wetland used for treatment of domestic sewage in Dar es Salaam

5.1.3 Wastewater reuse

Treated wastewater is being used for various purposes. Typical wastewater reuse is mostly practiced in a number of manufacturing industries with a view of reducing operational costs. Industry's requirement for water quality ranges widely, from very pure water for boilers of electricity generation to lower water quality for cooling towers.

In addition, wastewater reuse is also practiced to a limited extent in households for toilet flushing, watering of gardens and for suppressing dust in adjacent unpaved street roads.

5.2 Assessment of Existing Constraints in MWW Technologies

The development and deployment of sustainable, innovative and appropriate wastewater technologies whether in the form of integrated water management systems, or more economical, smaller treatment systems are important tools to solving the urban water and sanitation problems. There are of course many different reasons why this has not taken place. The most obvious one include the following:

i) Capital investment requirements

The capital investment of the various wastewater technology options plays a major role in choosing any of the options by the urban dwellers taking into account their low income levels. The cost of conventional wastewater infrastructure is prohibitive in view of other socio-economic and development issues by the Local Authorities. Therefore affordability is a major criterion in the choice of these technologies. This perhaps explains why more than 80% of the coastal communities use the pit latrines which are cheaper to construct, although most of them are sub-standard. Table 45 presents comparative qualitative costs for the various wastewater treatment technologies.

Table 44: Indicative costs for wastewater treatment technologies

Technology	Capital cost	Operation & maintenance cost	Environmental impact
A. On-site technology			
Open defecation	None	None	Pollution to surface and ground water
Traditional Pit latrine	Low	Low	Pollution of groundwater
Ventilated Improved Pit (VIP) latrine	Low	Low	Pollution of groundwater
Urine diverting toilets (Composting toilets/Eco-San toilets)	Low	Low	Reuse of nutrients
The Manual Pit Emptying Technology (MAPET)	Medium	Medium	Pollution of groundwater through burying of the sludge
Septic tank and soakage pit	Medium	Medium	Pollution of groundwater
B. Off-site technology			
B1. Collection technology	high	high	Dependent on treatment
Conventional sewerage network	High	High	Dependent on treatment
B2. Treatment technology			
Waste stabilization ponds (WSP)	High	High	Nutrients may need removal
Constructed wetlands	Low to medium	Low	Amenity value. Water reuse possible.
Aerated Lagoons	Medium to high	Medium	Nutrients may need removal, aquaculture can be incorporated

Vetiver grass	Low to medium	Low to medium	Reuse of water and nutrients

ii) Poor urban planning

Due to uncoordinated urban development, the coastal zone is poorly served, particularly in the residential areas, as the of utility services provision do not meet the demand. The infrastructure provided is inadequate and lags behind the pace of other development activities. Urban expansion has continued to take place regardless of inadequate efforts to provide infrastructure and amenities. There are areas that are being developed with either little or not infrastructure at all. Sometimes when it is provided, it is vividly haphazard and or un-coordinated.

The rate of urban growth and population increase has outpaced the Local Authority's capacity. Many of the social services that were provided in the past do not seem to be improved or extended to cater for the ever increasing coastal population and urban expansion. To combat this, a new and different urban planning approach needs to be put in place.

iii) Attitudinal barrier and social-cultural

Social considerations play an important role in the choice of the wastewater treatment option especially for on-site technologies. Cultural perceptions can result in a specific on-site technology being effective in one place but not acceptable in another. The case of limited adoption of *ecosan* toilets in Dar es Salaam can be considered to have been contributed by this factor.

iv) Weak institutional frameworks to support infrastructure development

The lack of an effective institutional framework for integrated water supply and sanitation has led to overlapping roles and responsibilities between various institutions leading to inefficient use of human and financial resources, duplication of effort, and gaps in effective provision of services.

v) Ineffective promotion of MWW technologies and low public awareness

The sustainability of the project has a lot to do with technology adopted and locality to be served. This also depends on how fast people can join the customer base. Public awareness can give rise to a viable project whereby customer base is assured. The scale of operations on sewerage projects has a cumulative effect on the cost reduction if proper campaigns are conducted from the commencement of the project.

vi) Limited attention in selecting appropriate MWW technology

Historically the water supply and sanitation technology chosen in any particular situation has not always taken appropriateness, affordability and sustainability as the main

criteria. The lack of attention to selecting the most appropriate technology in providing water supply and sanitation services has led to:

- Higher capital and operation and maintenance costs;
- Higher charges to consumer;
- Limited sustainability; and
- Lack of consumer or community acceptability.

5.3 Lessons Learnt from other Projects

5.3.1 Best Practices

Several projects have been undertaken in Tanzania to address the wastewater management issue. Such projects include the Community Infrastructure Upgrading Programme (CIUP) – Dar es Salaam; Sustainable Dar es Salaam Project (SDP); WIO-LaB (Western Indian Ocean – Land Based Activities Project); and PUMPSEA (Peri-Urban Mangrove Forests as Filters and Potential Phytoremediators of Domestic Sewerage in East Africa) Project. Table 21 presents an overview of these projects including achievements and experience gained in their implementation. Although the focus and geographical coverage varies among the projects, they share some aspects in terms of approach and policy context.

Some of the lessons learnt from the above projects are synthesized thematically as follows:

a) Participatory approach is critical for creating community ownership of projects

Community participation right from the start of the project is an essential component for the implementation and success of any project. Communities differ and therefore different approaches and methodologies should be used accordingly. In addition, it helps impart the sense of ownership and responsibility thus providing enabling environment for the sustainability of the project. In this regard, an institutional framework should guide responsibilities among stakeholders. If greater private sector involvement evolves out of this model, it is necessary to pre-determine the roles and responsibilities of each party.

b) Capacity building is worth investing

Capacity building of the participating entities can not be overemphasized particularly in ensuring sustainability and reliability of the project. For instance, most of the projects did include institutional strengthening for sustainable operation and maintenance of the water, drainage and wastewater systems. It is important therefore that projects emphasize learning by doing, and learning from good and bad examples. Some of the capacity building activities may include:

- Working closely with the residents in order to assist in the dialogue and training activities, in identification of their priority problems, and thus enhance their planning, implementation and monitoring capacities, in relation to social and environmental services and infrastructure provision;

- Promoting labour based and/or community construction contracting procedures, so as to maximize income-generating opportunities at community level;

- Promoting sustainable arrangements for the operation and maintenance of basic services particularly though community ownership and responsibility for upgrading proposals.

c) Demonstration schemes provide testing ground and a means of initiating collaboration among various partners.

Demonstration pilot projects or schemes serve as an eye opener and offer practical evidence and help facilitate mobilization of community participation and commitment.

d) Regional and sub-regional cooperation may facilitate mobilization of necessary resources

There is rich experience of successful regional and sub-regional collaborative projects on varied environmental issues along the coastal zone. Such cooperation and collaboration provides opportunity for strengthening the national capacity by collaborating with some of the most experienced experts and institutions in the respective region and worldwide. Therefore, regional and sub-regional cooperation reinforces the expertise resource base of the involved parties, to the gain of environmental management.

e) Targeting poor communities has a much greater overall impact in improving the quality of living

Statistics indicate the trend that those without access to social basic services are among the poorest in the community. This also holds for the case of coastal communities. In this regard, targeting this segment of population has a multiplicative impact and helps improving the environmental health and their social well being. Such impacts include:

- Improved resident's livelihood;
- Improved access to stormwater drainage and sewerage services;
- Provision of locally sourced and owned water supply scheme;
- The mushrooming of income generating activities such as shops, kiosks, hair saloons, secretarial services, groceries etc along the upgraded roads; and
- Increased value of land and properties.

5.3.2 Challenges

- Wastewater infrastructure development and/or upgrading is capital intensive and therefore requires huge financial resources that are not always available. Due to other competing demands, the government of Tanzania cannot allocate adequate financial resources for wastewater management. As a result there is too much dependency on external support, which is always not forthcoming and if it does, the government has limited control on what needs to be done. Over reliance on donor funding may undermine, rather than enhance local initiatives, commitment and eventually sustainability of environmental improvements.

- The cost of operation and maintenance of the existing wastewater management systems is high with very limited returns. Funds for continued maintenance are always limited.

- Political willingness and goodwill is not at the most desired level to influence allocation of budgetary resources to wastewater management projects. Political interference may limit the extend to which tarrifs can be increased and in most cases, such increases do not allow for attainment of full cost recovery objective of wastewater management projects.

- Poor physical planning in most of the main urban centres means that land has not been set aside for location of wastewater treatment plants. Expansion of the current sewer network to informal squatter settlements is complicated by poor physical planning of urban centres.

- Conflicts are inevitable when working with various stakeholders because of vested interests among the partners or members of the community;. Such conflicts causes delay in implementing projects. Furthermore delay by one partner affects implementation plans of other stakeholders. This raises the costs of implementing projects.

- Community contribution are unrealistically exaggerated. A community may show willingness to contribute towards the implementation of a project but in reality they do not honour their pledges. This partly attributed to extreme poverty;

Table 45: Summary of relevant project in the Tanzania coastal zone with some bearing on improving MWW management

Project	Objective	Achievements	Lessons Learnt
Community Infrastructure Upgrading Programme (CIUP), Dar es Salaam	• Aims to improve access to infrastructure and services in unplanned and under-served areas of Dar es Salaam. 31 Communities will benefit . • These Communities comprise an estimated 330,000 people and cover an area of 1000 hectares or approximately 20% of the unplanned area of the City.	• Capacity of CBOs built to plan, manage, evaluate and maintain their infrastructure in their areas. • Community participation and contribution in community infrastructure upgrading and other community development activities. • Infrastructure upgraded:- ➢ km – Spine roads constructed ➢ 26 km – Neighbourhood roads constructed with storm water drainage. ➢ 15 km – Sewerage System constructed and used by Kijitonyama residents. ➢ Community Owned and Managed Water System in place. 4 Boreholes constructed with reservoirs and 22-water distribution point.	• Elaborate CBO structure allow effective flow of information from the community to the CBO and vise versa. • Community mobilization and participation create trust, self help spirit and sense of ownership of the project. • Transparency in all aspects of the programme held to maintain harmony and commitment during project implementation. • Communities differ and therefore different approaches and methodologies should be used accordingly.
Sustainable Dar es Salaam Programme (SDP)	The overall goal of the SDP is to build the capacity of local authorities in environmental planning and management (EPM) though broad-based consensus with stakeholders in the public, private and popular sectors.	• A demonstration project was implemented in Sinza 'B' to improve a community based pit-emptying service. • Another innovative demonstration project involved the construction of shallow sewers in unplanned settlements. These proposals were discussed and agreed with	• Sensitization and mobilization of stakeholders should be continuous. • Capacity building programmes should emphasize learning by doing, and learning from good and bad examples, etc. • Over reliance on donor funding may undermine, rather than enhance local initiatives, commitment and eventually

Project	Objective	Achievements	Lessons Learnt
		community leaders in the concerned areas, but there were no funds for implementation. • A culture of collaboration and partnership in planning and management has been built. • EPM has contributed to improved governance and poverty reduction. • Knowledge on the EPM process and skills for its application has been accumulated.	sustainability of environmental improvements. • Involvement of relevant training and research institutions right from the beginning of a programme will ensure local capacity building and sustainable technical support in EPM.
Wio-LaB	The WIO-Lab Project is designed to serve as a demonstration project of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA), UNEP and aims to achieve three major objectives: - Reduce stress to the ecosystem by improving water and sediment quality - Strengthen regional legal basis for preventing land-based sources of pollution, including implementation of GPA. - Develop regional capacity and strengthen institutions in the Western Indian Ocean Region for sustainable, less polluting development including the implementation of the Nairobi Convention.	• On-going demonstration of leachate treatment from the closed Vinguguti solid waste dump site using vetiver grass along the heavily-polluted Msimbazi River/Creek, Dar es Salaam. • Conducted workshops/seminars to community groups and other stakeholders. • Initial marketing of potential application of vetiver grass as thatching materials. • Preparations for participating in the International Trade Fair (Sabasaba) to advocate the potential application of vetiver grass to the public and interested parties.	• Involvement of various entities including NGOs/CBOs, academia, Local Government, Government institutions and international partners has provided an opportunity for sharing ideas and mutual cooperation and collaboration. • Demonstration schemes serve as an eye opener and offer practical evidence and help facilitate mobilization of community participation and commitment.
PUMPSEA Project	The overall objective of this project is to demonstrate the ecological and economic service that peri-urban mangroves provide by mitigating coastal pollution through sewage filtration, and to offer innovative	• On-going successful demonstration of a mangrove scheme for treating domestic sewage. • Conducted awareness and planning workshops involving various	• Involvement of various entities including NGOs/CBOs, academia, Local Government, Government institutions and international partners has provided an opportunity for

Project	Objective	Achievements	Lessons Learnt
	solutions for the exploitation and management of this quality. Specific objectives are: ➢ To evaluate effects of sewage-filtration by peri-urban mangroves on ecosystem condition and processes (microbiology, biogeochemistry, ecology) ➢ Experimental development of mangrove sewage filtration technology. ➢ To develop ecological models that combine field observations and experimental results ➢ To compare the available sewage management options from a socio-economic and ecological perspective.	stakeholders. • Developed policy framework for improving wastewater treatment in the East Africa sub-region (Kenya, Tanzania and Mozambique).	sharing ideas and mutual cooperation and collaboration. • Demonstration schemes serve as an eye opener and offer practical evidence and help facilitate mobilization of community participation and commitment.
Msingini-Mtoni Wastewater Management - Pemba, Zanzibar	The goal of the project is to contribute to the protection and management of costal and marine environment in the WIO- region from land-based activities with a view of improving the quality of life of the people in addition to, sustaining economies of the countries of the region and maintaining the productivity and diversity of the marine ecosystems:. Specific objectives are: ➢ To provide a safe and accessible storm water drainage system for Msingini and Mtoni communities in Pemba; ➢ To reduce pollution load associated with from wastewater/sewage through treatment using application of biological treatment using thea	The project has not taken off, however, the expected outcomes of the project includes the following: • Treatment of wastewater using a constructed wetland system, leading to a reduction of pollution of the marine and coastal environment. • Increased public education and awareness on wastewater management issues leading to reduction in risks associated with waterborne diseases. • Improved coastal and marine fisheries and tourism activities leading to increased and sustainable livelihood to the local communities. • Empowered communities that takes responsibility for waste management.	•

Project	Objective	Achievements	Lessons Learnt
	constructed wetland system; ➢ To improve the health status of the Msingini-Mtoni communities in Pemba through controlling of wastewater discharges and littering; and ➢ To empower the local communities to incorporate environmental norms in to their daily activities lives through public awareness and participation	• Strengthened capacity of Department of Environment, Zanzibar and Chake Chake Municipality with regard to Environmental Management.	

5.4 Recommendations for Appropriate Technology

The choice of MWW technology in any particular situation has to take into account appropriateness, affordability and sustainability as the main criteria. However, in order to simplify the selection of appropriate technology, an algorithm presented in Figure below is recommended for this purpose.

The algorithm has considered several main criteria in the selection process that includes:

- Availability of water (hand-carried water supplies, yard tap water supplies and in-house water supplies);
- Topography and geological characteristics of the area (rocks, soil permeability, water table);
- Space availability (population density);
- Capital and operational costs.

What is clear from the algorithm is that there many technologies that are environmentally sound, from which a community can select based on their local conditions and preference. In water shortage area, the amount of tap water required to transport pollutants to the treatment facility is hardly affordable, therefore disposal of excreta and other household wastewaters could opt for VIP latrines or composting latrines. In the Tanzania coastal urban areas, access to sewerage system is very limited (<15%), therefore most communities rely on on-site sanitation in its various forms, which happens to be a relevant and viable option, meeting a very string demand.

On the other hand, where there is adequate water supply, simplified sewerage system, conventional sewerage system or settled sewerage system (wetlands/lagoons) may be applicable.

For developing countries like Tanzania, the MWW treatment should preferably make use of natural and artificial wetlands. Constructed wetlands are potentially good, low-cost, appropriate technological systems for domestic wastewater for both household and institutional/communal levels. Better still, they can be integrated into agricultural and fish production systems where the products are useable and/or recycled for optimal efficiency. However, currently, constructed wetlands are rarely installed in the coastal zone. However, the use of constructed wetlands for wastewater treatment for urban areas is gaining increasing attention as a cost-effective option for treating wastewater..

6.0 APPLICABILITY OF THE GPA GUIDELINES

6.1 Introduction

Since the adoption of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) in 1995, UNEP has pioneered the development of tools addressing marine pollution originating from land-based activities. GPA is the only global action programme addressing the interface between the fresh water and coastal environment. One of the problems the GPA address's is the uncontrolled discharge of wastewater into the fresh water and coastal environment.

In response to the challenge faced by many governments in addressing municipal wastewater problems, the GPA has developed guidelines for municipal wastewater management. The guidelines provide practical guidance on how to plan appropriate and environmentally sound municipal wastewater management systems. The guidelines are meant for decision-makers, operational professionals in government institutions, and in the private sector, development banks and related organizations. The guidelines focus on four elements: approaches and policies, institutional arrangements, technological choices, and financing options. Each element is supported by a practical checklist.

The guidelines address and stress the need to link water supply and the provision of household sanitation, wastewater collection, treatment and re-use, cost-recovery, and re-allocation to the natural environment. Local participation is advocated and stepwise approach to technology and financing, starting at modest levels, expanding if and when more resources become available. The guidelines are summarized in 10 keys for action covering: political commitment; action at national and local level; going beyond taps and toilets; integrated management; long-term perspectives with step-by-step approaches; time-bound targets and indicators; appropriate technology; demand-driven approaches; stakeholder involvement; transparency; and financial stability and sustainability.

6.2 Review of the GPA Guidelines

The UNEP GPA Guidelines on Municipal Wastewater Management were reviewed by the National MWW Task Force. The review included individual review of the Guidelines followed by plenary discussion and consensus building on the applicability of the different sections of the Guidelines. The results of the review are summarized in Table 46.

With regard to the water supply and sanitation in Tanzania, the Guidelines are applicable in addressing the MWW management challenges.

Table 46: Applicability of the UNEP GPA Guidelines on Municipal Wastewater Management in the national context

UNEP-GPA MWW thematic keys	Applicable	Not Applicable	Comment
1. Secure political commitment and domestic financial resources	×		Political commitment has been demonstrated in terms of institutional reforms, policy formulation and capacity building
2. Create an enabling environment at national and local levels	×		The institutional arrangement reforms particularly by establishing and empowering UWSAs has provided some improvement in MWW management
3. Do not restrict water supply and sanitation to taps and toilets	×		The Government has adopted a number of Strategies, Plans and Guidelines that emphasize holistic water resource management including the Strategy on Urgent Actions to Combat Land Degradation and Water Catchment Conservation (2006), and Water Sector Development Strategy (2004).
4. Develop integrated urban water supply and sanitation management systems also addressing environmental impacts	×		The current institutional framework for the water sector integrates the provision of urban water supply and sewerage services.
5. Adopt a long term perspective, taking action step-by-step, starting now	×		Water Sector Development Programme has been formulated whose implementation intends to widen the stakeholder participation, improve the necessary infrastructure and provide a viable platform for facilitating improved MWW management
6. Use well-defined time-lines, and time-bound targets and indicators	×		The overall performance of the water sector is already monitored by a series of key performance indicators including water supply and sewerage coverage, cost recovery, staffing levels and training, and customer satisfaction
7. Select appropriate technology for efficient and cost-effective use of water resources and consider ecological sanitation alternatives	×		Promotion of low-cost appropriate technologies has received increased attention including constructed wetlands, vetiver grass and waste stabilization ponds as well as improved pit latrines.
8. Apply demand-driven approaches	×		Community participation is necessary from the planning stage to the implementation of the best available technology on MWW that is affordable in terms of investment and operational and

			management cost
9. Involve all stakeholders from the beginning and ensure transparency in management and decision-making process	×		There has been improved involvement of stakeholders including private sector in water supply and wastewater projects.
10. Ensure financial sustainability and sustainability	×		Existing tariff structures do not guarantee the financial sustainability of the UWSAs in terms of recovery of operation and maintenance costs as well investment in improving service delivery. Also, most of the exiting MWW infrastructures are old and dilapidated and this pose a serious challenge to UWSAs in addressing the situation.

6.3 Enabling Policy Environment for Sustainable Wastewater Management

This is an essential tool in setting up a practical framework that will facilitate achieving sustainable MWW management goals.

Tanzania is particularly faced with the challenge of many competing national development needs (such as agriculture development, education, health services, and infrastructure) in the midst of critical financial constraints resulting into low priority to MWW management. Having that in mind, obtaining a political commitment should be viewed to be more of a process rather than a one time initiative. In this regard, the Guidelines could go a step further to offer an insight on different applicable mechanisms to mainstream MWW management in the planning and decision processes both at national and local government levels as well as among different relevant sectors. Citing successful stories in this context could offer a practical understanding in achieving a meaningful political commitment.

6.4 Institutional Arrangement and Social Participation

It can be said that this is the back bone in achieving sustainable MWW management.

Experience in Tanzania has shown that some of the existing institutional arrangements dealing with MWW management have failed to fulfill their functions for a number of reasons including overlapping mandates for both vertical (national, regional, local) and horizontal (among stakeholders and sectors); weak communication, cooperation and coordination; and lack of experience in institutional management particularly in identifying non-core activities to be outsourced as a way of enhancing efficiency in service delivery.

In view of the above, the UNEP/GPA Guidelines could include institutional arrangement and social participation models outlining their advantages, disadvantages and experience in their application in different parts of the world. This would offer a practical guidance in instituting influential institutional reforms for achieving sustainable MWW management.

6.5 Planning Sustainable and Cost-effective Technologies

The low-cost wastewater treatment technologies is a matter of necessity rather than choice not only to the majority of the poor population in developing countries but also to the poorly operated industrial establishments.

The experience of Tanzania with regard to selection of sustainable and cost-effective technologies is influenced by emergence of unplanned settlements (squatters) particularly in urban areas. For instance, Dar es Salaam City with a population of about 3.5 million people has about 70-80% of the population residing in squatter areas. Initiatives undertaken to upgrade these settlements have not matched with fast expansion rate of the city. In this regard, the UNEP/GPA Guidelines could include a focused discussion on potential low-cost technologies applicable in low-income, densely populated squatter areas such as condominial system.

In Tanzania, most of the industries were established without Environmental Impact Assessment (EIA) and as a result, most of them lack wastewater treatment facilities. It would be helpful for the UNEP/GPA Guidelines to provide guidance on low-cost technologies at least to selected industrial sub-sectors that are more prominent in the WIO region. The list may include textile industries, breweries, leather industry, sugar industry, fish processing and pulp and paper industry.

In addition, the Guidelines should attempt to provide illustrative examples, for instance, in selection of technologies to offer a practical insight.

6.6 Financial Mechanisms for Wastewater Management

Sustainable financing mechanisms for wastewater development and management are one of the critical elements in the hierarchy of sustainable wastewater management.

Experience in Tanzania has shown that tariffs for urban water and sewerage services are very low resulting in very low revenue inadequate to meet even the basic operation and maintenance requirements. Provision of water and sewerage services has been as a social service, resulting in low willingness to pay, making revenue collection very difficult. In this regard, the UNEP/GPA

Guidelines could include illustrative guidance on different approaches in setting up tariffs.

7.0 MECHANISMS FOR DOMESTICATION OF REGIONAL GUIDELINES

7.1 Mechanisms for Domestication

a) Mainstreaming the Guidelines in the implementation of existing relevant plans, strategies and programmes

There are a number of existing relevant sectoral plans in Tanzania that can be used to mainstream the GPA MWWM Guidelines. This also includes strategies and programmes that provide an enabling mechanism for disseminating and internalizing the GPA Guidelines by key stakeholders. Some of them include the following:

- *The National Water Sector Development Strategy (NWSDS) (2004):* This strategy aims at developing a coherent, holistic and integrated strategy for the water sector in order to implement the National Water Policy (2002). This will then allow the on-going sub-sectoral initiatives and projects to be set within the overall strategic framework for the sector, supported through a Sector Wide Approach to Planning (SWAP).

- *The National Urban Water and Sewerage Strategic Programme (NUWSSP) (2006*): This programme complements the NWSDS. It is intended to address the needs of urban water authorities to improve service delivery and includes proposals for future infrastructure developments that will contribute towards achieving national targets.

- *The National Tanzania Development Vision 2025:* Targets universal access to safe water by 2025. The Millennium Development Goals aim to have the number of people without access to clean water and adequate sanitation facilities by 2015 – for the urban water sector this means achieving 86.3% coverage by 2015. These goals have been taken account when setting the operational targets for National Strategy for Growth and Reduction of Poverty (NSGRP) which are:

    - Raise the proportion of urban population with access to safe and clean water from 73% in June 2003 to 90% by 2010.
    - Raise sewerage service coverage from 17% in June 2003 to 30% by 2010.

- *The National Strategy for Urgent Actions on Combating Land Degradation and Water Catchments (2006):* This strategy is a recent effort by Government to deal with serious degradation of land and water sources which has accelerated the severity of the impacts of drought in the country leading to inadequacy of water for different uses including hydropower generation. The strategy identifies 12 environmental challenges, cites

examples of areas seriously affected for each challenge and prescribes actions required in addressing each challenge in a given time frame. As such, the Strategy attempts to address the water supply in a more holistic approach and the Guidelines could be incorporated in the Environmental Education Programme under the Strategy.

- *The National Rural Water Supply and Sanitation Programme (2006):* This programme involves the transformation of rural water and sanitation projects and programme into harmonized nationwide programme. The initiative will ensure active participation of communities in planning, implementation and taking full responsibilities in operation and maintenance for sustainability of rural water schemes. It will also strengthen the capacity of all actors at all levels especially at district level and ensure the participation of private sector in all stages of rural water projects.

- *Draft National Environmental Health, Hygiene and Sanitation Strategy (NEHHSS) (2005):* This strategy's rationale rests with the fact that people in the households and communities need environmental health, hygiene and sanitation skills to protect them from vulnerability infectious risks. The Strategy emphasize on promotion and strengthening of participatory approaches in order to utilize the existing resources within the community.

- *National Integrated Coastal Environment Management Strategy*: This strategy places emphasis on mainstreaming coastal environment concerns by enhancing stakeholder participation, enforcing laws and regulations, support for research, training, education and awareness at all levels. One of the implementation mechanisms of the Strategy involves development of district and local level coastal strategy implementation plans. This mechanism caters for stakeholders' participation at different levels and this amplifies its participatory approach.

- *National Programme of Action for the protection of marine environment from land-based activities (NPA)(2008):* The objective of the programme is to reduce environmental threats to the coastal and marine environment of Tanzania from land-based activities. Some of the strategic components of the programme includes improving the control and management of pollution reaching the marine environment; enhancing sustainable extraction and management of coastal resources; and improving the legal, planning, management and enforcement framework

b) Information exchange and experience sharing through professional and scientific Forums, Conference and Associations

A number of forum and association exists in Tanzania whose development should be encouraged as they provide a platform to discuss common issues and exchange information. In addition they offer an opportunity for collective voice for different stakeholders. This provides a viable platform for disseminating the GPA Guidelines and their application for improvement of MWW management. Such forums and associations include the following;

i) *Association of Tanzania Water Suppliers (ATWAS*): The ATWAS was formed in 2002 to represent the interest of those agencies and institutions involved in water production and supply. The objective of the association is to promote the interests of water suppliers through;

- Coordinating the search for knowledge and gathering technical, legal, administrative and economic data
- Promoting exchange of information on research and processes of water supply and sanitation
- Promoting professional training
- Establishing a fund for investment

ii) *EWURA Consumer Consultative Council (CCC):* The Consumer Consultative Council (CCC) has been established under the EWURA Act (2001) with the following functions:

- Represent the interest of consumers by making submissions to, providing views and information to an consulting with the Authority, Minister and Sector Ministries
- Receive and disseminate information and views on matters of interest to consumers of regulated services,
- Establish regional and sector consumer committees and consult with them
- Consult with industry, Government and other consumer groups
- Establish local and sector consumer committees and consult with them

iii) *Association of Local Authorities of Tanzania (ALAT):* The ALAT was established in 1983 and serves as the national focal point of Local Government Authorities on Mainland Tanzania. It consists of all Local Government Authorities in Tanzania Mainland. Its role is promoting and sustaining the goal and ideas of decentralization. According to its constitution, the objective of ALAT includes:

- To foster and promote smooth Local Government development in Tanzania;

- To maintain and further the rights, interests and values of Local Government Authorities; and
- Represent the Local Government Authorities of Tanzania in the International Union of Local Authorities and other international fora.

iv) *Institution of Engineers Tanzania (IET*): IET organizes various meetings and conferences including annual seminars, international scientific conferences, Annual Engineers Day and public lectures.

i) *Engineers Registration Board of Tanzania (ERB):* ERB oversees Structured Engineer Apprecentship Practice.

ii) *Annual Scientific Conference on Environment:* The series of these conferences started in 2005 and is organized by the National Environment Management Council (NEMC) in collaboration with other institutions. The conference gathers processionals, academia, government institutions, development partners and the private sector. The Conference series aims to provide a platform for discussing and providing proposals for addressing the environmental challenges as identifies in the National Environmental Policy (1997) and other sectoral policies.

As these forums and associations develop and gain experience, it is anticipated that they will transform to assume the following relevant roles in the near future:

- Contributing to policy development in the water sector;
- Assisting members to develop and adopt 'best practices';
- Representing members' collective interest in national and international forums (e.g. Tanzania Bureau of Standards and Union of African Water Suppliers);
- Collecting and publishing baseline data;
- Networking between and among the Authorities which will facilitate exposure to more efficient management, experience of new technologies, advice on overcoming problems, and access to skilled experts.

c) Mainstreaming the Guidelines in the Environmental Health and Sanitation Competition

Tanzania has been conducting environmental health and sanitation competition since 1998. Originally the competition covered urban areas including two cities, 12 municipal councils and 9 town councils. The coverage for the competition has expanded to 114 districts councils, 2,539 wards and 8,342 villages. It has stimulated challenges and builds morale towards improvement of environmental conditions in respective areas. It is an annual event drawing a wide variety of stakeholders directed to achieve among others, the following objectives:

- To raise the sanitation standards in the country;
- To raise community awareness on the importance of maintaining a clean environment;
- To promote community and private sector participation in the delivery of environmental health and sanitation services stipulated in the government policies;
- To reduce communicable and non-communicable diseases which are sanitation-related.

Local authorities are the core participants in the competition as they plan and budget for the promotion of environmental health and sanitation in their respective areas annually. Community participation in sanitation service delivery including financial contribution is emphasized to ensure sustainability of the initiative. Therefore, the competition scheme provides an excellent practical context for incorporating, disseminating and sensitizing the key stakeholders on the GPA Guidelines.

d) Implementation of the National Environment Research Agenda (NERA)

NERA was prepared in 2006 in fulfilling one of the requirements of the Environmental Management Act (2004) under the coordination of the National Environment Management Council (NEMC). Among others, NERA focuses on natural resources management, pollution control and monitoring and enforcement. NERA offers framework within which wastewater management approaches could be studies and improved.

e) Incorporating the Guidelines in the existing media and awareness initiatives

Several information dissemination pathways exist that could be utilized for dissemination of GPA Guidelines. Present public information tools and mechanisms that are in place include: publication materials such as brochures, newsletters, booklets, stickers, fliers, posters etc; radio programmes; television programmes; seminars/workshops/meetings; District/Village Environmental Committees; commemoration of World Environment Day and International Trade Fair (Saba Saba); Essay Competitions (especially for school children); NGOs/CBOs/Environmental Clubs, and drama/songs/traditional dance.

A government website is in place under the Commission for Planning and Privatization as well as the website for Prime Minister's Office Regional Administration and Local Government (PMO-RALG) and NEMC which could be used to disseminate information on the GPA Guidelines to the public.

7.2 Opportunities for Domestication

a) *Finalization and enactment of the Water Supply and Sanitation Bill (2005)*

Legislation to implement the National Water policy (2002), the Water Supply and Sanitation Bill (2005) is currently under review. Major changes proposed in the Bill includes:

- Authorities are created as Corporate Bodies with perpetual succession
- Authorities are to provide sanitation services in addition to water supply services in their designated area
- Authorities may appoint Services Providers to assist in fulfilling their functions
- Authorities are to be licensed and regulated by the Energy and Water Utilities Regulatory Authority (EWURA)
- EWURA is to issue guidelines on tariffs and examine and approve tariffs proposed by Authorities
- EWURA is to monitor water quality and standards and standards of performance of Authorities
- Creation of a National Water Fund to provide investment support for water and sanitation service provision.

The Guidelines could be integrated or adopted under this Bill as a way of encouraging its application and internalization.

b) *Supporting development and dissemination of public information and awareness materials on GPA Guidelines in a common and simple language preferably 'kiswahili'*

c) *Supporting awareness activities of institutions with related programs such as NEMC, PMO-RALG, ALAT, ATWAS, IET, ERB and Local Authorities.*

d) *Facilitating participation of national experts as well as policy and decision makers in related international meetings and conference.*

e) *Organizing study tours for Municipal and Sector Ministry technical staff as a way of enhancing institutional capacity and mainstreaming the Guidelines in the planning process in MWW management.*

f) *Mainstreaming the GPA Guidelines in formal educational curriculum*

This could be achieved by developing training modules for academic and professional development programmes including from primary schools to the university. At the University level, encourage the creation of a formal

education track for MWW management within existing institutes or universities including University of Dar es Salaam, Institute of Marine Science (Zanzibar), Dar es Salaam Maritime Institute (DMI).

7.3 Impediments to Domestication

The domestication of UNEP/GPA MWWM Guidelines in Tanzania could be limited by the following factors;

- Lack of financial resources to support human resource capacity building, and improving coordination and dissemination of information on best practices and appropriate technologies;

- Lack of awareness among different key sectors (stakeholders) and the general public may interfere internalization of the Guidelines;

- Existing information dissemination pathways lack focus on MWW management and there is deficiency of MWW technical expertise in the media;

- Lack of priority on MWW daily planning; and

- Weak enforcement capacity.

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