

**THE PRACTICES AND CHALLENGES FOR MUNICIPAL SOLID WASTE
MANAGEMENT IN TEMEKE MUNICIPALITY,
DAR ES SALAM, TANZANIA**

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**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE
REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS IN NATURAL
RESOURCE ASSESSMENT AND MANAGEMENT OF
THE OPEN UNIVERSITY OF TANZANIA**

2017

CERTIFICATION

The undersigned certifies that he has read and hereby recommends for acceptance by the Open University of Tanzania a dissertation titled: *The Practices and Challenges for Municipal Solid Waste Management (MSWM) In Temeke Municipality, Dar Es Salam (DSM), Tanzania*, in partial fulfillment of the requirements for the degree of Master in Natural Resource Assessment and Management of the Open University of Tanzania.

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DECLARATION

I, **Ahmed Lubwama**, do hereby declare that this dissertation is my own original work and it has not been presented and will not be presented to any other University for the similar or any other Degree award.

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Signature

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Date

ACKNOWLEDGEMENT

I am very grateful to Almighty who has given respite from the commencement to the brink of accomplishment of the entire course. Indeed I can't grease the palms of all those who either directly or indirectly contributed to this chunk of work.

However a special bottle of thank is indebted to all my lecturers who taught me in the face-to-face sessions including; Dr. J. D. Kalwani, Prof. D. Ngaruko, Dr. J. Msindai, Dr. S. Gwalema, Dr. A. Wawa and Dr. C. Haule whose efforts laid a basis of developing this work. I can't miss out uttering Dr. J. Salia, Dr. Chacha in conjunction with my lecturers who attended the seminar which prudently polished our initial research proposals.

DEDICATION

This work is dedicated to my entire family; spouses, daughters and son; Fatma Othman Shabaan, Leyla Musa, Taqiyya Ahmed Qasim, Hadiyya Ahmed Qasim and Qasim Ahmed Qasim respectively.

ABSTRACT

Dar es Salam as one of the enlarging cities characterized by rapid increase in the population, rampant sprung of informal settlement municipal solid waste generation rates become abnormal. This is worsened by the less collection rates which threatens the health status of the urbanites. The study was conducted in Temeke Municipality purposely due to its low waste collection rates of all the then three municipalities of Dar es Salaam that is Kinondoni, Temeke and Ilala. The study assessed the practices and challenges of MSWM and suggests the possible measures to correct the situation. The wards studied are Kiburugwa, Mbagala Kuu, Charambe, Mianzini, Azimio and Yombo Vituka which were purposively chosen given their high number of females. 156 women were interviewed since they are the ones indulging most in the waste management activities at the household level. The study had to identify the typology of solid waste collected and disposed, to examine the solid waste collection and disposal methods used as well as the challenges of solid waste management in Temeke Municipality. Basing on the data obtained from field observations, face-to-face interviews undertaken from the females in the selected wards, ward executive officers, the respective chairpersons, and the questionnaires filled up by the Temeke Municipal officer in-charge of waste revealed that the most generated waste is in form of rubbish, food waste with few reported paper material and observed glass material. There are two methods of municipal solid waste collection; door-to-door and the communal, the generators get rid of their wastes by collecting, whereas others disposed at their backyards, nearby open space and temporal dumpsites, the challenges for MSWM were inconsistency in waste collection, low budget, a distant official dumpsite at Pugu Kinyamwezi. The study recommends waste sorting, provision of official dumpsites.

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ABBREVIATIONS

CBOs	Community-Based Organizations
CO ₂	Carbon dioxide
DCC	Dar es Salaam City Council
DEFRA	UK Department for Environment, Food and Rural Affairs
DLAs	Dar es Salaam Local Authorities
DSM	Dar es Salaam
EAC	East African Community
ERC	Environmental Resources Consultancy
GHE	Greenhouse Effect
GHG	Greenhouse Gas
GWMO	Global Waste Management Outlook
KIWODET	Kisutu Women Development Trust
MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
NGO	Non-governmental organization
SWCPC	Solid Waste Collection Private Contractors
SWM	Solid Waste Management
SWP	Somerset Waste Partnership
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
WHO	World Health Organization
WtE	Waste to Energy

CHAPTER ONE

INTRODUCTION

1.1 Background of the Research problem

Waste material is an unavoidable by-product of human activities. Wastes are liable to increase in cases where there is population growth and high industrialization levels. For that sake there are more wastes generated in densely populated residential places as well as in the industrialized ones. However the accumulation of wastes becomes a big concern as poor management may pose high risks of health problems as well as environmental pollution. For instance according to Lyeme (2011), accumulated wastes can lead to degradation of urban environment, stress on natural resources and health problems. Large cities in the world are facing a great challenge of managing the generated wastes with some of the developing countries in a more critical condition.

Waste management involves proper and correct handling of waste products at the lowest cost and with minimum destruction and pollution to the environment. However, the most challenging elements of waste management are waste collection and disposal as a result of increase in waste quantity and complexity.

In the early days there was no worry about waste management since the rate of generation was very low given the low population and industrial levels. However, as time went on with economic and demographic changes, the rate of waste generation increased and its management becomes an issue in order to preserve the environment and avoid the risks of diseases associated to the mismanagement.

Countries have not just notified the urgency for waste management for instance in 1890s, major cities in North America realized the necessity for a better management of their sewage and solid wastes. Local governments assumed the responsibility for dealing with urban refuse. Waste management services were provided either directly by the government or by private scavenging companies (Lyeme, 2011). Waste management services such as sanitary land filling, incineration, recycling are gradually replacing the ancient approaches such as dumping, animals slopping in the streets, and scavenging, which prevailed during the 18th century (Rathje, 1992). These modern approaches have strengthened the capacity for waste treatment and safe disposal. However, irrespective of advancement in waste management, burial and combustion under controlled environments were, and still are, the major methods for disposal. Landfill, the cheapest disposal option, became the most widely adopted method during this period of time (Lyeme, 2011).

Though Municipal Solid Waste Management (MSWM) is a responsibility for the local government, as population grows and industries spring up, management becomes more complex hence making the accomplishment of the task difficult. However, most governments have improvised by laying a ground for the private sector to contribute towards problem solving whose steps has proved fruitful to a certain extent (Kassim, 2009).

Tanzania, Dar es Salaam (DSM) is one of the cities in developing countries in which the private sector stepped in since 1994 to manage its wastes where even the operations of the private contractors are aided by the passed bylaws. For instance according to the

Government Notices No 353 and 45 published on 16/11/2001 and 25/1/2002, the bylaws as regards to collection and disposal of refuse for Kinondoni and Temeke Municipalities respectively were passed (Salha & Ali, 2003). Before MSWM privatization, the city was able to collect only 2 – 4% of the daily solid waste, for instance in 1992 out of the daily city's generated 1400 tons of solid waste, only 30 – 60 tons was collected (Mengiseny et al, 2005). The amount of waste collected has continuously increased since 1994 when the city introduced private sector in collection service.

The city's generation rate has increased whereas the collection rate is not commensurate. It is estimated to generate about 4,252 tonnes MSW per day of which only 59% is managed and the rest is left near residential places, in open pits, markets, drains and open spaces. (NBS & Office, November 2014). According to Expert Team, (2016) it is safe to assume that approximately 3,000 tons of waste per day is buried, burned and/or left somewhere in DSM's streets, open spaces, canals, sewers and shores, thus contributing to health problems for local residents, flooding and methane emissions. Therefore the accumulation of the solid waste has a negative impact on public health and the environment at large.

1.2 Statement of Research Problem

Despite the fact that private sector has played a big role in the chopping of the rates of uncollected wastes, the situation in Dar es Salaam still prevails. The uncollected and poorly disposed wastes can threaten human health and environmental status of the victimized areas. According to Kassim (2009), the climate of DSM characterized by temperature ranging between 24⁰ C and 35⁰ C, humid conditions between March and

May accelerates the decomposition rate hence there is a need for quick removal and safe disposal of wastes. The population growth rates of 4.3% per annum in DSM (National Bureau of Statistics, 2012) will imply a further increase in the wastes generated amongst the three municipalities of DSM; Temeke inclusive. The overall waste generation in DSM has tremendously increased from 2,000 tons per day in 1998 to 4,000 tons per day in 2010 (DCC, 2010) and 4,242 tonnes in 2012 (NBS & Office, November 2014). However the amount of waste collected from Temeke municipality has lagged behind at 27% of the 1,035 tones of wastes generated in the municipality (Expert Team, 2016). Therefore the current low waste collection rates in Temeke municipality imply higher chances of increase in uncollected wastes in future as the collection rates do not tally with the generation rate if no serious measure is taken to correct the situation. This will make the municipality susceptible to the negative impacts of poor MSWM such as diseases, odor, water pollution emanating from leachates, and others. This called for the need to study about the practices and challenges of MSWM in the Temeke municipality in order to raise the prospect of a better MSWM to ultimately improve the environmental conditions and minimize the liability of diseases amongst the residents of Temeke municipality.

1.3. Research Objectives

1.3.1 Main Objective

The overall objective of the study was to assess the practices and challenges of MSWM in Dar es Salam in Tanzania.

1.3.2 Specific Objectives

- i. To identify the typology of municipal solid waste collected and disposed in Temeke municipality.
- ii. To examine the municipal solid waste collection methods used in the Temeke municipality.
- iii. To examine the municipal solid waste disposal methods used in Temeke municipality.
- iv. To examine the problems facing municipal solid waste management in Temeke municipality.

1.4 Research questions

- i. What is the typology of the municipal solid waste collected in Temeke municipality?
- ii. What are the municipal solid waste collection methods used in the Temeke municipality?
- iii. What are the municipal solid waste disposal methods used in Temeke municipality?
- iv. What are the problems facing municipal solid waste management system in Temeke municipality?

1.5 Scope of the study

The study was undertaken in Temeke municipality. It focused on the typology of MSW, municipal solid waste collection and disposal methods as well as the challenges towards a better municipal solid waste management. The study did not quantify (weight and volume) the municipal solid wastes generated at the source areas. This is because the increase in the amount of waste is not a controversy. In addition to that the nature of municipal waste plays more a significant role in determining the most appropriate approach of handling, collecting and disposal of the wastes. For instance the , hazardous, biodegradable municipal wastes may require a quick, special handling irrespective of their quantity which can call for sorting of the wastes at the generation point. Data was collected immediately after the approval of the research proposal.

1.6 Significance of the study

The study will boost the understanding of the typology of the municipal solid waste. This will be useful amongst the municipal solid waste collection contractors by enacting appropriate collection strategies for specific sources which is made easier for instance through the sorting of municipal wastes in case of heterogeneous wastes. The study will assist the assessment of the present municipal solid waste collection and disposal methods within Temeke municipality. This will be important for the collection contractors as the identified loopholes can be worked upon to upgrade the quality of service. This will ultimately facilitate the proposal for the recommendations which can improve the rates of collected municipal wastes thereby improving the health conditions as well as a clean environment. In addition to that, the government may use it to assess

the service and determine whether respective private contractors can continue with the service.

1.7 Conceptual Framework

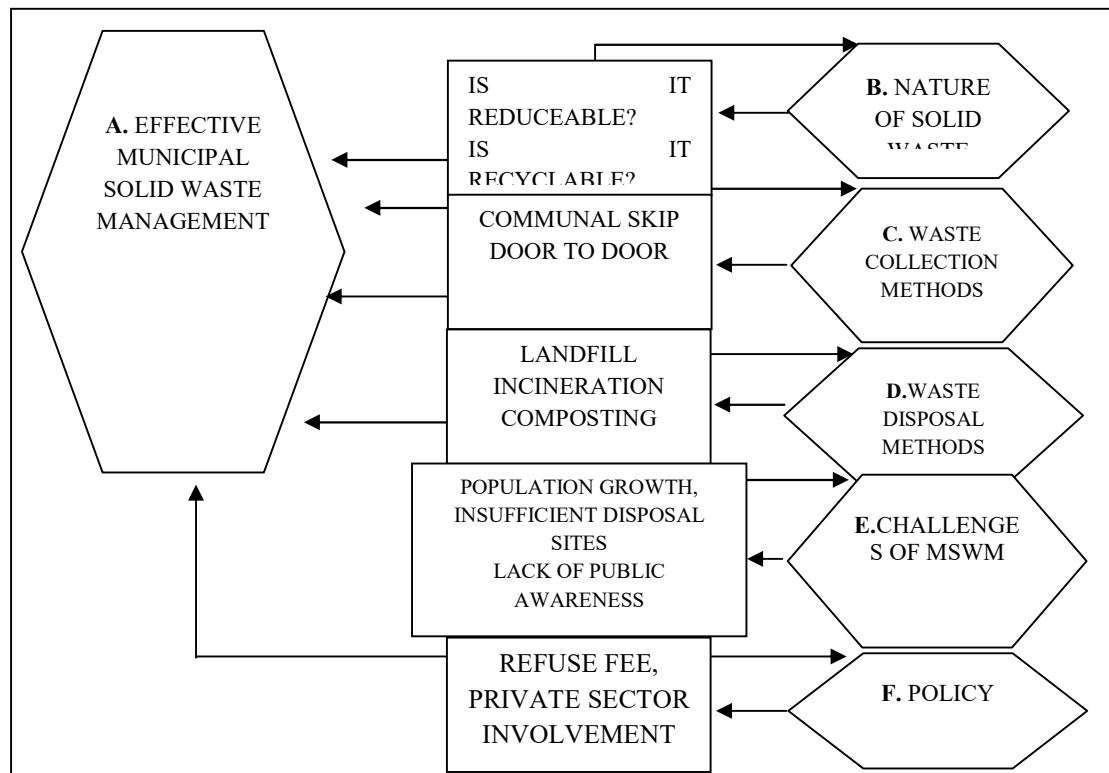


Figure 1.1 : A Conceptual Framework for Municipal Solid Waste Management

Source: Own Construct

Solid waste management is a collection of activities such as waste generation, waste storage, waste collection and final disposal. The effectiveness of solid waste management is influenced by the nature of solid waste, solid waste collection and deposition methods, challenges of MSWM, policies associated with MSWM. However, the identifying of the nature of waste will ultimately facilitate effective MSWM through the application of the waste hierarchy theory especially where the waste is recyclable,

reusable or reduce-able. Well organized waste collection strategies by municipal council, private contractors or private individuals may boost effective MSWM as a result of reduced random waste dumping. The adoption of better waste disposal mechanisms such as sanitary landfill, recycling units, composting units or incinerators can be a bigger stride towards effective MSWM .There are very many hurdles such as financial constraint, distant disposal sites, unclear policies, etc are encountered during MSWM which can be overcome by using the Integrated Solid Waste Management (ISWM) approach. The enacting of proper policies regarding MSWM can be part of the remedy to ultimately achieve effective MSWM.

1.8 Organization of the Study

The dissertation is sub-divided into five chapters. Chapter one embodies the introduction of the study which encompasses background of the research problem, stipulates the statement of the research problem, research objectives, research questions, scopes of the study, significance of the study, conceptual framework. The literature related to the study is reviewed in chapter two. The research methodology adopted was captured in chapter three while the findings were presented and discussed in chapter four. Chapter five depicted the summary of the results, conclusion and the recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Chapter overview

This chapter reviews literature about solid waste management at global, regional and local levels. It has been presented in sections where the first section discusses the systems advocated for municipal waste management, solid waste management discusses the type of solid waste, solid collection and disposal methods.

2.2 Theoretical Literature

2.2.1 Waste Management Hierarchy

This is a waste management strategy which advocates minimization, recovery and transformation and disposal. It has different actions which should be undertaken in order to manage the generated wastes. The strategy has been adopted by developed countries and advocated by some of the developing countries. For instance the waste strategy for England 2007, explains how waste is to be managed in England by using the hierarchy. (DEFRA,2007a). The hierarchy highlights waste reduction or prevention, reuse, recycling/composting, recovery and then finally disposal and it categorizes the five phases of waste management from the most preferred option to the least preferred option and the different impacts that they might have on the environment when used (William, 2005).

(a) Reduction

Reduction of wastes generated at the source is preferred as the best option for waste management and according to William, (2005), this can be achieved through cleaner

technologies and processes by manufacturing products that are more durable. In order to achieve waste reduction option in waste hierarchy, emphasis must be placed on waste reduction from the generation point (Kaseva & Gupta, 1999), and producers must take responsibility for creating longer lasting products with increased durability (Cooper, 1994). Waste reduction may be helpful in chopping the wastes generated especially in areas of burgeoning population with unsustainable municipal solid waste management strategies. Some of the waste reduction strategies may include; production of multi-purpose items, using the new type of stapler that does not require metal staples, using proper mugs rather than using disposable cups, using low energy light bulbs (which have a product lifespan of 8 standard bulbs), rechargeable batteries, using refillable marker pens, and by using products with longer life spans (Bendall, 2005).

(b) Reuse

Waste reuse involves where an item can be used over and over either for the same purpose or any other. According to EEA (2009), reuse is any operation by which end of life products and equipments (such as electrical and electronic goods) and its components are used for the same purpose for which they are conceived. In this case the item such as old jars/pots, tyres, used wood, old newspapers, waste paper, old books, old clothes, etc which could be dumped to end up on the landfill can either be used for storing items, making tyre-swing, firewood/woodcrafts, packing old items, making notes/sketches or donated to those who could have a use for the wastes. This reduces the amount of wastes as such reused items will not be disposed in a short time.

(c) Recycling

Waste recycling may involve changing the waste into a raw material that can be used to produce a new or similar item. This can be crucial in waste management as it reduces discarded items, pressure on natural resources and saves energy as recycling require less energy than a totally new item. Composting the biodegradable waste stream especially food and garden has been viewed as having a great potential in diverting biodegradable waste from landfill and has been encouraged so as to derive compost which is a form of fertilizer and soil conditioner (William, 2005). Municipal solid waste management has become a challenging environmental problem. Many cities in both urban and rural areas have encountered problems with disposal and treatment facilities that are inadequate to deal with the enormous quantities of solid waste. In Thailand for instance, it is estimated that around 24.73 million tons of municipal solid waste was generated in the year 2012 of which only 15.90 million tons (64.29%) was disposed off in prepared waste bins and 11.90 million tons was collected.

Therefore, more than half of the waste (13.62 million tons or 55.08%) was untreated or incorrectly treated (Tranchu, 2012). It is very expensive to improve disposal and treatment facilities (Duffy & Verges, 2009). Thus, the budgets for municipal solid waste management are insufficient to provide disposal facilities. Many cities confront objections from the community due to concerns about environmental conservation. Thus, new treatment plants, both sanitary landfills and incineration, have been banned in many municipalities. The perpetual increase in the amount of wastes makes recycling paramount in curtailing the wastes which can be more compatible with the budget constraints of MSWM for most of the developing countries.

(d) Recovery

Recovery which is usually energy from waste or burning of landfill gas is also an option in the waste hierarchy and the energy recovered can be used for heating and electricity generation. Other energy from waste technologies includes anaerobic digestion which produces methane that can be burnt to generate electricity. Anaerobic digestion involves the use of biological processes in the absence of oxygen for the breakdown of organic matter and the stabilization of these materials by conversion to biogas and nearly stable residue. (Marchaim, 1992).

(e) Disposal

Disposal of waste is the least preferred method because of the environmental impacts such as release of methane and carbon dioxide from the breakdown of materials contributing to climate change, production of leachate which is a source of groundwater pollution and a loss of natural resources associated with landfill (DEFRA, 2007a). Waste disposal is inevitable as a result of the production of some hazardous and clinical waste which cannot be reused, recycled or incinerated and this call for stringent operation laws to ensure that humans and the environment are not endangered. (William, 2005) For instance the relevant Act for land fill waste is the Council Directive 1999/31/EC enacted on 26 April, 1999 which lays down strict requirements for landfills preventing and reducing the negative effects on the environment especially on surface water ground water, soil, air and human health (Directive, 1999/31, 1999). Council Directive 2000/76/EC of the European Parliament and of the Council enacted on 4th December, 2000 lays down measures to prevent or reduce air, water and soil pollution caused by the incineration of waste and reducing risk on the health of human beings. The directive

imposes strict operating conditions and technical requirement waste incineration plants (Directive 2000/76/EC On the incineration of waste. (Directive, 2000/76/EC, 2000)

The hierarchy waste management theory may be employed in the study as it can reveal an option for managing the increased generated waste in the study area. For instance identifying the nature of wastes generated can guide about for the best option which can pave a way for sorting and ultimately recycling, reducing, reusing.

2.2.2 Integrated Solid Waste Management System (ISWMS)

It is a comprehensive waste management system which ensures all components of solid waste management are incorporated into investigation. A system that integrates various effective techniques towards achieving safe and sustainable wastes management is called the Integrated Solid Waste Management (ISWM). According to UN-HABITAT, (2010) ISWM system for convenience is categorized into two ‘triangles’, the physical elements and the governance features. The first triangle comprises the three key physical elements that all need to be addressed for an ISWM system to work well and to work sustainably over the long term: public health geared at maintaining healthy conditions in cities, particularly through a good waste collection service; environment: protection of the environment throughout the waste chain, especially during treatment and disposal; and resource management: ‘closing the loop’ by returning both materials and nutrients to beneficial use, through preventing waste and striving for high rates of organics recovery, reuse and recycling. On the other hand the governance aspect considers inclusivity: who are the stakeholders in the MSWM; financial sustainability: and sound institution, proactive policies.

The ISWM system can be applied in dealing with the problem of uncollected wastes in Temeke municipality as MSWM is influenced by several other factors which should be considered in order to curb the situation. For instance as regards to financial sustainability, it should be ensured to succeed in solid waste management as the generators can pay the refuse charges promptly which support the operation of the service providers.

2.3 Municipal Solid Waste Management

Solid waste can be any material that arises from human and animal activities that are normally discarded as useless or unwanted (Tchobanoglous, et.al 1993). According to Zerbock, (2003) solid waste includes non-hazardous industrial, commercial and domestic waste including; household organic trash, street sweepings, institutional garbage and construction wastes.

Waste generation is inevitable especially as countries become populous, industrialized or modernized. Waste generation is associated with activities where materials are regarded useless in their present form and should be avoided by either thrown away or gathered together for disposal.

Globally, the 20th and the early 21st century indicate that wastes irrespective of their nature have resulted from rapid modernization and economic development (Tsiboe & Marbell, 2004) . According to United Nations Environmental Programme, (2009) the total amount of municipal solid waste (MSW) generated globally reached 2.02 billion tones in 2006 which imply a 7 per cent annual increase since 2003. It is further estimated

that between that by 2025, global generation of municipal waste will strike 2.2 billion tones. (USAID, 2009). UNEP also says that, as per WHO estimations, the total health-care waste per person per year in most low income countries range from 0.5 kg to 3 kg unlike their counterparts the high-income countries which have a higher waste per capita. Comparatively, according to the USAID, (2009), the high and low income countries generate approximately 1,649,547 and 204,802 tons of waste per day.

In East Africa the overall waste generation rate for EAC urban centers vary on average between 0.26 (low income) and 0.78 (high income) kg/cap/day (Mengiseny et.al, 2005; Okot-Okum & Nyenje, 2011). Similar waste generation rates have been reported for developing countries of other regions of the world (Achankeng, 2003).

One of the fast growing cities of East Africa Dar es Salaam with an estimated population of approximately five million and a growth rate of 8-10% per year (Kassim, 2009) will experience an increase in waste generation. The then Dar es Salaam was divided into three municipalities; Ilala, Kinondoni and Temeke with variation in waste generation rates. For instance until 1991 the city of Dar es Salaam (DSM) was generating about 1400 tones of solid waste per day out of which only 5% of the daily generation was being collected. (Kassim, 2009).

According to Kassim (2009), it has been estimated by Dar es Salaam municipal governments; Dar es Salaam City Council, Kinondoni Municipal Council, Ilala Municipal Council, and Temeke Municipal Council that approximately 4,200 tons per day of solid waste were generated in DSM in 2011. This represents a generation rate of

0.93 kg/cap/day based on a population of 4.5 million. Using a population growth rate of 4.3% and a generation rate of 0.815 kg/cap/day, Environmental Resources Consultancy (ERC) has estimated that DSM could be generating over 12,000 tons per day by 2025. This represents a tripling of the waste generated in just 14 years. According to Expert Team (2016), daily waste generation in Dar es Salaam City is 4,100 tonnes per day. The population of DSM has been increasing and automatically the waste generation rate has been inflated. For instance the table below shows population changes and the waste generated in the respective years.

Table 2.1 : Population and MSW Generation for Dar es Salaam

Year	Population	Solid Waste Generation (tons/day)
2001	2,356,263	2,300
2002	2,487,288	2,400
2003	2,564,394	2,500
2004	2,642,708	2,600
2005	2,721,926	2,800
2006	2,801,675	3,100
2007	2,881,548	3,200
2008	2,961,150	3,400
2009	3,040,118	3,500
2010	3,118,132	3,800
2011	3,194,903	4,200

Source: NBS, 2012 and Dar City profile

Much effort has been made to improve the situation as regards to waste collection for instance the involvement of the private sector in waste management. However the waste collected in Temeke municipality has lagged behind than the other municipalities. The

overall waste generation in DSM has tremendously increased from 2000 tons per day in 1998 to 4000 tons per day in 2010. (DCC, 2010) The waste collected from Temeke municipality has lagged behind at 27% of the 1,035 tones of wastes generated in the municipality. Therefore the current low waste collection rates in Temeke municipality imply higher chances of increase in uncollected wastes in future as the collection rates do not tally with the generation rate if no serious measure is taken to correct the situation.

Table 2.2 : Amount of waste generated/collected & percentage of collected wastes

Municipalities	Amount Generated (Tonnes/Day)	Amount Collected (Tonnes/Day)	Collection Rate (%)
Ilala	1,100	430	39
Temeke	1,035	280	27
Kinondoni	2,026	823	41
Total	4,161	1,533	37

Source: Dar es Salaam City Council (DCC), 2011

This will make the municipality susceptible to the negative impacts of poor MSWM such as diseases, odor, water pollution emanating from leachates, and others.

2.3.1 The typology of municipal solid waste collected and disposed

Municipal solid wastes vary in their nature ranging from their source and type. For instance according to Tchobanoglous, et.al (1993) types of solid waste are classified in

relation to the sources and generation facilities, activities, or locations associated with each type.

Table 2.3 : Types of Wastes

Source	Typical Location	Type of waste
Residential	Single-family and multifamily dwellings, low-medium, and high-rise apartments	Food wastes, rubbish, ashes, special wastes
Commercial/ Municipal	Stores, restaurants, markets, office buildings, hotels, motels, print shops, auto repair shops, medical facilities and institutions.	Food wastes, rubbish, ashes, demolition and construction wastes, special wastes, occasionally hazardous wastes
Industrial	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, lumbering, mining, demolition.	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, lumbering, mining, demolition. Food wastes, rubbish, ashes, demolition and construction wastes, special wastes, occasionally hazardous wastes
Open spaces	Streets, alleys, parks, vacant plots, playgrounds, beaches, highway and recreational areas.	Special wastes, rubbish
Treatment plant sites	Water, waste water and industrial treatment processes	Treatment plant wastes (Residual sludge)
Agricultural	Field and row crops, orchards, vineyards, dairies, feedlots and farms.	Spoiled food wastes, agricultural wastes, rubbish, hazardous wastes

Source: Tchobanoglous, Theisen, & Vigil, 1993

Dar es Salaam is a city which serves as a residential area, industrial area, business centre, medical centre. Therefore, this implies the heterogeneous nature of the generated wastes. The heterogenous nature of the wastes generated in Dar es Salaam is shown in the table below;

Table 2.4 : Waste Composition in Dar es Salaam

Waste Components	Percentage by wet weight (%)
Kitchen waste	39
Grass/wood	10
Papers	8
Ceramic and stones	6
Metals	5
Plastics	16
Glass	2
Leather and rubber	6
Textiles	5
Others	3
Total	100

Source: DCC, 2009

In Dar es Salaam, the available studies indicate that solid wastes generated are primarily composed of vegetables (about 39% of waste generated) and other putrefied materials (ERC 2004). The moisture content is very high, typically in the range of 55 to 75%, high organic content (70%) and the average solid waste density was estimated at 310 390 kg/m³ (Yhdego, 1995; JICA, 1997; Mbuligwe, 2004 In Kassim; 2009).

The density of the organic wastes varies basing on the seasons with the rain seasons having more weight due to the increased moisture content and higher availability of fruit and vegetables. Solid waste characteristics are useful for the evaluation of alternatives on storage, collection and disposal techniques. It is also noticed that large volume of wastes are generated from households and easily decompose. The study carried out by Kasseva and Mbuligwe (2003) and Kassim (2009) shows that the households alone

generate about 56% of total waste generated. This result sets out the need for household waste to receive the appropriate collection and disposal services for the better public health and clean environment.

According to Senzige et.al (2014), the per capita waste generation rate was found to be higher in Kinondoni 1.03kg/cap/day followed by Ilala and Temeke with 0.97 and 0.95 kg/cap/day respectively. In addition to that Ilala municipality produces more organic waste (60.9%) followed by Kinondoni with 58.6%. A more surprising scenario is that Temeke produces more plastic waste (21.6%) compared with Kinondoni (14.4%) and Ilala (13.2%). That notwithstanding, plastics waste is the second largest waste produced by all the municipalities. Notably, Kinondoni generates more e-waste compared to Ilala which is a central business district and hence expected to use more e-products.

Table 2.5 : Solid Waste Generation by Municipality and Type

Type of waste	Municipal					
	Kinondoni		Ilala		Temeke	
	Kilograms	%	Kilograms	%	Kilograms	%
Organic waste	24,1500.00	58.6	25,617.00	60.9	14,727.00	54.2
Paper & cardboards	4,830.00	11.7	4,215.00	10.0	2,480.00	9.1
Plastics	5,950.00	14.4	5,547.00	13.2	5,867.00	21.6
Glass	3,852.00	9.3	4,150.00	9.9	2,267.00	8.3
Metal	923.00	2.2	1,215.00	2.9	952.00	3.5
E-waste	789.00	1.9	625.00	1.5	453.00	1.7
Textile	293.00	0.7	284.00	0.7	273.00	1.0
Others	458.00	1.1	433.00	1.03	172.00	0.6
Total	41,245.00	100	42,086.00	100	27,191.00	100
Generation (kg/cap/day)	1.03		0.97		0.95	

Source: Senzige, Nkansah-Gyeke, & Njau., 2014

2.3.2 Municipal Solid Waste Collection Methods

Municipal Solid Waste (MSW) is a worldwide problem where countries in Europe, Asia, Africa and elsewhere have been experiencing for a long time (Jatput et.al, 2009). When solid waste is not efficiently and effectively managed it results into serious environmental pollution which has harmful effects upon people's health, animals, biodiversity and the environment. Solid waste collection is the transfer of wastes from the source or generated area to either point of use and disposal to the point of treatment or landfill.

Waste collection includes not only the gathering of solid waste, but also the hauling of waste after collection to the location where the collection vehicle is emptied (Kreith, 1994). There are different methods of waste collection used in different areas. For instance according to Kreith (1994), the most common type of residential collection services in the United States include curb, setout-setback and backyard carry while in the city of Thimphu in Bhutan the waste collection from households, commercial set-ups was done in concrete receptacles placed at strategic points and conveyed by trucks/tractors. Accordingly, there were concrete bins and containers provided at various locations from where the waste was lifted for disposal. Individual bins/containers were also placed alongside the shops in certain areas, which were emptied directly into the trucks/tippers. This prevents people from dumping waste indiscriminately.

According to KMA, (2006) the modes of waste collection in the Kumasi Metropolis are house-to-house and communal collection. In most of the cities in India the predominant system of collection is through the communal bins at various points along the roads. On

the other hand, house-to-house collection is just starting in many megacities such as Delhi, Mumbai, Bangalore, Madras and Hyderabad with the help of NGOs. Some urban areas are using the welfare associations, on specified monthly payment, to arrange collection. Private contractors for secondary transportation from the communal bins or collection points to the disposal sites, have been employed by many municipalities while other have employed NGOs and citizen's committees to supervise segregation and collection from the generation source to collection points located at intermediate points between sources and dumpsites (Kaushal, et.al 2012).

Municipal solid waste collection method may depend on the set up of the settlement; planned/unplanned.

In the planned areas of the Dar es Salaam, wastes are generally collected at curbside from households, commercial establishments, institutions and industry by either the municipal authorities or the private sector and taken directly to the Pugu dumpsite for final disposal. Where access by collection vehicle is impractical, collected wastes from these areas are taken initially to neighborhood collection sites by handcart for bulking and informal resource recovery before transportation to Pugu for final disposal.

2.3.3 Municipal Solid Waste Disposal Methods

According to Tchobanoglous et.al (1993) the most commonly recognized methods for the final disposal of solid wastes were dumping on land, canyons and mining pits, dumping in water, ploughing into the soil, feeding to hogs, reduction and incineration. Some of these unwholesome practices of solid waste identified during the early disposal practices still exist in cities, towns and villages today. Indiscriminate dumping on

opened land and dumping in gutters particularly are clearly evident in towns and cities, while dumping in water especially people living in coastal towns or near wetlands is common. Burning of dumps is also common in peri-urban and rural communities in developing countries. For instance according to Momoh & Oladebeye (2010), a study carried out in Ado-Akiti in Nigeria showed that, the methods of solid waste disposal include dumping of waste in gutters, drains, by roadside, unauthorized dumping sites and stream.

Waste collected will end up either disposed off or recycled/reused. The most traditional way of waste disposal is a landfill.

(a) Landfill disposal

The Landfill is the most popularly used method of waste disposal today. This process of waste disposal focuses attention on burying the waste in the land. Landfills are found in all areas. There is a process used that eliminates the odors and dangers of waste before it is placed into the ground. While it is true this is the most popular form of waste disposal it is certainly far from the only procedure and one that may also bring with it an assortment of space (Breeze, 2012).

This method is becoming less common these days although, thanks to the lack of space available and the strong presence of methane and other landfill gases, both of which can cause numerous contamination problems. Many areas are reconsidering the use of landfills.

The city of Dar es Salaam is currently using the open dumping site at Pugu Kinyamwezi which replaced the dump site of Tabata, Vingunguti and Mtoni. This site is projected to serve the city for ten years and all wastes from three municipalities are collected and deposited at this site. The site is about 30km from the city centre. The operations involve: waste spreading, covering waste with soil material, fumigation and Weighing of the waste. Solid Waste Collection Private Contractors (SWCPC) and the municipal authorities contribute towards the costs of operating the dumping site. For instance according to Breeze (2012), the private sector/municipal authority haulers are required to pay 1,500 TZS per ton to the DCC whenever they enter at the dumping site though the three local authorities rarely pay the charges.

(b) Material Recovery

Material recovery is the process of taking useful discarded items for a specific next use. These discarded items are then processed to extract or recover materials and resources or convert them to energy in the form of useable heat, electricity or fuel. This may be associated with recycling, reuse, composting.

Recycling is the process of converting waste products into new products to prevent energy usage and consumption of fresh raw materials. Recycling is the third component of Reduce, Reuse and Recycle waste hierarchy. The idea behind recycling is to reduce energy usage, reduce volume of landfills, reduce air and water pollution, reduce greenhouse gas emissions and preserve natural resources for future use. Recycling is more prominent in the developed countries though even the developing countries are following the footsteps. For instance according to Burnley, et.al (2006), the emergence

of sustainability has induced most countries to shift from landfill method of disposal to resource recovery. Since the world is shifting to integrated approach in MSWM termed as 3Rs, it was high time for the Dar es Salaam city authorities to buy the idea urgently (Kalwani, 2016). This is depicted through the setting of national and international targets geared towards the boosting of recovery and recycling. In the European Union (EU) legislations have put more pressure on its member states to manage waste in a more sustainable and environmentally friendly manner (Burnley, et.al 2006). Other EU countries such as Germany, Belgium and Netherlands achieved 64%, 62% and 60% respectively in recycling municipal waste in 2007, the UK which is known as the “dirty man of Europe” is still far behind with a recycling rate of 34% in 2007 (Letsrecycle.com, 2009).

In Tanzania there is no law or policy which states clearly how recycling should be done. In Dar-es –Salaam City which is the largest and commercial city in Tanzania, recycling of bio waste is done only by Ilala Municipality with the help of a Germany organization called Bremen Overseas Research and Development Association (BORDA). The two municipalities of Kinondoni and Temeke do not undertake recycling (according to verbal communication with Bernado, Environmental Engineer at KIKUTA Waste Recycling Station, Gongo la Mboto; Dar-es-Salaam, in November, 2013).

According to Environmental Resources Consultancy (ERC), less than 200 tons per day of waste are recycled. This represents about 5% of the waste stream. The Dar es Salaam Local Authorities (DLAs), on the other hand, have estimated that 18% (750 tons) are recovered from the waste stream. The answer may be more in the middle of these two

estimates as it was difficult for ERC to take into account the recoverable material sold directly by homeowners to middle men. The DLA figures, on the other hand, are estimates and not based on a waste quantities study. Much of the recycling is undertaken by about 3,000 waste pickers at source, at neighborhood collection points, at illegal dump sites and at the Pugu Kajiungeni-site. The recovered materials are sold directly or through middle men to users/ exporters. There was some indication during site visits that some of the scavenging, although still informal, is becoming more organized at the neighborhood collection sites. The DLAs support the formalization of waste recovery at the neighborhood level with full revenue retention. According to the Temeke waste focal point, the revenues from the sale of recyclables do not flow to the Wards but are retained by the recycling contractors. Organic waste accounts for more than fifty per cent followed by plastics and then paper and cardboards and glass. 98% (organic waste, paper and cardboards, plastics, glass, metal and e-waste) of the solid waste generated in the three municipalities of Dar es Salaam is recyclable. (Senzige, Nkansah-Gyeke, & Njau., 2014) Therefore basing on that, strengthening recycling may greatly reduce the amount of wastes disposed.

Composting is a natural bio-degradation process that takes organic wastes i.e. remains of plants, garden and kitchen waste and turns into nutrient rich food for your plants. Composting, normally used for organic farming, occurs by allowing organic materials to sit in one place for months until microbes decompose it. Composting is one of the best methods of waste disposal as it can turn unsafe organic products into safe compost. On the other side, it is slow process and takes lot of space. In East Africa composting is being practiced in more than 11 urban councils of Uganda under the Clean Development

Mechanism (CDM) pilot project promoted by the World Bank (NEMA, 2007; Kumar 2006). In Dar es Salaam composting was initiated by women CBO (KIWODET-Kisutu Women Development Trust) operating in Kinondoni (Oberlin & Szanto' 2011).

The KIWODET composting project was suspended because of land use pressure and negative consumer attitude. Oberlin & Szanto' (2011) observed that even though successful composting can arise from local community capacity, lack of municipal integration and support leaves such technically viable initiatives vulnerable to external factors. Besides economic benefits aerobic composting is partially environmentally important because it eliminates GHG emission that would occur during waste decomposition at dumpsites or landfill (National Environment Management Authority, 2000 and Kumar 2006). EAC countries should consider composting as an option for the implementation of an integrated approach to solid waste management.

Waste to energy (WtE) process involves converting of non-recyclable waste items into useable heat, electricity, or fuel through a variety of processes. This type of source of energy is a renewable energy source as non-recyclable waste can be used over and over again to create energy. It can also help to reduce carbon emissions by offsetting the need for energy from fossil sources. Waste-to-Energy, also widely recognized by its acronym WtE is the generation of energy in the form of heat or electricity from waste.

(c) Incineration

Incineration or combustion is a type disposal method in which municipal solid wastes are burned at high temperatures so as to convert them into residue and gaseous products.

The biggest advantage of this type of method is that it can reduce the volume of solid waste to 20 to 30 percent of the original volume, decreases the space they take up and reduce the stress on landfills. This process is also known as thermal treatment where solid waste materials are converted by incinerators into heat, gas, steam and ash. Incineration is something that is very common in countries where landfill space is no longer available, which includes Japan.

2.4 The challenges associated with Municipal solid waste management system

According to Ogawa (2005), a typical solid waste management system in a developing country displays an array of problems, including low collection coverage and irregular collection services, crude open dumping and burning without air and water pollution control. He categorized these challenges into technical, financial, institutional and social constraints.

2.4.1 Population growth

The rate of population growth influences the rate of waste generation. Therefore in case of a rapid population growth coupled with a poor MSWM system, it becomes a challenge to improve the situation. Forecasts suggest that the rate of population growth and unplanned urbanization in most of the developing countries as in DSM are unlikely to stabilize any time in the near future, so it is vital that a hands-on approach is taken to combat the on-going waste crisis. Whereas planned areas have door-to-door collection, the inaccessibility of the unplanned shanty-towns necessitates pushcarts to carry waste to transfer points. At street level, the actual situation is underpinned by five everyday management problems which have been identified by Ilala Municipal Council as follows

(Bubegwa, 2012). The high rates of urbanization in Temeke municipality will as well worsen the situation given that of the 24 wards of Temeke, 15 wards have an urban set up.

2.4.2 Insufficient disposal sites

Landfill still plays a big role as the major disposal method in most of the developing countries. Countries with low rate of recycling, recovery and reduction strategies still generate high volumes of wastes which have to be disposed by dumping on landfills. However, the large volumes of wastes dumped on non-sanitary landfill may pose a threat for diseases especially amongst the surrounding community. This has prompted the closure of some dumping sites. For instance in DSM, the closure of Mtoni, Vigunguti and Tabata dumping sites prompted the opening of the only dumpsite at Pugu Kinyamwezi serving the whole city. According to Ayuba, et.al (2013), the Federal Capital Territory Abuja has four waste dumpsites Mpape, Gosa, Ajata and Kubuwa which were opened and closed at different times. Mpape dumpsite was opened in 1989 and closed in 2005, spanning 16 ha with waste depth of 15-30 m; Ajata dumpsite was opened in 1999 and Kubuwa dumpsite was opened in 2004 but the Kubuwa dumpsite was forced to close due to odour and random fire outbreaks. Moreover, despite the attempts for fumigation, spreading waste and covering it with soil, most of the dumpsites in the developing countries have current conditions which do not meet any kind of international guidelines. In DSM, the long distance to the current disposal site at Pugu (about 30 km from city centre) causes excessively high operational costs and reduced collection capacity, particularly when traffic conditions and opportunity costs are accounted for.

2.4.3 Insufficient transportation facilities

The problem of transportation influences the transportation of collected waste as often delayed or stopped altogether due to an inadequate fleet of vehicles and trucks supported by insufficient equipment and tools. This situation emanates from the financial constraint faced by the municipal or private contractors. For instance according to Achankeng, (2003), most cities spend 20-50% of their annual budget on solid waste management and only 20-80% of the waste is collected. The standards of waste management is still poor and outdated in many developing countries, with poor documentation of waste generation rates and its composition, inefficient storage and collection systems, disposal of municipal wastes with toxic and hazardous waste, indiscriminate disposal or dumping of wastes and inefficient utilization of disposal site space. This will result into piling of the wastes in the households due to lack of inconsistency in the collection of the wastes. The situation will worsen in the rainy season as the households may lack good storage facilities.

2.4.4 Poor storage facilities for the households

Waste generated should be kept till collected especially where there MSWM system is not associated with daily waste collection. On-site storage is crucial because of public health concerns and aesthetic consideration. In most of the developing countries, waste is stored in containers or even on an open ground surface. Some countries have developed waste storage special containers which are bought by the generators. For instance the Abuja Environmental Protection Board in Nigeria sell specific waste storage containers of varying type and sizes ranging from 10L, 50L, 100L, 240L and more. The smaller sizes come in hard plastic while the larger storage containers are made of metal

(Ayuba, AbdManaf, Sabrina, & Azmin, 2013). A network of neighborhood collection and transfer stations is vitally needed, but currently unavailable due to the lack of physical space in congested urban areas. Poor storage facilities may wet the wastes culminating into a bad smell.

2.4.5 Low public awareness

Low community awareness and public apathy for environmental issues including waste (Mkoma, 2013). Consequently, the single biggest cause of ineffective MSWM was found to be non-payment of RCCs, “especially in low-income areas where collection of RCCs ranges only between 25% and 28%, while in high-income areas it is between 50% and 62%” (Kaseva and Mbuligwe, 2005). This discrepancy is crucial as over 70% of Dar es Salaam residents are estimated to live in unplanned areas. Even this may be an underestimate, since more recent appraisals have suggested the figure “is likely to be higher than 80%” (Kironde, 2006). Public awareness is crucial in the transformation of the attitude of the urbanites devoid of which there will be ineffective MSWM partially due to less compliance to the principles of sustainable MSWM. According to Kalwani, (2016) in principle, stakeholders viewed that public health education awareness creation were needed to transform urban communities from negative attitudes of waiting the government to clean their environment for them to adopting participatory MSWM.

2.4.6 Inaccessibility of some residential areas

The physical inaccessibility of the unplanned residential areas renders door-to-door collection services unfeasible, instead necessitating waste collection in pushcarts before

it is carried to the transfer points. However some of the individuals collecting by use of pushcarts may dispose the wastes in the unofficial sites.

2.4.7 Policy and Legislation Challenges

Policies and legislations govern and influence attitudes and behaviors of individuals and the entire community at large. The presence of bi-laws such as fines, charges, roles played by each party may influence the actions of people in that a clear stipulation, monitoring may spark off effective implementation of the target. However, out-dated laws, low fines/penalties, corrupt leaders have been a stumbling block to effective MSWM (Kalwani, 2016). The success of Moshi Municipality in North-Eastern Tanzania in cleanliness has resulted from committed, creative and pragmatic leadership (Kalwani, 2016) which can be emulated by other regions to improve MSWM.

2.5 Empirical Review

2.5.1 Case Studies in Selected Countries

(a) Household Waste Management in Mashad, Iran: Characteristics and factors influencing on the Demand for collecting services

The study was taken between 2004-2005 by Gorbani, et.al in the Iran's second metropolitan city Mashad (Northeast of Iran). The perpetual increase in the waste generated in Mashad city results into more costs for collection and land filling, land scarcity for landfills, ecological costs for hazardous wastes against municipal budgetary constraints posed a need for the study and developed a waste minimization system characterized of reuse of some material, recycle and reduce produce. The study aimed at identifying the aspects of waste production and demand for collecting wastes in Mashadi

and to clarify some strategies for improvement for household waste collecting system. However in order to achieve this, education, pricing of collection services and controlling of waste production were inevitable. The factors which were realized to influence the demand for collection services were family income and size, commodity price, education, price of recycled material, home tenure (private/rental), and waste collecting frequency.

(b) Enhancing Municipal Solid Waste Management System with 3Rs Options in Thimphu, Bhutan

Thimphu, is the capital city of Bhutan which has a conventional system of MSW initiated in 1993. There has been not much improvement or changes in the system over the years. The collected wastes is transported and dumped at Memelakha, an open site about 10 kilometers away from the downtown. Around 80,000 people live in the 26 square kilometers city area of Thimphu, which stretches from Chantagang in the north to Ngabi Rongchu in the south, fanning on Thimphu River. The Thimphu City Corporation (TCC) is solely responsible for managing the MSW of Thimphu city. It has limited resources, manpower and facilities. Public responsibility sharing and specific waste management institutional tools also are limited. The visit at the Memelakha disposal site during the study found that around 32 tons of commingled wastes is daily collected and transported to this site. The site is virtually over used and wastes are physically overflowing. The physical survey at the source point conducted for three months, from March to May 2007 found that the per day source point waste generation capacity is around 65 tones. Residential household per capita waste generation was estimated to be 0.56 kg/day. All the uncollected 50% wastes may not be remaining in the environment

because certain recyclable waste components are collected by business vendors and informal waste pickers for trading across the border or recycled.

The situation prompted the study about the cost effective policy options in the 3Rs paradigm to address the MSW management of Thimphu. The study aimed to develop a segregated waste inventory to have an overview of the waste compositions, per capita and total waste generation capacity, to collect secondary data and interview relevant respondents to understand the gaps, mainly the policy gaps in the present waste management system, and to find potential 3Rs options, mainly affordable policy options for the management of the predominant waste components in Thimphu. It revealed the need for the introduction of 'polluters pay principle' (municipal taxation and service fees) for financial security and responsibility sharing, formalization of the international/regional waste management cooperation, encouragement of private parties and industries to initiate cooperation in MSW management, enhancing MSW management awareness and education, very importantly to apply waste segregation practice at source and establish a transfer station. It is inevitable that the upcoming National Solid Waste Management Act must embrace all these crucial elements.

(c) Does a Change in Kerbside Collection Scheme has an Effect on Waste Generation, Recycling and Behavior of Householders in Sedgemoor District Council?

The study was taken by Ajirioghene Akpowowo in the Sedgemoor District Council in the south west of England with a population of 111,500. The District council operates a waste collection authority. It covers an area of 56,797 hectares and holds about 45,000

households. The main centers of population are Bridgewater, Burnham on Sea, Highbridge and Cheddar. 78% of the industry in the area is predominantly agriculture. In 1992, the Somerset waste partnership (SWP) was formed with Somerset county council, Sedgemoor, South Somerset, Mendip and West Somerset district council and Taunton Deane borough council. In October 2007, the responsibilities of waste collection and disposal were combined into a single Somerset waste board with Somerset County Council as the administrating authority.

The study aimed to determine the actual weight of reduction between the old and the new scheme and also calculate percentage of reduction, the variations in waste reduction across the various categories that have been sampled. This could lead to determine the category which had the highest reduction, the type or category of waste material that have been affected mostly as a result of the new collection scheme, the capture rate of materials for recycling/composting with the old and the new scheme and identify which was higher, determine if change in waste collection scheme had an effect on the behavior of householders towards waste reduction and increased recycling, give appropriate recommendations from the results attained. In the 2007/8 audit measuring performance of Sedgemoor, amount of waste collected per head fell from 396kg to 388kg and recycling improved from 21.4% to 24%, but performance was still poor compared to similar councils as they fall into the category of worst 25% but the Council rose to the challenge by trialing the “sort it plus” scheme which has been rolled out in four phases in the district managed by Somerset waste Partnership. In 2008/9, a total household waste of 40743.28 tones was generated in which 10818 tones was sent for recycling increasing recycling to 26.55%.

2.6 Policy Review for Solid Waste Management

The UNEP Governing Council of February 2013, in its decision GC 27/12 on Chemicals and Waste Management, requested UNEP “to develop a global outlook of challenges, trends and policies in relation to waste prevention, minimization and management. UNEP’s International Environmental Technology Centre (IETC), in collaboration with the International Solid Waste Association (ISWA), has taken the lead on this initiative; aiming to develop the Global Waste Management Outlook as a tool to provide an authoritative overview, analysis and recommendations for action of policy instruments and financing models for waste management.

The Global Waste Management Outlook (GWMO) is the result of two year’s work and provides the first comprehensive global overview of the state of waste management around the world in the 21st century. It is an important and timely status report and call for action to the international community.

Basing on the global efforts towards solid waste management countries, regional blocks have taken initiative to combat the situation. For instance in the European Union, the most important EU directive governing and controlling waste management is the Waste Framework Directive 75/442/EEC which has been amended several times as years passed, the latest being in 2008 (DEFRA 2009a). William (2005) notes that the main reason for implementing the directive is to avoid or reduce harm done to the environment especially to land, water and air while disposing of waste and without causing nuisance and affecting the aesthetic quality of the countryside. The directive emphasizes that member states should manage waste using the waste hierarchy which is

the approach that the EU has picked to tackle waste with targets set to reduce landfill waste by 20% of 2000 levels by 2010 and 50% by 2050 (European Union 2010). The directive allows each member states to draw up waste management plans that outline how they will specifically meet the targets set by the waste framework directive and the UK government responded by writing the waste strategy for England and Wales 2000 which was replaced by the Waste strategy for England 2007 (DEFRA 2009a).

According to Breeze (2012), Environmental Resource Consultancy (ERC) and other donor funded waste management studies which undertook an extensive review on Tanzania's environmental legislative and policy framework. They found that Tanzania lacks a single comprehensive legislative framework for the environment. Efforts are underway through a draft of the Environmental Management Act, 2004 towards an integrated approach to environment policy however, natural resources and the environment are currently governed by fragmented sector pieces of legislation that are not yet harmonized. Part IX of the draft Act does focus on waste management by charging local government with the duty to manage and minimize solid waste at source. This Part of the Act sets basic standards for the collection of waste including source separation and the use of appropriate waste containers. The Act goes on to assign responsibility for waste management to the local authorities and requires that they must carry out regular studies into the management of wastes including waste quantity and composition to guide the development of appropriate methods for sorting, storage and disposal. The local authorities also have the prime responsibility for managing waste collection in both urban and peri-urban areas and for establishing waste transfer and

final disposal facilities. The local authorities must also oversee and ensure that industry appropriately manages all solid waste generated from their activities.

All in all in principle, waste management; collection inclusive is directly the responsibility of Local Authorities. The Local Government (Urban Authority) Act 1982 (Section 55 grams) imposes on urban authorities the mandate to remove refuse and filth from any public or private place and to provide and maintain public refuse containers for the temporary deposit and collection of waste (URT, 2004; Lyeme, 2011). Solid waste collection and disposal is administered through city cleansing section, which is a subsection of the City Health Department in the three municipalities of Ilala, Kinondoni and Temeke and private contractors (URT, 2004; Lyeme, 2011). For instance in Nigeria's town of Abuja, the Abuja Environmental Protection Board (AEPB, 2012) have the sole responsibility of solid waste management in the Federal Capital Territory (Abuja-Citiserive, 2004). Therefore local governments have made their level best to manage the wastes in the respective areas.

However the rapid inflating waste generation rate has posed a burden to the local authorities to provide commensurate services of collection. This has exacerbated the situation as wastes are poorly disposed into riverbanks, valleys, open spaces or road reserves reducing the aesthetic nature of the areas. This compelled the government to indulge private contractors to participate in the waste management in September 1994. This could chop the costs incurred on waste management as well as facilitating efficiency. For instance a reliable municipal solid waste collection and transportation system could require vehicles costing around US\$100,000 and collection operating costs

approaching 50% of overall municipal budgets. (Breeze, 2012) It started with a single Solid Waste Collection Private contractor (SWCPC) that served 10-city centre wards. For instance failure for Morogoro Municipal council to provide MSW services to the urbanites in the area, it created the need for community participation in 1998. (Kalwani, 2010) The contractor was empowered to collect solid waste collection charges directly from the service recipients' (household had to pay some amount of money TSh 300 – 800 per month). For instance it is mandatory for the households who receive the service to pay basing on the bylaws of the Temeke Municipal Council (Collection and Disposal of Refuse), Bylaws, and Government Notice No.45 published on 25/1/2002. (Kassim, 2009) Presently privatization covers 44 wards out of 73 city wards and 20 active private companies are involved, and approx. 60% of the city wards are covered with the service (Chinamo, 2003 In Kassim, 2009).

In Dar es Salaam, the three city municipalities (Ilala, Kinondoni and Temeke) and the Solid Waste Collection Private Contractors (SWCPC) both participate in solid waste collection and disposal. The SWCPC also include non-governmental organizations (NGOs) and community-based organizations (CBOs). The CBOs normally specialize in the collection of wastes from household to collection points or enclosures, while SWCPC and some NGOs collect wastes to the dumping sites. As time goes on, more SWCPC increase in the offering of the service. For instance some of the CBOs in Temeke are Upendo Youth Group (UYOGRO), Mbagala Kwa Nyoka Development trust, which is found in Mbagala ward in Mbagala division, Concern for Development Initiatives in Vituka Ward (CODIV).

2.7 Knowledge Gap

Most of the solid waste management studies are undertaken within urban centers especially where solid waste generation rates are vibrant. Temeke municipality which is the case study in the current study is characterized by heterogeneous settlement with unplanned, rural and urban. The current study will improve on the solid waste management practice and challenges in the even unplanned settlements and ultimately guide the municipal authorities and other stakeholders to boost solid management within the study area.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Study Area

Despite the increased efforts in waste collection since the increase in the participation of SWCPC in Dar es Salaam, Temeke municipality has lagged behind in terms of wastes collected. The prospects for increasing population in the municipality will threaten the environmental, aesthetic and health conditions of the residents. Temeke municipality is one of the three municipalities which made up Dar es Salaam City. It is found in the southern part and considered to be the largest municipality compared to Ilala and Kinondoni. It is composed of about 30 wards with a total population of 1,368,881; male 669,056 and female 699,823. (National Bureau of Statistics, 2012) The population of Dar es Salaam, Temeke Municipality inclusive is expected to increase given the high rates of urbanization. The city has a warm temperature, moist monsoon climate, cold and dry from April to October, hot and humid from November to March. The average annual precipitation in Dar es Salaam is over 1000mm occurring between March and May due to long and heavy rains. The average temperature is 24⁰C whereas the maximum temperature is 35⁰C and the minimum temperature is 13⁰C. This temperature demonstrates the necessity for quick removal and disposal of wastes due to rapid decomposition process that takes place in this tropical climate and to the high organic content in the waste generated.

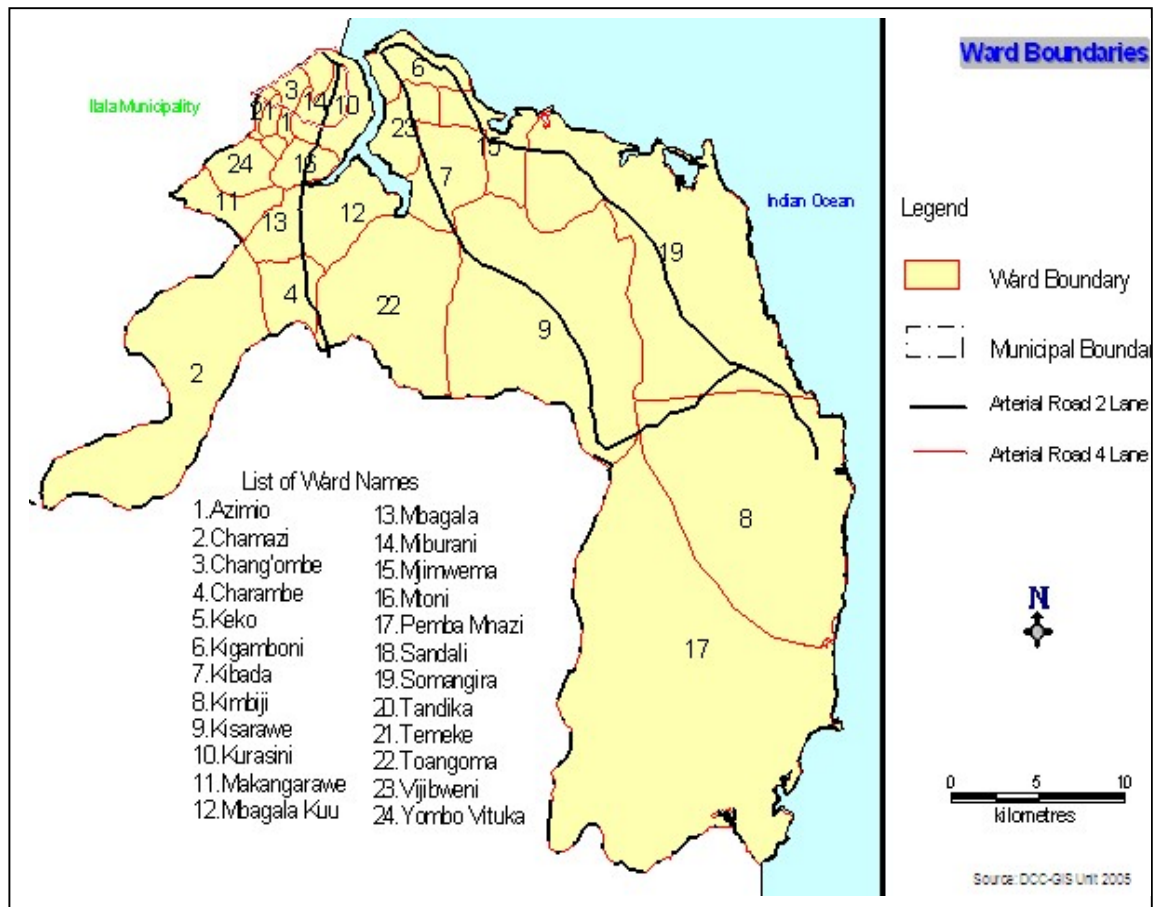


Figure 3.1 Map of Temeke Municipality

3.2 Research Design

The study used a descriptive research design as the research tools to be used were questionnaire, observation and interview techniques.

3.3 Sampling Procedure

3.3.1 The Rationale for Selection of the Study Area

The study was conducted in late 2016 when Dar es Salam still had three municipalities which are currently five; Temeke, Ilala, Kinondoni, Ubungu and Kigamboni. However Temeke Municipality was chosen using Purposive sampling as its waste collection rate was still low compared to the counterpart municipalities; Ilala and Kinondoni. In

addition to that the then Temeke municipality experienced the highest population growth rates of 5.6% unlike its counterparts, 4.6, 5.0 for Ilala and Kinondoni respectively basing on the intercensal population growth rates between 2002 and 2012 (NBS & Office, November 2014). This increases the prospects for high urbanization rates which will exacerbate municipal waste generation rates.

3.3.2 Selection of study wards

The wards in Temeke vary in the set up of the households i.e urban, rural and mixed though the study will be carried out in those wards with high population sizes and will be deliberately chosen since they are expected to have more generation rates and so do the waste uncollected rates. Out of 30 wards of Temeke municipality, 20% will be used in the study. Therefore the 6 wards with the highest population will be used as the sample. The wards to be a proxy for the 30 wards will be Charambe, Mianzini, Kiburugwa, Yombo Vituka, Azimio and Mbagala kuu.

3.3.3 Selection of sample

At the household level, the target population for the interview was women as they mostly indulge in sweeping, gathering of domestic solid waste in homes and disposing of them unlike men who are culturally not bound to perform such duties at home. The total number of female in the six wards of Temeke is 262,321. (National Bureau of Statistics, 2012). Using Slovin's formula, with a confidential level of 92% and a marginal error of 8% (0.08), the number of samples from the six wards was 156 females. The number of women from respective wards is shown in the table below;

Table 3.1 : Number of Sampled Women in the sampled wards of Temeke Municipality

Sample wards	Azimio	Charambe	Kiburugwa	Mbagala Kuu	Mianzini	Yombo Vituba	Total
Number of women	24	31	24	23	31	23	156

Source: Own Construct

The women in the respective wards were obtained by convenience sampling. The municipal authority that filled the questionnaire was obtained by purposive sampling while the SWCPC/private collectors operating in the wards were obtained by snow ball sampling.

3.4 Data collection Methods

3.4.1 Sources of Data

Primary Data

Data was collected from primary and secondary sources. The primary data was collected from the households from Temeke Municipality, SWCPC, waste workers, scavengers, municipal officials, included the type of waste generated/collected/disposed; the current solid waste management system such as collection, disposal, recycling system, place of disposal, availability of skips and bins for storing waste, Mode of collection and payment for collection and distances covered to dispose of waste in skips.

Secondary Data

Secondary data was obtained from the documentations, reports and any other useful literature from the municipality library associated to solid waste management system, SWCPC.

3.4.2 Data collection instruments/tools

The study used various research methods in data collection to include the primary and secondary sources. Data was obtained by using interview, report review, questionnaires and observation techniques which could be for triangulation. Triangulation helps in establishing truth from different sources and tools (Kalwani, 2010).

(a) Interview technique

Interviews were undertaken amongst the female, SWCPC/waste collectors. During the interviews, the households were asked the major types of wastes generated whether food leftovers, plastic material, glass material, papers, demolition material; how waste is collected whether using wheel burrows, bicycles, tricycles, portage, from house-to-house or vehicles collect from a collection point; are the waste generators applying waste sorting; whether the households pay for waste collection, how much they pay, how frequent they pay.

On the other hand the SWCPC/waste collectors were asked the waste collection whether collect from the generation point or from a common point or collection point, frequency of waste collection; disposal system whether generators get rid of their wastes by collecting, burning, burying, feeding animals; availability of equipments whether the

trucks, skips, tractors, compactors are sufficient; place of disposal whether a collection point or direction to a landfill, do they pay on disposal.

(b) Questionnaire technique

The municipal official was issued with a questionnaire to inquire about almost similar questions as SWCPC/waste collectors.

(c) Observation technique

Non-participant observation was used to verify some of the responses given by the interviewees. For instance the observation checklist could seek to check the characteristics of wastes generated, availability of different bins for different wastes, available equipments with SWCPC, presence of waste heaps randomly, are there trucks/bicycles/tricycle carrying wastes, type of waste storage facilities.

(d) Report review

The source of information involved reviewing literature related to waste management such as journals, academic works, and reports.

3.5 Data Analysis

The raw data obtained from the questionnaires and interviews responses was systematically organized in a manner that facilitates analysis. Both qualitative and quantitative analyses were involved, thus the responses in the questionnaires and interview guide were interpreted and assigned numerical values. Coding, entering data and analysis were done using Statistical Package for Social Sciences (SPSS).

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter is divided into three main components. The first section provides an overview of waste management plan for Dar es Salam City Council (DCC). Section two analyses the primary data collected from the sampled six wards of Temeke municipality; Yombo Vituka, Azimio, Kiburugwa, Mbagala Kuu, Charambe and Mianzini. The third section presents a discussion of the research findings from the current study.

4.2 Characteristics of Municipal Solid Waste Management in Temeke Municipality

Data were collected on the following issues; on the nature and source of solid waste collected and disposed; the solid waste collection methods used in the Temeke Municipality; the solid waste disposal methods used in Temeke municipality; the alternatives and challenges of solid waste management in Temeke municipality. These are discussed in the sub- sections below.

4.2.1 Typology of Municipal Solid Waste Collected and Disposed

Data about the typology of municipal solid waste generated/collected/disposed will give a clue to the responsible solid waste management institution that is mainly Temeke Municipality to choose the most appropriate methods on how to effectively deal with the different types of solid waste. For that case therefore this can pose the need for recycling, sorting at the generation points, composting to be incorporated in the waste management. The data about the nature of the waste was obtained by using triangulation

that is through questionnaire, observation and interview technique. The wastes included food remains, plastic material such as bottles, polythene bags; paper material in form of boxes, papers; swept rubbish included leaf litter; glass material were not mentioned by the households but observed at the collection points like that for Azimio ward adjacent the Ward office at “Temeke Mwisho”. All respondents from all wards reported to generate rubbish, food waste and plastic material especially the bottles and polythene bags. Few of them mentioned paper material. None of the respondents said to generate glass material though were seen at a near collection point in Azimio ward, unofficial open dumping site in Mianzini ward. The glass materials seen at Azimio collection point were in form of bottles. However these might have been generated from other areas mainly from not the six wards studied. This is because the collection point is used by other wards other than Azimio. According to the Azimio’s Health Officer,

“Our collection point does not cater only for wastes from our ward, but also serve areas such as Keko, Temeke, Mtoni, Kurasini, Tandika.

4.2.2 Municipal Solid waste collection methods used in the Temeke municipality

There are basically two modes of waste collection in Temeke Municipality which include the door-to-door collection method and a similitude of communal waste collection method. The study has shown that waste is collected by the municipal council, CBO’s, the informal private collectors and with no SWCPC which can be seen from Table 4.1.

Table 4.1 : Municipal Solid Waste Collectors in Temeke Municipality

Waste Collectors	Sampled Wards in Temeke Municipality					
	Azimio	Charambe	Kiburugwa	Mbagala Kuu	Mianzini	Yombo Vituka
CBO's	10	-	-	-	-	-
Municipal Council	-	10	-	-	04	04
Informal Private collectors	11	06	20	16	17	09
SWCPC	-	-	-	-	-	-
Not collected	03	15	04	07	10	10
Total	24	31	24	23	31	23

Source: Field Data, 2016

Informal private collectors are individuals who are unauthorized and move door-to-door collecting wastes for the households willing to receive the service. The willingness is shown by their readiness to pay for the service. These are the most prominent waste collectors in the surveyed wards of Temeke municipality. For instance about 51% (79 of 156 households) of the households receive the waste collection service from the informal private collectors for Kiburugwa, Mabagala Kuu, Mianzini and Azimio spearheads in the reception of the waste collection service from the informal private collectors. CBO's have operations in only Azimio with no services they offer in the rest of the wards; Kiburugwa, Mabagala Kuu, Mianzini, Yombo Vituka and Charambe. This is due to inaccessibility. Municipal council operates only in few wards; Mianzini, Yombo Vituka and Charambe with no operation in the rest of the wards of the study; Mbagala Kuu, Azimio, Kiburugwa. No any of the wards does SWCPC offer its service.

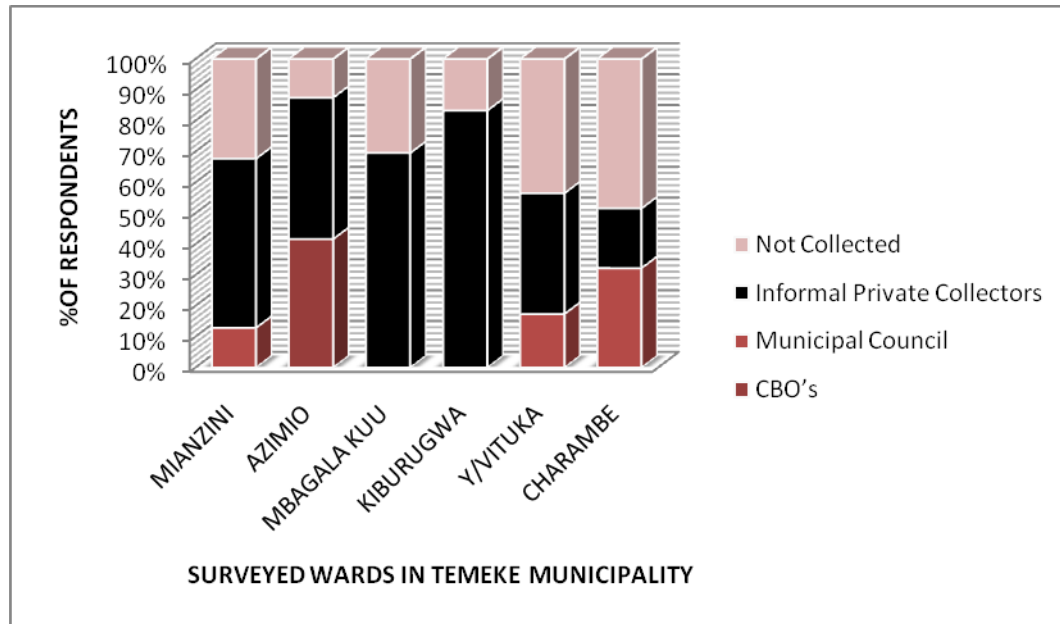


Figure 4.1: Municipal Solid Waste collectors in Temeke Municipality

Source: Field Data, 2016

4.2.2.1 Door-to-door Municipal Waste Collection Method

Basing on the study, 57.4 per cent of the respondents indicated that, waste was collected directly from the households/generators by the informal private waste collectors (51%) and Community Based Organizations (6.4%). This is where municipal service for solid waste collection is not available. Such areas are inaccessible by the waste collecting trucks. For instance in Yombo Vituka ward some streets (Mitaa) like Mzambarauni are inaccessible in that the door-to-door collection method of trucks is not possible unlike within Vituka street (Mtaa) where the municipal council collects wastes from the households. The private waste collectors are informal individuals/group who collects the wastes from households. They are not registered neither officially known by the ward/street authorities.

Table 4.2 : Percentage Role by Different Waste Collectors

Waste collectors	Number of respondents	Percentage (%)
Municipal Council	18	11.5
SWCPC	00	0.0
CBO's	10	6.4
Informal private collectors	79	51.0
Not Collected	49	31.0
Total	156	100%

Source: Field Data, 2016

Door-to-door MSW Collection by CBO's and Informal private waste collectors plays a big role in waste collection. This is shown by 57.4 percent of the respondents obtain the waste collection service by a door-to-door method.

4.2.2.2 Communal Municipal Waste Collection Method

This involves the collection of wastes to an official dumpsite/point. In the study area, this method is undertaken where there are occasional dumping sites especially along the deeply eroded areas as well as using the transfer collection point as the dumpsite especially for the households residing near the transfer collection point. Some of the areas are steep such that after the rain seasons are deeply eroded which compels the landowners to request the local government to allow waste to be dumped along the gullied areas. Basing on this, the Temeke Municipal official in charge of solid waste management said,

“Sometimes we are also requested by the local people to finally dump the wastes in their areas in order to fill up the deeply eroded area more especially after the rain season”.



Plate 1: Communal-like Solid Waste Collection along roadside in Miazini ward, Temeke Municipality

4.2.3 Municipal Solid Disposal Methods in Temeke Municipality

Municipal Solid waste generated is stored in plastic bags, polythene bags with no standard uniform storage gadget. After some days the waste is either collected or disposed off. The solid waste disposal methods in the surveyed wards can be summarized in Table 4.3 below.

Table 4.3 : Municipal Solid Waste Disposal Methods

Wards	WASTE DISPOSAL METHODS				Total
	Collected	Backyard	Open space	Temporal Dumpsite	
Mianzini	21	01	05	04	31
Azimio	21	00	03	00	24
Mbagala Kuu	16	01	04	02	23
Kiburugwa	20	00	04	00	24
Y/Vituka	13	00	10	00	23
Charambe	16	00	07	08	31

Source: Field Data, 2016

Much of the waste is collected for instance 68% (21 of 31), 88% (21 of 24), 70% (16 of 23), 83% (20 of 24), 57% (13 of 23), and 52% (16 of 31) in Mianzini, Azimio, Mbagala Kuu, Kiburugwa, Yombo Vituka, Charambe respectively is collected. In wards where the municipal council collects the waste, no skip is put for waste collection but rather the waste generators assemble their wastes along accessible locations such as along the road or open space. The waste is then directly dumped on the truck. Only 3.2%, 4.3% in Mianzini, Mbagala Kuu wards dispose their wastes in their backyards. The use of backyard is possible in Mianzini and Mbagala Kuu wards amongst households with large compounds within almost a rural setting. It was not evident in other wards since the houses are compacted with no space where the wastes could be dumped. In addition to that, it is the only waste disposing method which doesn't require paying. According to one respondent in Mianzini ward,

...."I can't pay money for waste collection yet I have a large space in my backyard within which I can just dump without inconveniencing anyone".

Illegal dumping of wastes in open spaces, eroded stream channels, bushy places, graveyards and other unofficial sites is also prevailing. The practice is very rampant as 43% (10 of 23), 26% (07 of 31), 16% (05 of 31), 17% (04 of 23), 17% (04 of 24), 12.5% (03 of 24) in Yombo Vituka, Charambe, Mianzini, Mbagala Kuu, Kiburugwa and Azimio dump their wastes in open spaces. Illegal dumping in Yombo Vituka may be inevitable in some *Mitaa*. For instance of all the *Mitaa* in Yombo Vituka ward only Vituka receives solid waste collection services from mainly the municipal council yet its collection frequency is not satisfying the households. The municipal council may collect wastes twice a month which makes the wastes to pile at homes of the waste generators. According to a shopkeeper in Yombo Vituka ward who operates in Vituka *mtaa* but lives in Mzambarauni *mtaa*;

..”Municipal council has failed to offer the service, see: they take a long time to collect the wastes. What can I do to the wastes; we are forced to give the unofficial collectors whom we don’t know even where they ultimately dump the wastes. Better we get rid of the wastes by dumping haphazardly especially during the night. It is common in Mzambarauni mtaa finding a heap of waste near non-generators’ home” in a morning.

Temporal dumpsites are those deeply eroded areas whereby the landlords request the Mitaa leaders or the municipal council to temporarily allow the residents to dump the wastes there. In most cases such requests arise after the rainy season having the surface runoff deeply eroded the steep areas. According to the Municipal official in charge of solid waste management,

...” We get many requests to take the collected wastes to the deeply eroded areas, though this is not sustainable, it saves us the costs which would be incurred hauling the wastes to the sole dumpsite in Pugu”



Plate 2: Communal-like Solid Waste Collection along roadside in Miazini ward, Temeke Municipality

The overall municipal waste collected is more than other disposal methods as 70% (out of 156) of the respondents collect their wastes with either the municipal council or informal private collectors or CBOs or collected directly to the collection point as in Azimio ward. Illegal open space dumping ranks second after the collected with 20% of the respondents dumping wastes haphazardly in bushy places, aside roads, graveyards, eroded stream channels. Temporal dumpsites are officially acting as dumpsites after a mutual agreement between the local authorities, the municipal council, the CBOs with the landlords of the areas to serve as temporal dumpsites. This agreement aims at filling

up the deeply eroded areas. Only 9% of the respondents dump their wastes directly onto temporal dumpsites. A minute number of respondents use backyard dumping as only 1% uses the disposal method.

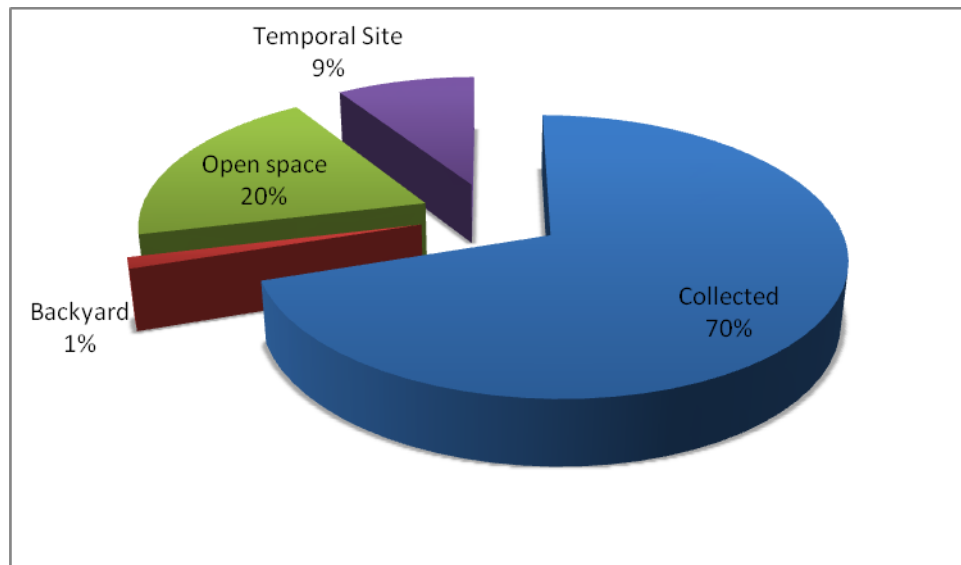


Figure 4.2: Municipal Solid Waste Disposal Methods

Source: Field Data, 2016

4.2.4 Problems facing Municipal solid waste management in Temeke Municipality

Solid waste management may have alternatives in different solid waste management practices ranging from generation, storage facilities, and collection and disposal methods.

4.2.4.1 Alternatives for the current Municipal Solid waste Management in Temeke Municipality

The reported alternative disposal methods in the surveyed wards of Temeke municipality included burning and burying of the wastes rather than collecting or dumping onto official dumpsites.

Households who neither collect their wastes to the municipal council, CBO's nor informal private collectors, dump their wastes in their backyards after which can burn or bury depending on the nature of the wastes. For instance as seen in section 2.3 of chapter four, 3.2%, 4.3% in Mianzini, Mbagala Kuu wards respectively dispose their wastes in their backyards especially amongst households with large compounds within almost a rural setting. In addition to those who use their backyards, households in wards where amongst the disposal methods include open space and temporal dumpsite have reported burning and burying as one of their alternative disposal methods. For instance 06 of 10 who use the backyard, open space and temporal dumpsite though overall 19.3% (06 of 31); 12.5% (03 of 24); 30.4% (07 of 23); 16.6% (04 of 24); 43.4% (10 of 23); 48.3% (15 of 31) from Mianzini, Azimio, Mbagala Kuu, Kiburugwa, Yombo Vituka and Charambe wards respectively considered burning and burying as their alternatives. However most of the households who reported burying as their alternative disposal methods said shortage of land as a stumbling block whereas those who reported burning as their alternative disposal methods had a challenge of smoke to the neighbors except 1% who use the backyard to dispose their wastes.

In Yombo Vituka ward where the frequency of waste collected is low, in the rainy season the wastes become wet. This calls for a need to spread the wastes so that they lose moisture and reduce the possibility of releasing dark smoke during burning which could be a nuisance to the neighbors.

Food wastes can be used as animal feeds such as dogs, cats, ducks and hens especially for those living in a rural setting or rearing or their neighbors are rearing.



Plate 3: A Temporal dumpsite a deeply eroded area in Kiburugwa ward, Temeke Municipality

4.2.4.2 Problems facing the current Municipal Solid waste Management in Temeke Municipality

Municipal Solid waste management is impeded by inconsistency in waste collection. Municipal Waste collection is not satisfying the households especially where the municipal council is the service provider. According to the surveyed wards, 12% (18 out of 156) of the respondents who receive municipal council service in Yombo Vituka, Charambe and Mianzini wards reported the continuous delays in the solid waste collection. For instance 17% (4 out of 23) in Yombo vituka reported the frequency of

waste collection by the municipal council to be twice monthly. One of the respondents in Vituka *mtaa* of Yombo Vituka ward said,

..” If the municipal council can’t offer the service, let it leave the work to capable SWCPC or the CBO’s or informal private collectors, it prompts us to pile waste in our homes which becomes a nuisance during the rainy season and we alternatively spend more money by giving the waste to the informal private collectors who were banned to operate”

Therefore, the irregular waste collection may prompt haphazard disposal, extra costs to the waste generators. The frequency of the CBO’s is once in a week (weekly) which is providing a good service given that the service charges are collected on a monthly basis unlike the informal private collectors who provide service on a cash basis. Basing on the survey, only Azimio ward obtains service for solid waste collection from CBO’s as 42% (10 out of 24) respondents pile their wastes which are collected on a weekly basis. The Chairperson of Kichangani *mtaa* of Azimio ward said,

..”The young boys of BORENGA (CBO’s name) use wheel burrow to collect wastes four times a month and collect their money once at the end of the month. A single collection of the service charge has minimized complications in the money collection though sometimes we are forced to interrupt in case of a non-cooperating resident. All in all their service ensures waste collection and minimizes random waste disposal...”

The CBO’s charges about 4000/= Tanzanian Shillings per month per house. On the other hand the informal private collectors are always moving around to collect wastes for

those who need the service and ready to pay. Their frequency is high but costly as for those who generate large amount of wastes would receive the service at least twice a week which implies a range of 1000-1500/= per collection which can cumulatively be approximately 8,000-12,000/= per month.

Sometimes the lack of cash may prompt the waste generator to dump the wastes in unofficial sites.

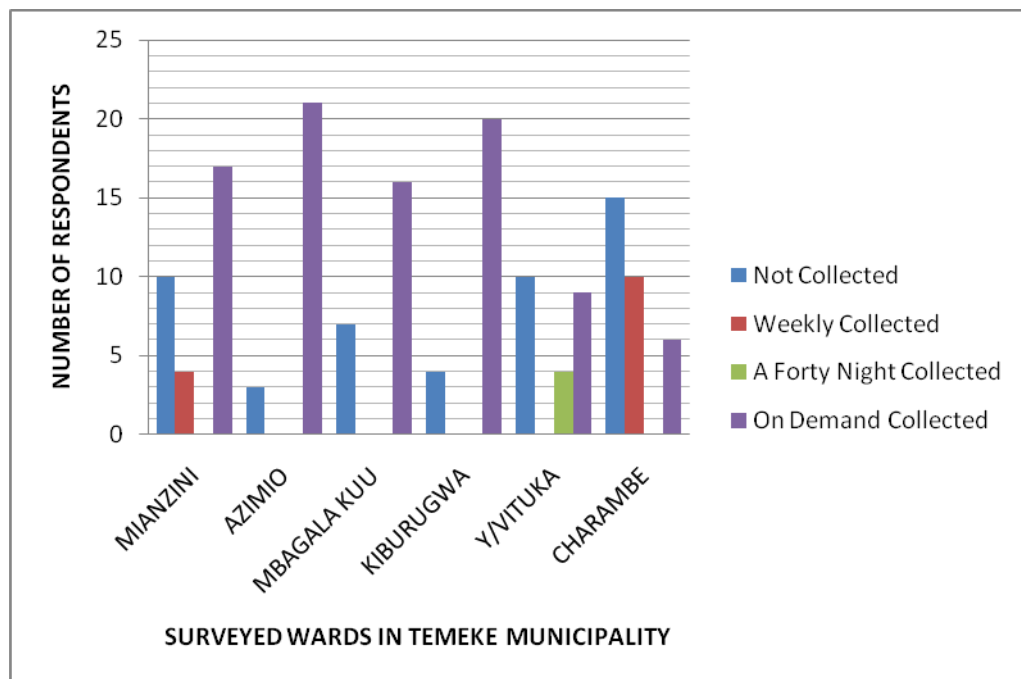


Figure 4.3: Frequency of Municipal Waste Collection

Source: Field Data, 2016

The municipal council is principally responsible for solid waste management and has the lowest frequency compared to the other solid waste collectors. This is brought about by a deficit of equipments. The municipal council collects wastes from households of Charambe, Mianzini and Yombo vituka wards as well as from collection points such as

that of Azimio ward around Temeke *Mwisho*. The task requires a wide range of equipments for effective MSWM.

The presence of the enough equipments increases efficiency in MSWM as well as lowering the operational costs. However, a deficit of equipments is one of the challenges in MSWM not only faced by the informal waste collectors but also the municipal council. For instance according to the Municipal waste management officer of Temeke, ..” *We lack equipments to fulfill our responsibility of waste management. Some of the vehicles have frequent technical breakdown because of their age. This prompts us to hire vehicles which make the operational costs high. A great deficit of skip containers encourages haphazard waste dumping which is a big hurdle to the success of MSWM in our municipality*”

Table 4.4 : Equipments Required for MSWM for Temeke Municipality

MSWM Equipments	Open truck	Skip container	Skip loader	Tractors	Compactor truck
Required	10	220	20	4	10
Available	-	18	2	2	-

Source: Extracted from Bubegwa, 2012

The situation is worsened by a low budget allocated for SMW. The amount of funds available can’t facilitate the purchase of other equipments. The lack of equipments prompts hiring which can’t be frequent to satisfy the need of waste collection thereby reducing the efficiency of waste management. According to the Temeke Municipal waste management officer,

....”There is no even a single skip container in any of the wards under your study. In fact the shortage of skip container costs us much, worsened by shortage of trucks to collect the wastes more often. Worse still the reserved budget is too small to frequently hire the equipments to fulfill the waste management task as required. Therefore this challenge may partially account for our effectiveness in MSWM”....

The presence of the only distant dumpsite in Pugu Kinyamwezi is a big blow to the operation of waste management. The increasing waste generation rate necessitates frequent haulage to a distant dumpsite which inflates the operational costs. The municipal council collects wastes and finally disposes at Pugu Kinyamwezi. According to the health officer for Azimio ward,

..”The Municipal lacks enough trucks which assist in hauling the wastes at a fair cost. This sometimes prompts hiring a truck to a skip loader, truck to get rid of the piled wastes. The money collected from the waste disposers doesn’t tally with costs to operate the collection point and hauling costs.....”

The situation is exacerbated by the absence of a proximate local dumpsite or collection points as it accelerates illegal dumping especially given the high operational costs which disfavor high frequency of waste collection.

4.3 Discussion of the Findings

This section discussed the findings with other scholars who researched on more or less similar issues related to MSWM as follows;

4.3.1 On the nature and source of MSW in Temeke Municipality

This study established that wastes included food remains, plastic material such as bottles, polythene bags; paper material in form of boxes, papers; swept rubbish included leaf litter and glass material which was vividly seen at the collection points like that for Azimio ward adjacent the Ward office at “Temeke Mwisho”. All respondents from all wards generate rubbish, food waste and plastic material especially the bottles and polythene bags. This is because the activities associated to the generation of these types of wastes are found in all households of various statuses. All people cook and the food remains emanate from gone bad food, food leftovers, and burnt food. Plastic material wastes such as bottles and polythene bags are rampantly used in packaging. However bottles are not haphazardly disposed since they are recycled unlike the polythene bags which are non-recycled and easily be blown by wind. Glass material has been not much recorded lest as glassed bottles. The low record of glassed bottles is due to the shift to plastic bottles.

Likewise Senzige et.al, (2014) and DCC (2009) in their studies conducted in Dar es Salaam established the presence of a wide range of types of MSW disposed/collected in Dar es Salaam region.

4.3.2 On the MSW Collection Methods in Temeke Municipality

Urban areas have a wide range of MSW collection methods given the diverse settlement set up. The study has basically revealed two methods of municipal solid waste collection; door-to-door and a communal-like collection methods.

Door to door MSW involves the service providers collecting wastes from the households. In Temeke municipality door-to-door is provided by informal private collectors and CBO's though the informal private collectors play the major role. The collection method is common elsewhere in the cities across the world with variation in the use of trucks, pushcarts or human portage. Like Obirih-Opore & Post, (2002) who carried out a study in Accra, Ghana whereby the findings established a door-to-door collection system though the collectors are initially waste pickers who are persuaded by the generators to take up their wastes as well in return of a little pay. Whereas basing on Swai (2003)'s study; Assessment on Cost Recovery and Peoples' attitudes Towards Public Private Partnership in Domestic Solid Waste Management in the City of Dar es Salaam, a door-to-door collection is undertaken by private contractors especially serving the medium and high income areas. However in this study area where the residential places have poor access roads it is easier for the informal private collectors and CBO's to provide the service than the private contractors who use trucks that cannot reach all individual generators. In addition to that sometimes the inconsistency services provided by the municipal council have compelled people to adopt the use of the private collectors; CBO's and the informal private collectors who have proved to perform better depicted by the available service on demand. This has been proved in Mzambarauni Street of Yombo Vituka ward during the study.

Communal-like collection involves the waste generators collecting the wastes in an official dumping site or point or communal containers or curb. During the study, waste generators were revealed to collect their wastes along roads, temporal dumping sites. For instance some of the residents of Azimio collect their wastes at the official temporary

collection point at “Temeke Mwisho”. This is influenced by the level of proximity to the collection point in that the closer is the resident to the collection point the more the waste generator uses the collection point.

In most of other cities in developing countries the use of communal containers is vivid whereby the waste generators put their waste in a shared containers/skip. Addo-Yobo & Ali, (2003) ‘s study in the city of Accra, Ghana showed that generators collect their wastes in a shared skip which imply generators have to move a certain distance to collect their wastes.

4.3.3 On the MSW Disposal Methods in Temeke Municipality

The study recognized disposal methods for the MSW in Temeke municipality as collection, into generators’ backyard, nearby open space and temporal dumpsites.

Wards with effective CBO’s, informal private collectors, municipal councils disposed their wastes by collecting them to the collectors. Therefore, in such wards households could get rid of their wastes by collecting them to the respective active collectors. However in some wards where the municipal council is not consistent or delays in the collection, the informal private collectors could collect the wastes. For instance in the Vituka street of Yombo Vituka ward, the twice per month frequency of waste collection by the municipal council sometimes prompts the households to use the informal private collectors to collect the wastes. The low performance for municipal council in MSWM compared to CBO’s was also vividly found out during a study by Kalwani (2009) in Morogoro municipality.

Waste is also disposed by using the backyard, nearby unauthorized open spaces and the temporal dumpsites. Households with big chunks of land can dispose their wastes within their backyard as in Mianzini and Mbagala Kuu wards. Therefore this is determined by the availability of unutilized land owned by the households. On the hand households within inaccessible unplanned ramshackle residential places are more prominent for haphazard disposal of wastes. In this case waste is dumped into unauthorized nearby open spaces such as grave yards, gullies along the deeply eroded stream. Similar results were reveled in Ado-Akiti in Nigeria that, the methods of solid waste disposal include dumping of waste in gutters, drains, by roadside, unauthorized dumping sites and stream channels during raining season (Momoh & Oladebeye, 2010). The haphazard dumping may be due to the absence of collection services or unwillingness/ inability for paying the collection service charges.

Sometimes especially after the rainy season, wastes may be disposed into temporal dumpsites which are the deeply eroded areas like in Mianzini ward of Temeke municipality. This is done purposely to fill up the deeply eroded areas on request by the landlords. The proximity to the temporal dumpsite may encourage the nearby households accelerated by absence of dumping charges despite of the presence of waste collectors. Therefore for that case the distant collection point or dumpsite may open up avenue for haphazard dumping or device other alternatives.

4.3.4 On the Alternatives of MSWM in Temeke Municipality

The study in Temeke municipality showed that the alternative waste disposal methods were burning, burying and use for animal feeds. Alternatives arise when the prevailing

proper means of waste disposal is either not consistent/affordable. For instance where waste collectors delay to offer the service especially the municipal council for the case of the study in Temeke municipality, waste generators improvise means to get rid of the wastes. Burying and burning have been always as alternatives to collection amongst those with vast land as shown in Mbagala Kuu and Miazini wards. It is therefore possible in a rural setting. Food wastes are a proxy to animal feed. Therefore it is a good alternative for households who undertake poultry or animal rearing as these food leftovers can be a good food for the animals/birds. However the stumbling block for burning has been the nuisance from the spewed dark smoke/dust especially in the densely populated areas in addition to the shortage of land.

4.3.5 On the Problems facing MSWM in Temeke Municipality

The study revealed challenges for Municipal Solid Waste Management (MSWM) in Temeke Municipality as inconsistency in waste collection, low budget and a distant official dumpsite at Pugu Kinyamwezi.

This study also tried to discuss with other authors on the observed tendency of frequently low waste collection and inconsistency whenever the municipal council assumed the role of a MSW collection service provider. This was seen in Vituka Street of Yombo Vituka ward. The usual answer to this by municipal authorities had been the high cost of operation within a deficit budget set for MSWM hence it impeded effective and efficient collection of solid waste. This statement need to be taken with reservations. Because, a recent study conducted in Dar es Salaam by Kalwani (2016) revealed that in some quarters, the 'budgetary deficit' for MSWM is over-exaggerated as an excuse to

hide inefficiency and/or even sidelining the budget set for waste collection activities for other unauthorized expenditure or embezzled. Kalwani (*Ibid*) supported the observation by comparing MSWM by previous governments with the present government of the Fifth United Republic of Tanzania which does not compromise with irresponsible civil servants and embezzlers of public funds evidenced by sentiments uttered by the President popularly the “*Hapa Kazi tu*” (in Kiswahili meaning *work earnestly and responsibly* and “*Kutumbua majipu*” literally meaning *the only cure for an abscess though painful, is crudely splitting it open with a sharp blade and squeeze out the unhealthy fluid*. As a result, many parts of the Dar es Salaam city today enjoy some degree of cleanliness. One would wonder where the funds came from to replace ‘deficit budgets’. Impliedly, it appears that the current government’s uncompromising statements and deeds have instilled responsibility and accountability among government officials to care not only for the urban environmental cleanliness but also other sectors.

Dar es Salaam city is served by the sole distant official dumpsite at Pugu Kinyamwezi. This increases the amount of fuel, number of routes and ultimately raising the operation costs. However the dependency on landfill disposal is a problem related to continued reliance on the traditional method of MSWM. According to Kalwani, (2016) in the study carried out in Dar es Salaam the traditional method of relying on the landfill is unsustainable as it is costly and a health hazard to the communities living around the landfill. Therefore, there is the need for the Dar es Salaam City authorities to buy the idea of integrated approach to effective and efficient MSWM through the “3Rs” (recovery, recycling and reduction) in order to reduce large quantities of wastes daily hauled at exorbitant costs from the city centre to the Pugu Kinyamwezi official dump.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Findings

Basing on the survey in the sampled wards; the findings have shown that the most generated waste is in the form of rubbish, food waste and plastic material especially the bottles and polythene bags, few reported paper material with non reported to be generating glass material though these were seen amongst the informal sorting group adjacent Azimio ward collection point near “Temeke Misho”. The study had to examine the solid waste collection methods used in the Temeke municipality, Dar es Salam in Tanzania. The study revealed basically two methods of solid waste collection; door-to-door and the communal. Most of the solid waste was being collected by the informal private collectors and CBO’s with municipal playing a minute role. None of the SWCPC was offering service in the surveyed area.

The door-to-door collection method was used by the private informal collectors and CBO’s whereas the municipal was using a more-like communal collection method where the waste generators bring their wastes along an accessible location or an open space from the wastes are dumped onto a truck for hauling to the dumpsite. The study had to examine the waste disposal methods and was revealed that some of the wastes are collected, whereas others disposed at the generators’ backyard, nearby open space and temporal dumpsites. In the wards where wastes are collected the task was carried out by informal private collectors, CBO’s and municipal council with a very minute role devoid of SWCPC operation in any other the surveyed wards. The study also aimed at

examining the alternatives and challenges in solid waste management in Temeke municipality. The alternative waste disposal methods were burning, burying and use for animal feeds though burning was hampered by the dark smoke especially in the congested areas while shortage of land was the major stumbling block for burying as few could not use. The challenges for MSWM in Temeke municipality were inconsistency in waste collect, low budget, with a distant official dumpsite at Pugu Kinyamwezi, weak governance.

5.2 Conclusion

The study revealed less paper material with most of the generated wastes being in form of rubbish, food waste, bottles and polythene bags which is being collected by using a door-to-door and the communal collection method. The informal private collectors and the CBO's play a significant role in MSW collection compared to the municipal council which is characterized by unreliable collection pattern. The waste generators within the study area get rid of their wastes by collecting them to the informal private collectors or CBO's or municipal council. Others bury in their backyard, dump in the official/temporal dumpsites or the collection points. A minute number burn their wastes or use their wastes as animal feeds. MSWM is ineffective characterized by haphazard illegal dumping especially where municipal council is the MSW collector. This is due to budget deficit, distant landfill. MSWM should inevitably be improved in order to improve on the health conditions of the surroundings and the residents. This can be achieved through practicing waste sorting at the generation points, provision of official dumpsites, empowering informal private solid waste collectors and CBO's as well decentralizing sanitary landfill.

5.3 Recommendations

Basing on the findings of the practices and challenges for MSWM in Temeke municipality with reference to the surveyed wards; Mbagala Kuu, Kiburugwa, Yombo Vituka, Azimio, Mianzini and Charambe, some of the recommendations which can boost MSWM in Temeke municipality may include;

(a) Waste Sorting

As most of the waste generators are not sorting their wastes at the generation points ie at the household level, it is recommendable to encourage waste sorting. This will reduce the refuse costs as the quantity of the wastes to be collected will reduce especially in areas where the informal private collectors are predominant. In order to lay a motivation for sorting, local authorities can open up official points which buy the recyclable sorted material by the households. This will be a source of revenue for the local government and the same proving a ready proximate market for the recyclable wastes.

(b) Provision of Official Dumpsites

It has been revealed that some waste generators dump their wastes haphazardly as a result of the absence of dumpsites which could be official dumpsites or skips or collection points. Some generators who are closer to the collection points such as that of Azimio ward at Temeke Mwisho in addition to those who can access the roads can easily receive collection services from the municipal council. Therefore the municipal council in conjunction with the local authorities can identify appropriate locations for proximate dumpsites/skips for those who live within inaccessible locations such as in Mianzini, Mzambarauni Mtaa of Yombo Vituka and other similar places elsewhere. This

will minimize illegal dumping of wastes in open spaces, gutters and other unofficial sites. However these dumpsites should be managed in a hygienic manner to reduce the associated nuisance of flies, leachates, odor to mention but a few.

(c) Empower informal private waste collectors and CBO's

The study has shown that informal private collectors and the CBO's are promising in the solid waste collection service as their frequency of collection is better compared to where the municipal council is operating. However the informal private waste collectors have less capacity to operate effectively and may end up dumping the wastes in unofficial sites. The municipal council should recognize their role and not antagonize with them especially where neither the SWCPC nor the CBO's are not operating or in circumstances where there is underperformance of any solid waste collectors. This is because the informal private waste collectors will act as a remedy to irregular waste collection.

(d) Decentralization of sanitary Landfill

The only landfill in Pugu Kinyamwezi is distant from some locations which raise the operation costs of MSWM which tend to reduce the frequency of waste collection. This situation can be overcome by the establishment of other landfills basing on municipal basis though can serve the other places which can be near them though not within the same municipality. This will ultimately lower the hauling costs which can increase the frequency of waste collection. However these landfills should be well managed which can involve gas recovery, frequent fumigation.

5.4 Areas for further research

The study has raised a concern and sparks off a need for examining the;

(a) Possibility adopting the waste hierarchy in waste management within Dar es Salaam city.

(b) Assess the impact of present day slogan of “Hapa Kazi tu” in MSWM in Tanzania.

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APPENDICES

Appendix 1 : Interview Schedule (01)

INTERVIEW SCHEDULE FOR HOUSEHOLD/GENERATOR

The research is mainly for academic purpose. Therefore, answers given will be treated as confidential. Thank you.

Location of House:

.....

House Number (if available):

.....

Date of Interview:

.....

Assigned Interview Number:

.....

A. Waste Generation/Collection (Put a ✓ on the appropriate response)

i) Which type of waste is generated from your home? (You can tick more than one item)

A. Food wastes.

☐

B. Rubbish.

☐

C. Ashes.

☐

D. Others (Specify)

ii) Who collects your wastes?

A. Municipal council.

☐
☐

B. Private contractors.

C. Others (specify)

iii) If B, can you name the company.

iv) How many times is the waste collected weekly?

A. Once in a week.

B. Twice.

☐

C. Thrice.

☐

D. Every day.

☐

E. Not at all.

☐
☐

iv) What is the mode of waste collection?

A. Door to door.

☐

B. Communal.

☐

C. Curb.

☐

D. Others (specify)

B. Waste Storage

i) What do you use to store your waste?

A. Dustbin.

☐

B. Plastic bag.

☐

C. Others (specify)

ii) Do you store different types of wastes differently?

A. Yes. ☐

B. No. ☐

iii) If yes, why?

A. I sell some wastes. ☐

B. I avoid rotting wastes. ☐

C. Others (Specify)

C. Waste Disposal

i) Where do you dispose your waste?

A. Dump site. ☐

B. Roadside. ☐

C. Open space. ☐

D. Skip. ☐

E. Backyard.

F. Others (Specify)

ii) Do you pay as you throw?

A. Yes ☐

B. No ☐

iii) If yes, how much do you pay per month?

iv) Are you willing and able to pay the amount?

A. Yes ☐

B. No ☐

v) If No, what is the reason?

A. I don't have the money. ☐

B. I am not satisfied with the service. ☐

C. Others (specify)

vi) If you don't have money, what do you do to your waste?

A. Dump in nearest open space. ☐

B. I burry the waste. ☐

C. I burn. ☐

D. Others (Specify)

vii) What do you think can help to effectively manage waste disposal in your area?

A. Prompt pay for waste disposal. ☐

B. Buy good waste storage containers. ☐

C. Distinguish wastes containers basing on type. ☐

D. Collect and dump waste in the appropriate place. ☐

E. Others (specify)

viii) Do you think poor solid disposal is dangerous?

☐

A. Yes.

☐

B. No.

☐

C. I don't know.

ix) If Yes, how?

.....

.....

x) Suggest the other disposal methods you can opt.

.....

.....

.....

xi) What limits you to use such other disposal methods?

.....

.....

THANK YOU

Appendix 2 : Questionnaire (01)

QUESTIONNAIRE FOR MUNICIPAL OFFICIAL

The research is mainly for academic purpose. Therefore, answers given will be treated as confidential. Thank you

Position of Respondent:

Date of Response:

Please record answers in the spaces provided

Municipal Solid waste collection and disposal

i) What is the estimated population in the area (in figures):

ii) Availability of collection bins;

Type of collection bin	Number available	Number required
Skips		
Bins		
Others		

iii) If they are no enough, what is the done to the wastes?

.....

iv) How many times is the waste collected weekly?

.....

.....

v) What are the modes of collection?

.....

.....

.....

vi) Do the residents pay for the collection service?

A. Yes. ☐

B. No

vii) If yes, how much money per house monthly?

.....

viii) Are the people cooperative in paying?

A. Yes. ☐

B. No ☐

ix) If No, what are the possible reasons?

.....

.....

.....

.....

x) For those who can't pay, what happens to the wastes?

.....

.....

.....

.....

xi) What do you think affect effective municipal solid waste management?

.....

.....

.....

.....

xii) What do you suggest for an effective municipal solid waste management?

.....

.....

.....

.....

THANK YOU

[illegible]

B. Nature of Wastes (Put a \sqrt on the appropriate response)

1. Most of the waste is Collected from;

- i) Residential places. ☐
- ii) Commercial places like markets. ☐
- iii) Industrial areas. ☐
- iv) Others (Specify)

2. The type of waste collected include;

- i) Food waste. ☐
- ii) Plastic material. ☐
- iii) Glasses. ☐
- iv) Others (Specify)

B. Waste Collection (Put a \sqrt on the appropriate response)

i) How frequent do you collect waste?

- A. Weekly/Once a week. ☐
- B. Fortnight/after 2 weeks. ☐
- C. Twice a week. ☐
- D. Others (Specify)

ii) Wastes are collected by using;

- A. Trucks. ☐
- B. Pushcarts. ☐
- C. Others (Specify).....

iii) Do you sort the wastes at the collection point? (Put a tick)

A. Yes

☐

B. No

☐

iv) Which equipments do you require in your operation?

.....

.....

.....

.....

.....

v) Are the equipments sufficient?

A. Yes.

☐

B. No.

☐

vi) If No, which equipments do you lack?

.....

.....

.....

vii) Can you cover your operation costs?

A. Yes.

☐

B. No.

☐

viii) If No, how does it affect your operations?

.....

.....

.....

.....

ix) What do you suggest to improve solid waste management?

.....

.....

.....

.....

.....

C. Waste Disposal (Put a \checkmark on the appropriate response)

i) Where is the waste disposed finally?

.....

.....

ii) Is the distance inconveniencing the operation?

A. Yes.

☐

B. No.

☐

iii) If Yes, how does it inconvenience?

.....

.....

.....

iv) When you dispose on the landfill, which operations do you do on the wastes?

.....

.....

.....

.....

.....

v) Other than disposal, is there any other approach of dealing with the wastes?

.....

.....

.....

.....

.....

THANK YOU

Appendix 4 : Observation Checklist

1. Which types of wastes are seen?
2. Are the wastes separated at the generation station?
3. Are there dustbins?
4. Are there communal waste collection skips?
5. Are the skips overfilled?
6. Are there dump sites?
7. Are there landfills?
8. Are there solid wastes dumped haphazardly?