IMPACT OF SOLID WASTE MANAGEMENT ON THE PEOPLES' LIVELIHOOD IN KIGALI: A CASE OF GASABO DISTRICT

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ABSTRACT

This study evaluates the impact of solid waste management on the livelihoods of people in Kigali, focusing on the Gasabo district. It examines how families, businesses, and organizations in Gasabo collect, transport, and dispose of waste in landfills. Data collection methods included questionnaire surveys, GPS data collection, observations, literature reviews, and mapping using Arc GIS software. The study surveyed 339 individuals involved in solid waste management from private companies, households, and institutions in the Jabana, Bumbogo, and Nduba sectors, using random, purposive sampling. Data collected from 2021 to 2023 were analyzed using descriptive statistics. The primary findings indicate an average respondent rating of 2.99 for the city's solid waste management strategies. The study highlights the need for improvements in all aspects of solid waste management at the Nduba landfill in the Gasabo district, including financial, technical, policy, legislative, and supportive measures. The research connects with land management, sustainable development, community development, and environmental management. Its impact lies in encouraging practical solutions and addressing the priorities of the Gasabo District community for effective solid waste management.

Keywords: Solid waste management, Livelihoods, Gasabo district, Sustainability, environment

Ananias Micomyiza[1*], Marie Claire Mukeshimana[2]

Introduction

Around the world, enormous amounts of Municipal Solid Waste (MSW) are created daily. Trash generated at home that is subsequently disposed of as undesired or superfluous is referred to as domestic trash (DW) (Telesphore, 2020). Reusing, recycling, and recovering resources are also possible using DW. The primary reason for the problems with solid waste management in Africa's developing nations is urbanization. Rapid urbanization is one of the characteristics of rising nations. (Yoada et al, 2014) the quick urbanization of Africa suggests a quick buildup of undesired trash. In order to provide services for home waste collection, disposal, and management, the commercial and public sectors are now partnering with one another around the world.

This is a result of the waste sector's failure in developing nations, which has prevented citizens from receiving effective and sustainable solid waste management services. Kigali city, the capital of Rwanda is no exception where urban population growth and economic development are driving up MSW output. According to (Akimanizanye, 2020), Kigali city has not yet built an appropriate and thorough waste management procedure, and in underdeveloped nations, sludge treatment in metropolitan areas is frequently improperly carried out, and it is frequently dumped in an unhealthy manner. Unsafe chemical waste disposal frequently pollutes wetlands and waterways. Rwanda lacks adequate resources and medical expertise to manage garbage (REMA, 2022).

Ineffective waste management increases the risk of rubbish landslides, foul odors, methane gas explosions, and groundwater damage. The City of Kigali's rapid population growth has put a strain on the city's infrastructure, which has led to several complicated issues with settlement and the treatment of solid and liquid waste. As a result, solid waste management has been elevated to a top priority. By 2022, the Rwandan government hopes to develop enough sewage and disposal systems to be successful, and every Rwandan city will have access to a sufficient solid waste management system.

The waste collection businesses provided all houses in Rwandan cities with appropriate services. The following common issues arise while dealing with Municipal Solid Waste Management (MSWM) in economically growing nations: (i) insufficient service availability and operational inefficiencies; (ii) low recycling activity utilization; (iii) insufficient landfill disposal; and (iv) insufficient handling of hazardous and medical waste (UNEP, 2019). Solid,

medicinal, hazardous, and liquid wastes are the four primary categories used to classify trash in Rwanda. There was only one peer-reviewed paper on Rwanda's solid waste management (SWM) studies, which focused on Kigali city (Kabera, 2020), along with a small amount of "grey" literature and a few student projects, the final phase of an effective solid waste management system is the disposal of solid waste produced in a community (Iraguha et al., 2022; Nshimiyimana, 2015; Bazimenyera et al., 2012). The objective of this study is to evaluate the effects of solid waste management on the people's livelihood in Kigali in the context of the Gasabo district.

Descriptions of the study areas

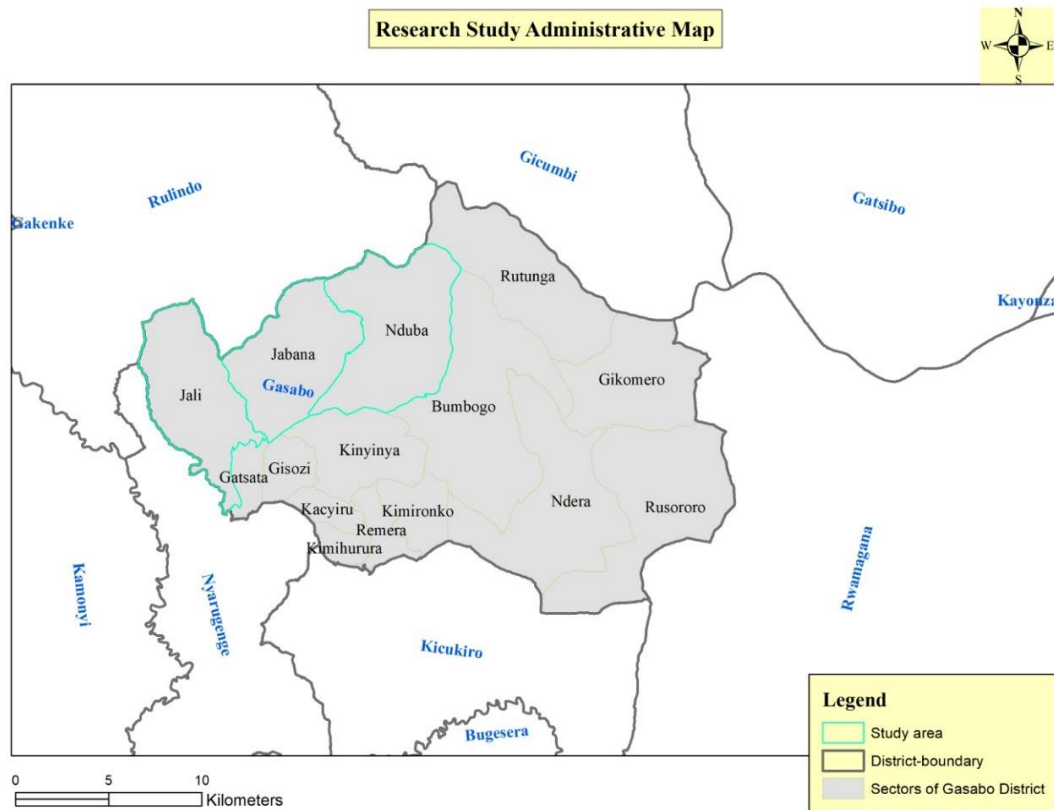The study selected three sectors, Jabana, Bumbogo, and Nduba from the Gasabo district.

Figure 1. Map showing the study area

Ananias Micomyiza[1*], Marie Claire Mukeshimana[2]

Literature review

Waste can take many forms, although it usually takes the form of solids, liquids, or gases. It is composed of a variety of waste materials from industrial, social, and economic activity. There are some obvious similarities between the creation, manufacturing, and transportation of urban waste, even though it is economically foolish to extrapolate numbers from one region or country to another. According to (Asnani,2016), the field of solid waste management includes all planning, engineering, financial, administrative, and planning duties associated with resolving any solid waste-related problems. Selections may include advanced multidisciplinary fields such as political science, engineering, conservation, geography, public health, sociology, demography, and materials science; or they may include public health, engineering, and conservation.

Chitoliya (2010), states that the ultimate objective of solid waste management is to decrease the quantity of waste storage that clogs streets and pollutes the environment, regardless of whether the rubbish is recycled or disposed of. The six functional categories outlined in Solid Waste management can be used to classify the activities involved in managing solid waste from the point of generation to final disposal. According to estimates based on international research and these dipstick experiments, between 60 and 80% of the garbage produced in urban areas is organic, and over 90% of the waste produced in rural regions may be organic (Sarika & Aradhana, 2022). There aren't many precise estimates of the entire amount of waste produced. With estimates of 1,800 to 2,000 tons annually, Rwanda Environment Management Authority: REMA's State of the Environment offers the most accurate total trash generation figures with a daily production rate per person of between 1.8 and 2 kg (REMA, 2017).

As the population and economic activity in Kigali City grow, so do the city's solid wastes in both quantity and quality (Akimanizanye, 2020) but there is a limited amount of land available for disposal. Based on information from the Kigali Office of the Auditor General of State Financing, (Kabera, 2020). estimated that collection rates were 88% citywide. 44 However, based on The Fifth Integrated Household Living Survey data (EICV5), it was reported that about 49% of Kigali households report having access to trash management services and waste management procedures, (Rajashekar et al., 2019).

Numerous techniques for treating and disposing of solid waste are used in

private facilities as well. These techniques include landfilling, hazardous waste treatment, hazardous waste recycling, incineration, and energy recovery (Kofi, et al., 2019). Different approaches to managing solid waste materials include source reduction and reuse, Animal feeding, recycling, composting, fermentation, landfills, incineration, and land application.

These activities clearly show differences between rural and urban areas. In 2017, only 1.7% of rural households reported having access to waste collection services, compared to roughly 46% of metropolitan households. (Nicola, et al., 2017) Furthermore, during the last ten years (2011–2021), these trends have remained consistent and as a result of the government of Rwanda's asbestos removal operation, each district also has a disposal site for asbestos (REMA, 2022). The majority of disposal facilities are run by private companies, and on-site garbage beneficiation and separation are done to provide valuable outputs

One of the essential components of a nation's social and economic development is adequate access to sanitation services (Jacqueline, 2024). According to a seven-year government plan, Rwanda has committed to achieving highly lofty goals in the area of sanitation,

to achieve 100% service coverage by 2024. The majority of organic waste is made up of food waste, according to a recent report on the fast assessment and options analysis for Kigali waste disposal in 2019 (Rajashekar et al., 2019). There are two dumpsites for trash disposal in the City of Kigali, which are situated in two different locations: Nyanza and Nduba. The disposal of waste influences the environment and human health, even though this is not a sanitary landfill (MINIFRA, 2022).

Sorting is the process of separating various waste types based on how dangerous they are as well as how they will be treated and disposed of. It is advised to dispose of different types of solid waste in color-coded bags or containers with prominent labels (Franz & Dettenkofer, 1997). However, (Donald, 2018) indicates that there are significant technical, environmental, and health concerns regarding the inadequacies found in the successful separation of solid waste. The volume of contaminated waste has increased due to a lack of source sorting, even though this process is crucial to the efficient management of solid waste (Mühlich et al., 2003).

Research Methodology

Research design

This study applied a descriptive and correlational research design: a quantitative

Ananias Micomyiza[1*], Marie Claire Mukeshimana[2]

and qualitative prospective study design used to assess the impacts of solid waste management on people's livelihood in Kigali City, Rwanda.

Population of the study

Population can be defined as" the totality of persons or objects with which a study is concerned. Thus, a population is any group of people or organization about which one wants to conclude (Grinnell & Williams, 1990). The total population of this study was 399 from selected sectors of Nduba, Bumbogo, and Jabana, which come from private companies, households, and institutions related to solid waste management. Demographic characteristics are presented in this section. It includes gender, age, experience, and educational status.

Sample size

The sample size is the number of respondents that the researcher used to answer the questions and a fair representation of all the members of a union. Due to the large size of populations, researchers often cannot test every individual in the population because it is too expensive and time-consuming. This is why researchers rely on sampling size. The sample size is computed using the Yamane formula $\frac{N}{1+N(e)^2}$.

Where

n is the sample size,

N represents the total population, and e is the

error margin: in this study, we used e = 5%. Calculating the sample size according to the formula above gives the sample size:

$\frac{104000}{1+104000(0.05)^2}$ = 339 respondents

Table 1 shows the proportionate population size and sample size for the private companies, households, and institutions related to solid waste management in the selected three sectors of Jabana, Bumbogo, and Nduba.

Table 1: Proportionate sample size

Numbers	SECTOR : Jabana, Bumbogo, Nduba	Population	Sample size
1	PRIVATE COMPANY	400	140
2	HOUSEHOLDS	18000	189
3	INSTUTITIONS	290	70
Total	3	18690	399

Data collection techniques

The study used questionnaires, documentation, survey research, and field observation as data collection techniques.

Questionnaire

This questionnaire's primary goal is to gather data on the following topics: the characteristics of urban waste, the process of managing it, and the adverse effects of improper waste management, the

questionnaire contains closed-ended questions; respondents were given different alternatives to choose from. The questionnaire is designed by following the research objectives; this technique is preferred because it minimizes bias and enables the researcher to cover a larger sample in a limited time. The questionnaire tool is designed with a Likert scale range of strongly disagree (SD), disagree (D), neutral (N), agree (A), and strongly agree (SA).

Documentary review

It is important to indicate the review of existing literature reviewed by different authors. The researcher consulted UNILAK library, and other libraries in Kigali, electronic sources, websites documents, and environment conservation studies used for Rwanda Environment Management Authority (REMA), Water and Sanitation Corporation(WASAC), Ministry in Charge of Emergency Management (MINEMA) and Kigali city.

Field observation

Events in the research area were observed via observation. During fieldwork, photos were collected with a digital camera equipped with GPS points to localize the spatial data. By pinpointing each source of solid waste, this method assisted in choosing the sampling technique.

Data analysis

The data were analysed using descriptive statistics, Microsoft Excel, and SPSS for data analysis, and interpretation, it also includes information about evaluating solid waste management by looking at frequency distribution and presenting information in terms of percentage, mean, and standard deviation.

Descriptive statistics

In this research, descriptive statistics were used mainly to analyze and interpret the data. Descriptive statistics enable the researcher to summarize and organize the data in an effective and meaningful way. Correlation analysis was also done by SPSS with the help of.

Statistical tests such as the Z test, the t-test, and Mann-Whitney U GIS techniques were used for mapping. Tables 2 and table 3 show the mean interpretation and guidelines for the strength of correlation that were used during the interpretation of the results.

Table 2. Mean Interpretation

Mean iscore	Interpretation
4.21 i– i5.00	Very iHigh
3.41 i- i4.20	High
2.61 i- i3.40	Moderate

| 1.81 i- i2.60 | Low |
| 1.00 i- i1.80 | Very ilow |

Table 3. Guideline of Strength of Correlation

R-Value	Strength Of Correlation
r i= i0.10 ito i0.29 Or r i= i-0.10 ito i-0.29	Small
r i= i0.30 ito i0.49 Or r i= i-0.30 ito i-0.49	Medium
r i= i0.50 ito i1.00 Or r i= i-0.50 ito i-1.00	Large

Current status of Gasabo 's solid waste management situation

Table 6. revealed that private companies and households have waste minimization and waste-to-energy ratios for solid waste, with 20.6% of respondents strongly disagreeing and 42.4% disagreeing, while 28.3% of respondents agreed and 8.7% strongly agreed with this

statement, meaning that the majority of incinerators used by hospitals and households for managing solid waste are not operational.

Additionally, 10.6% of respondents strongly disagreed with this statement, as did 31.9% of respondents, and 32.4% of respondents strongly agreed that Storage time for solid waste is in the range of 24 to 72 hours and 24 to 72 hours. The standard abbreviation of.959 and the mean of 2.7 suggest that there is a significant risk of infections, and the treatment process was problematic because of the excess time needed for storage caused by a lack of good legislation and regulations. Last but not least, 13.8% strongly disagreed that the hospital and household storage room lacks enough lighting and ventilation. 32.4% of respondents disagreed, 35.1% agreed, and 18.6% strongly agreed with the mean and standard deviation of 2.58 and 9.46, respectively.

According to respondents, private companies and households do not treat solid waste generated because other key elements are not taken into consideration. Waste treatment plans therefore involve equipment, knowledge, and rules. The total average is 2.56.

Table 4: current status of Gasabo 's solid waste management situation

Statements i	SD	D	A	SA	Tot	Mean i	St idev
	%	%	%	%	%		
There is waste minimization and waste-to-recycle for other material	20.6	42.4	28.3	8.7	100	2.3830	.92043

Storage time for solid waste in the range of 24 to 72 hours	10.6	31.9	32.4	25	100	2.7181	.95922
Lack of good legislation and regulations	13.8	32.4	35.1	18.6	100	2.5851	.94682
Overall mean	**2.56206**						

Options to achieve sustainable integrated urban solid waste management in Gasabo district

Table 8. found that households respect the categorization of solid waste as biodegradable or non-biodegradable, with 37.2% agreeing and 20.2% strongly agreeing, with a mean of 2.6 and a standard deviation of 0.904. In addition, 9.6% of respondents strongly disagreed, and 33% disagreed. According to respondents' perceptions, sorting solid waste is an important aspect of managing waste in society, households, and hospitals. Some households don't sort their waste at all, while others do so without adhering to the rules of sorting.

In addition, 39.4% of respondents agreed and 17.5% strongly agreed, whereas 8.5% strongly disagreed and 34.6% agreed that the personnel have an understanding of safety for handling solid trash. The mean of 2.6 and the standard abbreviation of 0.865.

Since understanding how to sort bio and non-biodegradable waste is still crucial to managing solid waste and is essential to the process of sorting plastic and solid waste, it will be challenging to handle infectious waste without safety equipment and staff.

Finally, 9.6% strongly disagreed community establishments had sharp boxes and setting punishment for violating waste management strategies and 36.2% disagreed that biohazard gathering containers have a mean of 2.95 and a standard abbreviation of 0.809. Fortunately, 43.6% and 10.6% strongly agreed that this was the case. Overall, a 2.83-item-appropriate relationship. The assessments of staff members' waste-sorting behavior based on their gender, occupation, educational background, and working experience in the sector revealed that there weren't any statistically significant differences aside from occupation.

Table 5: options to achieve sustainable integrated urban solid waste management in the Gasabo district

Ananias Micomyiza[1*], Marie Claire Mukeshimana[2]

Statements i	SD	D	A	SA	Tot	Mean i	St idev
	%	%	%	%	%		
Households respect the categorizing of solid waste as biodegradable and non-biodegradable.	9.6	33	37.2	20.2	100	2.6809	.90409
The personnel has an understanding of the safety of handling solid trash.	8.5	34.6	39.4	17.6	100	2.6596	.86591
Community establishments had sharp boxes and punishments for violating waste management strategies.	9.6	36.2	43.6	10.6	100	2.9532	.80926
Overall mean						**2.63123**	

Result and Discussion

This research This research is assessing the impact of solid waste management and Nduba landfills on the people's livelihoods in Kigali. In the case of the Gasabo district, the research findings suggest that effective solid waste management has a positive impact on the livelihoods of communities in Kigali. The study showed that there is a need for improved waste management practices in community facilities in the city, as inadequate management of solid waste can have negative impacts on public health and the environment and can ultimately affect the livelihoods of the community.

Referencing determining the factors influencing the status of the existing solid waste management system today in the Gasabo district, according to the respondents of my study, SWM has gained momentum over time and is currently on the national agenda with enough political support to guarantee that the industry gets the funding it needs. Sanitary facilities. Practical regulations that encourage involvement from the private sector. Overall, the mean was 2.56 item-appropriate relationship. Waste collection may be organized by the district authorities or outsourced to private waste management companies. Segregation: waste segregation is an essential step in proper waste management. The government has created several regulations with a practical emphasis on encouraging private sector involvement.

Options to achieve sustainable integrated urban solid waste management might involve creating recommendations

for trash reduction and segregation as well as educating people and environmental staff on appropriate waste segregation households respect the categorizing of solid waste as biodegradable and non-biodegradable, the personnel has an understanding of safety for handling solid trash and community establishments had sharp boxes and setting punishment for violating waste management strategies by the overall mean of 2.63. Communities may minimize the dangers connected with solid waste and lower the expenses involved with garbage disposal by minimizing the amount of waste created and enhancing the segregation of different types of solid waste properly managed, considering environmental and public health guidelines. Public Awareness and Education. To promote responsible waste management, the Gasabo district authorities might conduct public awareness campaigns and educational programs.

Conclusion and Recommendation

Conclusion

This research is assessing the impact of solid waste management on the people's livelihood in Kigali, a case of the Gasabo district. The research findings suggest that effective solid waste management has a positive impact on the livelihoods of communities in Gasabo. The management of solid waste collection from point of generation to landfill is a major concern for communities and neighborhoods, particularly squatter settlements, where a large proportion of the population cannot afford collection services in comparison to wealthier neighborhoods due to financial constraints, while some cannot afford them altogether. Based on data analysis, we can say that the Gasabo district's solid waste management is primarily challenged by the city's population growing faster than its physical infrastructure, which includes developed roads and solid waste disposal facilities. This makes it more difficult for all residents to access collection services.

Poor solid waste management is mostly caused by two key changes: a lack of public awareness of solid waste management and a lack of cooperation among parties involved in solid waste management.

Recommendations

A comprehensive improvement is required in all aspects of solid waste management, in light of the situation surrounding the management of solid waste at the Nduba landfill in the Gasabo district. Policy level, the city and local leaders should create comprehensive action and implementation plans, as well as monitoring plans. Financial level, even though these resources are crucial for

Ananias Micomyiza[1*], Marie Claire Mukeshimana[2]

sustainable solid waste management. Technical level, Gasabo district and Kigali city would be deceiving if they managed solid waste without considering the local perspective.

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