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Abstract

This study aimed to assess the knowledge of local people in Nyamata City on solid waste management, with three specific objectives: to evaluate the level of knowledge on solid waste management among residents, to examine current practices, and to explore the relationship between knowledge and practices in waste management. The research employed a sample size of 393 respondents, selected using simple random sampling. Data collection was conducted through questionnaires, and data analysis involved descriptive statistics and correlation coefficient methods. The first objective focused on the level of knowledge among local residents. Findings indicated a high level of education and awareness regarding solid waste management, with a mean score of 4.21 for household training on waste management and 4.10 for the recognition of its importance to urban health and well-being. The overall mean score of 4.20 suggests that most respondents acknowledge the increasing educational efforts on waste management and its contributions to social and environmental protection. Additionally, access to information through mass media was rated highly effective, with a mean score of 4.21, leading to an overall mean of 4.18 for the role of solid waste management in community sanitation. Capacity building also showed a significant contribution, with an overall mean score of 4.16. The second objective assessed existing practices. Results showed moderate to low levels of waste segregation, with mean scores of 2.87 for excluding solid from liquid wastes, 2.54 for having different bins for each waste type, 2.34 for segregating waste to facilitate collection, and 1.98 for separating biodegradable from non-biodegradable waste. These low scores resulted in a grand mean of 3.93, indicating moderate efficiency in waste collection practices, with a score of 3.74 suggesting inefficiency. Waste disposal practices were rated more positively, with a mean score of 3.89. Regarding waste recycling, the presence of sufficient facilities was rated high, with a mean score of 4.13,

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and the adequacy of the reuse and recycling system was also rated highly, with a mean score of 4.11. Transport of waste received a moderate rating, with a grand mean of 3.38. The third objective explored the relationship between knowledge and practices, revealing a high positive correlation (correlation coefficient of 0.713, p-value of 0.006), indicating that higher knowledge levels significantly contribute to better solid waste management practices. In conclusion, the study found that while there is a high level of knowledge and awareness about solid waste management among Nyamata City residents, practical implementation of waste segregation and collection practices needs improvement. There is a significant positive relationship between the level of knowledge and effective solid waste management practices, underscoring the importance of continuous education and capacity building in enhancing waste management practices.

Keywords: *Bugesera District; Local People; Knowledge Assessment; Practices in Waste Management; Solid Waste management.*

1. Introduction

Waste management in developing countries like Rwanda is a major issue due to poor consumption patterns, high living standards, resource exploitation, and institutional structure (Ali et al., 2015). Waste management planning and organization are challenging due to inadequate policies, inadequate waste disposal facilities, community awareness, public understanding of garbage benefits, and financial and regulatory constraints (Kabera, 2019). Rapid urban growth and inadequate institutional authorities contribute to waste generation, highlighting the need for efficient and effective waste management (Al-Khatib et al., 207; Debrah et al., 2020).

Different studies highlighted the challenges in solid waste management in Kigali city and other developing cities like Nyamata, Residents near the Nyabugogo watershed have low community behavior and attitudes towards waste management, leading to poor collection fees and illegal waste disposal. During the rainy season, this trash pollutes the watershed, harming aquatic species and causing eutrophication, highlighting the need for improved waste management facilities and treatment skills (Iraguha et al, 2022). However, Nyamata City as case study highlighting poor understanding of waste management practices, insufficient knowledge, and Collection systems of these solid wastes are inefficient and illegal disposable.

To achieve efficient SWM in Nyamata city, awareness is needed not only addressed to decision-makers but also to public and private institutions, householders, and community especially the young generation. The sorting of waste at the production level should be implemented to get all waste still in good condition and separated per type. This will avoid contamination and increase the recyclability of waste. The collection point of waste has to be closed to protect waste against weather and then keep its quality for coming recovery. The recovery of waste at the collection point or nearby will be promoted to reduce the transport of waste, the air pollution like CO₂ released by cars when transporting the waste and the pollution created by waste disposal at the dumpsite (Hubert, 2021).

1.1 Research Objectives

1.1.1 General objective

The general objective of this study is to assess knowledge of local people on solid waste management case of Nyamata city of Bugesera District, Rwanda.

1.1.2 Specific objectives

This study sought to address the following specific objectives:

- (i) To assess the level of knowledge of local people on solid waste management in Nyamata city, Rwanda,
- (ii) To assess existing practices done by local people on solid waste management in Nyamata city, Rwanda,
- (iii) To determine the relationship between knowledge of local people and exiting practices on solid waste management in Nyamata city, Rwanda.

2. Materials and methods

2.1 Profile of Nyamata city in Bigesera District

Bugesera District, in Rwanda's Eastern Province, spans 1337 km² and consists of 15 sectors. It borders Rwamagana to the northeast, Kigali City's Nyarugenge and Kicukiro to the north, Kamonyi to the northwest, Ngoma to the east, Ruhango and Nyanza to the west, and Burundi to the south (Bugesera, 2019). Nyamata, one of Rwanda's three satellite cities, is set for rapid growth due to planned investments in an international airport and special economic zone. This mix of urban and rural areas includes markets, schools, healthcare facilities, and residential zones (The World Bank Group, 2017). Nyamata's five cells are Nyamata y'umujiyi, Kayumba, Maranyundo, Murama, and Kanazi. Solid waste management shows high awareness but needs improvement in segregation and collection practices, which are currently moderate to low in efficiency.

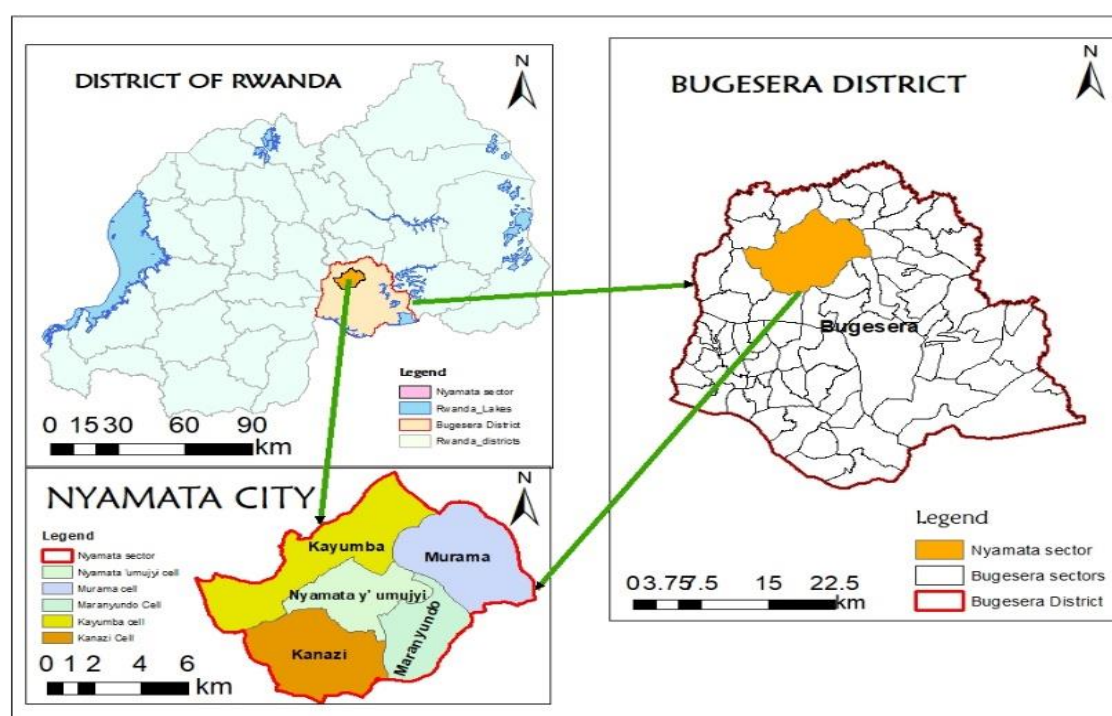


Figure 3.1. Location of study area, Source: ARC-GIS 10.8 produced on March 2024.

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2.2 Research design and sampling techniques

The study employs a descriptive case study research design, using questionnaires and interviews to gather data efficiently. The targeted population consists of 21,503 households in the Nyamata sector, Bugesera District, as per the 2022 Rwanda Population and Household Census. To ensure valid and generalizable results, Yamane's Simplified Formula was applied, calculating a sample size of approximately 393 households with a 5% margin of error. Simple random sampling was used, giving each household in Nyamata an equal chance of selection, and questionnaires were distributed to assess local knowledge of solid waste management.

2.3 Illustration of research methodology

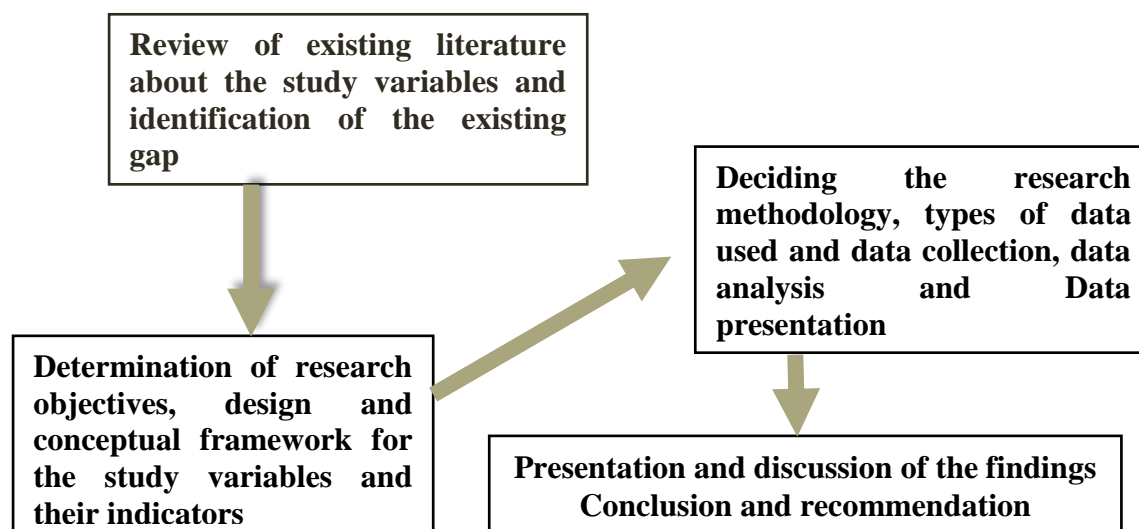


Figure 2.1: Methodology flowchart followed by the researcher

3. Results

3.1 Knowledge of local people

Local knowledge refers to the understandings and skills developed by individuals and populations, specific to the places where they live (UNESCO, 2021). This knowledge is accumulated through generations of lived experiences and shared practices. The first specific objective of this study was to assess the level knowledge of local people on solid waste management in study area. Moreover, the level of knowledge of local people was assessed in terms of Education, Access to information and capacity building.

Table 3.1: Views of respondents on education level

	N	Mean	Std. Deviation	Comments
The household revives training on solid waste management	393	4.21	.407	High mean
Proper management of solid waste is important to the health and well-being of urban residents.	393	4.10	.327	High mean
The community follow solid waste disposal procedure properly	393	4.14	.350	High mean
There a plan of waste management awareness education	393	4.21	.413	High mean
The improper managed solid wastes in your town affect the Environment and health of the residents	393	4.29	.460	Very High mean
Every people have to know about household solid waste management.	393	4.25	.439	Very High mean
Overall mean		4.20		

Source: Primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] = Moderate mean, 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean.

The findings from table 3.1 show the views of respondent's education level about solid waste management practiced where for the first statement, the respondents attested that the household revives training on solid waste management by considering the mean of 4.21, interpreted as high mean. For the second statement, the respondents revealed that Proper management of solid waste is important to the health and well-being of urban residents since the mean was 4.10 interpreted as high mean. For the third statement, the respondents attested that the community follows solid waste disposal procedure properly by considering the mean of 4.14 which is interpreted as high mean. For the fourth statement, the respondents attested that there a plan of waste management awareness education by considering the mean of 4.21 interpreted as high mean. For the last statement, the respondents attested that Every people have to know about household solid waste management by considering the mean of 4.25 interpreted as very high mean. The overall mean of 4.20 indicate that the majority of respondents agreed that there in increase of education level concerning solid waste management practices and contribute to social and environmental protections. Ezeah and Roberts (2012) described the importance of public education in SWM improvement. The results indicate that there is a requirement for a continuous public education initiative focused on waste prevention and reuse as a potential solution to waste issues in Nigeria. Study findings were similar to those of (Tatlonghari & Jamias, 2010) and (Barloa, 2016) whose reports indicated that the

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respondents with higher education levels were inclined to exhibiting good practices of SWM.

Table 3.2: Views of respondents on access to information

	N	Mean	Std. Deviation	Comments
The mass media components is more effective in generating awareness on solid waste management	393	4.13	.336	High mean
People who collect waste are protected enough	393	4.19	.395	High mean
Local people are awarded of any legislation which governs solid waste management.	393	4.23	.447	Very High mean
Local authorities have role to play in the house hold solid waste management.	393	4.20	.406	High mean
Overall mean		4.18		

Source: primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] = Moderate mean,
 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean.

The findings from table 3.2 show the Perceptions of respondents on access to information where the respondents revealed that The mass media components is more effective in generating awareness on solid waste management since the mean was 4.21 interpreted as high mean. For the second statement, the respondents revealed that people who collect waste are protected enough by considering the mean of 4.19 interpreted as high mean. For the third statement, the respondents revealed that the local people are awarded of any legislation which governs solid waste management since the mean was 4.23 interpreted as very high mean. For the fourth statement, the respondents reported that the local authorities have role to play in the house hold solid waste management.by considering the mean of 4.20, which is interpreted as high mean. In partial conclusion the overall mean of 4.18 implies that there is contribution of solid waste management on community sanitation in Nyamata Sector. Access to information about solid waste mainly promoted separation of solid wastes before disposing, use of dust bins and landfills, reuse and recycling of solid waste, willingness to pay for waste disposal, and enhanced good rapport among stakeholders concerned with SWM (Eab Juma, 2015).

Table 3.3: Views of respondents on capacity building

	N	Mean	Std. Deviation	Comments
Solid waste management practices support the householders to reduces the unemployment	393	4.17	.374	High mean
The use of fertilizer generated from waste creates employment opportunity	393	4.08	.393	High mean
Waste collection process provides employment opportunity	393	4.23	.507	Very High mean
Overall mean		4.16		

The findings from table 3.3 show the views of respondent's capacity building where the respondents revealed that Solid waste management practices support the householders to reduces the unemployment by considering the mean was 4.17 interpreted as high mean. For the second statement, the respondents revealed the use of fertilizer generated from waste creates employment opportunity by considering the mean of 4.08 interpreted as high mean. For the third statement, the respondents revealed that the local people are awarded of any legislation which governs solid waste management since the mean was 4.23 interpreted as very high mean. For the fourth statement, the respondents reported that the local authorities have role to play in the house hold solid waste management by considering the mean of 4.20, which is interpreted as high mean. In partial conclusion the overall mean of 4.16 implies that there is contribution of capacity building on solid waste management. The financial, institutional, human resource, political, social, and legal dimensions of waste management is important non-technical factors (Herat, 2015). Waste management training and capacity building can be effectively accomplished only by conveying both appropriate content and applying proven learning processes (Herat, 2015).

3.2. Solid waste management practices

The second specific objective of this study was to assess existing practices done by local people on solid waste management in Nyamata City where this was done through wastes segregation, waste collection, waste transportation, waste disposal and recycling.

Table 3.4: Views of respondents on waste segregation

	N	Mean	Std. Deviation	Comments
In households, wastes are segregated for facilitating collection process	393	2.87	1.380	Low mean
households have different bins for each kind of wastes	393	2.54	1.494	High mean
solid waste are excluded for liquid wastes	393	2.34	1.168	High mean
biodegradable and non-biodegradable are put into different bins	393	1.98.	.479	Very High mean
Overall mean		2.93		

Source Source: primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] moderate, 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean.

At households, it was revealed that waste segregation is explained excluding solid wastes from liquid wastes considering the mean of 2.41, which is interpreted as moderate mean but it was revealed that households that were surveyed don't have different bins for each kind of waste considering the mean of 2.54, which is interpreted as low mean, not segregating waste for facilitating the collection process with the mean of 2.34, which is interpreted as low mean, and households fail to put biodegradable and non-biodegradable wastes in different bins considering the mean of 1.98, which is interpreted as very low mean. Those results influenced the grand mean to become 2.93, which is interpreted as low mean. This means that waste segregation practices is not efficiently done in households located in Nyamata city. The indication that those who are not willing to pay for collection and disposal services choose to dump the waste by themselves/personal efforts is in tandem with studies conducted by Ali (2009) examining waste segregation and separation in Nairobi. He profoundly asserted that it has become a common practice to dump waste on streets, roadside and between plots especially in the middle and low income areas. He also attributed the high volume of household solid waste generation to increasing population, improved income, poor attitudes and behavior, low environmental awareness, absence of source reduction and recycling practices, geographical and physical conditions, low frequency of collection and characteristics of service area.

Table 3.5: Perceptions of respondents on status of waste collection

	N	Mean	Std. Deviation	Comments
there is a clear policy for waste collection	393	4.25	.419	high mean
waste are collected by trained people	393	2.52	1.078	moderate mean
collection of waste is done periodically	393	3.78	.631	high mean
household help in easing the process of waste collection	393	4.14	.464	very high mean
Overall mean		3.72		

Source Source: primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] = Moderate mean, 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean.

According to the table 3.5, the effectiveness of waste collection is based on the following: clear policy for waste collection with the mean of 4.25, which is interpreted as very high mean, waste are not collected by trained people with the mean of 2.52, which is interpreted as low mean, and collection of waste is done periodically considering the mean of 3.78, which is interpreted as high mean. But respondents found the following to be critical: collection of wastes by trained people considering the mean of 2.06, which is interpreted as low mean; where this means that wastes are not collected with people with trainings in wastes management, and households fail to easy the process of waste collection considering the mean of 4.14, which is interpreted as high

mean. In the end the grand mean shows that waste collection is not practiced effectively and efficiently since it is 3.74 which are interpreted as low mean.

Amdt (2001) also emphasizes that solid wastes should be stored in a container of solid, rigid material with a tight fitting lid or a ventilated structure with secure door or lid providing ready access and constructed such that no part will permit a sphere of 15 mm diameter to pass through so as to prevent the escape of effluent through the structure that could cause ground contamination or environmental pollution and to avoid endangering any water supply or watercourse caused by the seepage or overflow of effluent. Solid waste storage must be secured against access by vermin, as far as is reasonably practicable, until the waste is presented for removal by the collection authority.

Table 3.6: Perceptions of respondents on status of waste disposal

	N	Mean	Std. Deviation	Comments
landfill for waste are far away of the household	393	4.18	.443	High mean
there are adequate materials that are used for waste disposal	393	4.12	.294	High mean
there is effective mechanism of reducing the smell of wastes from landfill	393	3.13	.656	High mean
biodegradable and non-biodegradable wastes are disposed differently	393	4.14	.389	High mean
Overall mean		3.89		

Source: primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] = Moderate mean, 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean

According to the table 3.6, the effectiveness of waste disposal is explained by the following: landfill for waste are far away the households considering the mean of 4.18, which is interpreted as high mean, there are adequate materials that are used for waste disposal considering the mean of 4.12, which is interpreted as high mean, there is effective mechanism of reducing the smell of wastes from landfill at moderate level by considering the mean of 3.13 interpreted as moderate mean and biodegradable and non-wastes are disposed differently in landfills considering the mean of 4.14 which is interpreted as high mean.. And in conclusion it was revealed that wastes in general are disposed effectively considering the mean of 3.89 which is interpreted as high mean.

Links (2006) ranks reduction of solid wastes at source as the leading in municipal solid waste management hierarchy. According to Link, source reduction comprises of the following: Minimize the amount of waste being generated, use less material per product, make products last longer, and abandon the planned obsolescence approach and front-end approach to waste management. From the focus group discussions it was apparent that although Makina residents used various items for much longer period, it was not primarily to reduce waste generation but the main reason was to save on money.

Table 3.7: Perceptions of respondents on status of waste transportation

	N	Mean	Std. Deviation	Comments
loading time of wastes is not long	393	4.23	.440	very high mean
modern packing mechanisms followed for waste transportation	393	4.26	.447	very high mean
vehicles are were covered during transportation	393	2.15	1.252	moderate mean
the money for waste transport are affordable	393	3.73	1.010	high mean
people who collect waste are protected enough	393	2.57	1.316	moderate mean
Average mean		3.38		

Source: primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] = Moderate mean, 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean

Table 3.7 shows the perceptions of respondents of respondents on waste transportation to Landfill. It was revealed that transportation of wastes is characterized by the short time of loading wastes with the mean of 4.23, which is interpreted as very high mean, Modern packing mechanisms followed for waste transportation considering the mean of 4.26, which is interpreted as very high mean, Vehicles are not covered during transportation since the mean was 2.15, interpreted as low mean and the money for waste collection is affordable considering the mean of 3.74 which is interpreted as high mean. For the last statement, the respondents attested that People who collect waste are not protected enough by considering the mean of 2.54 interpreted as low mean.

By conclusion, transportation is not done in adequate manners considering the grand mean of 3.38, which is interpreted as moderate mean. It indicates that those who are not willing to pay for collection and disposal services choose to dump the waste by themselves/personal efforts is in tandem with studies conducted by Ali (2009), examining waste segregation and separation in Nairobi. He profoundly asserted that it has become a common practice to dump waste on streets, roadside and between plots especially in the middle and low income areas. He also attributed the high volume of household solid waste generation to increasing population, improved income, poor attitudes and behavior, low environmental awareness, absence of source reduction and recycling practices, geographical and physical conditions, low frequency of collection and characteristics of service area.

Table 3.8: Perceptions of respondents on status of waste recycling

	N	Mean	Std. Deviation	Comments
There sufficient and appropriate solid waste recycling facilities like dump hole	393	4.13	1.009	High mean
Current solid waste management reuse and recycling system is adequate	393	4.11	.372	High mean
There are recycling parties like cooperatives dealing with making valuable products from the waste	393	4.19	.433	high mean
Overall mean		3.47		

Source: primary data, 2024

Note: 5. Strongly Agree= [4.21-5.00] =very high mean, 4. Agree = [3.41-4.20] =high mean, 3. Not Sure = [2.61-3.40] = Moderate mean, 2. Disagree= [1.81-2.60] =low 1. Strongly Disagree= [1.00-1.80] = very low mean

The findings from table 3.8 show the perceptions of respondents on status of waste recycling. It was revealed that sufficient and appropriate solid waste recycling facilities like dump hole by considering the mean of 4.13, interpreted as high mean. Secondary, it was revealed that the current solid waste management through recycling system is adequate since the mean was 4.11, which is interpreted as high mean. For the third statement, the respondents revealed that there are recycling parties like cooperatives dealing with making valuable since the mean was 4.19 interpreted as high mean. Mihai and Ingrao (2018) also mentioned similar things in their research. During the interview, respondents talked about private businessmen collecting reusable waste products like plastic products, paper/books/magazines, iron/metal products, glass bottles, etc., from the household level. They offered different products in exchange for waste or provided money. In most cases, the individual collectors sold their waste to the big seller. They collect and store such products and send them to the upper market, sometimes directly to Dhaka, Bangladesh's capital, for further recycling

4.4 Relationship between knowledge of local people and solid waste management

The third specific objective of this study was to establish the link between knowledge of local people and solid waste management. This was achieved by correlating the results of the independent variable and the dependent variable meaning results of knowledge of local people and solid waste management. The correlation helps to show the relationship between variables where its positive value explains the positive relationship. And the significance relationship should be tested where the significance level of 0.05 was used in this study where the p-value less than the significance level indicates the significance of the relationship.

Table 3.9: Correlation between knowledge of local people and solid waste management

	Knowledge of local people	Solid waste management
Spearman's rho solid waste management	1.000	.713
Correlation Coefficient	.	.006
Sig. (2-tailed)	393	393
N		
Solid waste management	.713	1.000
Correlation Coefficient	.006	.
Sig. (2-tailed)	393	393
N		

The findings from table 3.9 indicate that, there is a high positive correlation which is statistically significant since the correlation is 0.713 and its p-value is 0.006 which is less than the p-alpha of 0.05. This means that knowledge of local people contributes on Solid waste management. A soil which has a high production potential and which at the same time is fertile can naturally produce high yields. Knowledge of local people influences their trust and acceptance of solid waste management authorities and their perception of environmental risk such as floods and spread of diseases. Perception of risk reflects the level of trust in the institutions and authorities managing solid waste (Ormerod & Scott, 2012). Public trust in Solid waste management authorities is considered as one of the principal factors shaping public acceptance in relation to solid waste disposal and management (Hummer, 2017). Effective knowledge of local people is therefore very important in-order to increase knowledge and awareness among residents. Public participation and involvement in Solid waste management projects is also important in increasing the level of knowledge. Feo & De Gisi (2010) as well as Ibrahim & Babayemi (2010) further emphasize that encouraging and educating citizens in taking part in Solid waste management processes is a cheaper and more efficient way of reducing household waste. Socio-demographic elements such as education levels of the residents, age, occupation and gender may influence the level of knowledge and ultimately the behaviour towards Solid waste management.

4. Conclusion

In conclusion, the study investigated the impact of local knowledge on solid waste management in Nyamata City. The findings revealed a high level of awareness and education among residents, with a mean of 4.20, indicating significant understanding of the importance of proper waste management for health and well-being. Mass media and capacity-building efforts were effective in generating awareness and employment opportunities, with mean scores of 4.18 and 4.16, respectively. However, waste segregation practices were inadequate, with low mean scores (2.87 to 1.98) indicating inefficiencies. Waste collection and disposal showed moderate to high effectiveness, while recycling systems were deemed sufficient, supported by a high mean of 4.13. Notably, a high positive correlation (0.713, $p=0.006$) was found between knowledge levels and solid waste management practices, underscoring the crucial role of community education in enhancing waste management.

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