

Assessment of solid waste management practices in Tanzania's cities

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Abstract

This study explores the causes of ineffective solid waste management services in Tanzania's cities. It is inspired by the fact that less than 35% of the generated waste in the country is collected. The study focuses on cities as they are accounting for 15.5% of the total generated waste in the country despite making up only 3.2% (6) of the total local government authorities (LGAs) (137). The study variables include data availability, waste minimization initiatives, financial reliability, service reliability, technological flexibility, convenient waste collection systems, responsive market, supportive legal framework, and stakeholder inclusivity.

Literature review, direct observation, interviews, and questionnaires form part of data collection techniques. Questionnaires were distributed to 184 (100%) LGAs with over 95% responses. Zonal consultative meetings were conducted in six (6) zones representing 26 regions of Tanzania's Mainland and attended by 26(100%) Regional Environmental Experts; and 56 (30%) District Environmental Management Officers (DEMOs).

The findings show inadequacy in waste minimization initiatives, financing, stakeholders' inclusiveness, data availability, waste management options, technological flexibility, and service reliability. The findings also show the presence of a supportive legal framework and a responsive market for the provision of waste management services.

To this end the study recommends; Improvement of waste management infrastructure; promotion of waste minimization initiatives, enhancement of waste management financing, and formalization of informal waste collection service providers.

Keywords: Solid Waste; Waste Management; Waste Minimization and Waste collection; Tanzania and Cities

1. Introduction

Solid Waste Management (SWM) has become one of the most serious environmental and public health issues confronting cities in developing countries. Rapid urbanization, economic growth, and changes in lifestyles and consumption patterns have resulted in a remarkable increase in waste volume and diversity in cities. However, such an increase has never been matched with the pace of economic growth necessary for supporting the required infrastructure for effective solid waste management service provision. This has resulted in poor waste management service in many cities in developing countries including Sub-Saharan Africa (Omar, 2019).

The average MSW collection rate in sub-Saharan Africa is lower at only 44%, although the coverage varies considerably between cities, from less than 20% to well above 90% (Linda et.al, 2019). Good waste collection services are often only found in the city centers, while municipal waste services in suburbs and peri-urban areas are usually poor (ibid). The

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situation is much worse in rural areas where often no formal waste collection services exist. Current MSW collection services in most African countries are therefore completely inadequate resulting in the leakage of waste into the environment, including the freshwater and marine environment (ibid).

In Tanzania, despite generating nearly 7 million tons annually, it is only 32.72% of the generated waste is collected countrywide (URT, 2022). Cities are leading with the highest collection rate of nearly 63% while district councils exhibit less collection rate of 7.67% (URT, 2022). This has been causing several health and environmental impacts including the incidence of diseases, such as increased cases of cholera, malaria, typhoid fever, dengue fever, and Zika; occurrences of flood incidences and deterioration of beach quality. However, the dire waste collection services in the country can be attributed to various factors. Therefore, it is the interest of this study to analyze the underlying causes of ineffective waste management practices in Tanzania's cities.

Objective

To explore the causes of ineffective solid waste management services in Tanzania's major cities.

2. Literature review

2.1 Solid waste Management Theories and Concepts

There are a number of concepts about waste management that vary in their usage between countries or regions. Some of the most general, widely-used concepts include the Waste hierarchy commonly known 3Rs (Reduce, Reuse and Recycle); Extended Producer Responsibility (EPR), and Polluter Pay Principle.

2.1.1 Reduce, Reuse, and Recycle (3R)

Diminishing natural resources, together with the environmental impacts of waste and the decreasing capacity of landfills, has prompted the need for reduced waste generation. The Waste Hierarchy which comprises five waste management categories: waste prevention (reduction), reuse, recycling, energy recovery, and finally disposal, is applied internationally to reduce the waste eventually disposed to landfill (CSIR, 2011). The hierarchy categorizes waste management strategies according to their desirability in terms of waste minimization. Thus, the hierarchy remains the basis of most waste minimization strategies. The purpose of the waste hierarchy is to extract the maximum practical benefits from products and to generate the minimum amount of waste (Lagbas – Aranas, 2015)

2.1.2 Extended Producer Responsibility (EPR)

Extended Producer Responsibility is “an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle” (OECD, 2001). The approach is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market. This means that firms that manufacture, import, and/or sell products are required to be responsible for the products after their useful life as well as during manufacture (Lagbas-Aranas, 2015).

2.1.3 Polluter Pays Principle

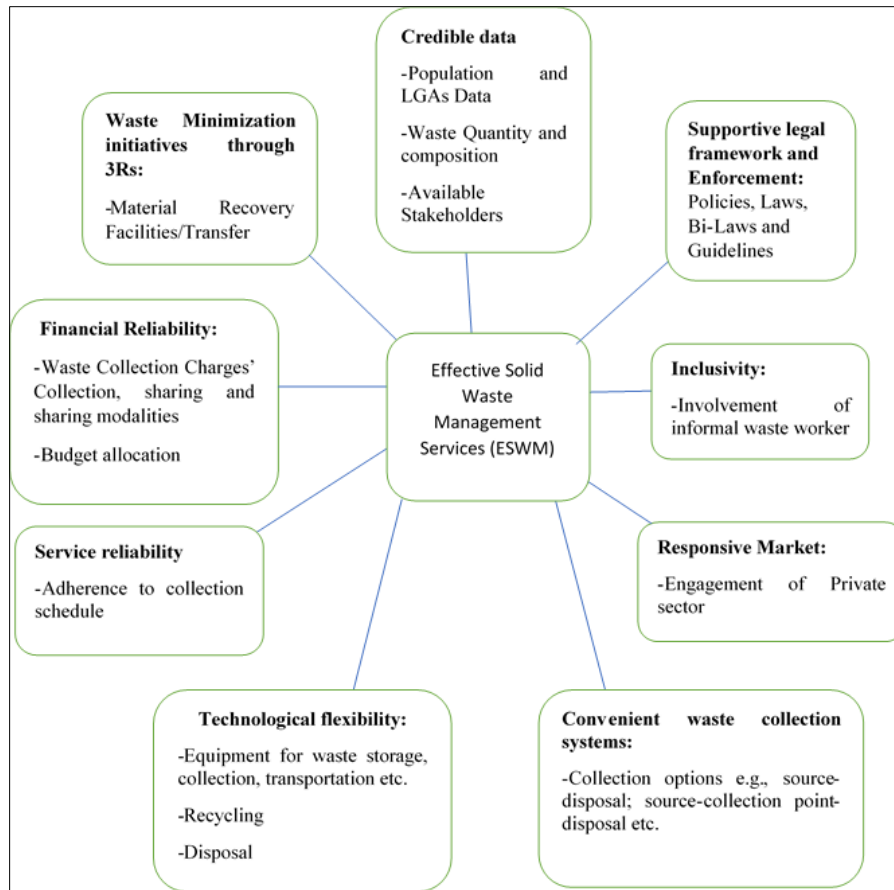
The 'polluter pays' principle is an environmental policy principle that requires that the costs of pollution be borne by those who cause it. The 'polluter pays' principle is normally implemented through command-and-control and market-based approaches. The former includes performance and technology standards, such as environmental regulations in the production of a given polluting technology, while the latter includes market instruments such as pollution or Eco taxes, tradable pollution permits, and product labeling.

Often, the 'polluter pays' principle is applied in the form of a tax collected by the government and levied per unit of pollution such as Refuse Collection Charges. As a policy instrument for the control of pollution, a tax on the environmental damage caused will theoretically reduce pollution, because firms or individuals will reduce the rate of pollution in order to avoid paying the tax or levy.

2.2 Conceptualizing effective solid waste management practices

The study applied the waste management concepts and the conceptual framework developed by Omar (2019) to conceptualize the effectiveness of waste management services in Tanzania. According to Omar (2019), effective solid waste management services require a supportive legal framework, a responsive market, a convenient waste collection schedule, technological flexibility, and effective cost recovery for the offered services. However, Omar's (2019)

conceptual framework has missed the element of waste minimization. The applied conceptual framework of this study has incorporated waste minimization as among the variable necessary for effective waste management as shown in Figure 1.



Source: Modified from Omar (2019)

Figure 1 Conceptualization of Effective Solid Waste Management Services

2.3 Description of variables

2.3.1 Credible data

Effective solid waste management requires effective waste management planning. However, the planning requires the availability of credible and reliable data. This may include profile and local Government Authority data which comprises of population size, area size, number of households, and the number of other potential sources of waste generating such as schools, industries, businesses; and health facilities; waste quantity and composition; Available waste management stakeholders and their influence and interest; waste management cost and available financing options; Available and applied technologies in waste management, especially on storage, collection, transportation, sorting, recycling, treatment, and disposal.

2.3.2 Waste minimization initiatives

The popular and well-known concept of "3R" refers to reducing, reusing, and recycling, particularly in the context of production and consumption. It calls for an increase in the ratio of recyclable materials, further reusing of raw materials and manufacturing wastes, and an overall reduction in resources and energy used. These ideas are applied to the entire lifecycles of products and services - from design and extraction of raw materials to transport, manufacture, use, dismantling/reuse, and disposal.

2.3.3 Financial Reliability

This entails having a system in place which ensures sufficient, stable, and reliable financing of waste management activities. This can effectively be achieved through the enforcement of Polluter Pays and Extended Producer

Responsibility principles. Financing waste management activities are important in ensuring the availability of necessary infrastructure as well as the implementation of various programs aimed at ensuring effective waste management services.

2.3.4 Service Reliability

As highlighted in Omar (2019), the reliability of waste collection service has an implication to waste collection performance. The unreliable services could directly be linked with environmental pollution whereas the generated waste is disposed of indiscriminately in freshwater bodies, open spaces, vacant plots, and along the streets. For effective waste management, the offered service must be predictable whereas, the service recipients have assurances of where, when, and how the waste collection service is going to be provided.

2.3.5 Technological flexibility

The applied technology in waste collection services has a consequence on the performance of waste collection service providers. Different context requires different technological applications for effective waste collection services. For example, narrow streets settlements especially in unplanned areas may require a different approach from the common waste collection trucks.

2.3.6 Convenient waste collection systems

The waste collection schedule has an implication on the effectiveness of the waste collection service provided. A schedule that does not respond to the demand of the service recipients may lead to ineffective waste collection. This may include the time of waste collection services. For example, the areas dominated by bachelor households' collection on weekdays afternoons may not be convenient compared to neighborhoods dominated by family households. Undermining such reality may lead to illegal dumping practices. This is because the missing schedule will leave no choice other than illegal waste disposal.

2.3.7 Responsive Market

Solid waste collection service provision involves several stakeholders. Some of the stakeholders include suppliers of various gears necessary for waste collection service provision. For example, there are stakeholders for manufacturing waste collection trucks, supplying waste collection trucks, providing rental services for waste collection trucks, supplying waste collection trucks spare parts, etc. It is necessary for the market to respond to the demands of waste collection service providers to ensure effective waste collection services.

2.3.8 Supportive legal framework

The effectiveness of solid waste collection service provision is very much influenced by legal backing. The provided services should be termed legal within the operating legal framework in order to grow and expand. Failure to be recognized by the existing policies, laws, and regulations will lead to unstable services as the operations might be disrupted by the law enforcers

2.3.9 Inclusivity

Effective solid waste management must build on what already exists in the efforts on managing solid waste. This includes the use of informal waste workers who are currently operating in many parts of the urban areas in the country. The inclusion of informal waste collection service providers in the waste collection system allows for a more frequent and thorough collection of neighborhood waste, reducing illegal dumping and open waste burning practices. Outsourcing to organized informal waste collection service providers may guarantee cheap labor which can be essential in reducing the burden of waste management costs to the Local Government Authorities.

3. Methodology

The methodology of this study involves a literature review, direct observation, interviews, and questionnaires. The study adopted theoretical and scoping literature reviews against other types of literature reviews such as systematic, argumentative, and integrative. The choice of theoretical and scoping literature reviews was based on the aim of the study which is to analyze the factors that affect the effectiveness of solid waste collection services. However, to achieve that the study had to explore the existing theories and concepts related to waste management as well as the status of waste management services in the country. This has impelled the exploration of existing profiles of local Governmental authorities in the country as well as regional and national strategies, waste management investment guides; laws and bylaws, and peer-reviewed and scientific reports related to waste management.

Further, Questionnaires were prepared and distributed through the google drive platform for the purpose of capturing the real-time response to 184 (100%) Local Government Authorities in the country whereby over 95% LGAs' have responded. This was also complimented by the conducted interviews through zonal consultative meetings in six (6) zones which cover 26 regions of Tanzania Mainland (Table 1.0). The zonal consultative meetings involved 26 (100%) Regional Environmental Experts (REMEs) representing every Region in Tanzania Mainland and 56 (30%) District Environmental Management Officers (DEMOs).

Table 1 Zonal consultative meetings

| Zone | Regions | Location of the meeting | Date of Meeting |
|-----------------------|---|-------------------------|------------------------|
| Northern | Arusha, Kilimanjaro and Manyara | Arusha | 26th-27th January 2022 |
| Central | Shinyanga, Tabora, Singida, Simiyu | Singida | 21st-22nd January 2022 |
| Eastern and Coastal | Tanga, Dar es Salaam, Pwani, Lindi, Morogoro and Mtwara | Dar es Salaam | 10th-11th January 2022 |
| Western and Lake Zone | Mwanza, Geita, Mara, Kagera, Kigoma, Katavi | Mwanza | 8th -9th February 2022 |
| Southern | Songwe, Mbeya, Iringa, Rukwa, Njombe, Ruvuma | Mbeya | 2nd-3rd February 2022 |
| Special zone | Dodoma | Dodoma | 1st -2nd February 2022 |

The interviews were also conducted with the targeted waste collection service providers in Dar es Salaam city. Moreover, direct observations were conducted in some selected waste disposal sites including Pugu Kinyamwezi dump site in Dar es Salaam city, Muriet landfill site in Arusha city, and Chidaya landfill site in Dodoma city, and the Waste disposal site in Chamwino District councils. The study used descriptive analysis to analyze the collected data.

4. Results and discussion

4.1 Introduction

Inadequate waste management services in Tanzania found to be associated with several causes. However, the most prominent identified causes include Inadequate data, inadequate waste minimization initiatives with supporting infrastructure such as Material Recovery Facilities/ transfer stations; Ineffective collection of waste collection charges; inequitable sharing of the collected waste collection charges between service providers and Local Government Authorities; inadequate budget allocation; lack of waste management plans, unfavorable waste collection charges sharing modalities, inadequate awareness to the general public on participating in fostering effective waste management practices; inadequate infrastructure; inadequate enforcement; inadequate manpower; inadequate private sector involvement; inadequate coordination among actors; inappropriate technology; and unrecognition of informal waste collection service providers.

4.2 Inadequate waste minimization initiatives

Solid waste minimization practices commonly implemented through the famous 3Rs require not only to waste segregation practices but also the availability of necessary infrastructure. However, countrywide there is the inadequate infrastructure necessary to support waste minimization initiatives. This includes waste transfer stations/Material Recovery Facilities (MRFs) and recycling infrastructure.

4.2.1 Inadequate Reduce, Reuse, and Recycling practices

The study found inadequate waste segregation practices at the source by households and other waste generators. The waste collected in all LGAs co-mingles recyclables, biodegradables, and other waste streams. A low percentage of recyclables is collected during primary and secondary collection. The remaining recyclables are transported to the disposal sites. Informal waste collectors/ waste pickers work at nearly all disposal sites in urban authorities collecting the remaining recyclables.



Source: Field Survey (2022)

Figure 2 Compost making at Muriet landfill site in Arusha city

4.2.2 *Lack of Waste Transfer Stations*

The Environmental Management Act of 2004 section 118 (2) requires the local Government authorities to establish waste transfer stations in their areas of jurisdiction. This sought among other things to minimize waste transportation costs by ensuring the collected waste is temporarily stored to be sorted before being taken to the final disposal. Consequently, the collected waste is directly transported and disposed of to the dumping places without any sorting practices which increase the amount of waste and trips made to the disposal sites.

4.2.3 *Lack of Material Recovery Facilities*

Although there is no official waste transfer station/Material recovery facility in all cities, Dar es Salaam is having a small Material Recovery Facility (MRF) at Bonyokwa Ward operated at the Mtaa level where its establishment is financed by a Non-Governmental Organization. It is a small MRF that aimed to serve just a small portion of the Sub-ward (Mtaa). At the MRF the collected waste is sorted whereas, organic waste is used to produce maggots (for animal feeding) while other recyclable waste is sold to recyclers. Only residues are taken to the dump site. The practice contributed to the reduction of the frequency of waste transportation to the dumpsite and thus, reduced waste management costs and pollution resulting from improper waste disposal practices.



Source: Field survey (2022)

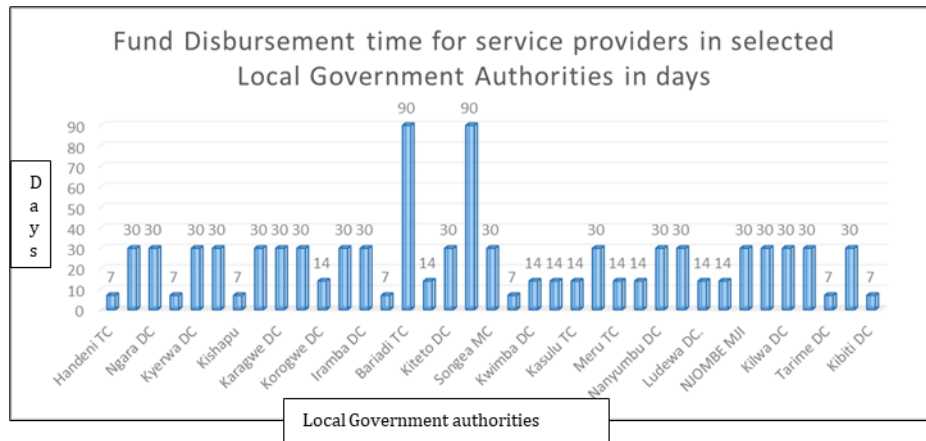
Figure 3 Material Recovery Facility in Bonyokwa Ward-Dar es Salaam, City

4.3 Inadequate Financing

Financing of waste management found to be affected by several factors. This includes; disbursement delays and short-term contract duration to service providers; an inadequate collection of waste charges; and unfair sharing of waste collection charges.

4.3.1 Disbursement delays for service providers

The collection of waste charges has been conducted by either contracted waste collection service providers, contracted Community Based Organizations (CBOs), Ward/Mtaa/Village Officers, Health officers, or direct payment to the local Government authorities' account. The use of waste collection service providers and direct payment to the Local Government authorities have become more predominant in cities. However, the time taken to pay the service providers after collection of the waste charges has been too long. The time taken is in the range of 7 to 90 days



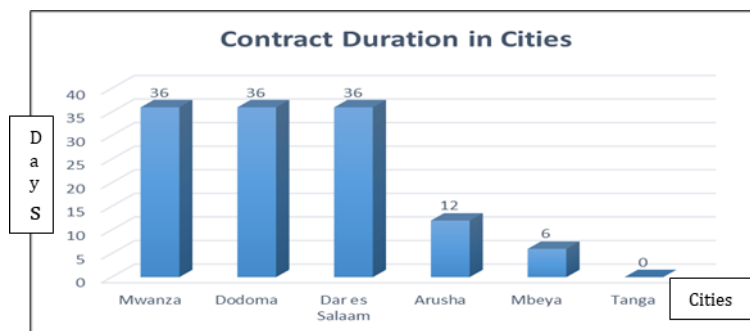
Source: Field survey, 2022

Figure 4 Disbursement time to service providers from the collected waste charges

The disbursement delays have significantly affected the performance of waste collection service providers. This is attributed to the fact that most of the service providers do not have enough capital to run the service by their own source for the whole month. Consequently, most of them concentrate on a few locations while a greater part of the areas is left un-serviced.

4.3.2 Inadequate contract duration for waste collection service providers

Inadequate waste management services have also been found to be linked with the provision of short contracts to service providers. The contract duration for cities has been in the range of 6-36 months. Mbeya is the only city that provides less than 6 months' contract. Arusha is the second city with the least contract duration of one year. However, the majority of the city waste collection service providers are operating with 3 years contract period. This includes Dar es Salaam, Mwanza, and Dodoma. During the study, Tanga city was found to have not yet outsourced waste collection services.

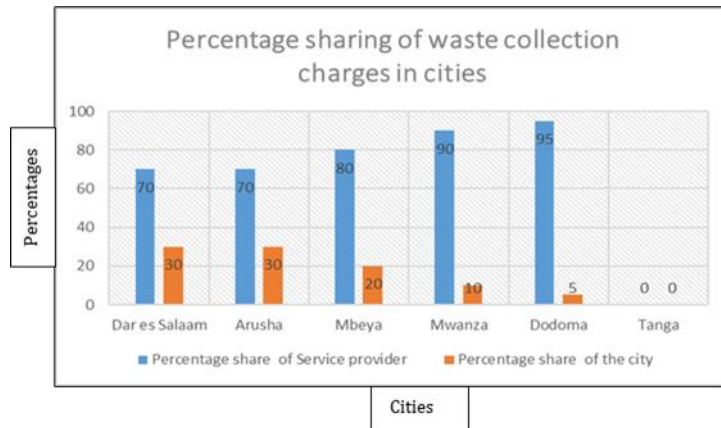


Source: Field Survey (2022)

Figure 5 Contract duration in cities

4.3.3 *Distribution of waste collection charges revenues*

Waste collection charges have been the major source of covering waste management services in cities. However, there have been differences in the percentage sharing of the collected waste charges between City councils and service providers. Dar es Salaam and Arusha cities enjoy 30% of the collected waste charges leaving the service provider with the remaining 70%. On the other hand, Dodoma city council enjoys less share of the collected waste charges among cities by taking only 5%. In Mbeya city, the sharing is 20% for the council and the remaining 80% for the service providers. During the study, Tanga city council was yet to engage the private sector in the provision of waste collection services.

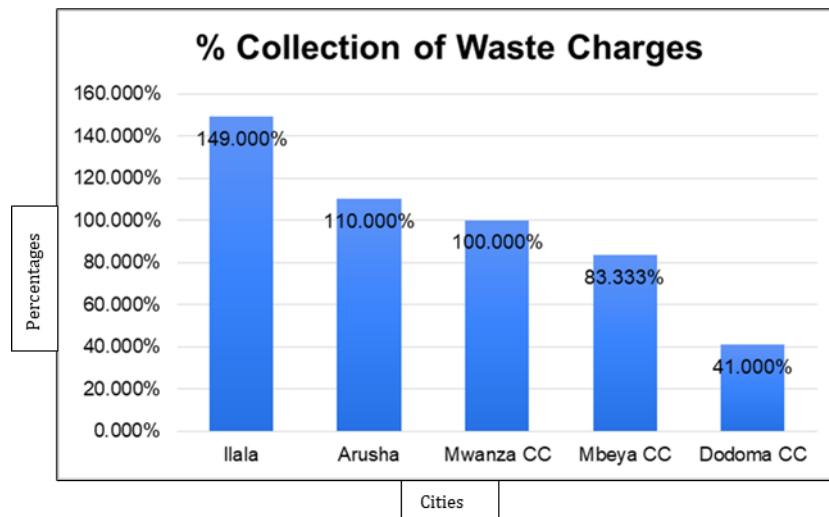


Source: Field Survey (2022)

Figure 6 Sharing percentages of Waste Collection Charges by Cities

4.3.4 *Ineffective Collection of Waste Collection Charges (WCCs)*

Effective management of generated waste requires sufficient resources. Waste collection charges are among the source of revenue for enhancing waste management activities. However, the collection of waste collection charges has been accompanied by unrealistic target settings and ineffective collection.



Source: Field Study (2022)

Figure 7 Percentage collection of Waste Charges in cities

This is attributed to inadequate data for estimating the waste collection charges potential. For example, the study conducted in 2018 on improving the waste management database for Ilala municipal council (now Ilala City) has revealed several statistical discrepancies. For instance, the data provided at the city council headquarter had shown the presence of 6,867 businesses in Kariakoo Ward, while the data obtained from the office of the Ward Executive Officer indicated the presence of only 140 businesses in the same Ward. These statistics are the ones that provide the basis for

projecting the expected revenue collection from waste collection charges. Erratic estimates will lead to inaccurate target settings.

4.3.5 Inadequate budget allocation

Solid waste management is associated with various costs including collection, transportation, and disposal. Several studies including Wahba (2019) have indicated that low-income countries including Tanzania require a minimum of Tshs 80,500 equivalent to 35 USD to manage a tone of generated waste. Based on that the budget allocated for solid waste management in all cities is highly inadequate. Dodoma city was found to allocate 39.43% of the required budget; Tanga allocate only 5.55% of the required budget; Ilala city allocate 25.13% of the required budget; Mbeya allocate only 11.42% of the required budget, and Arusha allocates only 15.28% of the required budget. However, in absolute value, Dar es Salaam is the leading city with over 8 billion Tanzanian shillings allocated annually for solid waste management. Tanga is the least whereby only about Tshs349 million allocated for solid waste management.

Table 2 Budget allocation for waste management in cities

| S/No | City | Generated waste | Required waste management budget (Tshs.) | Allocated budget (Tshs.) | Percentage of the Required Budget |
|------|----------|-----------------|--|--------------------------|-----------------------------------|
| 1 | Tanga CC | 217 | 6,288,660,000 | 349,499,965.00 | 5.55 |
| 2 | DSM CC | 1100 | 31878000000 | 8,011,955,024 | 25.13 |
| 3 | Mbeya | 362.3 | 10499454000 | 1,200,000,000 | 11.42 |
| 4 | Dodoma | 350 | 10143000000 | 4,000,000,000 | 39.43 |
| 5 | Arusha | 390 | 11302200000 | 1,728,000,000 | 15.28 |

Source: Field Survey (2022)

4.4 Supportive legal framework

Since 1982, the Government of Tanzania establishes various legal instruments including policies, legislation, and by-laws to govern waste management services. These include; The National Environmental Policy of 2021; the Environmental Management Act, Cap 191; The Local Government Urban Authority Act of 1982; The Environmental Management (Solid Waste Management) Regulations, 2009; The Public Health Act, 2009, and Local Government Authorities by-laws.

The Environmental Management Act, Part IX (a) deliberate the issues of solid waste management including; the duty of the local government to manage and ensure the minimization of solid waste in their respective areas (114); disposal of solid waste from market, business areas, and institutions (115); storage of solid waste from industries (116); solid waste collection in urban and rural areas (117); waste transfer station (118); and the final disposal of solid waste (119).

The Local Government Urban Authority Act 1982 section 55(g) stipulates clearly that, Solid waste management (collection, transportation, and disposal) is one of the key duties of all urban authorities in Tanzania. The Act, delegates to the Local Government Authorities (LGAs), including cities, the power to provide statutory provisions to govern waste management within their respective administrative areas. This has paved a way for Local Government Authorities to establish by-laws necessary for facilitating the Governance of Solid waste management. All cities in the country have by-laws to facilitate collection of waste collection charges and penalties on various offenses related to solid waste mismanagement.

These legal frameworks provide fertile grounds for enhancing waste management services in the country.

4.5 Inadequate stakeholders' Inclusiveness

In all cities in the country, there is the exclusion of informal solid waste collection service providers. The service of Informal service providers is considered illegal in all cities. This led to a lack of initiatives in all cities to establish the infrastructure necessary to support the work of informal service providers including collection points or Material recovery facilities within their reach. Consequently, informal service providers resort to disposing of waste in unauthorized areas such as water bodies, open spaces, and vacant plots.



Source: Field survey (2022)

Figure 8 Informal solid waste collection service providers carry waste in pushcarts

4.6 Lack of Credible data

Effective waste management services require credible data which will assist in developing plans necessary for ensuring effective waste management services. The basic data required may include Population; Waste quantity and composition; Waste policies and legislation; Institutions in place; Costs and financing of the waste management system; Technologies in use; and Stakeholders and their level of participation.

In all cities, only population data were found to be readily available. This is attributed to the presence of 2012 census reports and subsequent population projection reports. However, waste composition and quantity data have been major challenges. Though every city has provided such data the provided data were found to be the same for nearly 10 years. For example, Ilala city has been reporting the quantity of generated waste per day to be 1100 tons since 2013. There have never been waste management studies in nearly all cities despite being the requirement of section 115 (1) of the Environmental Management Act, Cap 191 and Section 76(1) (a) of Public Health Act, 2009. This hinders effective waste management services whereby, the allocated resources could either be under or over-estimated.

4.7 Limited technological flexibility

The applied technologies have an impact on waste management service efficiency. For example, waste collection services may involve several technologies such as pushcarts, tricycles, motorcycles, and lorries depending on the nature of the area to be serviced. In informal settlement which is found to be dominant in most cities (i.e., 80% in Arusha city; 79% in Tanga city; 70% in Mbeya city; 44% in Ilala and Mwanza cities; and 30% in Dodoma city) it is difficult for waste collection compactor trucks to access many parts. In turn, this call for a blended approach in waste collection technologies whereby, pushcarts can be used to access informal settlements while trucks can be used to access formal settlement or Pushcarts can access informal settlement and deposit waste in a collection point for trucks to transport to the designated disposal sites. Such a blended model was found to work well in some areas including Sandali Ward as highlighted in Omar (et. al., 2019).



Source: Omar et. al. (2019)

Figure 9 Informal service providers taking waste from Pushcarts to Compactor Trucks in Sandal Informal Settlement

Additionally, the adoption of waste minimization initiatives requires the thriving of waste recycling technologies. Most cities have shown the presence of recycling technologies. However, the available technologies mostly cover Plastic and Scrap metals. There is some waste stream with inadequate recycling technologies such as used tires and diapers. Consequently, much of such waste is indiscriminately disposed of in the environment.

4.8 Responsive Market

All cities in the country have shown the presence of positive market response with regard to the Solid waste collection service provision. Through Public-Private Partnerships Ilala, Arusha, Mwanza, and Dodoma cities there was positive involvement of several stakeholders. Some of the stakeholders include suppliers of various gears necessary for waste collection service provision. For example, there are stakeholders for manufacturing waste collection trucks, supplying waste collection trucks, providing rental services for waste collection trucks, supplying waste collection trucks spare, parts, etc. Such a response was found to contribute to the improvement of waste management services.

4.9 Convenient waste collection systems

In all cities, there are inadequate solid waste management options. The collection to disposal was observed and reported to be the most common waste management option. There were no intermediary waste handling facilities such as Transfer Stations (TS) and Material Recovery Facilities (MRFs). This was found to affect effective service provision by limiting service provision to inaccessible areas. This also disincentivized service providers to reach every house due to high fuel consumption linked with long routes. Consequently,

5. Conclusion

Tanzania has an adequate supportive legal framework for enhancing effective solid waste management services in its major cities. However, there is an insufficient political will to ensure robust resource allocation for effective waste management services. The study will guide waste management practitioners and policymakers in analyzing waste management challenges in their areas of jurisdiction and coming up with realistic and effective approaches.

Recommendation

As indicated in the National Environmental Master Plan for Strategic Intervention (2022-2032) the study recommends:

- Improvement of solid waste management infrastructure through the establishment of Material Recovery Facilities; Waste Transfer Stations and Sanitary landfills in Dar es Salaam city
- Promotion and adoption of waste minimization approach in all cities by increasing public awareness and participation in source reduction and recycling initiatives; establishing at least one source reduction and reuse program; increasing adoption of Reduce, Reuse, and Recycling (3Rs) by 50% of the households, industries, institutions, and commercial areas and to increase by 50% participation of the private sector in recycling initiatives
- Formalization of Informal Solid waste collection service providers through conducting assessment and mapping of informal waste collectors in all cities; establishing legal framework recognizing informal waste collection service and waste picking as formal livelihoods; Promoting the establishment of an association of informal waste collection service providers, and conducting an awareness campaign to householders and waste collectors on health and environmental impact of improper hazardous waste management.

Compliance with ethical standards

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Disclosure of conflict of interest

All authors have participated in (a) the conception, analysis, and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content, and (c) approval of the final version.

This manuscript has not been submitted to, nor is it under review at, another journal or other publishing venue.

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