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# ASSESMENT OF HOUSEHOLD SOLID WASTE MANAGEMENT IN SELECTED LOCAL GOVERNMENT AREAS IN PLATEAU STATE: A COMPARISON BETWEEN URBAN AND RURAL

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**Authors' contribution**

All authors contributed equally to this work. Grace Nandi Kuyahar conceived the study, designed and implemented the study and prepared the manuscript. Doris Tsilpi Malgwi contributed to the data collection and review of data collection tools. Princewill Chigoziri Chikwe analyzed and interpreted data. Echendu Dolly Adinma supervised the review of data collection tools, analysis of the results and contributed to the writing of the project. All authors reviewed the results and approved the final copy of the manuscript.

**Competing interest**

All authors declare that there is no competing interest.

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**Abstract:**

***Introduction:*** *Solid waste management has been recognized as one of the biggest challenges facing municipal authorities across the world as a result of population growth, urbanization, rising standard of living.* ***Objective****: To assess the knowledge of solid waste management among households, determine the practice of solid waste management, identify the factors militating against proper solid waste management in selected Local Government areas in Plateau state.* ***Materials and methods****: A cross sectional study of 350 households was selected using a multi-stage sampling technique. Quantitative data was collected by interview pre-tested semi-structured questionnaire and analyzed using SPSS 23. Qualitative data was obtained using an In-depth Interview guide. Chi-square was used to compare demographic and socio-demographic variables in urban and rural areas of Plateau state. A p-value of <0.05 a test of statistical significance was carried out using a post-hoc analysis (with multiple comparison Bonferoni test).* ***Result****: On household waste collection and handling, the result shows that there is significantly difference between urban than rural setting* $X^2$ *= 229.28, p<0.05. Majority of the urban household collect and handle waste by storing it on refuse bins 143 (20.4) and transported to distant dumpsites by residents 121 (17.2%). Whereas, majority of rural residence dump refuse on dumpsites around 172(25.5%), 83(11.9%) dump around house and transport to distant dumpsite 84 (12.0%), while few of the respondents store in refuse bin 11 (1.6). on number of respondents that had refuse bin, the result shows that there is significantly difference between urban than rural setting* $X^2$ *= 229.28, p<0.05. as urban residents all accepted to own a refuse bin 350 (100%), while rural residence had 91 (13.0%) who had refuse bin and majority 259 (37.0%) had no refuse bin. There are no state owned collection points.* ***Conclusion****: The study revealed poor waste management practices. The study recommends that the state government implements very comprehensive policies, sanitary inspection, infrastructure and community participation that will take into consideration municipal solid waste needs in the urban and rural areas of the state.*

**Key words:** Solid waste management, challenges, urban and rural areas, Plateau State

## Contribution to knowledge

This research will immensely benefit the environmental sanitation and protection unit of the state. The findings from this research will benefit policy makers to improve solid waste management in cities. Research have not been conducted on the issue related to the factors affecting solid waste management practice in the study areas. This study seeks to investigate the factors which affect solid waste management. This study seeks to find out differences in solid waste management between the urban and rural areas of the study area. The findings will also contribute to the body of knowledge on solid waste management by health professionals. The result of the study will help government and non-governmental organizations to organize seminars, workshop, and conferences on the importance of proper waste management and its importance to health and environments.

## Introduction:

Nigeria generates more than 32 million tons of solid waste annually, out of which 20-30% is collected. Generally, wastes generation rates vary from 0.66kg/capita/day in urban areas and 0.44kg/capita/day in rural areas in Nigeria as opposed 0.7-1.8kg/capita/day in developed countries. Bioenergy consult, (2021). Rapid economic development and related industrialization has led to increased urbanization and sizes of cities as well as changing consumption habits. The consequences of these, with increase in population size have been phenomenal increase in the amount of waste generated (Ezeah and Roberts, 2012). Prompt and proper management of these wastes is important to minimize negative environmental impact and significant risk to public health. (British Medical Bulletin, 2003). In Africa, WHO estimates that 1/3 of the burden of diseases is attributable to environmental risk factors. The study aim of this study is to assess and compare solid waste management knowledge, practices and challenges in some selected urban and rural areas of Plateau state. The average waste generation rate in Jos is 0.55- 0.58kg per person per day.(World Bank). The amount of waste generated has increased in quantity and diversity without adequate investment in collection, transport, treatment and disposal facilities (PEPSA, 2013). Collection and transportation are a major cost in the waste management process. The prevalence of parasites, tetanus, malaria, hookworm, cholera and diarrhoea in most cities in Nigeria is attributed to unsanitary health conditions WHO; UNICEF, (2004). Some of the gaps in managing solid waste such as inefficient collection of waste are varying due to poor management of waste, inadequate collection and unsuitable disposal of waste· (Agouru and Alu, 2015).Solid waste management is a very important public service which benefits public service and residents within a municipality (Ijeoma *et al.*, 2018). It is therefore very important to use proper solid waste disposal methods because public cleanliness is essential to the public health and for environmental protection (Angaye *et al.,* 2015; UNCHR, 2011). Nigeria faces many challenges in meeting the needs of the growing urban population including provision of infrastructure, employment, as well as basic services such as health care and solid waste management. Less than 50% of solid waste is collected in Nigeria and only 5% is recycled (Solomon *et al.*, 2009).

The government of plateau state has made conscious efforts to curb indiscriminate solid waste disposal. In 1976, Jos metropolitan development board (JMDB) was created to oversee urban development and city sanitation, but the board could not function properly and achieve its goal in sanitation. This led to the creation of Plateau Environmental Protection and Sanitation Agency (PEPSA) in 1991 to manage waste in the city. The desire for effective sanitation practices was still not met. Consequently, there was a declaration on the state of emergency on sanitation in 2008 whereby task force on sanitation was inaugurated to supervise the activities of PEPSA and report directly to the deputy governor. Owing to the consistent inability to manage solid waste in the area, it has become necessary to assess solid waste management practices and management. The average waste generation rate in Jos is 0.55- 0.58kg per person per day (Ogboji *et al.*, 2015).

**Materials and methods**: This study was a descriptive cross sectional design using both quantitative and qualitative data collection methods.This study was carried out in the urban and rural areas of Plateau state. Two rural Bassa and Barkin Ladi Local Government areas and two urban areas Jos South and Jos North Local Government Areas. The study used a descriptive cross sectional design. The study population consisted of individuals who were within 18 years and above age brackets and also those who have lived for more than a year and willingly participated in the study. A sample size of 700 was proportionally allocated based on the population of each Local Government Areas.

A multi-stage sampling method was employed. At stage one, plateau state was stratified into urban and rural areas. This was done using the classification by P.E.P.S.A. Next, random sampling by balloting with replacement was used to select two rural Bassa and Barkin Ladi Local Government areas and two urban areas Jos South and Jos North Local Government Areas. At stage three, each selected area was considered a cluster therefore, at each ward, a bottle was spun using the direction of the bottle neck. The bottle made a minimum of three spins before stopping. The direction of the bottle-neck was used as a starting point in a clockwise direction (WHO cluster sampling method). The central point of each cluster was used to spin the bottle. A systematic sampling technique was used to select eligible respondents/ households to participate in the study until the required sample size was obtained. If a compound had more than one household, one was selected by balloting (Adogu *et al.*, 2015).

An In Depth Interview (IDI) Guide was used to collect qualitative data from the Plateau State Environmental Protection and Sanitation Agency (PEPSA) management staff and its contractor agents, through direct questions that complemented the quantitative data obtained from the study population. Two participants from management staff, two truck drivers, two cleaners and two dump site managers were selected for the study (Ogboji *et al.*, 2015; Peter, 2016).

The study variables were place of residence i.e. rural or urban, household sociodemographic characteristics, and availability household solid disposal facilities. Survey data were analysed using statistical package for the social sciences version 23.0. Descriptive (frequencies, percentages, mean ± standard deviation) and inferential (Chi-square test) statistics were calculated and statistical significance was set at alpha level of 0.05. Due to the increased risk of a type I error following Chi-square analysis that includes explanatory variables with three or more categories, a post-hoc test to determine the source of overall significance was done using the Bonferroni adjustment of the p values.

Ethical approval was obtained from the University of Jos University Teaching Hospital ethics committee. Written informed consent was obtained from the participants.

## RESULTS

A 712 survey questionnaires were distributed and 700 were returned complete and without errors giving a response rate of 99.1%.

### 4.1.1. Socio-Demographic Characteristics

**Table 1. chi square test for demographic and socioeconomic characters and location of respondents**

| Variable | Category | Rural community *n* (%) | Urban community *n* (%) | Total *n* (%) | *P* value |
|---|---|---|---|---|---|
| **Sex** | Male | 112 (32.0) | 131 (37.4) | 243 (34.7) | 0.000 |
| | Female | 238 (68.0) | 219 (62.6) | 457 (65.3) | |
| | Total | 350 (100.0) | 350 (100.0) | 700 (100.0) | |
| **Age** | 18-30 | 39 (11.1) | 80 (12.0) | 119 (17) | 0.000 |
| | 31-40 | 73 (20.9) | 100 (29.3) | 173 (24.7) | |
| | 41-50 | 117(33.4) | 80(24.3) | 197(28.1) | |
| | 51-60 | 92 (26.3) | 70 (20.4) | 162 (23.1) | |
| | 60 and above | 29 (8.0) | 20 (14.0) | 49 (7.0) | |
| | Total | 350 (100.0) | 350 (100.0) | 700(100.0) | |
| **Ethnicity** | Christianity | 189 (54.0) | 169 (48.3) | 358 (51.1) | 0.210 |
| | Muslim | 161 (46.0) | 181 (51.7) | 342 (48.9) | |
| | Total | 350 (100.0) | 350 (100.0) | 700 (100.0) | |
| **Marital Status** | Single | 84 (24.0) | 219 (27.7) | 303 (43.3) | 0.012 |
| | Married | 236 (67.4) | 97 (62.6) | 333 (47.6) | |
| | Divorced | 30 (8.6) | 34 (9.7) | 64 (9.1) | |
| | Total | 350 (100.0) | 350 (100.0) | 700 (100.0) | |
| **Education Level** | No Formal Education | 106 (30.3) | 98 (28.0) | 204 (29.1) | 0.031 |
| | Primary | 30 (8.6) | 0 (0.0) | 30 (4.3) | |
| | Secondary | 112 (32.0) | 119 (34.0) | 231 (33) | |
| | Tertiary | 102 (29.1) | 133 (38.0) | 235 (33.6) | |
| | Total | 350 (100.0) | 350 (100.0) | 700 (100.0) | |

***Sociodemographic characteristics***

The socio demographic characteristics of the respondents are presented in Table 1. The mean ages of the urban and rural respondents were 38.7 ± 17.2 years and 43.4 ± 13.7 years respectively. The 18-30 years age group constituted the highest proportion (33.4%) among the urban respondents while the 41-50 years age group had the highest proportion among the rural respondents. There was a statistically significant difference in the ages by residence (p = 0.0001). Majority of the respondents in both the urban (34%) and rural (32%) areas had attained secondary education and above but a higher proportion in the urban compared to the rural have tertiary education (38% versus 29.1%). The difference in educational status was statistically significant (p = 0.0001).

**Table 2: Source of knowledge by location of respondents**

| Category | Rural community *n* (%) | Urban community *n* (%) | Total *n* (%) |
|---|---|---|---|
| Mass media | 31(8.9) | 183(52.3) | 214(61.2) |
| Posters and banners | 44(12.6) | 57(16.3) | 101(28.9) |
| Waste disposal agencies | 39(11.1) | 57(16.3) | 96(27.4) |
| Community meetings | 113(32.3) | 12(3.4) | 125(35.7) |
| Seminars | 33(9.4) | 39(11.1) | 72(20.5) |
| Neighbours | 90(25.7) | 2(6) | 92(31.7) |

***Knowledge of Solid Waste Management***

Table 2 shows the result of the knowledge of solid waste management in rural and urban areas. The result revealed that majority of the respondent get their information about solid waste disposal through the media 183 (52.3%) and 57 (16.3%) from seminars in the urban area. In the rural areas, 113 (32.3%) received the knowledge from community meetings and neighbours 90 (25.7%). This implies mass media and community meetings are preferable to discriminate information as regard solid waste disposal to other means in urban and rural areas respectively.

**Relationship between geographical location and household solid waste collection practices**

| Category | Rural community | Urban community |
|---|---|---|
| **Household waste collection** | | |
| Bags | 36(10.3) | 172(49.1) |
| Containers with covers | 80(22.9) | 131(37.4) |
| Waste separation before disposal | 134(38.3) | 14(4.0) |
| No waste separation | 84(24.0) | 49(14.0) |
| **Household waste handling** | | |
| Dumped around the house | 83(23.7) | 41(11.7) |
| Stored in refuse bins | 11(3.1) | 143(40.9) |
| Dumped in refuse dumpsites | 172(49.1) | 86(24.6) |
| Transported to distant dumpsites | 84(24.0) | 121(34.6) |
| **Refuse bin possession** | | |
| Yes | 91(26.0) | 350(100.0) |
| No | 259(74.0) | 0(0.0) |

| Solid waste collection and handling | Location | |
|---|---|---|
| | Rural | Urban |
| **How do you organize yourself to keep your Surrounding clean?** | | |
| Organizing groups of men in the house | 49(14.0) | 48(13.7) |
| Organizing women in the house | 122 (34.9) | 125(35.7) |
| Organizing children in the house | 134(38.3) | 128(38.6) |
| Contributing money to employ people to clean | 45(12.9) | 49(14.0) |
| **Are there refuse heaps near your house?** | | |
| Yes | 278(79.4) | 223(63.7) |
| No | 72(20.6) | 127(36.3) |
| **Are there refuse heaps on the sides of the Road / streets and behind some houses?** | | |
| Yes | 262(74.9) | 229(65.4) |
| No | 88(25.1) | 121(34.6) |
| **How have you been disposing your refuse?** | | |
| Disposing the refuse ourselves | 122(34.9) | 162(46.3) |
| Paying someone to burn the refuse | 88(25.1) | 101(28.9) |
| Being cleared by PEPSA | 31(8.9) | 9(5.4) |
| Open spaces | 109(31.1) | 68(19.4) |

***Solid waste disposal***

Table 3 shows how household waste is handle and collected, majority of the respondents in the urban areas use bags 172 (49.1%) while the rural respondents separated their waste before disposal 134 (38.3%). Majority of the respondents prefer to dump their refuse in dumpsite 172 (49.1%), followed closely to being dumped around the house 83 (23.7%) and transported to distant dumpsites by resident 84 (24.0%), in the rural areas while majority of the respondents in the urban area transport their waste to distant dumpsites 121 (34.6%) only few stored in refuse bins 97 (13.9%). The result revealed that rural households own refuse bins 91 (26.0%), while 259 (74%) do not have household refuse bin while in the urban households they all had refuse bins.

| Solid waste handling | Location | |
|---|---|---|
| | Rural | Urban |
| **How often do you empty your household waste?** | | |
| Daily | 80(22.9) | 45(13.0) |
| every two days | 120(34.3) | 169(48.3) |
| Twice a week | 97(27.7) | 91(26.0) |
| Once a week | 53(15.1) | 47(12.7) |
| **Method used to transport waste to final disposal site** | | |
| Hand carrying | 86(33.1) | 72(20.6) |
| Closed trucks | 45(12.9) | 48(13.7) |
| Open truck | 100(20.0) | 49(14.0) |
| Wheel barrow | 119(34.0) | 181(51.7) |

Table 4, Majority of the respondents in the urban and rural areas organize the children in the house to dispose their waste 134 (38%) and 128 (38.6%) respectively. Majority of the households had refuse heaps near their houses 278 (79.4%) in the rural areas and 223 (63.7%) in the urban area. Majority of the respondents in the urban and rural areas dispose their waste themselves. 109 (31.1%) of the rural households dispose their waste in open spaces while 68 (19.4%) in the urban areas. participant keep the surrounding clean by organizing women in the house had 259(37%), by organizing children or servants in the house had 250 (38.3%), by organizing groups of women in the house 122 (34.9%), while none were paid or money contributed for cleaning purposes. 45 (12.9%) in the rural area while 125 (35.7%) in the urban area organized women and 49 (14.0%) contributed money to employ people to clean in the urban area. Majority of respondents had heaps near their house in the urban and rural area 223 (63.7%) and 278 (79.4%) respectively, while 72 (20.6%) had no refuse heaps near their house in the rural area 262 (74.9%) accepted to have refuse heaps on the sides of the road/streets and behind their houses in the rural area and 229 (65.4%) in the urban area.

Table 5 shows how often household dispose waste, majority dispose waste every two days 120 (34.3%), in the rural area, 169 (48.3%) in the urban area. twice a week, 80 (22.9%) daily, while only 45 (13.0%) in the urban area while only a few dispose their refuse once a week 53 (15.1), 47 (12.7%) in the rural and urban households respectively.

| Solid waste management | Location | |
|---|---|---|
| | Rural | Urban |
| **Where do you dispose your refuse after storage?** | | |
| At the refuse heap nearby/ dump nearby | 157(44.9) | 41(11.7) |
| Behind the house | 145(41.9) | 158(45.1) |
| Environmental and Sanitation Agency | 24(6.9) | 49(514.0) |
| Solid waste management contractors | 24(6.9) | 102(29.1) |
| **What method of solid waste management** | | |
| Open dumping | 168(48.0) | 191(54.6) |
| Burying | 99(28.3) | 66(18.9) |
| Composting | 14(4.0) | 34(9.2) |
| Land filling | 69(19.7) | 59(16.9) |
| **What method of waste collection do you use?** | | |
| Bags | 172(49.1) | 56(10.3) |
| Containers with covers | 80(22.9) | 131(37.4) |
| Waste separation before disposal | 134(38.3) | 14(4.0) |
| No waste separation before disposal | 84(24.0) | 49(14.0) |
| **What method of solid waste disposal do you use?** | | |
| Composting | 168(48.0) | 34(9.7) |
| Burying | 69(19.7) | 98(38.0) |
| Hog feeding | 99(28.3) | 98(28.0) |
| Land filling | 14(4.0) | 84(24.0) |

***Solid waste management practices***

Table 6 shows that .majority of the respondents dump dispose their refuse behind their house 145 (41.9%) and 158 (45.1%) in the rural and urban areas respectively. 168 (48.0%) respondents in the rural areas practice open dumping and 168 (48.0%) practice composting method of solid waste management. 98 (38.0%) practiced burying in the urban area. 134 (38.3%) in the rural area practice waste separation before disposal, while 14 (4.0%) practice waste separation before disposal. On method used to transport waste to final disposal site, majority of the respondents use wheel barrows 119 (34.0%) in the rural area and 181 (51.7%) in the urban area and hand carrying 86 (33.1 %) in the rural areas and 72(20.6%) in the urban areas.

**Post hoc analysis (with multiple comparison Bonferroni test)**

| **Solid waste management** | **Adjusted P-values** | | **Lower boundary** | **Upper boundary** |
|---|---|---|---|---|
| Mass media | 0.0002* | 0.0002* | 8.3238 | -8.3238 |
| Posters and banner | 0.0002* | 0.0002* | -7.4523 | 7.4523 |
| Waste disposal agency | 0.0002* | 0.0002* | -14.6036 | 14.6036 |
| Community meetings | 0.0002* | 0.0002* | 4.4581 | -4.4581 |
| Seminars | 0.0002* | 0.0002* | 3.2430 | -3.2430 |
| Neighbors | 0.0431* | 0.0431* | 5.0012 | -5.0012 |

| **Waste collection and handling** | **Adjusted P-values** | | **Lower boundary** | **Upper boundary** |
|---|---|---|---|---|
| Dumped around the house | 0.0001* | 0.0001* | 2.6632 | -2.6632 |
| Stored in refuse bin | 0.0003* | 0.0003* | 6.0314 | -6.0314 |
| Dumped in refuse dumpsite around | 0.0001* | 0.0001* | -3.2771 | 3.2771 |
| Transported to distant dumpsites by residents | 0.0001* | 0.0001* | -4.6232 | 4.6232 |

| **House hold refuse bin possession** | **Adjusted P-values** | | **Lower boundary** | **Upper boundary** |
|---|---|---|---|---|
| Yes | 0.0002* | 0.0002* | - 5.3347 | 5.3347 |
| No | 0.0232* | 0.0232* | 4.1213 | -4.1213 |

*means statistically significant relationship

Post hoc analysis using benforoni multiple comparison test after Chi square show statistically significant difference between solid waste management and the various outcomes of basic waste disposal knowledge and practice (source of knowledge, solid waste collection and handling and possession of refuse bin). There is a statistically significant difference between solid waste management and all the variables of source of knowledge, solid waste collection and handling and possession of refuse bin.

## DISCUSSION

Majority of the respondents were between 31-40 years in the urban areas 29.3% while the majority of respondents in the rural areas were between ages 41-50 with 33.4%. This shows more youthful and growing population in urban communities. This is because the urban communities provide better jobs and the promise of a better life. This result corresponds with

findings of Simeon in Accra Ghana. In the urban and rural areas, females were seen to be more involved in household waste management with 62.6% in the rural and 68% in the urban areas compared to the males in urban and rural areas. This is a reflection of higher level of interest expressed by the female gender in a qualitative and quantitative study of women in household task (Malgorzata, 2003). The results on level of education, majority of respondents in the urban areas were tertiary 38% while and secondary level of education 34%. This was different from the rural areas with majority of respondents highest level of education was secondary with 32% and no formal education 30.3%. The results showed that respondents in the urban areas were more knowledgeable in waste management than those in the rural areas this may be due to the fact that majority of the respondents have tertiary education.In spite of good knowledge, the respondents having poor Practices regarding waste disposal due to lack of awareness, unavailability of public dustbins (Ambrin and Muhammad, 2018). Lack of knowledge, irregular and unplanned dumping of waste are the main reasons of improper waste disposal. Poor knowledge about waste disposal is the major Problem for human health. Waste container and dustbins are very important need for waste disposal. Due to lack of knowledge and insufficient availability of dustbins in homes people are faced many problems (Kiran *et al.,* 2018). Knowledge, attitude and practices are therefore important factors in addressing issues related to management of refuse and quality living (Adeyemi and Gboyesola, 2013).

Opinion about handling and final disposal methods seem to be guided by prevailing practices in each of the two study areas, with all respondents in rural district more disposed to proper methods. The study established a significant relationship between the knowledge of Plateau State residents including both rural and urban areas and their practice of solid waste management. The results of this study revealed that the residents generally had a low level of knowledge regarding solid waste management.

The dumping sites in urban communities had more solid waste problems than the rural communities and this was significant ($p< 0.001$). This is as a result of rapid increase in the volume of solid waste generation due to rapid urbanization and population increase. The changing consumption pattern of urban dwellers has also contributed to the massive generation of solid waste causing a lot of management problems to the urban solid waste managers (Keita and Mynepali, 2016). The method of waste collection adopted and equipment used are faced with many challenges and this is because there is no investment to initiate a modern waste collection system (Olukanni and Adeleke, 2016). The results show that in the urban areas, 49% of the respondents use bins while the rural areas 10.3% use bins. This also indicates that a higher percentage of respondents in urban communities stored solid waste by use of closed containers but this wasn't consistent with the checklist that was used by the researcher to ascertain the type and quality of storage bins used. The collection service serves all households of Jos as long as the waste is deposited in a public waste container. Taking waste from home to the container was observed to be mainly the responsibility of children.The waste containers often used are old and without handles. Households take waste to public collection containers rather than PEPSA collecting directly from households. PEPSA is solely responsible for waste collection but due to inadequate resources it is estimated that only 50% of this waste is collected and often waste is left in communities (Efe, 2013). There is little to no waste separation before disposal. However, a low percentage of respondents in rural communities stored solid waste by use of closed containers, and there is waste separation before disposal this is because the rural dwellers are mostly farmers. The Chi square test result ($p< 0.008$) shows a significant difference in solid waste storage between urban and rural communities. Uncovered waste containers frequently attract animals like dogs, goats, and sheep, as well as rodents which rummage for food in the waste piles

which are usually left at the roadside. The result of this is breeding of a mosquito which causes malaria and other diseases in both urban and rural areas.Majority of the respondents in the urban areas (48.3%) disposes wastes twice a week this is as a result of availability of underdeveloped plots of land and abandoned mining ponds. This did not correspond with the work of Aguoru on solid waste disposal and management methods in Markurdi. Among the respondents in the urban areas, 37.4% of the respondents admitted to using containers with covers to store waste. This study also explored solid waste company manager, drivers, supervisor's perspectives and experiences on solid waste management using a qualitative inquiry approach. Increased incidences of general morbidity and mortality (particularly cardiovascular and respiratory), and emergency hospital admissions, among community residents around incinerators and incinerator workers have also been documented (Ogbonna *et al*, 2002).

The findings from the research on Plateau Environmental Protection and Sanitation Agency revealed that the agency covers only parts of Jos metropolis, Bukuru, Bassa and parts of Jos east. There are presently no private contractors responsible for waste management leaving the burden for the waste management to the agency. There is also no state owned collection points abandoned mining ponds are presently used as final disposal sites. The equipment available at the time of this study are 3 roll-on/roll-off trucks, 1 compactor, 2open trucks, non-functional excavator and pure loader, diggers and shoulders. There has been no budgetary allowance since 2018 till 2021. They employ social media as means of communication for education on waste management. The agency is currently short staffed. Poor policy implementation, inadequate funding, inadequate collection points, required manpower, technical skills and competencies was discovered to be some of the factors contributing to improper solid waste management. Also, there was a significant difference in solid waste situation based on location (urban or rural), $p < 0.004$. The study reveals that there is a spatial disparity that exists between urban and rural communities with respect to solid waste situation and organization of solid waste management. While the general solid waste situation in Plateau State is bad, the urban communities receive majority of the investments made on solid waste management at the expense of the rural communities. Meanwhile, the study found that the issue of solid waste management is increasingly becoming a problem in the rural areas of Plateau State. This finding was consistent with that of (Lisah, *et al.,* 2021) on Managing urban solid waste in Ghana, this also agreed with the work of Ogboji on an assessment of plateau environmental protection and sanitation agency as a waste management institution in Jos city and also (Joseph *et al.,* 2016) on urban solid waste management and environmental sustainability in Abakiliki urban, Nigeria. It was also discovered that no private contractors are involved with solid waste management in the state leaving the responsibility on PEPSA (Plateau Environmental Protection and Sanitation Agency). The findings also revealed that PEPSA only operates within municipalities thereby leaving the rural dwellers to their fate. Not all areas enjoy effective waste collection services due to lack of adequate machinery, truck breakdowns, non-accessible roads and financial implications of cost and recovery challenges. These findings agree with that of Agunwamba et al in Onitsha where the few available trucks breakdown frequently due to overuse. There are presently no government approved dumpsites abandoned mining ponds have been adopted by the agency for waste disposal.

## CONCLUSION

This study has shown that in spite of the planned nature of Plateau state, it is still facing challenges with municipal solid waste management. Results of the study highlights varying levels of knowledge and attitudes among residents, with higher knowledge and

practices observed among residents with higher educational levels. Socio-economic variables appear to have minimal bearing on solid waste handling practices by the respondents. The proportion of residents served with proper and adequate solid waste management facilities are relatively small in the urban and rural areas.

The solid waste disposal and management practices in the urban area are still rudimentary, with open waste disposal commonly practiced. The existing solid waste management system is affected by unfavourable economic, institutional, legislative, technical and operational constraints and thus it is still poor and not fully effective. Because uniform patterns are not being applied in all parts of the state, the satellite towns are particularly affected by this improper solid waste management. Major factors militating against proper solid waste management in the study districts include lack of uniform institutional arrangement covering all areas, insufficient human, financial and material resources, absence of bylaws and standards, inappropriate technology and lack of uniform city design and layout.

Promotion of community and private sector participation is still only being developed, while skilled labour is grossly inadequate. On the whole, solid waste management practices are inadequate, inefficient and ineffective, coupled with differential solid waste management practices in all parts of the city.

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