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Municipal Solid Waste Collection Services in Rapidly Growing Cities of Tanzania

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Abstract

Globally, rapid urban and population growth poses a huge problem for solid waste management (SWM), with developing countries' fast-growing cities having more SWM challenges than industrialized countries. In Mbeya, Tanzania, a study to investigate the performance of Municipal Solid Waste (MSW) collection services was carried out using a descriptive cross-sectional research design, and a mixed research approach. Questionnaires, interviews, field observations, and document reviews were used to gather information. Among the indicators used to evaluate the performance of Solid Waste (SW) collection services were the levels of community participation in SW collection, means of SW collection, coverage, amount of SW collected daily, facilities for SW collection and transportation, timely SW removal from collection points, and the ability to address SW collection challenges. Quantitative data was analysed using the IBM-SPSS software. Multiple response functions in SPSS were used to analyse questions with more than one answer, while content analysis was used to analyse the qualitative data. The findings indicate that MSW collection services in Mbeya City are under-performing due to a number of factors, including the lack of vehicles and solid waste storage facilities, delays in removing solid waste from collection points, low city council budget allocation and disbursement for SWM activities, and the lack of willingness of the Mbeya City Council to address MSW collection challenges. It is thus concluded that adopting and enhancing the public-private partnership model in SWM is critical to addressing MSW collection difficulties in Tanzania's rapidly growing cities.

Keywords: *municipal, waste management, efficiency, performance, Mbeya, Tanzania*

1. Introduction

Solid waste management (SWM) encompasses all activities aimed at reducing the health, environmental, and aesthetic impacts of solid waste (Bigirwa, 2015; Zhu et al., 2008). Human activities generate garbage; and how that waste is handled, stored, collected, and disposed of can have negative consequences for the environment and human health. The scale of the problem varies from developed to developing countries, with high-income developed countries producing approximately 1.4m tons of urban solid waste per day, while middle-income developing countries and low-income developed countries producing 2.4m and 1.4m tons per day, respectively (Yao & Van Woerden, 2018).

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One of the most pressing issues in developing countries is solid waste collection services (SWCS) (Gomez et al., 2008). This problem is exacerbated by urbanization and population increase, which strain infrastructure and leave facilities unable to cope up with the amount of solid waste produced (Kalwani, 2010; Un-Habitat, 2010). According to studies, one to two-thirds of the solid trash created in most cities of developing country is not collected due to inadequate infrastructure (Bahauddin & Uddin, 2012; Zurbrugg, 2003). Municipal Solid Waste (MSW) collection is a big and costly duty for municipal waste management bodies, consuming approximately 80% of total trash disposal expenditures (Un-Habitat, 2010; Vidanaarachchi et al., 2006).

Low municipal solid waste collection capacities in most cities have prompted the search for other alternatives, such as engaging in public-private partnership (PPP) in MSW collecticion (Massoud and El-Fadel, 2002; Oduro-Kwarteng, 2011). PPP involves the transfer and control of goods or services currently provided by the public sector, either in whole or in part, to the private sector (Arbulu et al., 2016). According to Chopra and Kapoor (2016), private enterprises must be guaranteed a return on their investment to participate in PPP. Experience has shown that the majority of private enterprises are involved in building up, running, and maintaining composting facilities through which they can sell the compost (Koppenjan & Enserink, 2009). However, Spoann et al. (2019) have found that the long-term contract design for partnership in Cambodia could result in unsustainable MSW collection. According to Saadeh et al. (2019), the central government should help ensure the sustainability of MSW collection services by offering legal assistance to local authorities, and incentives to potential private enterprises to convince them to participate in PPPs.

In Tanzania, urban local governments are confronting solid waste collection issues, which include the lack of involvement by the community and other stakeholder in SWM; lack of community understanding about SWM; and insufficient money, infrastructure, waste collection trucks, trash bin access, and waste separation facilities. A majority of urban local governments operate SWM under open-dumps due to their relative cheapness (Mlozi, 2013; Yukalang et al., 2017). The environmental impact of open-dumps is becoming increasingly unbearable as cities and towns in Tanzania grow and generate more garbage (Breeze, 2012).

Tanzania has seen a significant expansion of cities from the year 2000, which has coincided with an increase in human population and economic activities (Mlozi, 2013). Arusha, Mwanza, Tanga, Mbeya, and Dodoma are among the important settlements that grew into cities after Dar es Salaam. These cities have a lot of socio-economic activities. Education, health, commerce and business, real estate development, and manufacturing industry operations are some of the socio-economic activities in these cities. These activities generate a variety of SW, including recyclables, reused materials, rubbish, and hazardous waste (Liyala, 2011).

Mbeya City is located in Tanzania's south western region, on the Tanzania-Zambia highway (TANZAM) and the Tanzania-Zambia Railway line (TAZARA). Its population, like that of other towns in Tanzania, has been growing quickly, accompanied by an expansion in socio-economic activities that generate a large quantity of SW. According to Mgimba and Sanga (2016), the main sources of solid waste in Mbeya City are business centres and residences. However, changes in SWM generation and collection capacity are associated with urbanization and population trends. This necessitated an investigation of the capacity of the Mbeya City council to provide solid waste collection services following rapid urbanization and population growth.

2. Methodology

This study was conducted in Mbeya City, Tanzania (Figure 1). Its population is estimated to be 160,640, with 49,790 households (NBS, 2013). Mbeya City covers a land area of 214 km^2. It is located between latitudes 8^0 50" and 8^0 57" South of the Equator, and 33^0 30" and 35^0 35" longitudes East of Greenwich. The study location specifically involved six wards: Ilemi, Ilomba, Luanda, Nzovwe, Iyela, and Mwakibete. These wards were selected purposively as they are highly populated compared to other wards in the City.

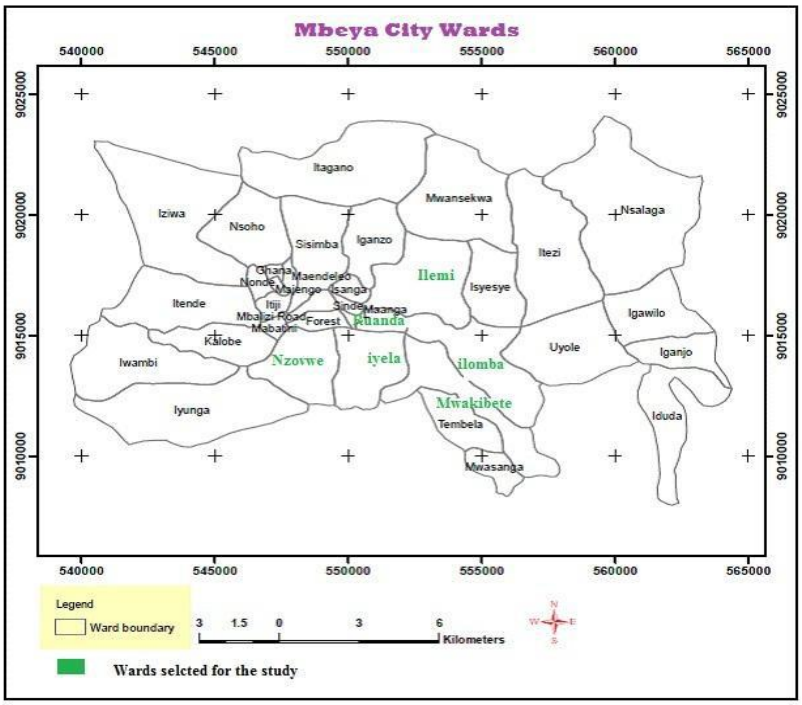

Figure 1: Location of the Study Areas
Source: GIS Lab-UDOM, 2020

Commerce and trade, agricultural and livestock keeping, small-scale industrial production, and service provision—such as transportation, hotels, and medical and civil services—are all key socio-economic activities in Mbeya City. Around 33.3% of the city residents are reported to rely on agriculture for their livelihood, while 21% work in the public sector, which is dominated by delivery processes.

This study used a descriptive cross-sectional research design, which allowed data to be collected only once at a specific point in time for the target population. The chosen design allowed for in-depth investigations of the study variables by encompassing a wide range of characteristics, ranging from individuals to the community, as well as obtaining a thorough information about solid waste disposal procedures in the study area. There were 160,640 individuals in the survey area, including 49,790 households. The sampling frame for the study involved the ward household list obtained from each ward executive officer (WEO)'s office. The sample size was estimated using the Yamane formula (1997), based on the number of households as follows:

$$n = \frac{N}{1 + Ne^2}$$

Where, n = sample size; N = total households involved in a study (49,970); and e = precision level (10%). Using the Israel formula (2009), the sample size was distributed across the participating wards as follows:

$$n = \frac{Np}{P}$$

Where, n = sampling distribution, N = sample size (100), p = number of households in a ward, and P = total number of households.

Following the Israel formula, the sampling distribution was 19 households for Ilomba, 19 households for Iyela, 21 households for Iyela, 16 households for Ilemi, 12 households for Mwakibete, 19 households for Luanda, and 13 households for Nzovwe.

Non-purposive (simple random) and purposive samplings were used to pick the study variables using probability and non-probability sampling procedures, respectively. The respondents for the questionnaire survey were chosen using simple random selection by picking individuals from the ward household list. Purposive sampling was also utilised to identify informants who were knowledgeable about, and experienced with, solid waste management. Based on its performance, the practice of solid waste collection services was investigated. Several indicators were chosen to evaluate the performance; and among these included: the levels of community participation in SW collection, SW production and collection, SW storage facilities, SW retention time at the collection point, SW transportation to dumpsites/sanitary landfills, SW collection budget, and the ability to address SW collection challenges.

Primary data was gathered using questionnaire surveys, field observation and key informant interviews; while secondary data was gathered by analysing documents such as solid waste management policies, regulations, and reports. To collect data from respondents, the study used both structured and non-structured questionnaires; which were administered by the researchers and assistant researchers. The surveys were designed to acquire information regarding the present methods and obstacles that are preventing solid waste management procedures from performing well.

With the use of interview guides, key informant interviews were conducted with the Mbeya City Health Officer, ward environmental cleaning group, City Environmental Officer, solid waste collectors and recyclers, drivers, and street executive officials. While backing up information provided by respondents during the survey, key informants gave in-depth information about solid waste collection services. The field observation took the form of a non-participant observation, in which the researcher became a part of the community's general attitude towards solid waste disposal. Photographs were taken for illustration purposes once verbal consent was obtained, particularly those photos that included the respondents. Rather than depending on second-hand stories, this strategy allowed researchers to watch directly what was happening in the field.

The statistical package for social sciences (SPSS) and excel software were used to analyses the data acquired through a questionnaire survey using descriptive statistics. Tables and in-text descriptions were used to present the findings. Themes and content analysis were used to analyse the data gathered from key informant interviews. The findings are presented through photos and in-text narration after the data gathered through field observation was analysed.

3. Results and Discussions

3.1 Methods of SW Collection

The findings in Table 1 show that the point-collection method was the most (76%) common form of SW collection in the research area. Recycling (16%), door-to-door collection (5%), and special collections (3%) came in second and third, respectively.

Table 1: Methods for SW Collection Used in Mbeya City, Tanzania (n=100)

Wards	**SW collection methods (%)**			
	Door-to-door Collection	***Point-collection***	***Special Collection***	***Recyclers***
Ilemi (n=16)	0	16	0	0
Ilomba (n=19)	0	12	1	6
Mwakibete (n=12)	0	11	0	1
Nzovwe (n=13)	1	10	1	1
Iyela (n=21)	4	14	0	3
Luanda (n=19)	0	13	1	5
Total	**5**	**76**	**3**	**16**

Source: Field data, 2020

In all wards in Mbeya, point-collection was the most common method of providing SW collection services (Photo 1). The communities judged that this technique was the most successful and cost-effective in collecting MSW in their areas. According to Karija et al. (2013), point-collection is primarily used in areas with good access roads to allow hauling trucks to travel and stop by at designated stations in streets for a short period, while alerting homeowners to deliver garbage from their homes. Households are required to leave their garbage at pre-determined sites where some sort of communal collection is stationed under point-collection. It reduces the number of sources from which trucks must collect garbage. However, if waste facilities are not correctly positioned, expenses will rise since people will be less likely to utilise them, and would trash their rubbish wherever they are (Cunningham & Cunningham, 2010).

Photo 1: Point-collection of Solid Waste in Mbeya City
Source: Field data, 2020

The recycling technology was also found in Mbeya City, where it has the potential to benefit recyclers by generating revenue from the sale of recyclables such as plastics and metals. One of the managing personnel for the Ikana Investment reported thus:

> *"This recycling facility not only reduces environmental pollution, but it also generates significant profits for our business, and jobs for the young people."*

The recycling process employs a large number of people in various positions, including waste collectors, sorters, drivers, watchmen, office attendants, machine operators (Photo 2), and other environmental advisors. The Ikana Investment Plant, for example, was found to employ up to 50 personnel who were responsible for collecting, sorting, and packing recyclables; driving recyclables-transporting trucks; and maintaining office and record-keeping.

Photo 2: Heavy Recycling Machine at IKANA Investment in Mbeya City
Source: Field data, 2020

Mlozi (2013) states that collected and recovered wastes are packed and delivered to recycling plants where they are reprocessed or used to make new items such as plastic bottlers, bone decorations, iron roofing, and envelopes made from boxes and nylon bags. Srivastava (2016) goes on to say that industrialised countries are employing modern technologies to avoid waste and increase the likelihood of recycling and reuse. The use of such technologies has allowed for a 62% increase in recycling, resulting in the reduction in land filling.

The practice of door-to-door collection was limited, and it only applied to families that were reachable by automobiles. According to Nkosi (2014), the door-to-door collection system is used in formal settlements, and is expedited by a high degree of community awareness; whilst private businesses handle the full operation of collecting garbage and dumping it for recycling. Elites and the educated community are more likely to engage in door-to-door collection. It is, however, accompanied with provisions for a variety of small skips to sort rubbish at homes (Sharholy et al., 2007). Due to the high costs of operation, Mnyanyi (2014) reported that door-to-door SW collection is less common in Dar es Salaam, Tanzania.

Specific collection, on the other hand, was only slightly used in Mbeya City, where it was done only by appointment and invitation, as it necessitates special processing and collecting of waste. According to the Mbeya City Health Officer, health institutions and industrial companies are the ones most heavily involved in this collection service due to the nature of medical and industrial waste that necessitates the use of special transport vehicles and familiar personnel to handle the entire process from collection to the disposal. Because of the nature and severity of the effects of such waste, special collection of infectious garbage, for example, is primarily done in healthcare institutions (Photo 3).

Photo 3: Special Collection of Infectious Waste at the Agha Khan Hospital in Mbeya City
Source: Field data, 2020

3.2 Coverage of Solid Waste Collection Services

Only 35% of Mbeya residents had access to solid waste collection services, while 65% did not (Table 2). This means that a large number of families were exposed to the risks of SW to human and environmental health. These finding supports the assertion by Lindell (2012): that in the developing world, only a small percentage of urban people have access to MSW collection services.

Table 2: Coverage of MSW Collection Services in Mbeya City (n=100)

Wards	Responses on coverage (%)	
	Covered with SW Collection Services	***No SW Collection Services***
Ilemi (n=16)	7	9
Ilomba (n=19)	7	12
Mwakibete (n=12)	4	8
Nzovwe (n=13)	4	9
Iyela (n=21)	9	12
Luanda (n=19)	4	15
Total	**35**	**65**

Source: Field data, 2020

The lack of MSW collection services is partly due to the authorities' inability to cope with the growing volume of rubbish generated. People without waste collection services are mainly low-income individuals who live in slums. Inadequate fees imposed, and insufficient finances from municipal budgets for MSW collection can

prevent the provision of proper SW collection services. This finding is also supported by Ogwueleka (2003), who said that most urban areas, particularly in developing nations, lacked effective SW collection services. According to Mwesigye et al. (2009), the increased output of MSW pose a significant burden on municipal/state administrations, particularly in developing countries' fast-growing cities, with a task that exceed their capabilities. Saadeh et al. (2019) and Koppenjan and Enserink (2009) suggest the adoption of public private partnerships (PPPs) to overcome the problem of inadequate municipal capacity to collect SW.

3.3 Community Perception on the Performance of SW Collection Services

Table 3 shows that the majority of the respondents (51%) thought that the SW collection services were inefficient, 41% thought they were efficient; while 8% were undecided due to the lack of knowledge of SW-related issues. This indicates that the communities in the research area are generally dissatisfied with the performance of SW collection services.

Table 3: Community Perceptions on the Performance of Solid Waste Collection in Mbeya City, Tanzania (n =100)

Wards	Perceptions on SW Collection Efficiency (%)		
	Efficient	*Not Efficient*	*Undecided*
Ilemi	8	8	0
Ilomba	10	9	0
Mwakibete	2	10	0
Nzovwe	5	5	3
Iyela	6	12	3
Luanda	10	7	2
Total	**41**	**51**	**8**

Source: Field data, 2020

The findings in Iyela ward suggest a low level of community satisfaction with SW collection services, which could be attributable to the slum conditions of the settlements. A study conducted by Kasala (2014) in Dar es Salaam, Tanzania, found that unplanned informal communities have considerable obstacles, including difficulty in planning for adequate sanitation. Wokekoro and Inyang (2014) further advise authorities dealing with SW management to implement sufficient settlement planning for regular collection of waste to protect public health and the environment.

According to Bubegwa (2012) and the Briggs (2011), only 41% of MSW generated daily in developing nations gets collected and disposed of off-site; while the rest is tossed haphazardly in streets, roadside ditches, drainage channels, commercial centres, and open spaces. In Zanzibar, Ally et al. (2014) say that MSW collection is still insufficient, with an average collection efficiency of 45% to 50% of mixed waste; and the use of open dumping for final SW disposal without suitable treatment: all of which pose health and environmental concerns.

3.4 SW Generation and Collection of SW

According to the findings on the perception of respondents, the rate of SW generation at the community level has increased (Table 4). The findings are consistent with those of previous researches (Kalwani, 2010; Un-Habitat, 2010; Yukalang et al., 2017), which show that the amount of daily SW generation increases as population and socio-economic activities rise. When the findings of the respondents were combined with secondary data from the Mbeya City report (Table 5), it was discovered that the daily SW generation in the study area was around 270 tons, while daily collection was 180 tons. According to the MCC's 2017/2018 report, the daily rate of SW collection was 66.7%, leaving 33.3% of the SW uncollected (Hyera, 2019).

Table 4: Respondents' Perception on the Rate of SW Generation in Mbeya City (n=100)

Response	Percentage (%)
Increasing	**57**
Not changing	**40**
Decreasing	**3**
Total	**100**

Source: Field data, 2020

When compared to Mlozi (2013), who showed that daily SW generation in Mbeya City was 167 tons, 44.3% of which was collected and disposed and the remaining 65.7% was uncollected (Table 5), these findings suggest an improvement in SW collection performance in the city.

Table 5: Secondary Data on SW Generation and Collection in Mbeya City During the Fiscal Year 2017/18

Rate	Solid waste generated (tons)	Solid waste collected (tons)	Percentage of solid waste collected
Daily	270	180	66.7%
Weekly	1890	1330	70.3%
Monthly	7560	5320	70.3%

Source: Field data, 2020

Low SW collection capacity is a significant concern in all developing country cities; for example, Nairobi's MSW collection capacity is estimated to be below 33%, leaving more than 63% uncollected (Njoroge et al., 2014).

3.5 SW Storage Facilities

According to the study findings, 69% of the respondents said there was a lack of SW storage facilities in the study area (Table 6). The analysis found that each of the wards that participated in the study had a shortage of SW storage facilities. Skips and litter bins were the prevalent SW storage facilities found to be insufficient in the research area.

Table 6: Respondents' Perception on the Shortage of SW Storage Facilities in Mbeya City (n=100)

Wards	Shortage of Storage Facilities (%)		
	Low	***Medium***	***High***
Ilemi	0	1	15
Ilomba	0	1	18
Mwakibete	1	3	8
Nzovwe	1	4	8
Iyela	6	6	9
Luanda	4	4	11
Total	**12**	**19**	**69**

Source: Field data, 2020

Moreover, the study area's MSW collection services have been cited as being hampered by the lack of SW storage facilities. The inability of the current infrastructure, coupled with the lack of facilities to cope with the volume of waste generated, were the major sources of concern. One of the ward executive officer had this to say with respect to SW storage facilities:

> *"The lack of SW storage facilities in our ward is attributed to rapid population growth, increased socio-economic activities, and the lack of community understanding of SW storage in installed skips."*

According to the MCC (2017/2018) report, there were 36 skip containers and 160 litter bins in low supply (Hyera, 2019). Thus, the performance of MSW collection services in Mbeya City is hampered by infrastructural deficiencies, with the majority of SW being managed through open-air burning (Photo 4). One of the forms of air pollution that contributes to the release of greenhouse gases into the atmosphere has been identified as open-air burning (Neurath, 2003; Pansuk et al., 2018).

Photo 4: Open Air Burning of SW Due to the Shortage of SW Storage Facilities in Mwakibete, Mbeya City

Source: Field data, 2020

This finding is corroborated by Mlozi (2013), who found that the Mbeya City administration was only capable of collecting and disposing of 44% of the collected SW, with the remainder being improperly managed, potentially resulting in environmental and health issues. Thus, this cements the assertion by Mgimba and Sanga (2016): that due to poor infrastructure, one to two-thirds of the SW generated in developing nations is not collected.

3.6 Availability of Vehicles and SW Retention Time at Collection Points

Vehicles are critical to the entire SW collection process, particularly in transporting waste from collection stations to final disposal points (Nguge, 2013). According to the Un-Habitat (2010), when choosing vehicles for SW collection, compactor trucks should be tailored to local conditions, including the type of waste, operators' financial capacity, maintenance standards, and access roads. Also, vehicles should be designed for SW rather than materials, with a much higher density to optimise load-carrying capacity and productivity.

According to the MCC's 2017/18 report, Mbeya City needs three tippers, four skip loaders, two Toyota double cabins, and two road sweepers. However, the City Council has three tippers, two skip loaders, and one Toyota double cabin to be used for SW collection services. Furthermore, the majority of the existing vehicles are in poor condition. These shortages have caused delays in the evacuation of SW skips in several wards, putting people's health and the environment in danger (Table 7). This is a similar situation as the one found by Ndugire et al. (2005) in a study on West African towns: that up to 70% of collection and transfer vehicles may be out of service and in need of maintenance.

Table 7: Solid Waste Removal Delays and Adherence to Timetable in Mbeya City (n=100)

Required Responses	Responses (%)	
	Yes	***No***
If there is SW removal delays	62	38
If there is adherence to SW removal timetables	23	77

Source: Field data, 2020

The time spent by vehicles collecting SW in designated sites has a substantial impact on the performance of a MSW collection service. The city's allocated time for SW collection at the community level ranges from 8 to 12 hours. However, due to a variety of factors—including the lack of permanent schedules and vehicle logistics such as acquiring fuel, services, traffic obstructions, and waiting for infrastructure for SW loading and offloading—drivers' working hours in the research area were mostly below the specified hours; and mostly exceeded the specified government time (MCC, 2017/18 Report). One of the SW truck drivers, who was among the key informants, had this to report:

"Many obstacles to SW collection include delayed vehicle services, a lack of seriousness, and fuel logistics."

Due to these difficulties, skip removal took longer than expected, and work began late, causing operations to fall behind schedule. Abdulrasoul and Bakari (2016) explain that delays in moving SW from collection stations to disposal sites cause environmental and community health issues.

The findings also revealed that the SW collection timetable is not adhered to (77%). Inadequate timetable follow-up has the effect of leaving SW uncollected on time, leading to SW being dispersed beyond skip containers. Timetable obstacles are ascribed to logistics, which include fuel acquisition delays, truck services and maintenance, abrupt timetable changes, and driver-related issues such as recklessness, rejections, and unpaid obligations (Longe et al., 2009). Irregularities in garbage collection from the station cause havoc on waste disposal operations, resulting in poor SW management practices (Karija et al., 2013; Longe et al., 2009).

3.7 SW Collection Budget and Disbursement

According to the secondary data results, the budget allocated for SWM in Mbeya City was fully disbursed in 2014/2015. Despite the growth in SW generation, however, disbursement began to drop over time (Table 8). Inadequate budgeting and disbursement appear to be among the main issues contributing to the poor performance of MSW collection in Mbeya City.

Table 8: Secondary Data on Mbeya City's Budget for SW Management Activities

Fiscal year	Funds (TZS)		Percentage of Fund Disbursed (%)
	Allocated	*Disbursed*	
2014/15	673,284,637.00	673,284,637.00	100
2015/16	814,849,994.00	775,785,081.60	95.2
2016/17	819,050,001.78	702,654,456.00	86
2017/18	838,358,600.00	621,126,750.00	74

Source: Field data, 2020

According to Mgimba (2016), funding determines the performance of MSW collection services, which remains an issue in Mbeya City. Funds are required for infrastructure development and improvement, labour payment, community education and capacity building, gifting and motivation, and monitoring and evaluation operations. As per Yhdego and Kingu (2016), insufficient funding for operations and vehicle maintenance is the biggest problem in the governments' SWM endeavours. In developing countries, SWM is expected to require roughly 30% of local government budget, with SW collection accounting for 60-75% of the total SWM expenses (Henry et al., 2006; Kadafa et al., 2012). However, according

to Bhalla et al. (2013) and Alagoz and Kocasoy (2008), SW collection alone accounted for 80-95% of overall SW expenditure in developing countries, while it accounted for less than 10% in developed countries.

3.8 Addressing SW Collection Challenges

3.8.1 Existing SW Collection Challenges

Despite the significant contribution of SW collection services to environmental cleanliness and human health protection, there are still obstacles to achieving maximum collection efficiency. The major SW collection difficulties identified in the research area included: illegal dumping of SW, the lack of knowledge and education, shortage of electronic fiscal machines (EFD), refuse fines, enforcement of environmental ordinances, and population increase (Table 9)

Table 9: Challenges Associated with MSW Collection Services in Mbeya City (n=100)*

Challenges	Reponses (%)
Illegal dumping of SW	100
Little awareness and education	90
Shortage of EFD machines	82
Refuse fees	81
Enforcement of environmental bylaws	79
Population growth	42

Note: *Multiple responses EFD = Electronic Fiscal Devices

Source: Field data, 2020

Despite the fact that various researches (Lindell, 2012; Okot-Okumu, 2012; UN-Habitat, 2010) link MSW concerns to population expansion, the results of this study show that population growth is the least of the challenges to SW collection in Mbeya City. This was due to the fact that the research focused just on SW collection as a single component of SWM. Population expansion is linked to an increase in socio-economic activities that generate SW to the point where SW collection systems and infrastructure may become overburdened (Mnyanyi, 2014).

The study findings further revealed that one of the major obstacles to MSW collection in the research area was the lack of environmental and health education and awareness. One of the Komondo Arts Group members, which was responsible for SW collection in Luanda ward, had this to say:

> *"The majority of inhabitants in Mbeya City have not been reminded that environmental cleaning is their responsibility, and not for the government alone. The lack of community knowledge has resulted in more unlawful SW dumping on the streets."*

This finding is similar to that of McAllister (2015): that one of the primary barriers to managing SW in developing countries' cities is the lack of awareness. The necessity to increase public awareness and participation is commonly advocated

as one of the means of ensuring long-term management of SW. Mlozi (2013) also says that the lack of environmental education is a critical concern, emphasizing the necessity for the government to engage in SWM education and awareness programs. Zurbrugg (2003) further adds that all components of the SWM system can be affected by public knowledge, education, and attitudes toward SW.

The most difficult aspect of SW collection in the study area was the dispersion of SW in undesirable places. Because of the considerable distance to SW collection stations, scarcity of skip buckets, and the lack of environmental education and awareness, the community members engaged in illegal dumping of SW. The researchers witnessed this during participant observations in Luanda ward: SW was visible in water drainages along the highways (Photo 5); and SW collection bays had been destroyed (Photo 6). According to Okot-Okumu (2012), most cities in East Africa have piled garbage on important roads and highways, eroding public trust in city officials' ability to successfully manage SW.

Photo 5: Illegal Dumping of SW along the Road Runoff Drainage Systems at Luanda Ward, Mbeya City
Source: Field data, 2020

One a key informant, a business-person, stated:

> *"Skip containers and buckets are too far away from our homes and enterprises, so we normally opt to keep waste in bags and assign youths to dispose it at a collection site at our own expense."*

Nguge (2013) asserts that illegal dumping is a severe problem in some areas, which is related to the shortage of garbage bays and skips; forcing people to establish public and unscheduled dumping sites that pose health and environmental dangers to the community. Such illegally deposited SW spreads throughout residential and commercial areas, posing health dangers, emitting foul odours, and clogging surface water channels and drains in urban areas (Ally, 2014).

Photo 6: Illegal SW Storage Bay Destructed in Ilomba, Mbeya City
Source: Field data, 2020

According to Jones and Mkoma (2013), waste charges are operational funds for SWM, particularly collection services from primary and secondary collection stations to final disposal points. A number of respondents in the research area, however, expressed dissatisfaction with the collection of refuse fees due to ongoing delays in garbage removal, insufficient skip buckets, the lack of official receipts of fee payment, and the lack of transparency in the collection and expenditure of fees collected. One of the retired public officials in Iyela expressed dissatisfaction with the monthly refuse fees, citing the lack of information on the expenditure of fees and the late pickup of SW as among the reasons of discontent.

The provision of receipts by SW service collectors is a major challenge for Mbeya City's SW collection authorities. Unless EFD machines are sufficient, understood and accepted by the communities, this may lead to a failure to meet targets of the collection of refuse fees from sources. According to Ikasu (2014), the malfunction some EFD machines, rotation, recurrent breakdowns, fairness in tax estimation, and the lack of education on the usage of devices are the factors that contribute to EFD-related issues in SW collection. All of these issues contribute to citizens' complaints, poor perceptions, and rejection of monthly refuse fees.

One of the refuse fee collectors had this to say, with respect to EFD machines:

> *"Collecting refuse fee at the home and institution level is very challenging, with many complaints, due to the lack of community understanding about the value of their fees in keeping the environment clean, as well as the lack of EFD machines."*

Similarly, one ward executive officer (WEO) had this complaint:

> *"The EFD machines are insufficient, this result in rejections and disputes with citizens when collecting refuse fees while issuing handwritten receipts."*

3.8.2 Measures for Improving MSW Collection Services

Despite the constraints of MSW collection, respondents suggested actions that may be taken to improve MSW collection services. Among the generic approaches, these included increased SW storage facilities, expanded environmental education and awareness, and amendment and enforcement of by-laws and regulations. Others included increasing the number of EFD devices, and boosting transparency on the use of waste collection fees (Table 10).

Table 10: Proposed Measures to Improve MSW Collection Services in Mbeya City (n=100)*

Proposed measures	Responses (%)
Increasing SW storage facilities	92
Environmental education and awareness	89
Amendment and enforcement of by-laws, and regulations	54
Increasing EFDs machines for refuse collection	48
Transparency on refuse collection fees	39

Note: *Multiple responses

Source: Field data, 2020

The majority of respondents (92%) called for the expansion of waste storage facilities as one of the solutions for improving the city's SW collection capacity. They claimed that SW collection could be improved by providing enough storage facilities, such as skip buckets and litter bins that are conveniently situated. This is similar to what Nguge (2013) also advised: that the number of garbage bags or skip buckets in the streets be increased to make it easier to discard SW in the appropriate locations.

According to the respondents, the provision of environmental education and community awareness are the best approaches for enhancing SWM in the city. Environmental cleanliness and hygiene can be ensured by a well-educated and informed population. Mgimba and Sanga (2016) advise that the relevant authorities should educate households about waste separation at the source. This process of sensitization can be combined with education regarding the use of appropriate technologies for SW management. Also, effective and long-term MSW management systems must be adopted by local governments with suitable organisational capabilities and collaboration amongst multiple stakeholders in the public and commercial sectors to achieve these objectives (Henry et al., 2006).

The respondents also acknowledged the importance of by-laws, rules, and procedures in the MSW collecting process, but stated that they needed to be amended as the current rates of refuse collection were insufficient to cover monthly expenses. As noted by the Mbeya City Health Officer, the refuse collection fees by-

laws need to be amended to reflect the current cost of holding and transporting garbage from primary collection stations to final disposal; as also recommended by Lawuo et al. (2014).

According to the MCC (2017/2018) report, the documented SW collecting success in Mbeya City was achieved by the enforcement of by-laws. On this issue, the respondents also suggested the enforcement of existing bylaws and regulations; only that it was emphasized that the community be educated on SW management prior to enforcement. Lawuo et al. (2014) has shown that SWM in Dodoma, Tanzania, is hampered by the lack of community knowledge of the SW laws, and the enforcement of such laws.

The issuing of EFD receipts upon the payment of monthly refuse fees was also mentioned as a way of improving SW collection services by the respondents. They argued that the issuing of EFD receipts would ensure that the government collected taxes, which would in turn increase the efficiency SW collection. According to the MCC (2017/2018) report, there were shortages, and malfunctioning, of EFD machines in the research area, resulting in the community's mistrust of the commissioned authority, and ultimately a refusal to pay the fees. In the acknowledgement of the importance of refuse collection fees in improving SWM, Nguge (2013) proposed that each ward in Mbeya City could open a separate bank account to better control SWM collection and expenditure.

The PPP was not listed as one of the respondents' suggestions to address the current issues with MSW collection services. This demonstrates that PPP is not known to the respondents in the study area. The absence of PPPs in the study area, however, was observed by the researchers. Numerous studies, including those by Arbulu et al. (2016), Chopra and Kapoor (2016), Koppenjan and Enserink (2009), Massoud and El-Fadel (2002), Oduro-Kwarteng (2011), Spoann et al. (2019), and Saadeh et al. (2019), have shown that rapidly expanding cities can address the issue of insufficient MSW collection services through PPPs.

4. Conclusions

This study investigated the performance of Mbeya City council in the provision of SW collection services using a variety of performance indicators in SW, including: community participation in collection, generation and collection, storage facilities, retention time at collection points, transportation, collection budget, and the ability of the city council to address collection challenges. The findings revealed these challenges to include an insufficient number of trucks, the lack of SW storage facilities, lack of timely disposal of collected SW, low SW collecting capacity, low SWM disbursement budget, and a low ability to address SWM concerns. Thus, to improve the effectiveness of SW collection services, the Mbeya City council should enhance waste storage facilities, promote public education and awareness on SW,

increase and improve the quality of EFD machines, review limits on refuse collection fees, and strengthen the enforcement of environmental management by-laws and regulations. One of the measures that would ensure this is to adopt PPPs initiatives to strengthen the MSW collection capacity.

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