



Assessment of Residents' Knowledge, Attitudes and Practices towards Sustainable Solid Waste Management in Maiduguri Metropolis, Borno State, Nigeria

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ABSTRACT

Sustainable solid waste management remains an important environmental and public health concern in rapidly growing urban areas. This study assessed residents' knowledge, attitudes and practices (KAP) towards sustainable solid waste management in Maiduguri Metropolis, Borno State, Nigeria. The study used a sample of 120 respondents to examine selected socio-demographic characteristics, KAP levels, waste-disposal practices and the relationships among knowledge, attitude and practice. Data were summarized using descriptive statistics, while Pearson correlation, independent-samples comparisons and one-way analysis of variance were used to examine relationships and differences across socio-demographic groups. The results showed mean scores of 2.98 ± 0.54 for knowledge, 2.94 ± 0.53 for attitude and 3.01 ± 0.56 for practice, giving a combined KAP mean of 2.98 ± 0.38 . The KAP instrument demonstrated acceptable internal consistency, with Cronbach's alpha coefficients of 0.784 for knowledge, 0.784 for attitude and 0.785 for practice. Knowledge was positively associated with attitude ($r = 0.208$, $p = 0.023$) and practice ($r = 0.337$, $p < 0.001$), while attitude also showed a positive relationship with practice ($r = 0.186$, $p = 0.042$). However, differences in combined KAP scores across age groups ($F = 0.417$, $p = 0.796$), sex ($t = 0.515$, $p = 0.607$), educational level ($t = 0.126$, $p = 0.900$) and occupation ($F = 2.581$, $p = 0.057$) were not statistically significant at the 0.05 level. Regarding disposal practices, open dumping (32.50%) and municipal collection (31.67%) were the most frequently reported methods. Waste separation, recycling and composting were practiced with varying frequency among respondents. The findings indicate that residents' knowledge, attitudes and practices were related, particularly knowledge and waste-management practice, while socio-demographic characteristics did not show statistically significant differences in combined KAP scores. These findings provide a basis for refining the study framework and identifying areas requiring attention in sustainable solid waste management in Maiduguri Metropolis.

Keywords: Knowledge, attitude, practice, solid waste management, waste disposal, Maiduguri Metropolis, sustainable waste management.

INTRODUCTION

Solid waste management has become an important environmental and public-health concern, particularly in rapidly growing towns and cities where waste generation is increasing faster than the capacity of existing collection and disposal systems. The World Bank estimates that global municipal solid waste generation reached about 2.56 billion tonnes in 2022 and projects a substantial increase in the coming decades, with Sub-Saharan Africa expected to experience particularly rapid growth in waste generation (World Bank, 2024). At the same time, a considerable proportion of municipal waste remains uncollected or is disposed of through uncontrolled practices. These challenges are especially pronounced in low-income settings, where limited



collection services, inadequate disposal infrastructure and rapid urban growth can make safe waste management difficult.

The consequences extend beyond the appearance of the environment. When waste is openly dumped, poorly contained or burned under uncontrolled conditions, pollutants can enter the soil, air and water and create conditions that may affect human health and environmental quality. Poorly managed waste can contribute to exposure to smoke, hazardous substances, disease vectors and other environmental hazards. These concerns are particularly relevant in communities where residents have limited access to reliable waste collection and disposal services. In Nigeria, inadequate waste-management infrastructure and inconsistent collection services have contributed to continued reliance on practices such as open dumping, open burning and burial of household waste (Aderinoye-Abdulwahab et al., 2022). However, the way residents manage their waste cannot be understood from infrastructure alone. People's knowledge, attitudes, daily habits and the conditions within their communities also influence how waste is handled.

The knowledge, attitude and practice (KAP) framework provides a useful way of examining these dimensions together. The framework has been widely applied in studies of health and environmental behaviour because it allows researchers to examine what people know, how they perceive an issue and what they report doing in practice (Razu et al., 2021). Knowledge is often considered important for shaping attitudes, while attitudes may influence behaviour; however, these relationships are not necessarily straightforward. Having adequate knowledge does not automatically result in appropriate practice, particularly when people face practical barriers such as inadequate collection services, limited disposal facilities, cost, convenience or established household habits. Recent studies have similarly reported differences between knowledge, attitudes and actual waste-management practices among communities and households in different settings (Gautam et al., 2023; Lim et al., 2026). This suggests that examining the three domains together can provide a more realistic understanding of waste-management behaviour than considering knowledge alone.

The relationship between knowledge and practice is particularly important in communities where formal waste-management services are limited or unevenly available. A resident may understand the environmental and health risks associated with indiscriminate disposal but still dispose of waste improperly when there is no convenient collection point or affordable disposal option. Likewise, the presence of waste facilities does not necessarily guarantee appropriate use if residents have limited awareness or hold unfavourable attitudes toward proper waste handling. Waste-management behaviour therefore develops within a broader social and environmental context in which individual understanding interacts with available services, community practices and everyday circumstances.

Much of the existing KAP literature on waste management has focused on specific populations, including students, healthcare workers, institutional employees and residents of larger urban centres. Findings from such settings are useful, but they may not fully reflect the circumstances of mixed residential communities where people from different occupational and socioeconomic backgrounds manage waste within the same local environment. In communities where farmers, traders, civil servants, students and other residents live alongside one another, waste-management practices may vary according to household circumstances, access to services, convenience and local norms. Understanding these differences is important because interventions developed in institutional or highly serviced settings may not necessarily correspond to the realities of less-resourced communities.

Maiduguri Metropolitan Centre provides an important setting for examining these issues. Like many growing urban areas, the city faces the practical challenge of managing waste generated by households and other everyday activities. Within individual communities, residents may encounter different levels of access to waste collection and disposal services, while household practices may also differ in how waste is stored, separated, reused, burned or discarded. Yet, there is limited community-level evidence describing how residents' knowledge and attitudes correspond with their reported waste-management practices in selected communities of Maiduguri. Generating such evidence can help clarify whether the three KAP domains move together and where important differences may exist among residents.

This study therefore assessed residents' knowledge, attitudes and reported practices regarding solid waste management in Mashidmami, Dala and Shuwari communities of Maiduguri Metropolitan Centre, Borno State, Nigeria. Specifically, the study examined residents' knowledge, attitudes and practices regarding solid waste management, assessed the relationships among the three KAP domains, and examined variations in KAP scores across selected sociodemographic characteristics. By considering these dimensions together, the study provides community-level evidence that helps to explain how residents' knowledge and attitudes relate to their reported waste-management practices in the selected communities.

LITERATURE REVIEW

Concept of Municipal Solid Waste Management

Waste management refers to the organised activities involved in handling waste from the point at which it is generated to its final treatment or disposal. These activities include waste collection, transportation, treatment, disposal, monitoring, regulation, and the application of appropriate technologies and economic measures (United Nations Statistics Division, 2017). The nature and effectiveness of waste management vary considerably between countries and communities because of differences in income, population density, settlement patterns, infrastructure, institutional capacity, and the types and quantities of waste generated (Davidson, 2011). The financial requirements can also be substantial because waste systems require resources for collection, transportation, treatment, recovery, and final disposal (World Bank, 2020).

Municipal solid waste is generated largely from households, commercial activities, institutions, and other urban activities. Its management therefore requires coordination among households, communities, local authorities, private operators, and other relevant stakeholders. In settings where formal collection and disposal systems are inadequate, uncontrolled dumping and open burning may occur alongside formal waste-management practices (World Bank, 2020). The problem is particularly important in low- and middle-income settings where rapid urbanization and population growth may increase waste generation faster than the development of supporting infrastructure.

Waste management is not only concerned with the removal of unwanted materials. It also involves preventing waste generation, reducing unnecessary consumption, extending the useful life of materials, recovering recyclable components, and ensuring that residual waste is safely treated or disposed of. The waste hierarchy provides a useful framework for understanding these options. It generally gives priority to prevention and reduction, followed by reuse, recycling and other forms of recovery, with final disposal considered only after opportunities for higher-value management options have been exhausted (UNEP, 2013; Medicine LibreTexts, 2021). This hierarchy is relevant to a KAP study because residents' knowledge and practices can determine whether waste is prevented, reused, recycled, recovered, or simply discarded.

The principles of resource efficiency and product-life-cycle thinking further emphasize that waste management begins before waste reaches a disposal site. Product design, production, distribution, consumption, reuse, recycling, recovery, and final disposal are interconnected stages that influence the quantity and characteristics of waste generated. Source reduction and the efficient use of materials can reduce environmental pressure associated with production and consumption (U.S. Environmental Protection Agency [EPA], n.d.; EPA, 2023). From a community perspective, these principles can be expressed through relatively simple behaviours such as avoiding unnecessary purchases, reducing the use of disposable materials, repairing usable products, reusing containers, and separating recyclable materials.

The principle of the polluter-pays approach also provides a policy dimension to waste management. It is based on the idea that those responsible for generating pollution should bear appropriate costs associated with its prevention or management (London School of Economics, 2018). In practical waste-management systems, this principle may influence attitudes toward payment for collection services, responsibility for disposal, and incentives for waste reduction. Its relevance to the present study lies in understanding how residents perceive their responsibility for waste management and the costs associated with proper waste disposal, where these issues are captured by the study variables.

Knowledge of Waste Management

Knowledge is an important component of waste-management behaviour because residents need to understand the consequences of improper disposal and the basic requirements for safe handling before they can consistently adopt appropriate practices. Relevant knowledge includes understanding the different types and sources of waste, the health and environmental consequences of improper disposal, appropriate storage and collection methods, waste separation, recycling, reuse, and the responsibilities of households and waste-management authorities. Knowledge of waste-management principles also includes awareness of the waste hierarchy. Residents who understand the distinction between prevention, reduction, reuse, recycling, recovery, and disposal may be better positioned to recognize preferred management options. Waste reduction involves preventing waste before it is generated, while reuse extends the useful life of products and materials. Recycling involves recovering materials for processing into new products, whereas resource recovery may involve the extraction of materials, nutrients, or energy from waste that cannot readily be reused or recycled.

Recycling is particularly dependent on knowledge because residents need information about what materials can be recovered, how recyclable materials should be separated and prepared, and where they can be taken. Common recyclable materials include paper, cardboard, plastics, glass, and metals, although the materials accepted vary according to local infrastructure, markets, collection arrangements, and processing capacity (U.S. EPA, 2025, 2026). Similarly, knowledge of reuse can encourage residents to extend product life through repair, repeated use, donation, or alternative uses rather than immediately discarding usable materials.

Knowledge also extends to waste-treatment and recovery options. Organic waste may be treated through composting or anaerobic digestion, while selected residual waste may be subjected to energy-recovery processes. Energy recovery technologies include combustion, gasification, pyrolysis, anaerobic digestion, and landfill-gas recovery (U.S. EPA, 2026; Ambaye et al., 2023). Pyrolysis involves thermal decomposition under oxygen-limited conditions and can produce gaseous, liquid, and solid products, depending on feedstock and operating conditions (Chen et al., 2014; Czajczyńska et al., 2017). These technologies are relevant to the wider waste-management system, although detailed technical knowledge of them may not be necessary for ordinary household waste-management decisions.

Recent empirical evidence demonstrates why knowledge should be considered separately from actual practice. A 2024 study involving households in Southwestern Nigeria found a substantial difference between reported awareness of municipal solid waste management and the implementation of appropriate practices, showing that awareness alone does not necessarily result in effective waste-management behaviour (Etim, 2024). Similar evidence from Jos, Nigeria, reported a gap between environmental knowledge and the translation of that knowledge into concrete waste-management practices.

Attitudes toward Waste Management

Attitude represents how individuals perceive, value, and respond to waste-management issues. It may include perceptions of the seriousness of waste problems, personal responsibility for waste disposal, willingness to separate waste, willingness to cooperate with collection services, and views concerning the responsibilities of government, households, businesses, and communities.

Positive attitudes can support appropriate waste-management behaviour, but favourable attitudes do not necessarily guarantee good practice. The relationship between awareness, attitudes, and behaviour is influenced by practical conditions such as availability of collection services, disposal facilities, cost, convenience, enforcement, and social norms. Evidence from Nigeria illustrates this distinction. Etim (2024) reported high awareness among surveyed households but comparatively weak implementation of effective municipal solid-waste practices, indicating that the presence of knowledge and favourable perceptions does not automatically remove practical barriers to appropriate behaviour.

Public perception is therefore an important dimension of waste-management research. A study conducted in Ogun State examined public perceptions and attitudes alongside household and municipal waste-disposal practices and considered factors such as collection frequency and the effectiveness of environmental agencies



(2020). Research among residents of Agege Local Government Area, Lagos State, similarly examined knowledge, attitudes, perceptions, and waste-disposal practices, illustrating the usefulness of examining these dimensions together rather than treating waste disposal as a purely technical issue.

Waste-Management Practices

Waste-management practices refer to the actions individuals and households actually undertake in dealing with waste. These include storage, separation, collection, transportation, reuse, recycling, burning, dumping, and final disposal. Unlike knowledge and attitudes, practices reflect what people do in their daily lives and are therefore strongly influenced by the physical and institutional environment in which they live. Appropriate waste handling begins with storage at the point of generation. Waste should be stored in suitable containers and protected from conditions that may encourage contact with people, animals, insects, or water. Collection and transportation then provide the link between waste generation and treatment or disposal. Where formal systems are available, waste may be collected by local authorities or private operators and transported to transfer stations, recycling facilities, treatment plants, or final disposal sites (World Bank, 2018). Where such services are limited, households may rely on informal collection, open dumping, or burning.

Waste separation is particularly important where recycling, composting, or other recovery systems are available. Separation at source allows materials with different treatment requirements to be handled appropriately and can improve the recovery of recyclable and biodegradable materials (U.S. EPA, 2012; World Bank, 2018). Contemporary waste-management systems may therefore distinguish recyclable materials, organic or compostable waste, and residual waste destined for final disposal (U.S. EPA, 2026).

Collection methods differ according to the characteristics and infrastructure of individual communities. Conventional systems may use household or curbside collection, while some urban environments have adopted pneumatic or vacuum-based systems in which waste is transported through enclosed pipe networks. Aranda et al. (2023) examined pneumatic waste-collection systems and their application in urban environments. Although such systems demonstrate the range of technological approaches available, their relevance to household KAP depends on whether such infrastructure is accessible to the population under study.

Community participation is also an important part of waste-management practice. Local authorities, community organisations, households, businesses, and other stakeholders may contribute to cleaning activities, environmental awareness, collection, and monitoring. Community-led initiatives in Accra bring residents and volunteers together to take part in activities such as community clean-ups and better waste-handling practices (Accra Metropolitan Assembly, 2024; National Petroleum Authority, 2025). By involving people directly in keeping their surroundings clean, these efforts reduce reliance on government agencies alone and encourage residents to see waste management as a shared community responsibility.

Waste Reduction, Reuse, Recycling and Resource Recovery

Waste prevention and reduction occupy an important position in sustainable waste management because they address waste before it requires collection or disposal. Practical measures include avoiding unnecessary purchases, reducing disposable materials, selecting products with less packaging, repairing damaged products, using reusable containers, and extending product life (UNEP, 2021, 2024; U.S. EPA, 2026). These actions can reduce the quantity of waste requiring collection, treatment, and final disposal.

Reuse can benefit the environment by keeping products in use for longer, reducing the amount of waste that needs to be disposed of, and lowering the need for new raw materials. It involves using products or materials repeatedly rather than discarding them after a single use. At household level, examples include reusing containers and bags, repairing damaged products, donating usable items, and finding alternative uses for materials that might otherwise be discarded. Organic materials can also be recovered through composting and anaerobic digestion. Food residues, plant materials, and other biodegradable wastes may be transformed into compost, soil amendments, biomass, or energy (Mishra et al., 2024; Siddiqui et al., 2024).



Recycling involves recovering useful materials from discarded items and processing them for reuse in new products or applications. Its success depends on several factors, including the type and condition of the waste, collection systems, processing capacity, market demand, and access to appropriate facilities (U.S. EPA, 2025, 2026). For households, understanding which materials can be recycled and how they should be separated is therefore an important aspect of responsible waste management. Resource recovery extends this principle by seeking to recover useful materials, nutrients, or energy from waste. It can include recycling, composting, anaerobic digestion, material recovery, and energy recovery. Ambaye et al. (2023) emphasized the importance of source separation, efficient collection, reuse and recycling of non-organic materials, and biological treatment of organic waste within sustainable municipal solid-waste systems. Resource recovery can also create economic opportunities through the collection, processing, and resale of metals, paper, plastics, and other recoverable resources.

Waste valorization is closely related to resource recovery because it considers whether discarded materials can become useful inputs for another process. It has links with circular-economy approaches, industrial ecology, and sustainable production. Industrial residues and other relatively consistent waste streams may be particularly suitable for valorization (Nzihou & Lifset, 2010; Arancon et al., 2013). However, from the perspective of a community KAP study, the important issue is not the technical details of valorization but residents' awareness and practices concerning the reuse, recycling, and recovery of potentially valuable materials.

Health and Environmental Implications of Improper Waste Management

Improperly managed waste can create environmental and public-health problems through contamination of air, water, and soil and through direct or indirect exposure to hazardous materials. The risks vary according to the type of waste, method of handling, duration of exposure, location of disposal, and availability of protective measures. Tomita et al. (2020), for example, examined associations between exposure to waste sites and health outcomes using nationally representative data from South Africa. Open dumping and uncontrolled burning are particularly important concerns. Waste burning may reduce the visible volume of waste, but uncontrolled combustion can release particulate matter, greenhouse gases, and other potentially harmful pollutants (Velis, 2021). Poorly managed waste can also block drainage systems and create conditions favourable to standing water and disease vectors. WHO identifies improperly disposed of or burned solid waste as a pathway for air, water, and soil contamination and associated health risks.

Different types of waste require different methods of handling and disposal. Hazardous, medical, chemical, and other specialised wastes should therefore be separated from ordinary household waste and managed according to their specific risks. Proper segregation, storage, transportation, treatment, and final disposal are important for reducing potential exposure among waste workers, residents, and other members of the community (World Health Organization, 2019). More recent WHO guidance also highlights the health and environmental risks associated with inadequate waste collection, uncontrolled disposal, and unsafe treatment practices.

These risks provide an important basis for examining residents' knowledge, attitudes, and practices regarding waste management. However, knowledge alone may not result in appropriate behaviour when residents have limited access to suitable waste-management services. Similarly, the availability of waste facilities may have limited effect when awareness is low or attitudes toward proper waste handling are unfavorable. Examining these factors together through a KAP approach therefore provides a useful way of understanding how knowledge, attitudes, available services, and everyday waste-management practices interact within communities.

Factors Influencing Waste-Management Knowledge, Attitudes and Practices

How people manage their waste depends not only on what they know and believe, but also on the conditions around them, including access to proper disposal facilities and the way waste is managed in their communities. Demographic characteristics such as age, sex, education, occupation, household size, and socioeconomic status



may influence exposure to environmental information and the resources available for appropriate waste management. However, the influence of these factors can vary between communities. Institutional and infrastructural conditions are also important. Access to regular collection, availability of disposal sites, distance to collection points, cost of waste services, enforcement of environmental regulations, and the reliability of municipal services may affect residents' ability to adopt appropriate practices (World Bank, 2018). Where formal services are inadequate, households may resort to practices such as open dumping or burning even when they understand the environmental and health consequences. Social and community factors can also shape behaviour. Community participation, environmental education, local norms, communication, and the visibility of enforcement can influence how residents perceive their responsibilities. The experience of community-led sanitation initiatives demonstrates how collective participation can strengthen local waste-management efforts by encouraging shared responsibility, improving community engagement, and supporting cleaner neighbourhoods (Accra Metropolitan Assembly, 2024; National Petroleum Authority, 2025).

The distinction between knowledge and practice is particularly important. Evidence from Nigeria has repeatedly indicated that awareness does not always translate into appropriate waste-management behaviour. Etim (2024) found a substantial awareness-practice gap among households in Southwestern Nigeria, while research in Jos also reported a difference between environmental knowledge and the application of that knowledge in waste-management practices. These findings suggest that KAP assessment should consider not only whether residents know appropriate waste-management methods but also whether the social, economic, and infrastructural environment enables them to apply that knowledge.

Empirical Studies on Waste-Management KAP

Empirical studies have increasingly examined knowledge, attitudes, perceptions, and practices as interconnected components of waste management. A 2024 study in Southwestern Nigeria involving 400 households found high awareness of municipal solid-waste management but comparatively low adoption of effective practices. The study also found that awareness of waste-management policies was associated with more positive attitudes, suggesting that clear communication and greater policy awareness may play an important role in shaping perceptions and waste-management behaviour (Etim, 2024). Ajieh et al. (2024) assessed knowledge, attitudes, and practices of waste management in Oleh, Isoko South Local Government Area of Delta State, Nigeria. The study examined waste-management perceptions, policy implementation, and the potential relationship between waste management and energy and food production. The findings identified gaps in perception, policy implementation, and waste-to-energy opportunities, leading the authors to emphasize community engagement and improved policy approaches.

Research among market traders in Calabar Municipality also examined knowledge, attitudes, and practices concerning solid-waste disposal, demonstrating the relevance of KAP approaches in specific occupational and community settings (Ekor et al., 2022). Similarly, a study of residents in Oshodi-Isolo Local Government Area of Lagos State found relatively high levels of knowledge and positive perceptions but comparatively weaker waste-management practices, illustrating the possibility of a gap between what residents know and what they actually do. A study conducted in Agege Local Government Area of Lagos State examined knowledge, attitude, perception, and waste-disposal practices and reported variation across these dimensions, further demonstrating the importance of examining behavioural and contextual factors together rather than relying on knowledge alone (Belinda & Dangana, 2023). Studies in other Nigerian settings have similarly continued to investigate KAP as a means of understanding differences in waste-management behaviour between populations and locations.

Evidence from Ogun State has also highlighted the importance of public perception, household characteristics, collection frequency, and institutional effectiveness in understanding local waste-management practices (2020). Collectively, these studies suggest that waste-management behaviour is shaped by a combination of knowledge, attitudes, available services, institutional conditions, and community characteristics.

Research Gap

Existing literature demonstrates that waste management is a multidimensional issue involving environmental



protection, public health, infrastructure, policy, household behaviour, and resource recovery. However, much of the broader literature focuses on technical systems, waste-treatment technologies, recycling processes, resource recovery, and policy approaches. Although these areas are important to the wider field of waste management, they do not by themselves explain how residents understand waste-management problems, how they perceive their responsibilities, or how those perceptions are reflected in everyday practices.

Recent empirical evidence from Nigeria has also demonstrated that relatively high awareness or favourable attitudes may coexist with inadequate waste-management practices (Etim, 2024). This suggests that KAP cannot be adequately understood by considering knowledge alone. The interaction between residents' knowledge, attitudes, actual practices, socioeconomic characteristics, and access to waste-management services requires location-specific investigation.

There is therefore a need for empirical evidence that focuses specifically on the KAP of residents within the study area and identifies the factors associated with their waste-management behaviour. Such evidence is particularly important in urban communities where population growth, waste generation, service limitations, environmental risks, and public-health concerns may interact. The present study addresses this need by examining residents' knowledge, attitudes, and practices concerning waste management and by relating these dimensions to relevant demographic and contextual characteristics within the study area.

METHODOLOGY

Study Design and Area

A descriptive cross-sectional survey design with a correlational component was used to evaluate residents' knowledge, attitudes, and practices on solid waste management. The cross-sectional approach was adopted as data were collected from the respondents during the same study period, while the correlational component enabled the relationships between the measured domains to be examined without implying causality.

The study was carried out in the Maiduguri Metropolitan Centre of Borno State, northeastern Nigeria, in the communities of Mashidmami, Dala and Shuwari. These communities include residential and commercial activities, which produce a variety of municipal solid waste and are appropriate for measuring household- and community-level waste management practices, attitudes and knowledge. Because the study was conducted in only three selected communities, the findings should not be considered generalizable to all communities in Maiduguri or Borno State.

Study Population and Sampling

The study population comprised adult's resident in the selected communities, including respondents from different occupational groups such as farmers, traders, civil servants and students. A two-stage sampling approach combining purposive and simple random sampling was employed. In the first stage, the three communities and the occupational categories were selected purposively. In the second stage, eligible respondents within the selected categories were selected by simple random sampling where this was feasible. Eligibility criteria were being aged 18 years or above, residing in one of the selected communities, and being willing to participate in the study. Respondents who did not meet these criteria or who returned substantially incomplete questionnaires were excluded.

A total of 120 questionnaires were administered and all 120 were sufficiently completed for analysis, giving a response rate of 100%. The sample was treated as a community-level study sample and not as a probability sample representative of the entire Maiduguri population.

Table 3.1: Distribution of Respondents by Community and Demographic Characteristics

Characteristic	Category	n	%
Community	Mashidmami	40	33.3

	Dala	40	33.3
	Shuwari	40	33.3
Age group (years)	18–25	24	20
	26–35	44	36.7
	36–45	34	28.3
	46–55	14	11.7
	56 and above	4	3.3
Sex	Male	72	60
	Female	48	40
Education	Secondary	44	36.7
	Tertiary	76	63.3
Occupation	Farmers	40	33.3
	Traders	38	31.7
	Civil servants	18	15
	Students	24	20
Total		120	100

Source: Author's analysis, 2026.

Data Collection Instrument

Data were collected using a structured, self-administered questionnaire containing four sections: respondents' sociodemographic characteristics and the knowledge, attitude and practice domains. The questionnaire was structured around the objectives of the study and the KAP literature. The knowledge section contained 10 items, the attitude section 10 items and the practice section 10 items. KAP items were rated on a five-point response scale, with higher values representing greater knowledge, more favourable attitudes and better reported practice. Negatively worded items, where present, were reverse-scored. The questionnaire was reviewed for clarity and relevance before administration.

Scoring and Reliability

Each domain score was calculated as the mean of the responses to the items in that domain, giving a possible range of 1 to 5, with 3.00 as the scale midpoint. Higher scores indicate greater knowledge, more favourable attitudes and better reported practice. For the revised manuscript, internal consistency should be reported from the actual item-level dataset. Because item-level responses were not supplied with the manuscript, Cronbach's alpha values are not fabricated here and should be inserted from the dataset before journal submission.

The combined KAP score was calculated as the mean of the three domain scores. Because knowledge, attitude and practice are conceptually distinct constructs, the combined score is not treated as a measure of a single underlying construct. It is used only as a descriptive summary index to allow broad comparison across respondent groups, such as age groups. The domain-specific scores and their inter-relationships are the primary results of the study and are interpreted separately throughout.

Data Analysis

Data were analysed using descriptive statistics and Pearson's product-moment correlation coefficient. Means, standard deviations and ranges were computed for each domain and respondent category. Relationships among the three domains were examined using Pearson correlation and interpreted at the 0.05 significance level. Because the revised sample size is 120, the correlation estimates are more precise than they would be with the earlier sample of 31 respondents. Age-group and other subgroup results are presented primarily descriptively unless the corresponding inferential test is available from the raw data.

RESULTS

Socio-Demographic Characteristics of Respondents

The age distribution of the respondents is presented in Table 4.1. The largest age group was 26–35 years, comprising 43 respondents (35.83%), followed by respondents aged 36–45 years with 32 respondents (26.67%). Respondents aged 18–25 years accounted for 26 (21.67%), while 13 (10.83%) were aged 46–55 years. The smallest group was respondents aged 56 years and above, with 6 respondents (5.00%).

The age distribution indicates that the sample was dominated by respondents between 26 and 45 years, who together accounted for 62.50% of the sample. The relatively small number of respondents aged 56 years and above should be considered when interpreting age-group comparisons. The sex distribution is presented in Table 4.2. Male respondents constituted 70 (58.33%) of the sample, while female respondents accounted for 50 (41.67%).

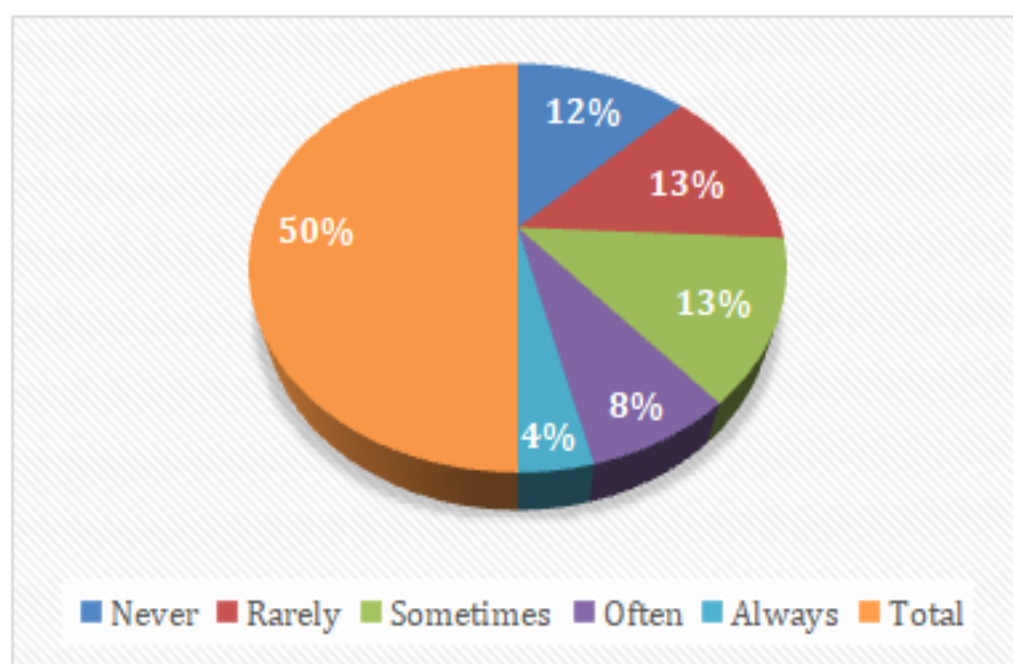


Fig 1: Distribution of Respondents by Age

Source: Author's analysis, 2026.

The distribution shows a larger proportion of male respondents than female respondents. However, the difference in sample composition does not by itself indicate a difference in waste-management knowledge, attitudes or practices; such differences were examined separately using inferential statistics. Educational attainment is presented in fig 3. Of the 120 respondents, 71 (59.17%) had tertiary education, while 49 (40.83%) had secondary education.

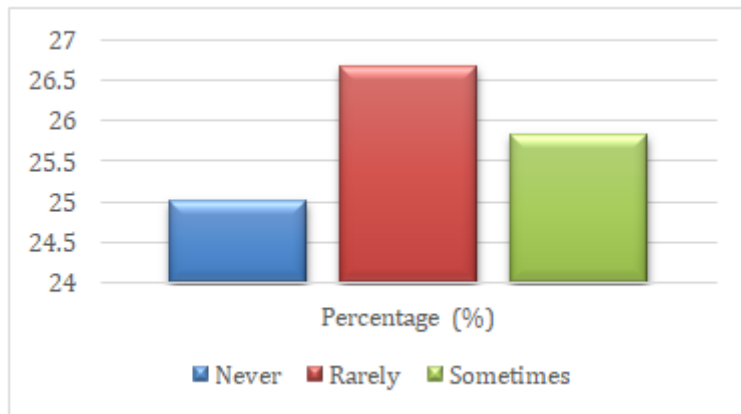


Fig 2: Distribution of Respondents by Sex

Source: Author's analysis, 2026.

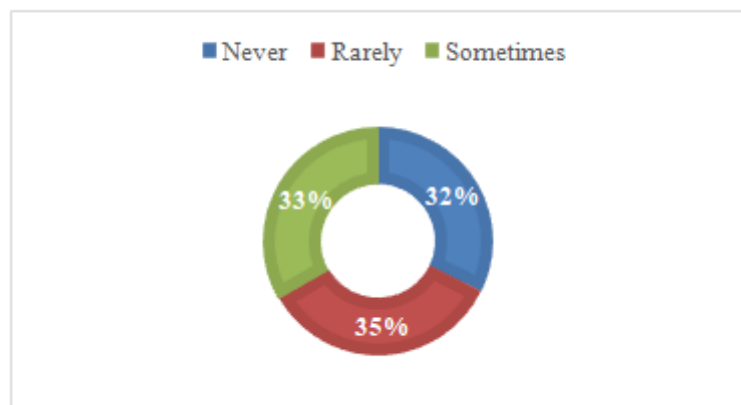


Fig 3: Distribution of Respondents by Educational Level

Source: Author's analysis, 2026.

The results indicate that respondents with tertiary education constituted the larger proportion of the sample. The two educational categories were subsequently compared to determine whether educational level was associated with differences in combined KAP scores. Occupation was also examined because residents' daily activities may be associated with different waste-generation and disposal experiences.

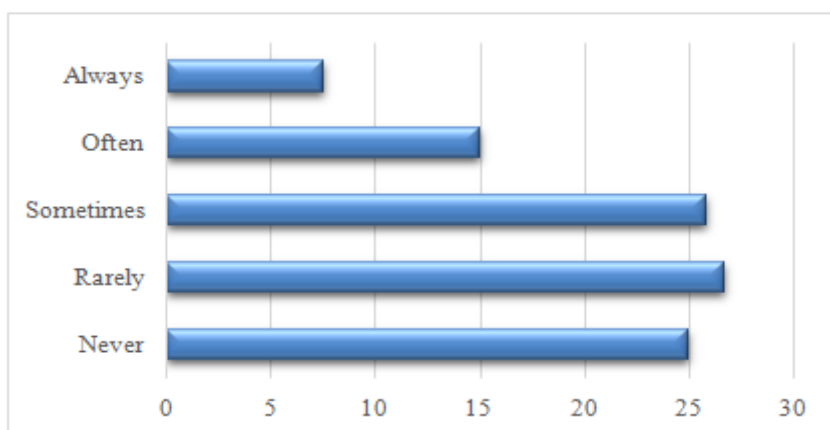


Fig 4: Distribution of Respondents by Occupation



Source: Author's analysis, 2026.

Traders represented the largest occupational group, with 42 respondents (35.00%), followed by farmers with 34 (28.33%) and students with 28 (23.33%). Civil servants constituted 16 respondents (13.33%). The unequal group sizes were taken into consideration when interpreting the occupation-based comparison.

Knowledge, Attitude and Practice Scores

The descriptive statistics for the three KAP domains are presented in Table 4.5. The mean knowledge score was 2.98 (SD = 0.54), while the mean attitude score was 2.94 (SD = 0.53). The practice domain recorded a mean of 3.01 (SD = 0.56). The combined KAP score was 2.98 (SD = 0.38).

Table 4.1: Knowledge, Attitude and Practice Scores

KAP domain	Mean	Standard deviation	Minimum	Maximum
Knowledge	2.983	0.539	1.8	4.4
Attitude	2.938	0.528	1.6	4.3
Practice	3.005	0.556	1.5	4.3
Combined KAP score	2.975	0.381	2	3.87

Source: Author's analysis, 2026.

The practice domain had the highest mean score among the three individual KAP domains, although the difference from knowledge and attitude was small. The combined KAP score of 2.98 indicates that the three domains, when summarized together, were centred close to the midpoint of the five-point scoring scale. The standard deviations indicate moderate variation among respondents. The practice scores showed slightly greater dispersion than the attitude scores, while the combined KAP score had a smaller standard deviation because it represented the mean of the three domain scores.

Reliability of the KAP Instrument

The internal consistency of the questionnaire was examined using Cronbach's alpha. The results are presented in Table 4.2.

Table 4.2: Cronbach's Alpha Reliability Results

KAP domain	Number of items	Cronbach's alpha
Knowledge	10	0.784
Attitude	10	0.784
Practice	10	0.785

Source: Author's analysis, 2026.

The Cronbach's alpha coefficients ranged from 0.784 to 0.785. Knowledge and attitude each recorded an alpha coefficient of 0.784, while practice recorded 0.785. These values indicate acceptable internal consistency among the items within each domain. The similarity of the coefficients across the three domains suggests that the item sets had comparable internal consistency.

Relationship among Knowledge, Attitude and Practice

Pearson correlation analysis was conducted to examine the relationships among knowledge, attitude and practice scores. The correlation coefficients, confidence intervals and p-values are presented in Table 4.7.

Table 4.3: Correlation among Knowledge, Attitude and Practice

Variables	r	95% CI lower	95% CI upper	p-value
Knowledge vs Attitude	0.208	0.030	0.373	0.023
Knowledge vs Practice	0.337	0.168	0.487	<0.001
Attitude vs Practice	0.186	0.007	0.353	0.042

Source: Author's analysis, 2026.

Knowledge was positively associated with attitude, with a correlation coefficient of 0.208 (95% CI: 0.030–0.373; $p = 0.023$). This represents a modest positive association, indicating that higher knowledge scores tended to occur alongside higher attitude scores. Knowledge also demonstrated a positive association with practice ($r = 0.337$; 95% CI: 0.168–0.487; $p < 0.001$). This was the strongest of the three relationships. The confidence interval remained above zero, supporting a statistically significant positive association in the dataset. Similarly, attitude was positively associated with practice ($r = 0.186$; 95% CI: 0.007–0.353; $p = 0.042$). Although statistically significant at the 5% level, the magnitude of the association was small. Taken together, the results indicate that the three KAP domains were positively related in the dataset. However, the correlations do not establish causation or demonstrate that knowledge necessarily leads to attitude or that attitude necessarily leads to practice.

KAP Scores According to Age

The mean KAP scores across the five age categories are presented in Table 4.8.

Table 4.4: KAP Scores by Age Group

Age group	n	Knowledge Mean	Knowledge SD	Attitude Mean	Attitude SD	Practice Mean	Practice SD	Combined KAP Mean	Combined KAP SD
18–25	26	2.892	0.497	2.954	0.489	2.965	0.447	2.937	0.339
26–35	43	3.007	0.549	2.919	0.535	2.948	0.637	2.958	0.424
36–45	32	2.978	0.556	2.994	0.530	3.109	0.544	3.027	0.353
46–55	13	3.177	0.556	3.062	0.501	2.854	0.475	3.031	0.314
56+	6	2.800	0.540	2.667	0.541	3.133	0.708	2.867	0.563

Source: Author's analysis, 2026.

Respondents aged 46–55 years recorded the highest knowledge mean (3.18), while respondents aged 56 years and above recorded the lowest knowledge mean (2.80). The highest attitude mean was observed among respondents aged 46–55 years (3.06), whereas the 56+ group had the lowest attitude mean (2.67). For practice, respondents aged 56 years and above recorded the highest mean (3.13), closely followed by respondents aged 36–45 years (3.11). The lowest practice mean was recorded among respondents aged 46–55 years (2.85). The highest combined KAP mean was recorded among respondents aged 46–55 years (3.03), closely followed by the 36–45 group (3.03), while the 56+ group had the lowest combined KAP mean (2.87). These descriptive differences were subjected to statistical testing.

Table 4.5: Comparison of Combined KAP Score by Age

Variable	Test statistic	p-value
Age group	0.417	0.796

The one-way ANOVA produced an F-value of 0.417 with a p-value of 0.796. Since the p-value is greater than 0.05, there was no statistically significant difference in combined KAP scores across the age groups in the dataset. Therefore, although some descriptive differences were observed between age groups, the evidence does not support a statistically significant age-group difference in combined KAP scores.

Comparison of KAP Scores by Sex

The comparison of combined KAP scores between male and female respondents is presented in Table 4.10.

Table 4.6: Comparison of Combined KAP Score by Sex

Sex	n	Mean	SD	Test statistic	p-value
Male	70	2.960	0.406	0.515	0.607
Female	50	2.996	0.346		

Source: Author's analysis, 2026.

Female respondents recorded a slightly higher combined KAP mean (2.996) than male respondents (2.960). However, the Welch independent-samples t-test gave a test statistic of 0.515 and a p-value of 0.607. Since the p-value exceeds 0.05, the difference between male and female respondents was not statistically significant in the analysis. The observed difference in mean scores was therefore small relative to the variation within the two groups.

Comparison of KAP Scores by Educational Level

The relationship between educational level and combined KAP score is presented in Table 4.11.

Table 4.7: Comparison of Combined KAP Score by Educational Level

Education	n	Mean	SD	Test statistic	p-value
Secondary	49	2.980	0.309	0.126	0.900
Tertiary	71	2.972	0.426		

Source: Author's analysis, 2026.

Respondents with secondary education had a combined KAP mean of 2.980, compared with 2.972 among respondents with tertiary education. The difference was very small. The Welch independent-samples t-test produced a test statistic of 0.126 and a p-value of 0.900. The result indicates that there was no statistically significant difference in combined KAP scores between the two educational categories in the dataset.

Table 4.8: Comparison of Combined KAP Score by Occupation

Occupation	n	Mean	SD
Farmers	34	2.852	0.342
Traders	42	3.090	0.399
Civil servants	16	2.946	0.388
Students	28	2.970	0.362
ANOVA F-value			2.581
p-value			0.057

Source: Author's analysis, 2026.

Traders recorded the highest combined KAP mean (3.090), followed by students (2.970), civil servants (2.946) and farmers (2.852). Thus, the largest descriptive difference was between traders and farmers. However, the one-way ANOVA produced an F-value of 2.581 and a p-value of 0.057. Although the p-value was close to 0.05, it remained above the conventional significance threshold. Therefore, the analysis did not demonstrate a statistically significant difference in combined KAP scores among the occupational groups.

Waste-Disposal Methods

The reported methods of waste disposal are presented in Table 4.13. Open dumping was the most frequently reported disposal method, accounting for 39 respondents (32.50%). Municipal collection was reported by 38 respondents (31.67%), while burning accounted for 22 respondents (18.33%). Private collection and burial accounted for 11 (9.17%) and 10 respondents (8.33%), respectively.

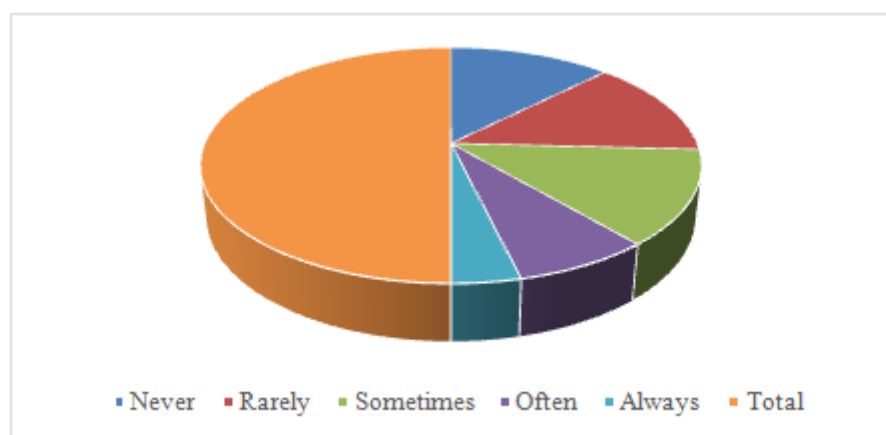


Fig. 4.5: Reported Methods of Household Waste Disposal

Source: Author's analysis, 2026.

The results show that open dumping and municipal collection were the two most frequently reported methods. The proportion reporting open dumping illustrates the continued presence of uncontrolled disposal practices within the sample. Burning was also reported by a notable proportion of respondents. The findings indicate that different disposal routes coexist within the study setting. However, the reasons for choosing a particular disposal method cannot be established from these descriptive data alone because variables such as cost, distance, accessibility and reliability of collection services were not directly analysed.

The frequency with which respondents reportedly separated waste is presented in Table 4.14. The largest category was "sometimes," reported by 37 respondents (30.83%), followed by "often" with 34 respondents (28.33%).

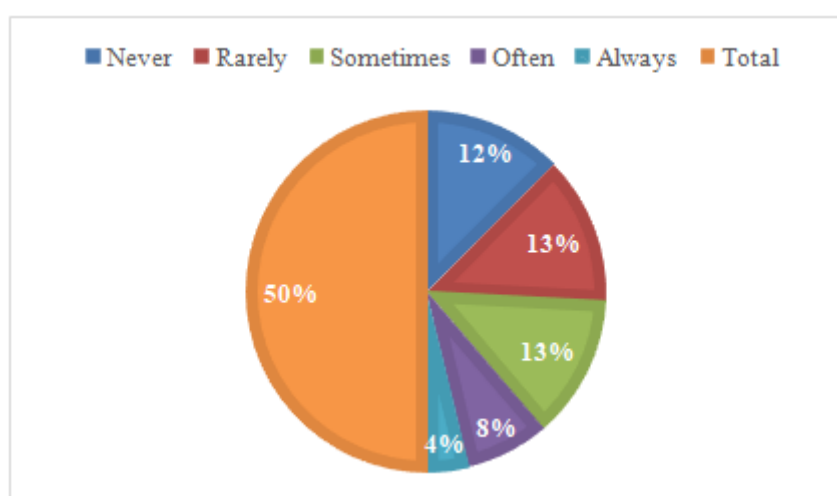


fig 4.6: Frequency of Waste Separation

Source: Author's analysis, 2026.

The results suggest that waste separation was not consistently practised by all respondents. Although 28.33% reported separating waste often, only 10.00% reported always doing so. Nearly one-third reported doing so sometimes. This pattern suggests that waste separation may be present as a household practice without being fully established as a routine behaviour

Frequency of Recycling

Table 4.15 presents the reported frequency of recycling. The largest proportion of respondents, 39 (32.50%), reported recycling often. Thirty respondents (25.00%) reported recycling sometimes, while 22 (18.33%) reported always recycling.

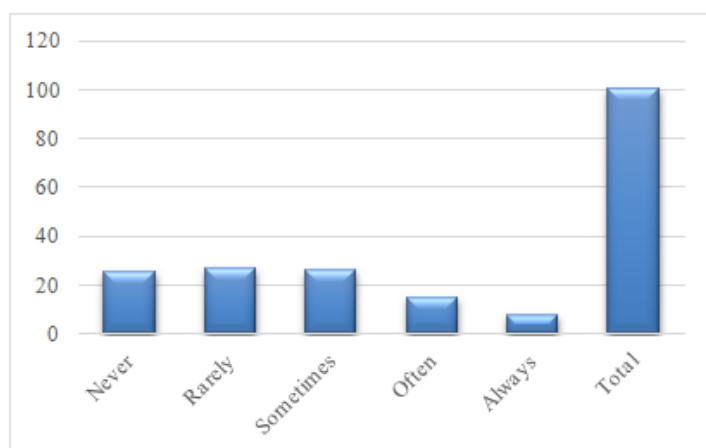


fig 4.7: Frequency of Recycling

Source: Author's analysis, 2026.

The results indicate that recycling was relatively common within the responses, although consistent recycling was not universal. A combined 50.83% reported recycling often or always, while 24.16% reported rarely or never recycling. These findings demonstrate the value of reporting the frequency categories separately rather than reducing recycling behaviour to a simple yes/no response. Such an approach provides a clearer picture of how regularly the practice occurs.

The frequency of composting is presented in Table 4.16. Thirty respondents (25.00%) reported never composting, while 32 (26.67%) reported composting rarely. Thirty-one respondents (25.83%) reported composting sometimes.

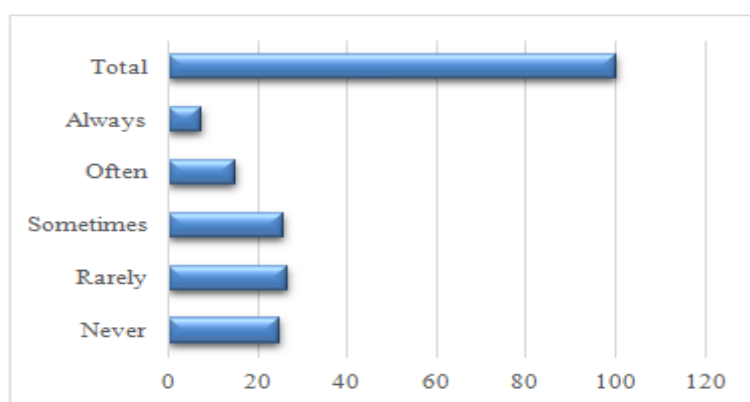


Fig 4.8: Frequency of Composting

Source: Author's analysis, 2026.

Only 22.50% of respondents reported composting often or always, whereas 51.67% reported doing so never or rarely. Thus, composting was less frequently reported than recycling in the dataset. The relatively low frequency of composting may indicate that it is not yet a routine household waste-management practice. Nevertheless, reasons for this pattern cannot be determined without additional information on household waste composition, knowledge of composting, space availability and access to appropriate facilities.

The frequency of using waste-collection services is presented in Table 4.17. The largest group, 39 respondents (32.50%), reported using collection services sometimes. This was followed by 33 respondents (27.50%) who reported using them often.

Table 4.9: Frequency of Waste-Collection Use

Frequency	n	Percentage (%)
Never	7	5.83
Rarely	21	17.50
Sometimes	39	32.50
Often	33	27.50
Always	20	16.67
Total	120	100.00

Source: Author's analysis, 2026.

The results show variation in the use of waste-collection services. A total of 44.17% reported using collection services often or always, while 23.33% reported never or rarely using them. This variation may be important for understanding why formal collection and uncontrolled disposal practices can occur simultaneously within the same community. However, the data do not provide sufficient evidence to determine whether the differences are caused by service availability, cost, convenience or household preference.

Item-Level Knowledge Results

Table 4.18 presents the mean and standard deviation for each knowledge item. The mean scores ranged from 2.84 to 3.11.

Table 4.10: Knowledge Item-Level Descriptive Statistics

Item	Mean	SD
Knowledge Item 1	3.042	0.844
Knowledge Item 2	2.942	1.040
Knowledge Item 3	2.992	0.921
Knowledge Item 4	3.008	0.948
Knowledge Item 5	3.108	0.887
Knowledge Item 6	2.842	0.935
Knowledge Item 7	2.900	0.991
Knowledge Item 8	3.000	0.917
Knowledge Item 9	2.925	0.871
Knowledge Item 10	3.067	0.877

Source: Author's analysis, 2026.

Knowledge Item 5 recorded the highest mean score (3.108), followed by Knowledge Item 10 (3.067). Knowledge Item 6 recorded the lowest mean score (2.842). The standard deviations ranged from 0.844 to 1.040, indicating varying degrees of response dispersion among the items. The item-level results show why reporting only the domain mean can conceal differences between individual questionnaire items. In the actual study, the item wording should be included or clearly defined so that readers can identify the specific areas represented by the higher and lower scores.

Item-Level Attitude Results

The descriptive statistics for the attitude items are presented in Table 4.19. The mean scores ranged from 2.83 to 3.08.

Table 4.11: Attitude Item-Level Descriptive Statistics

Item	Mean	SD
Attitude Item 1	2.967	0.961
Attitude Item 2	3.008	0.957
Attitude Item 3	2.867	0.869
Attitude Item 4	2.842	0.810
Attitude Item 5	2.950	0.934
Attitude Item 6	3.000	0.898
Attitude Item 7	2.833	0.964
Attitude Item 8	2.875	0.894
Attitude Item 9	2.967	0.898
Attitude Item 10	3.075	0.852

Source: Author's analysis, 2026.

Attitude Item 10 recorded the highest mean (3.075), followed by Attitude Item 2 (3.008). Attitude Item 7 recorded the lowest mean (2.833). The standard deviations indicate moderate variation in responses across the attitude items. The relatively narrow range of item means corresponds with the domain-level attitude mean of 2.94. This suggests that no single attitude item produced an extremely high or extremely low average response.

The descriptive statistics for the practice items are presented in Table 4.20.

Table 4.12: Practice Item-Level Descriptive Statistics

Item	Mean	SD
Practice Item 1	3.042	0.883
Practice Item 2	2.983	0.979
Practice Item 3	3.008	0.966
Practice Item 4	2.975	0.921
Practice Item 5	2.925	0.936
Practice Item 6	3	0.987
Practice Item 7	3.008	0.983

Practice Item 8	2.983	0.961
Practice Item 9	3.1	0.947
Practice Item 10	3.025	0.948

Source: Author's analysis, 2026.

Practice Item 9 recorded the highest mean score (3.100), while Practice Item 5 recorded the lowest (2.925). The relatively small difference between the highest and lowest item means indicates that the practice items produced fairly similar average responses. The practice-domain mean of 3.01 was therefore not driven by a single unusually high item. Rather, the scores were distributed relatively evenly across the ten practice items.

Summary of Inferential Tests

Table 4.21 summarizes the statistical tests conducted to examine differences in combined KAP scores across selected sociodemographic characteristics.

Table 4.13: Summary of Sociodemographic Tests

Variable	Statistical test	Test statistic	p-value	Interpretation
Age group	One-way ANOVA	F = 0.417	0.796	Not significant
Sex	Welch t-test	t = 0.515	0.607	Not significant
Education	Welch t-test	t = 0.126	0.9	Not significant
Occupation	One-way ANOVA	F = 2.581	0.057	Not significant at 0.05

Source: Author's analysis, 2026.

The results show that none of the examined sociodemographic variables produced a statistically significant difference in combined KAP scores at the 0.05 level. Age produced the largest p-value (0.796), followed by education (0.900) and sex (0.607). Occupation produced the smallest p-value (0.057), but this remained slightly above the predefined 0.05 significance level. Therefore, based on the analysis, there was no statistically significant evidence that combined KAP scores differed according to age, sex, educational level or occupation.

Summary of Major Findings

The analysis of 120 respondents produced several principal findings. First, the combined KAP score was 2.98 ± 0.38 , with knowledge, attitude and practice means of 2.98, 2.94 and 3.01, respectively. Second, the three KAP domains demonstrated positive relationships, with the strongest association occurring between knowledge and practice ($r = 0.337$, $p < 0.001$). Third, the analysis found no statistically significant differences in combined KAP scores across age, sex, education or occupation. Although descriptive differences were observed between occupational groups, the occupation comparison did not reach statistical significance at the 5% level. Fourth, open dumping was the most frequently reported disposal method (32.50%), followed closely by municipal collection (31.67%). Waste separation and recycling were reported at varying frequencies, while composting was less commonly reported. Finally, the results demonstrate the importance of considering knowledge, attitudes, practices and waste-management behaviour as related but distinct dimensions. The findings do not establish causal relationships between the KAP domains or demonstrate that any particular sociodemographic characteristic determines waste-management behaviour.

DISCUSSION OF FINDINGS

Knowledge, Attitudes and Practices Towards Sustainable Solid Waste Management

The findings showed mean scores of 2.98 for knowledge, 2.94 for attitude and 3.01 for practice, with a combined KAP mean of 2.98. These results suggest that respondents demonstrated a reasonably consistent level of knowledge, attitude and reported waste-management practice, although the scores also indicate that



positive knowledge and attitudes did not necessarily translate into uniformly strong waste-management behaviours. This distinction is important because sustainable solid waste management depends not only on what residents know, but also on whether appropriate disposal, separation, recycling and recovery options are accessible and routinely used. The pattern is consistent with recent Nigerian research showing that awareness of waste-management issues does not always correspond to appropriate waste-management practices. A 2024 study of municipal solid waste management in Southwestern Nigeria, for example, reported a substantial gap between awareness and the actual implementation of effective waste-management practices. Similarly, research among Nigerian households on food-waste management found that respondents generally had good knowledge and moderate attitudes and behaviours, but inappropriate disposal remained evident.

The practice score in the present results was slightly higher than the knowledge and attitude scores. This should not be interpreted as evidence that knowledge automatically produces better practice. Waste-management behaviour is influenced by several practical conditions, including the availability of collection services, disposal facilities, household routines, economic considerations and perceived control over waste-management decisions. Research applying the Theory of Planned Behaviour in Nigeria has also identified perceived behavioural control and behavioural intention as relevant to littering-prevention behaviour.

Reliability of the KAP Instrument

The three KAP domains produced Cronbach's alpha coefficients ranging from 0.784 to 0.785. These values indicate acceptable internal consistency for the instrument and suggest that the items within each domain were reasonably related in measuring their respective constructs. The reliability result is particularly relevant because KAP studies depend on clearly structured items capable of distinguishing knowledge, attitudes and reported practices. Nevertheless, internal consistency alone does not establish validity.

Relationship Between Knowledge, Attitude and Practice

The results showed statistically significant positive relationships between knowledge and attitude ($r = 0.208$, $p = 0.023$), knowledge and practice ($r = 0.337$, $p < 0.001$), and attitude and practice ($r = 0.186$, $p = 0.042$). The strongest of the three associations was between knowledge and practice. The positive relationship between knowledge and practice suggests that respondents with higher knowledge scores tended to report better waste-management practices. However, the correlation was moderate rather than strong, indicating that knowledge alone does not explain differences in practice. Similarly, the relatively weak relationships involving attitude suggest that having favourable views about waste management may not be sufficient to produce consistent behavioural change. This finding agrees with recent Nigerian evidence showing that awareness and positive perceptions can coexist with less satisfactory waste-management practices. The finding therefore supports an interpretation of waste management as a behavioural and service-delivery issue rather than simply an information deficit. Availability of waste containers, regular collection, affordable disposal services, opportunities for recycling and local enforcement may all influence whether residents can convert their knowledge and attitudes into appropriate practices.

KAP Scores Across Age Groups

The comparison across age groups showed no statistically significant difference in combined KAP scores ($F = 0.417$, $p = 0.796$). Although the mean scores varied between age categories, the differences were not sufficiently large to establish a statistically meaningful association between age group and combined KAP. The absence of a statistically significant age difference suggests that waste-management knowledge, attitudes and reported practices may be distributed across different age categories rather than concentrated within a particular age group. This finding also indicates that interventions based solely on age targeting may not address the practical factors responsible for inappropriate waste disposal.

KAP Scores by Sex

Male respondents recorded a combined KAP mean of 2.960, while female respondents recorded 2.996. The difference was not statistically significant (Welch $t = 0.515$, $p = 0.607$). The relatively close mean scores

indicate that male and female respondents in the sample reported broadly similar levels of knowledge, attitude and practice. This suggests that waste-management activities in the study setting can reasonably involve both men and women rather than assuming that one sex has substantially different KAP characteristics. This interpretation should remain cautious because sex differences can depend on household responsibilities, occupation, access to waste services and community roles. The present result simply indicates that such a difference was not statistically demonstrated in the model.

KAP Scores by Educational Level

Respondents with secondary education had a combined KAP mean of 2.980, compared with 2.972 among respondents with tertiary education. The difference was not statistically significant (Welch $t = 0.126$, $p = 0.900$). The finding suggests that formal educational attainment, within the two categories used in this study, did not distinguish respondents' combined KAP scores. This is important because waste-management behaviour is not necessarily determined by educational qualification alone. Practical knowledge, environmental conditions, availability of services and household practices may be more directly connected with day-to-day waste-management decisions. Therefore, waste-management communication should remain accessible to residents across educational backgrounds rather than being designed only for people with higher formal education.

KAP Scores by Occupation

Occupation produced a relatively larger variation in combined KAP scores than the other socio-demographic variables considered. Traders recorded a mean of 3.090, students 2.970, civil servants 2.946 and farmers 2.852. However, the difference did not reach statistical significance at the 5% level ($F = 2.581$, $p = 0.057$). Although the p -value was close to 0.05, it would be inappropriate to describe the occupational differences as statistically significant. The result may indicate some variation worth investigating in a larger empirical study, particularly because different occupational groups may generate, handle and dispose of waste under different conditions. Traders, for example, may encounter considerable packaging and commercial waste, while farmers may deal with organic and agricultural residues

Waste-Disposal Practices

Open dumping was the most frequently reported disposal method, accounting for 32.50% of respondents, followed closely by municipal collection at 31.67%. Burning accounted for 18.33%, while private collection and burial accounted for 9.17% and 8.33%, respectively. The prominence of open dumping is particularly important because it demonstrates a gap between sustainable waste-management principles and reported disposal behaviour. The coexistence of municipal collection and open dumping also suggests that access to formal collection alone may not guarantee exclusive use of appropriate disposal channels. Frequency, convenience, affordability, reliability and accessibility of collection services may influence household choices.

The pattern is consistent with broader Nigerian literature describing continuing difficulties in converting public awareness into effective municipal solid waste-management practices. Earlier work specifically examining solid waste management in Maiduguri has also documented problems associated with waste disposal and management in the local context. Open burning, reported by 18.33% of respondents, also deserves attention because it represents another disposal pathway that may generate environmental and public-health concerns. Consequently, sustainable waste management in Maiduguri requires attention not only to residents' knowledge but also to the availability and reliability of practical waste-collection and recovery systems.

Waste Separation, Recycling and Composting

Waste separation was reported as occurring sometimes by 30.83% of respondents and often by 28.33%, while only 10.00% reported always separating waste. This pattern indicates that source separation had some presence among respondents but was not yet a consistent routine for most households. Recycling showed a somewhat stronger pattern, with 32.50% reporting that they often recycled and 18.33% reporting that they always did so.



However, 25.00% reported recycling sometimes and 18.33% rarely. Composting was less frequently reported, with only 7.50% indicating that they always composted and 15.00% reporting that they often did so.

These results suggest that recycling and source separation may have greater practical visibility than composting. The lower frequency of composting could reflect limited awareness of household composting methods, inadequate space, lack of incentives or the absence of established systems for collecting and using compostable materials. Recent Nigerian research similarly emphasizes the gap between awareness of waste management and consistent implementation of sustainable practices. Rather than assuming that residents simply need more information, the findings point towards the importance of creating conditions that make sustainable practices convenient. This includes accessible collection points, clearly designated containers, opportunities for material recovery and locally appropriate systems for handling organic waste.

Implications for Sustainable Waste Management in Maiduguri

Taken together, the findings indicate that sustainable waste management in Maiduguri should be approached as a combination of behavioural, infrastructural and institutional issues. The significant positive relationships among the three KAP domains indicate that knowledge, attitude and practice are connected, but the modest correlation coefficients also show that improving knowledge alone may not be sufficient. Recent Nigerian studies similarly emphasize the importance of moving beyond awareness towards systems that support actual participation in sustainable waste management. Therefore, interventions should consider resident education alongside reliable waste collection, source separation, recycling opportunities, community participation and appropriate monitoring. It is also important to distinguish the present findings from intervention studies. For example, a community intervention in Ibadan reported improvements in waste-management knowledge, attitudes and practices following a structured recycling intervention. That study involved an intervention, whereas the present study is observational and therefore cannot attribute the observed KAP relationships to any intervention.

CONCLUSION

The findings indicate that residents demonstrated moderately consistent levels of knowledge, attitudes and reported practices regarding sustainable solid waste management. Knowledge, attitude and practice were positively related, with the strongest association observed between knowledge and practice. However, the relatively modest strength of these relationships suggests that knowledge and attitudes alone may not fully explain waste-management behaviour. No statistically significant differences were observed in combined KAP scores across age, sex, educational level or occupation. In contrast, the reported disposal patterns showed continued reliance on open dumping and, to a lesser extent, open burning, while waste separation, recycling and composting were not consistently practiced by all respondents. The findings therefore suggest that sustainable solid waste management in Maiduguri requires attention to both behavioural and service-related factors. Improving residents' understanding of appropriate waste management should be accompanied by practical opportunities to separate, collect, recycle and properly dispose of waste.

Based on the pattern of findings, the following recommendations are proposed:

1. Municipal authorities and relevant waste-management stakeholders should strengthen the availability, coverage and reliability of household and community waste-collection services.
2. Residents should be encouraged and supported to separate recyclable, organic and residual waste at the point of generation.
3. Local recycling and material-recovery opportunities should be developed so that residents have practical outlets for recyclable materials.
4. Community-level waste-management planning should address the factors that encourage residents to use open dumping and burning as disposal options.

5. Waste-management communication should focus on practical household actions, including separation, safe storage, collection and recovery, rather than awareness alone.
6. Local authorities, community leaders, environmental organizations and residents should be involved in planning and monitoring waste-management activities.
7. Future studies should use verified field data and, where possible, larger samples and mixed-method approaches to examine the practical, economic and institutional factors influencing waste-management behaviour in Maiduguri.

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