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Analysis of solid waste management practices in rural settings of Tanzania

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Abstract

This study explores the causes of ineffective solid waste management services in Tanzania's rural settings which are made up of district councils. It is inspired by the fact that only 7.6% of the generated waste in the district councils which makes up 74% of the total local government authorities in the country is collected. 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 constitute part of the data collection methods. Questionnaires were distributed to 137 (100%) district councils 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 data availability, waste minimization initiatives, financing, stakeholders' inclusiveness, 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.

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; Waste collection; Tanzania and Cities

1 Introduction

Solid Waste Management (SWM) has become one of the most serious environmental and public health issues confronting local and sub-national Governments in developing countries (Omar, 2022a). Rapid urbanization, economic growth, and changes in lifestyles and consumption patterns have resulted in a remarkable increase in waste volume and diversity in cities (Omar, 2022a).

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 situation is much worse in rural areas where often no formal waste collection services exist.

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In Tanzania's district local councils (i.e., Rural authorities) constitute 74% of the total Local Government Authorities countrywide. The councils generate approximately three million tons of waste per year, accounting for approximately 43.7 percent of total waste generated in the country whereas, only 7.67% of the generated waste is collected.

Historically, the focus of solid waste management practices in many parts of the World has been on prevention or reducing the impact of waste materials on human health (Babaei et al., 2015) and social amenities (Abeliotis et al., 2014; Leblanc, 2019). However, over the last 30 years, the focus was redirected from simply prevention for the purpose of reducing the environmental impact of waste, but also, recovering resources from waste materials through various treatments or technologies (Cappellini and Parsons, 2012; Cecere et al., 2014; Reyes and Furto, 2013).

Therefore, it is the interest of this study to assess waste management practices in Tanzania's rural settings.

Objective

To explore the waste management practices in Tanzania's district councils' authorities.

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 as highlighted by Omar (2022a). Some of the most general, widely-used concepts include the Waste hierarchy commonly known 3Rs (Reduce, Reuse and Recycle); Extended Producer Responsibility (EPR), Polluter Pay Principle, Integrated solid waste management principle, and the zero-waste concept.

2.1.1 Integrated solid waste management (ISWM) Principle

Integrated Solid Waste Management refers to the strategic approach to sustainable management of solid wastes covering all waste systems elements including generation, segregation, transfer, sorting, treatment, recovery, and disposal in an integrated manner, with an emphasis on the protection of humans and environment and maximizing resource use efficiency, and considering all relevant stakeholders (UNIDO, 2018, and Omar, 2022b). As highlighted in Omar (2022b) and Oteng-Ababio, (2011), the principle also, entails the selection and application of suitable techniques, technologies, and management programs to achieve specific goals and objectives including environmental and health regulations, economic reliability, and social acceptability. According to Hoornweg and Bhada-Tata, (2012) ISWM should be driven by clear objectives and based on the hierarchy of waste management: reduce, reuse, recycle — often adding a fourth 'R' for recovery.

2.1.2 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 (Omar, 2022a). 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 landfills (Omar, 2022a) and CSIR, 2011). 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 and Omar, 2022a)

2.1.3 Extended Producer Responsibility (EPR)

According to OECD, (2001) in Omar, 2022a, Extended Producer Responsibility can be defined as “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”). The approach is meant to impose accountability over the entire lifecycle of products and packaging introduced to the market (Omar, 2022a). 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).

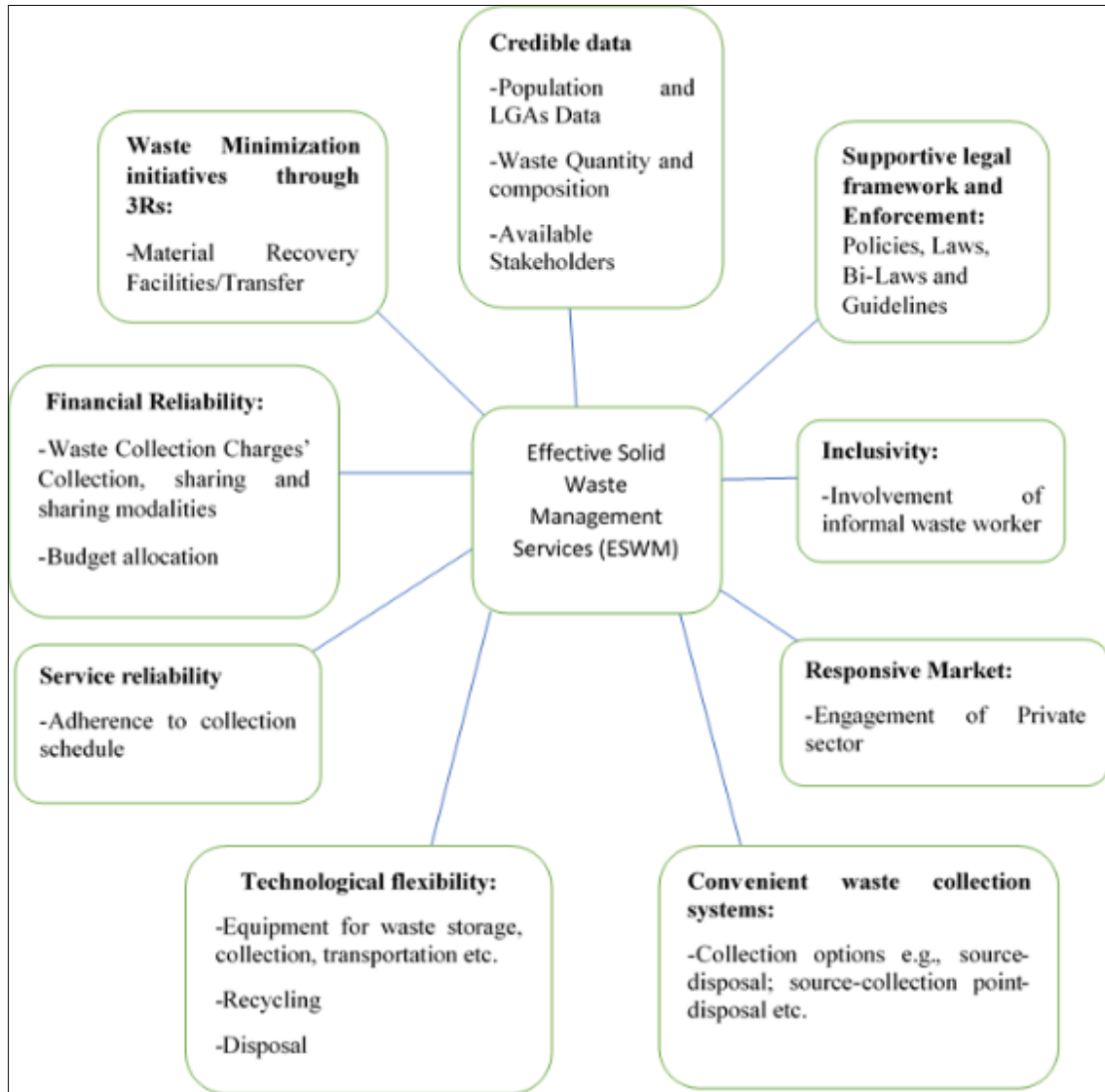
2.1.4 Polluter Pays Principle

The 'polluter pays' principle is an environmental policy principle that the cost of environmental pollution be attached to the polluters, The 'polluter pays' principle is normally implemented through command-and-control and market-based approaches. As indicated in Omar, (2022a) 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 levies, 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 (2022a) to conceptualize the effectiveness of waste management services as shown in Figure 1.



Source: Adopted from Omar (2022a)

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. Nevertheless, the planning needs the availability of trustworthy and reliable data. Some of the important data might include profile of the local Government Authority which contains data of population, area coverage, number of households, number of the available institution such as schools, industries, businesses; and health facilities; the amount of waste generated and its composition; Available waste management stakeholders and their influence and interest; the cost of waste management and financing

options; The available and applied technologies in managing waste, particularly on storage, collection, transportation, sorting, recycling, treatment, and disposal.

2.3.2 *Waste minimization initiatives*

The 3Rs have been applied as a popular concept related to waste minimization. The concept refers to reducing, reusing, and recycling waste. It advocated for raising the ratio of recyclable materials, reusing raw materials and manufactured wastes, and reduction in resources and energy used. These concepts 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 involves having a system in place that guarantees adequate, steady, and unfailing financing of waste management activities. The polluter pay principle is among the important tool to achieve financial reliability. Adequate, credible, and reliable financing is very important in ensuring the availability of necessary infrastructure and the implementation of various programs aimed at ensuring effective waste management services.

2.3.4 *Service Reliability*

As highlighted in Omar et. al. (2019) and Omar, (2022a), the reliability of waste collection services has an impact to waste management services performance. In the environment of unreliable services, the extent of environmental pollution is expected to be high as the generated waste is disposed of indiscriminately in various ecosystems including freshwater bodies. 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 (Omar 2022b).

2.3.5 *Technological flexibility*

As highlighted in Omar, (2022a), the used technologies in waste management services have significant impacts on the performance of waste collection services. This is attributed to the fact that different context requires different technological applications. A case in point is of narrow streets, especially in unplanned settlement may require a different approach from the common waste collection trucks in the wider street in planned settlements.

2.3.6 *Convenient waste collection systems*

The waste collection schedule has an impact on the efficacy of the waste collection services. A waste collection timetable that does not fit the demand of the service beneficiaries might lead to ineffective waste collection. The waste collection schedule needs to reflect the realities of the particular settlement. For example, as highlighted by Omar, (2022a), in the areas dominated by bachelor households' collection it will be inconvenient to conduct collection on weekdays afternoons contrary to the street dominated by family households. may not be convenient compared to neighborhoods dominated by family households where there are family members at all times. Undermining such reality may lead to illegal dumping practices. This is because the missing schedule will leave no choice other than illegal waste disposal (Omar, 2022a).

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 support. The provided services should be considered legal within the operating legal framework in order to grow and expand. Unrecognition 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 (Omar, 2022a). This includes the use of informal waste workers who are currently operating in many parts of the urban areas in the country (ibid). 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 (ibid).

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 137 (100%) district councils 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
Eastern and Coastal	Tanga, Dar es Salaam, Pwani, Lindi, Morogoro and Mtwara	Dar es Salaam	10th-11th January 2022
Central	Shinyanga, Tabora, Singida, Simiyu	Singida	21st-22nd January 2022
Northern	Arusha, Kilimanjaro and Manyara	Arusha	26th-27th January 2022
Special zone	Dodoma	Dodoma	1st -2nd February 2022
Southern	Songwe, Mbeya, Iringa, Rukwa, Njombe, Ruvuma	Mbeya	2nd-3rd February 2022
Western and Lake Zone	Mwanza, Geita, Mara, Kagera, Kigoma, Katavi	Mwanza	8th -9th February 2022

Direct observations were conducted in some selected informal disposal sites in the Chamwino district council in Dodoma Region, and Kibaha, Chalinze, and Bagamoyo district councils in Pwani Region. The study used descriptive analysis to analyze the collected data.

4 Results and discussion

4.1 Introduction

Inadequate waste management services in Rural settings of 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

The Environmental Management Act; of 2004 Section 114 and Solid Waste Management Regulations PART IV sections 14, 19, 20, and 25 require Local Government authorities (LGAs) including District councils to segregate waste at source; designation of waste Transfer stations; integrate waste recovery with recycling and designation of waste composting sites. Solid waste minimization practices commonly implemented through the 3Rs concept require not only, waste segregation practices but also require the availability of necessary 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. 100% of the district councils in the country have the inadequate infrastructure necessary to support waste minimization initiatives such as waste segregation bins, separate waste collection systems, and recycling facilities, especially for specific waste types such as used tires, electronic equipment, diapers, and waste minimization programs. Consequently, the waste collected in all district councils is in the mix of recyclables, biodegradables, and other waste streams.



Figure 2 Unsegregated waste at the disposal sites in Kwala Ward-Kibaha District Council

4.2.2 *Lack of Waste Transfer Stations*

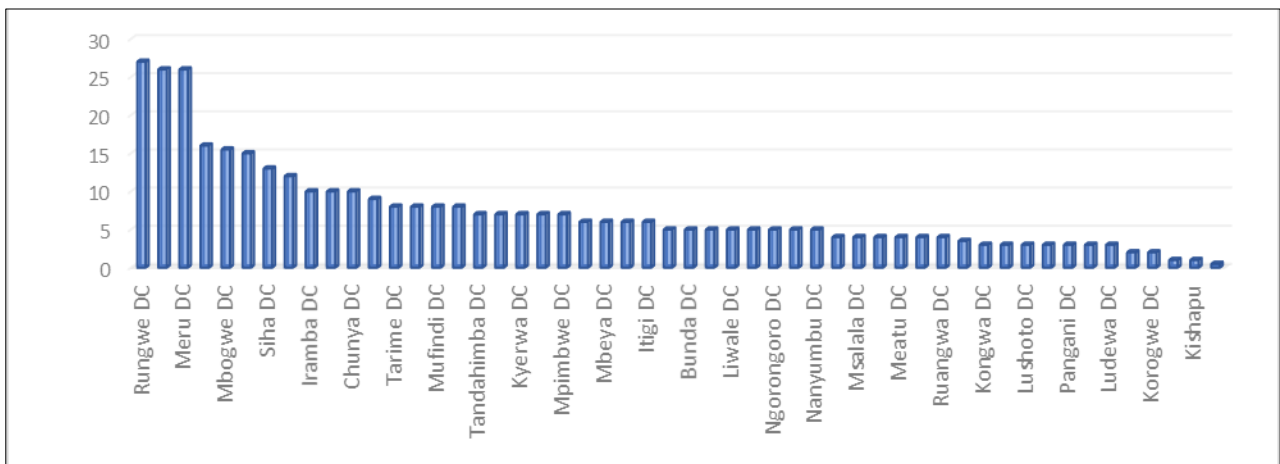
The Environmental Management Act of 2004 section 118 (2) requires the local Government authorities to establish waste transfer stations in their areas of jurisdiction. This as was claimed by Omar, (2022a) aimed at minimizing waste transportation costs which cater to 70% of waste management costs by ensuring the collected waste is temporarily stored to be sorted before being taken to the final disposal. However, 100% of the district councils in the country neither have waste transfer stations nor Material Recovery Facilities (MRFs). Consequently, the collected waste is directly transported and disposed of at the dumping places without any sorting practices. As most of the district councils use tractors for waste transportation, the lack of waste transfer stations increases the number of trips made to the disposal site due small capacity of the tractors compared to waste collection trucks. Consequently, that has increased mushrooming of illegal waste disposal practices and waste open burning.



Figure 3 Waste open burning practice in Bagamoyo District councils (left) and Improper solid waste disposal practice in Chamwino district council (right)

Waste open burning in Bagamoyo District Council (left) and improper waste disposal practices in Chamwino district council (Right).

Additionally, despite the fact that many of the district councils do not have properly designated disposal sites, few that have are located at a long distance which encourages improper waste disposal. For example, in Rungwe and Meru DC, the waste collection service provider has to travel over 25km to reach a disposal site. However, the majority are in the range of 10 to 15km.



Source: Field survey, 2022

Figure 4 Distance to the disposal site in district councils

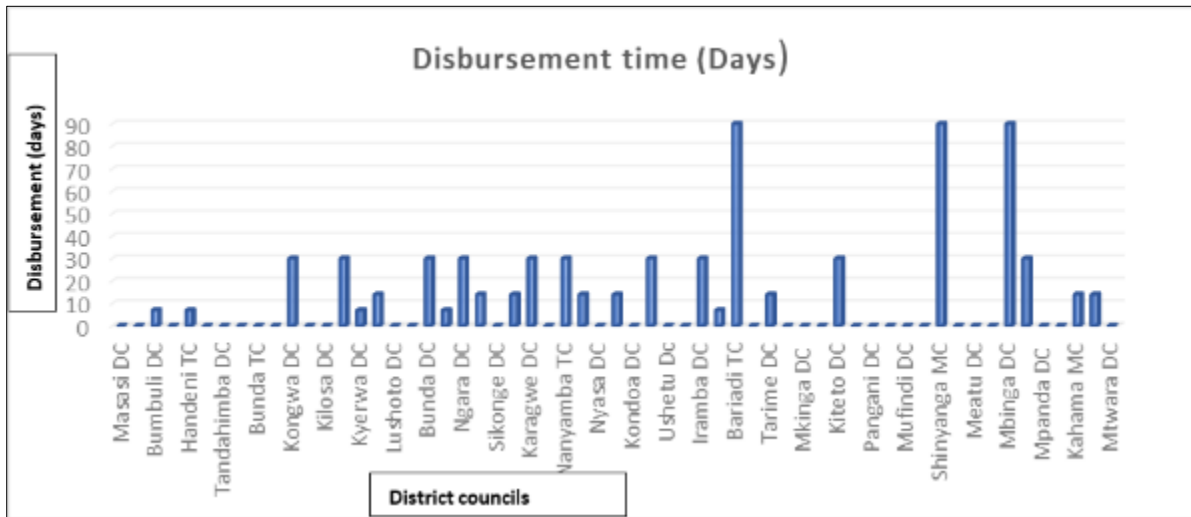
4.3 Inadequate Financing

As highlighted in Omar (2022a) financing of waste management was found to be affected by some factors such as 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 is predominantly conducted by CBOs in district councils. However, for the few cases where the collected waste collection charges are deposited to the district council account the time taken to pay the service providers after collection of the waste charges is in the range of 7 to 90 days. The majority are in the range of fewer than 14 days with some few district councils such as Mbinga DC where it takes 90 days for the reimbursement of the service providers. For about 10 district councils the disbursement period was found to be 30 days. Despite that, it is

worth mentioning that the district councils that have waste charges collection practices constitute less than 25% of the total district councils in the country.



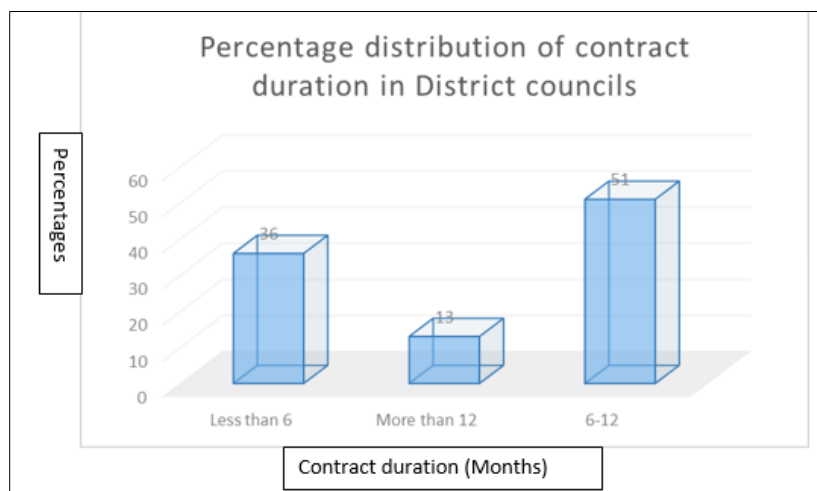
; Source: Field survey, 2022

Figure 5 Disbursement time to service providers from the collected waste charges in District councils

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 District councils has been in the range of fewer than 6 months to 12 months. 13% of the district councils provide more than 12 months contract; 51% provide 6-12 months contract and 36% provide less than 6 months contract. This implies that more than 87% of the waste collection service contract are of not more than a year. This affects the ability of the service providers to access financial institutions.



Source: Field Survey (2022)

Figure 6 Contract duration in district councils

4.3.3 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 majority of the district council in the country do not collect waste collection charges. This is attributed to various factors including the absence of a legal framework to facilitate the collection of waste charges. However, few that collect waste charge a collection rate in the range of 10 to 80%. There are particular cases like that of Kilosa district council where the collection rate is 250%. Consequently, most of the district councils provide waste collection services using district council resources which are not enough for providing effective services.

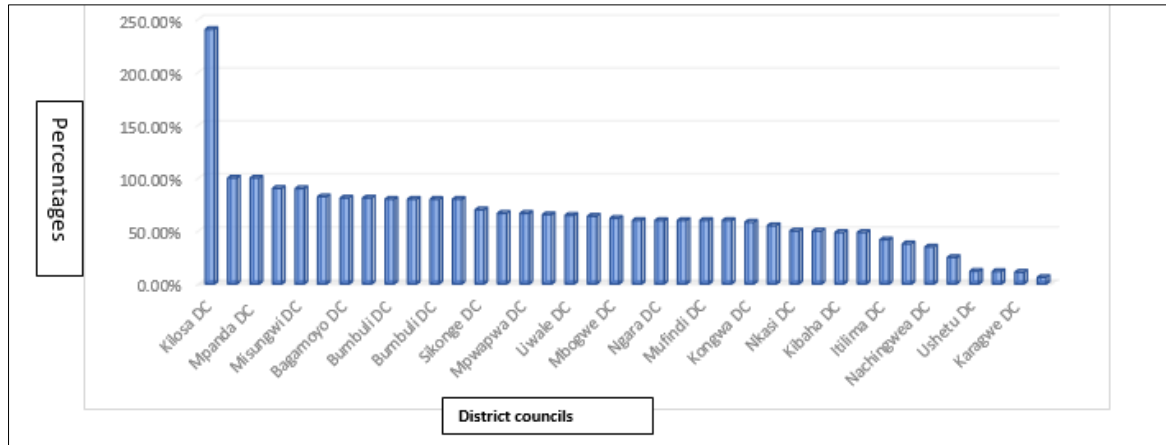


Figure 7 Collection rate of waste collection charges in district councils

4.3.4 Inadequate budget allocation

As indicated in Omar, (2022a) Solid waste management is associated with various costs including collection, transportation, and disposal. Several studies including Wahba (2019) in Omar (2022a) 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. Consequently, the average solid waste collection rate in district councils has been only 7% as much of the district councils’ solid waste management services were not among the provided services.

4.4 Supportive legal framework

As indicated in Omar (2020a), The Government of the United Republic of Tanzania Since 1982, instituted several legal tools including policies, laws, and by-laws to oversee 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) specifies undoubtedly that, Solid waste management (collection, transportation, and disposal) is one of the key duties of local Government authorities in Tanzania. The Act, delegates to the Local Government Authorities (LGAs), including district councils, the power to provide statutory provisions to administrate waste management within their respective administrative areas. This has created room for district councils to establish by-laws necessary for facilitating the Governance of Solid waste management. Hover, over 90% of the district councils in the country do not have by-laws that facilitate collection of waste collection charges. Thus, the financing of solid waste management services entirely depends on the meager resources of the district councils. Consequently, most of the residents in district councils do not enjoy waste collection services.

4.5 Inadequate stakeholders' Inclusiveness

Lack of formal services in almost all district councils in the country, in some areas informal service providers emerged especially in town centres. However, there is no legal basis that facilitates the operation of these informal players. Consequently, they are not getting the necessary support which leads them to dispose of waste in unauthorized areas such as water bodies, open spaces, and vacant plots.

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. As indicated in Omar (2022a), 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.

However, in all district councils, only population data were found to be readily available. Other important data for solid waste management such as waste generation rate, composition, collection rate, and disposal methods have been very unreliable. None of the district councils conduct waste management studies despite being the requirement of section 115 (1) of the Environmental Management Act, Cap 191, and Section 76(1) (a) of the Public Health Act, 2009.

4.7 Limited technological flexibility

The applied technologies have an impact on waste management service efficiency (Omar, 2022a). For example, the adoption of waste minimization initiatives requires the thriving of waste recycling technologies. However, in most of the district councils, there were recycling technologies to facilitate waste minimization initiatives. Also, despite the generation of a large quantity of organic waste composting was found not to be practiced in most of the district councils. Consequently, the generated waste ends up buried, burned, or disposed of in water channels.

4.8 Responsive Market

The lack of a legal framework for charging waste collection fees has made most of the district councils not attractive to private waste collection service providers. Only, Community Based Organizations with limited resources were found to provide services in district councils. Large-scale investors concentrate in cities and municipalities where there is a large economic base as well as a supportive legal framework for private sector investment.

Recommendation

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

- Improvement of solid waste management infrastructure through the establishment of Material Recovery Facilities (MRFs); Waste Transfer Stations and Sharing Sanitary landfills among neighboring district councils
- Promotion and adoption of waste minimization approach especially composting at the household level to be used locally.
- Formalization of Informal Solid waste collection service providers and equipping them with composting skills and marketing for their compost.
- Conducting awareness campaigns to householders on the health and environmental impact of improper waste management especially waste open burning practices which are highly practiced in rural settings.

5 Conclusion

Despite accounting for 74% of the total local government authorities in the country solid waste management has never been a priority service in District Councils which constitute rural settings of Tanzania. Consequently, only 7.6% of the generated waste is collected. This poses a threat to both human health and environmental taking into consideration the level of understanding on the impact of improper waste management in rural setting is expected to be low compared to the urban settings.

The study will guide district council authorities and waste management stakeholders to come up with realistic and effective approaches in addressing waste management dire situation of the rural settings.

Compliance with ethical standards

Acknowledgments

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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. The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

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