ASSESSMENT OF SOLID WASTE MANAGEMENT PRACTICE AT THE STAFF QUARTERS OF WAZIRI UMARU FEDERAL POLYTECHNIC, BIRNIN KEBBI, NIGERIA

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ABSTRACT
Solid wastes generation is an inevitable outcome of human living. While they are potentially harmful, understanding how to manage them can lead to wealth creation and a safe community. However, studies on solid wastes management in campuses in north-west Nigeria are limited. Therefore, this paper aimed to evaluate solid waste management practice at the staff quarters of Waziri Umaru Federal Polytechnic, Birnin Kebbi. The research gathered data through administering questionnaires on participants via electronic means. The authors analysed questionnaires received using descriptive statistics using MicroSoft Excel, version2013 and obtained frequencies including means and ratios. The study found that much of the solid wastes generated in the study area were conveyed in open carts to disposal sites - a practice that caused air pollution. The study also found that recycling was a below-average practice among most of the participants. The paper suggested that sensitization on effective solid waste management be held for the residents. The paper also recommended formal designation of disposal sites and routine monitoring of the sites to ensure compliance.
Keywords: health hazard, higher institutions, recycle, open waste dump, global warming.
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1. INTRODUCTION
Waste is an 'end-of-life' product, generated in the closing phase of the product-consumption process (Zaman & Lehmann, 2013 in Kasam et al., 2018). Solid waste generation is an inevitable accompaniment of human living (Coker, et al., 2016). Its importance lies in the fact that it can be a source of wealth creation if properly harnessed and exploited. However, it is also a potential source of environmental and health hazards (Dahlawi & El Sharkawy, 2020). This makes solid waste management a vital occupation for all, and especially management of communities where people live or work. Solid waste management includes the systematic collection, accumulation, transportation, treatment, disposal and recycling of solid waste materials.

In most Nigerian cities, solid waste management is an important environmental challenge. Waste generation rate in Nigeria is put at 0.65-0.95 kg/capita/day which is an average of 42 million tonnes of wastes generated every year (Ike et al., 2018).

The reason behind solid waste management is to reduce the health and environmental challenges that come along with solid waste materials (Ambrose-Agabi & Uzoagu, 2023). Higher education institutions can be regarded as small cities, and they exhibit the attributes of solid waste generation in cities (Rajamanikam, & Poyyamoli, 2014). The activities of human beings and animals is what results to the accumulation of solid wastes. Population and urban growth in developing countries often lead to increase in huge deposits of solid waste materials (Otchere et al., 2015). The management of solid waste within developing countries in the world has been neglected for the fact of inadequate research on the area of solid waste management. (Otchere et al., 2015). Institutions of higher education generate quite a reasonable amount of solid waste within urban and rural communities that host those institutions (Rugatiri et al., 2021). There is also a growing concern about management of solid waste materials in higher institutions including Nigeria. Solid waste generation and management has been neglected in higher institution of learning meanwhile effective ways of managing solid waste in institutions of learning is important for achieving healthy and physical environment for effective learning, research and teaching activities. (Onyilokwu et al., 2024). The increase in population and development in our institutions of higher learning have resulted in increase in consumption, and the daily generation of solid wastes.

According to Ouattara et al., (2022) proper solid waste management practice is pivotal to ensuring the quality of the living environment and the health of the staff and students of institutions. It is therefore essential to understand and advise on ways to enhance the management of solid wastes generated within the Polytechnic staff quarters of Waziri Umaru Federal Polytechnic, Birnin Kebbi, Nigeria. This informed the undertaking of the study. The logical structure of the paper then is as follows: first an introduction which provides an overview of the menace of solid wastes and the imperative of the management of solid wastes in the municipality as well as in institutions of higher learning. The introduction concludes with the justification for the study and its logical structure. The literature review which summarizes some important texts on the subject follows, then comes the methodology. The results and discussion of findings come next, while conclusion and policy recommendations conclude the paper. A list of references is also provided.

2. LITERATURE REVIEW

Solid waste management according to Dimpka et al., (2023) has become a foremost challenge confronting many semi-urban and rural municipalities in Nigeria.

The processes of solid waste management begin with waste generation. Solid wastes in our environment are mostly generated because of the activities of man. There are also, solid wastes generated due to industrial activities initiated and controlled by man. Another type of wastes there are, are the institutional solid wastes, which are basically generated in and around institutional buildings. Broadly speaking, solid wastes are categorized as either organic or inorganic in nature. Wastes may also be viewed as either hazardous or non-hazardous. In many cases, with some touch of creativity, Solid wastes can be recycled. According to Ikpe et al., (2020), the Reduce, Reuse, Recycle (R3) system of waste management recommended by Environmental Protection Agency's (EPA) waste management framework is the route to a sustainable environment.

Another important process of solid waste management is the storage of the waste itself which can be achieved through the use of containers, bins or dumpsters placed at strategic places of generation. The collection of the solid waste materials for upward movement to the processing facility, and as well disposing the solid waste at disposal facility is another important phase in

the waste management cycle. Waste disposal methods can include landfilling or incineration. Waste management activities are mostly monitored and evaluated to ensure compliance with the rules and maintaining standard best practices. Singh et al., (2022) noted that effective management strategies were necessary for dealing with large quantities of wastes generated by organizations, suing for waste characterization in the waste management cycle.

Helelo et al., (2019) has argued for recycling of solid wastes stating that conversion of organic wastes to biogas could reduce expenditure on fuel and other socio-economic and environmental impacts associated with solid waste management. Recycling of paper wastes by selling to pulp and paper factory can also be a feasible and win-win strategy for institutions of higher learning and the environment.

Some other recent studies on municipal solid waste management have revealed that open waste dumping accounted for outbreak of some infectious diseases including Cholera, Diarrhoea, Malaria, Tetanus, Lassa fever, Typhoid and Yellow fever as well as Hookworm, and other parasite infestations. They noted that open waste dumping also promoted fecal contamination of the hands, food and water that often resulted in fecal-oral transmission of diseases. They concluded that careless waste management therefore, was responsible for water pollution, land pollution and air pollution through the release of foul odour in the atmosphere. (Dehghani, et al., 2021; Ikpe et al., 2020)

Furthermore, California Environmental Protection Agency (2015) in Adamu et al., (2023) found that recycling and other wastes diversion practices appeared to create twice the economic activity/tonne of conventional waste disposal. Recycling was also shown by the authors to reduce pollution and conserve natural resources leading to cleaner air and water, and increasing open space, while also reducing greenhouse gases.

As a solution to indiscriminate open waste dumping, Rahman et al., (2013) recommended the establishment of defined disposal sites in the institution they studied, further calling for oversight of the disposal sites.

3. METHODOLOGY

3.1 Study Area and Population

The study area was the staff quarters at WUFP BK, Nigeria. The quarters which is comprised of 5 groups of buildings namely; Area 'A' comprising 17 three-bedroom bungalows and 17 one-bedroom flats as boys quarters, Area 'B' comprising 24 three-bedroom bungalows and 24 one-bedroom flats as boys quarters, Area 'C' comprising 12 two-bedroom apartments, Area 'D' comprising 28 three-bedroom bungalows and Area 'E' comprising 2 two-bedroom apartments and 2 boys quarters. One three-bedroom bungalow in Area 'A' and its boys quarters currently serve as an office building while three other buildings, one in Area 'A' and two others in Area 'B' were unoccupied at the time of the study having been gutted by fire. Thus the study population was 121 heads of household domiciled in the staff quarters of the polytechnic.

3.2 Research Design, study frame and Sample Size

The authors employed the descriptive research survey method. The authors administered validated questionnaires on participants and generated quantitative data. The sampling frame consisted of all members of the study population who were members of the Polytechnic virtual community on WhatsApp. Questionnaire in the form of Google form was set out to participants electronically, however, a total of 22 participants only completed and submitted the questionnaire. Therefore the sample size utilized was 18.18% of the study population. The researchers analysed quantitative data generated from questionnaires submitted, using descriptive statistics in MicroSoft Excel version 13.

The questionnaires administered sought response to 44 questions grouped into 2 sections. The first section which comprised 3 questions seeking the demography of the responders namely, location of accommodation, type of accommodation and household size. Responders had to choose between 5 residential settlements on the main campus and it off-campus staff accommodations viz, Area 'A', Area 'B', Area 'C', Area 'D' and Area 'E'. Responders also had to choose one of 3 types of accommodation namely: one-bedroom apartment, two-bedroom apartment or three-bedroom apartment. Another variable in the first section of the questionnaire was the household size. Here responders had to choose between 1-5, 6-10, 11-15, 16-20 and above 20.

The second section of the questionnaire enquired about the participant's assessments of nature of solid wastes generated, assessment of waste recycling practice, assessment of solid waste storage practice, assessment of solid waste transportation practice and assessment of solid waste disposal practice. The authors used a 5-point Likert scale to obtain users response to entries in the second part of the questionnaire.

The coding scheme for the second part of the questionnaire was as follows:

Table 1: Coding scheme for second part of questionnaire

1=Never	2=Rarely	3=Fairly often	4=Frequently	5=Always

The authors applied the above coding scheme throughout the second section of the questionnaire.

4. RESULTS AND DISCUSSION OF FINDINGS

The analysis showed that a total of 22 households participated in the survey. While participants from Areas 'B' and 'D' accounted for 54. 6% of total number of participants, residents of each, residents of Area 'C' participated the least accounting for 9.1% of the sample size.

Table 2: Response rate by location of accommodation

Serial number	**Location of Accommodation**	**Response (%)**
1	Area 'A'	22.7
2	Area 'B'	27.3
3	Area 'C'	9.1
4	Area 'D'	27.3
5	Area 'E'	13.6
Total response (%)		**100**

Response rate according to the type of accommodation showed that residents dwelling in two-bedroom apartments participated most in the survey, accounting for 59.1% of respondents, as shown in the table following.

Table 3: Response rate by type of accommodation

Serial number	**Type of Accommodation**	**Response (%)**
1	One-bedroom apartment	13.6
2	Two-bedroom apartment	59.1
3	Three-bedroom bungalow	27.3
Total response (%)		**100**

45.45% of respondents said they 'never' generated animal dung as solid wastes in their residence/premise. 22.75% of respondents however said that the generated animal dung 'fairly often'. The mean score on a 5-point Likert scale for the generation of animal dung in the study area was 3.46.

While 40% of respondents said they generated other organic solid wastes like food remnants and leaves, 18.2% of participants said they generated plastic wastes 'always' just as 27.3% generated plastic wastes frequently. 4.5% of respondents however, said they 'never' generated plastic wastes in their residences/premises.

The frequency of generation and recycling of the different types of solid wastes according to the study is presented in the table following.

Table 4: Mean frequencies of generation and recycling of different types of solid wastes

Type of solid waste	**Mean frequency of generation of wastes on a 5-point Likert scale**	**Mean frequency of recycling (reuse or conversion to other uses) of wastes on a 5-point Likert scale**
Animal dung	3.45	Not available
Other organic wastes	3.41	2.05
Plastic wastes	2	1.32
Glass wastes	2.55	1.91
Metal wastes	1.91	1.68
Electronic wastes	2.41	1.86
Textile wastes	2.36	1.91
Leather wastes	3.05	2.05
Paper/ cardboard wastes	2.05	1.68

The analysis also revealed the frequency of storage of solid wastes in different types of containers/places as presented in the following table.

Table 5: Frequency of storage of solid wastes in different containers

Type of storage container/place	**Mean frequency of storage of solid wastes on a 5-point Likert scale**
Plastic containers	3
Metal containers	2.05
Sacks	2.45
Private pit in compound/premises	1.82
Waste baskets	2.82
Private dump in compound/premises	2.64

The table following presents the frequency of evacuation of solid wastes collected in residences/premises of the participants to disposal sites.

Table 6: Rate of evacuation of solid wastes to disposal sites

Rate of evacuation of solid wastes to disposal sites	**Frequency of evacuation of solid wastes (%)**
0 – 12 hourly	27.27
13 – 24 hourly	50
25 – 28 hourly	13.63

3 – 7 days interval	4.55
Over 1 week intervals	4.55

Another finding from the analysis was the mode of transportation of solid wastes collected, to disposal sites, and is presented in the following table.

Table 7: Frequency of use of different modes of transportation of solid wastes to disposal sites

Mode of transportation of solid wastes to disposal sites	**Mean frequency of transportation of solid wastes on a 5-point Likert scale**
By services of Cart pushers	3
By services of Truck drivers	2.05
Use of wheelbarrows or other containers	2.45
Use of private vehicle	1.82
Services of animal-pulled carts	2.82

The analysis further revealed the final disposal points for solid waste products generated at the residences/premises of participants in the study as tabulated below.

Table 8: Frequency of disposal of solid wastes at different sites

Final disposal site	**Mean frequency of utilization of the site on a 5-point Likert scale**
Burying in yard/compound	1.77
Burning within yard/compound	2.86
Open waste dumps	3.36
Roadside	1.96
Drainages	1.59
Composting for use in farms/gardens	2.59
Local authority-approved dump sites.	2.63

The analysis revealed that animal dung and other organic wastes such as leaves, branches and food remnants were the solid waste products most generated in the study area. Though less than 55% of the participants in study generated animal dung in their residences/premises, both animal dung and other organic wastes, returned a mean score of 3.45 and 3.41 respectively on a 5-point Likert scale, attesting to the presence of much vegetation, as well as animal husbandry and domestic activities in the study area. Solid waste products from leather and other organic wastes were the most recycled, with a mean score of 2.05 each, on the 5-point Likert scale implying a below-average practice of recycling of waste products among participants of the study. The analysis of the results also showed that plastic wastes such as polythene and nylon bags were the least recycled solid wastes.

Most solid wastes according to the study, were first collected and stored in plastic containers before they were finally disposed of. 50% of participants in the study disposed of solid wastes collected in their residences/premises daily, and this was mostly done by engaging cart pushers. The analysis also showed that respondents rarely used private vehicles for the purpose of transporting solid wastes to disposal sites.

Furthermore, according to the results of the study, most solid wastes collected in the study area ended up in open wastes dumps while the next-patronised method of solid waste disposal was 'burning within yard/compound'. These two methods of waste disposal present environmental concerns. While open waste dumps are obviously synonymous with air pollution, an investigation of the effect of economic welfare on life expectancy in sub-Saharan Africa which analaysed data generated between 2000 and 2001, and focused on economic welfare found that reduction in carbon dioxide emission significantly increased life expectancy. The study therefore recommended policy reforms towards reducing carbon dioxide emissions for improved life expectancy in Sub-Saharan Africa, a feat that cannot be achieved without curtailing open waste dumping and burning (Samuel et al., 2022; Momoh et al., 2024).

Open waste dumping also mars the landscape and constitutes a breeding ground for rodents and pathogens. It also calls the attention of scavengers who collect plastic bottles and recycle them without properly sterilising them.

Open burning of solid wastes in the yards/compounds of residents on the other hand, increases the carbon footprint of the household, and contributes to depletion of the ozone layer thereby inviting climate change.

The results also show an extant practice of disposal of solid wastes in drainages which presents the risk of blocked channels which can in turn predispose the study area to erosion and even flooding.

5. CONCLUSION AND POLICY RECOMMENDATIONS

The study set out to assess solid wastes management practice in the staff quarters of WUFPBK. The authors collected data via questionnaire administered on participants among residents of the target area and analysed the questionnaires using descriptive statistics in Microsoft Excel version 2013. The results of the analysis showed that animal dung generated, along with other organic wastes generated by most of the participants were been recycled, and particularly used as manure in farms and garden. The results of the analysis further revealed appreciable levels of generation of inorganic wastes like plastics and glass products. However, the practice of recycling waste products was generally below-average among participants of the study. The inevitable implication of which is potential decrease in waste performance score of the study area. The study also found that much of the solid wastes generated in the study area were conveyed in open carts to disposal sites - a practice that causes air pollution. This lends credence to Etim et al., (2024) whose study showed the pivotal role that waste management authorities could play in ensuring sustainable waste management awareness and practices

The study after examining waste management practice in the staff quarters of Waziri Umaru Federal Polytechnic, Birnin Kebbi recommends as follows:

1. The collection of solid wastes from doorsteps of residences by institution-owned specialized vehicle to eliminate the transportation of solid wastes to disposal sites in open carts and containers,
2. Sensitization of residents of the study area on appropriate solid waste disposal practices.
3. The establishment of a reward system for high waste performance score among residents of the study area so as to encourage recycling and reduced waste generation.
4. Formal designation of disposal sites and routine monitoring the sites to ensure compliance in agreement with Rahman et al., (2013).

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