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Assessment of the Environmental Impact and Awareness of Solid Waste Disposal in Jos Urban Area, Plateau State, Nigeria

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ABSTRACT

Rapid development and population growth have led to a surge in waste generation. Noncompliance with best practices for environmental waste disposal has led to escalating environmental impacts; however, this practice has drastic public health risks in the Jos urban area. Purposive sampling was used in selecting the study areas. Random sampling method was used in selecting 600 respondents. One hundred questionnaires were administered to each of the six settlements selected. Both descriptive and five-point Likert statistics were used to analyze the data. The results indicated that females are more engaged in environmental management than their male counterparts. There is inadequate awareness and education about waste disposal among respondents, distance to the point of disposal and inadequate disposal facilities are major factors influencing proper waste disposal. In addition, the findings indicated that respondents are knowledgeable that poor solid waste disposal creates a dirty environment thus, leads to pest infestations and spread diseases among communities. The results showed that respondents are aware that bad and offensive odors pollute the environment hence affect their health. It is recommended that communities should be educated on proper waste disposal and its health impact. Environmental monitoring by Ministries of Health and the Environment should be conducted for physicochemical analysis of underground- water which are closer to solid waste disposal sites to detect evidence of contamination. Monthly sanitation exercise should be reintroduced. Adequate containers within communities at short intervals should be provided.

Keywords: Environmental, Waste Disposal, Impact, Awareness, Pollution

1. INTRODUCTION

Solid waste has become one of the greatest threats in the world, but the situation in developing countries has become problematic (Nelson, Agbu, and Jonathan, 2013; Bassey, et al., 2024). Waste not only increasing in composition but is also changing in quantity from a few kilograms to tons (Zia and Devadas, 2008). Globally, approximately 1.3 billion tons of waste are generated annually. This amount is expected to reach 2.2 billion tons by 2025 (McDougall and Broome, 2008; Debnath, 2015; Tahulela and Ballard, 2017). Globally, solid waste management costs will increase from annual US$205.4 billion in 2016 to approximately US$375.5 billion in 2025 (Puopiel, 2010; Tahulela and Ballard, 2017; Ghosh, 2017).

Solid wastes can be defined as nonliquid and nongaseous products of human activities and are regarded as useless. It can take the forms of garbage, refuse and sludge (Jiya, Saidu, and Musa, 2016). Indiscriminate dumping of solid waste has serious consequences for the environment, particularly in relation to human health and the ecosystem (Wilson, Adebisi, Kaine and Cheeseman, 2009; Babalola, Ishaku, Busu and Rafee, 2010). The improper disposal of waste equally predisposes people to infections of various magnitudes (Sonika and Chhipa, 2013; Ogundele, Opeagbe & Abiodun, 2018). The World Health Organization (WHO) (2016) reports that approximately 5.2 million people, including 4 million children, die each year from diseases

caused by improper disposal of sewage and solid wastes. However, they further noted that urban residents who live in proximity to waste dumps sites are susceptible to respiratory infections, skin diseases, acute intestinal infections, cholera, and eye cancer. Wastes reduce the aesthetic value of the environment, hence producing odors that are injurious to human health and serving as breeding grounds for pathogenic organisms that cause sporadic outbreaks of disease (Orajekwe, 2011). A high rate of population growth and increasing per capita income have resulted in the generation of an enormous volume of waste, which poses a serious threat to environmental quality (Ojemudia and Ojigi, 2006; Hosetti, 2006; Achankeng, 2013). Changing economic trends and rapid urbanization have increased waste disposal in many communities. Continuing advancements in science and technology are contributing significantly to the increasing toxicity and volume of waste generated (Thitame, Phalke and Pondhe, 2015).

A considerable amount of domestic and industrial waste generated is dumped within the city. Such waste can generate pollutants ranging from metals to organic materials. Some of these wastes are disposed of through sewer systems. These disposal methods threaten human health, safety, and the environment and impose additional indirect costs on society (Nkala, 2012; Tahulela and Ballard, 2017). Nevertheless, most industrial, commercial, and household waste is now being placed in landfills or surface impoundments. Many of the small premises do not have access to any disposal system other than allowing waste to soak into the ground. Industrial contaminants can also reach local aquifers via interaction with surface water or directly through infiltration (Palczynski, 2013). When waste is burned, hazardous gases are released into the air, and toxic residues are left in the form of ash (Fahzy, 2014). These hazardous waste byproducts find way into humans and animals in one form or another (Abila and Kantola, 2013).

According to Sthiannopkao and Wong (2013), developing countries are facing problems with the management of solid waste because of ineffective policy implementation, poor waste awareness, insufficient facilities, poor public participation, lack of technology and commitment to waste minimization. A study performed in Hanoi, Vietnam, indicated that individuals are ignorant or lack understanding of waste management. This study showed that illegal dumping is a norm in the Hanoi community (Nkala, 2012; Nguyen, Zhu and Le, 2015).

The environment plays an immense role in maintaining and supporting the health of all people (United Nations Environment Programme (UNEP), 2014). Consequently, the environment continues to suffer, and the planet is facing serious and complex environmental issues such as environmental pollution, depletion of natural resources, population overload, and many others (UNEP, 2014). According to Aydin (2013), awareness is the condition of being aware and able to understand what is happening around one environment. In agreement with the above views, Bandara (2008) equates awareness with the perception of being conscious of acquaintance with something. In the context of this study, awareness implies understanding and knowledge of activities and events such as land pollution occurring around one's environment.

One of the greatest challenges facing most urban centers in Nigeria today is how to cope with the increasing volume of waste generated daily by the populace (Ahmed and Ali, 2011; Mshelia, 2015). Nigeria generates 25 million tons of municipal solid waste annually, and the waste generation rates range from 0.66 kg/cap/d in urban areas to 0.44 kg/cap/d in rural areas. Ahmed and Ali (2011) noted that this number is expected to double by 2040 (Bassey et al., 2024). This is manifested by large refuse heaps, which are seen in streets and carriageways defacing the landscape of the environment (Gukop, 2012). The 1998 Koko waste episode in Nigeria opened up behind-the-scene deals on hazardous wastes involving many African countries (Sangodoyin, and Ipadeola, 2000).

Overall population growth and increasing urbanization in Jos have led to rapid growth in the city, which has been overwhelmed by the sudden increase in waste disposal demand. The supply of waste disposal infrastructure lags far behind that of other infrastructure, hence affecting human

health and the ecosystem. Garbage and solid waste pose serious threats to human health and the environment in Jos due to the hazards faced by the households living in town.

Refuse from domestic work, commercial areas and agricultural waste products littered on streets and residential areas can result in health problems such as malaria and cholera (Bandara, 2008; Achankeng, 2013). An obvious way to reduce the problem of environmentally induced diseases is to manage waste properly. In Jos, generating solid waste is at an alarming rate such that in most cases, the volume of waste generated is often greater than what the city system can absorb or handle. Projected volumes of solid waste generated in Jos city in tone per year in 1982; 9,871, 1985; 11,905, 1990; 135,272, 2000; 197,990 and (Federal Ministry of Environment, 2000). However, Alubo, Isma'il, and Arigbede (2023) revealed that a projected figure of 221 tons of waste is generated per day in Jos metropolis with a projected increase to 299 tons by 2032, reflecting a 35.29%.

The municipal solid waste situation continues to worsen thereby posing serious threats to public health and environment. However, the problem in Jos can be counted as follows: problems caused by the urbanization process with irregular and unplanned urban growth is generating more wastes, the Jos' master plans lacked sustainable solid waste management strategies for implementation in line with best global practices. These had hampered the effective solid waste management within the city.

With this background, this study seeks to assess the environmental impact of solid waste disposal in Jos metropolis. This goal was achieved through the demographic and socioeconomic characteristics of the respondents, the factors contributing to poor solid waste disposal, the waste disposal method and the respondents' perceptions of the environmental impact of poor solid waste disposal.

2. MATERIALS AND METHODS

Jos lies within latitudes 9º 36' N and 9º 62' N of the equator and between Longitudes 8º 41'E and 8º 59' E of the Greenwich Meridian. Jos is situated 1,300 meters above sea level in Nigeria's Middle Belt (Vivian, Adesikuteb, Danjuma and Abdulrahman, 2015; Wuyep, 2018). Jos city is the administrative capital of the Plateau State in Nigeria see Figure 1. The metropolis has a population of 1,101,300 people and covers an area of 249,9 km² (NPC, 2022). The climate is influenced by the height above sea level and spatial position across the seasonal migration belt of the Intertropical Discontinuity (ITD) region (Wuyep and Rampedi, 2018; Wuyep, and Akinseye, 2020). The study area has a wet-and-dry tropical rainy (AW) climate, as classified by Koppen (1923). Jos is characterized by a mean annual rainfall of 1,260 mm and a peak between July and August, while the mean annual temperature is approximately 22°C (Alfred, 2012). Six settlements were purposively selected from both Jos south (Bukuru town, Gyel, Dadin Kowa) and Jos North (Bauchi Ring Road, Millionaires quarters, Tudun Wada). These settlements were selected to have a spatial coverage of the city and the waste generation of these areas. A random sampling method was used to administer questionnaires to 600 respondents who are engaged in waste management. One hundred questionnaires were administered to each of the settlements. Both descriptive and five-point Likert scale statistics were used to analyze the data.

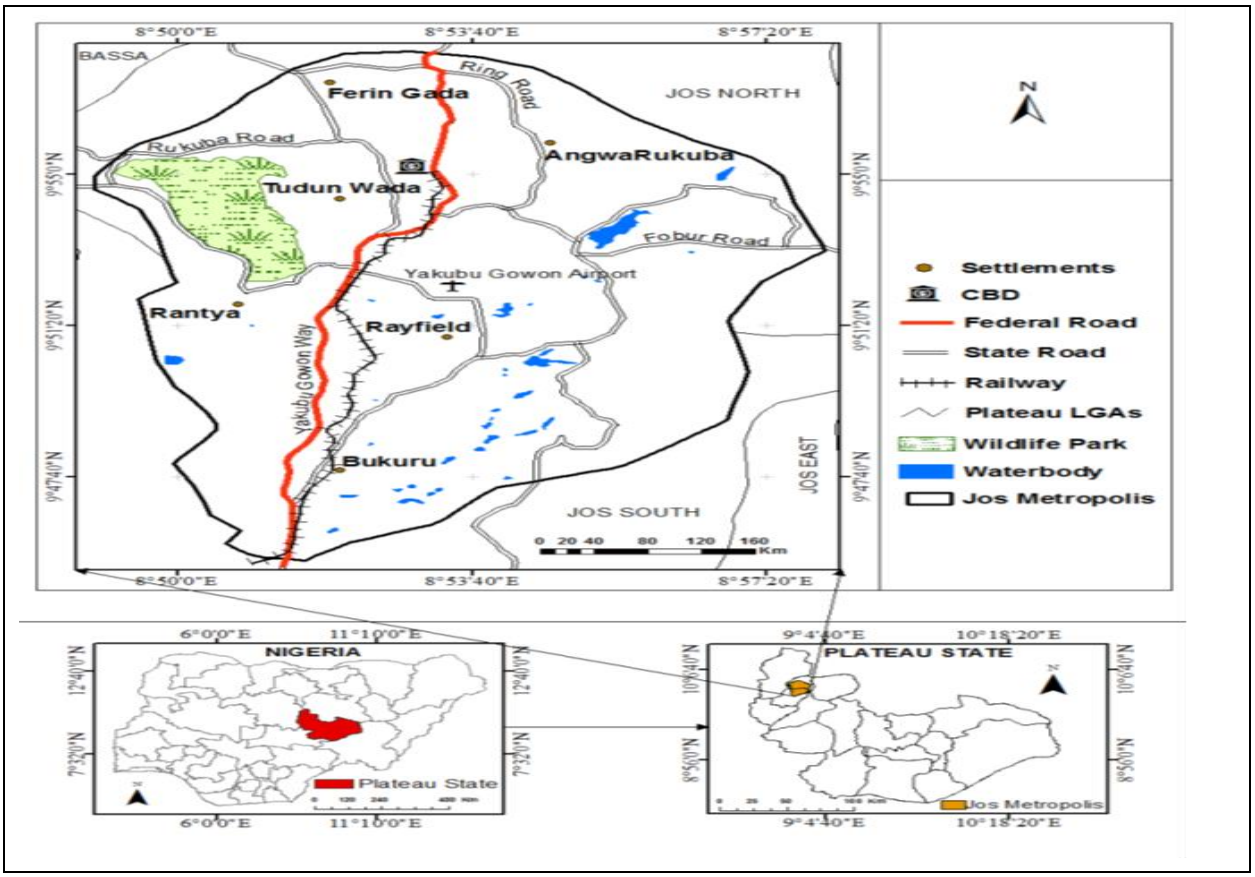

Figure 1: Nigeria map showing Jos urban area.

3. RESULTS AND DISCUSSION

The results in Table 1 show the demographic and socioeconomic characteristics of the respondents. Approximately 52% of the respondents were female, while approximately 48% were male. This shows that females are the dominant group in terms of handling waste in the environment. Females are closer to the environment and engage in environmental management by cleaning the environment, especially in terms of garbage disposal (Wuyep, Vincent, Arin, Daloeng and Baminda, 2014; Tadesse and Hadgu, 2009; Kiboigo, 2024). Twenty-one percent of the respondents were aged between 20 and 30 years, 43% were aged 31 and 40 years, 18% were aged 41 and 50 years, and 18% were aged 51 and 60 years. This shows that most of the age groups engaged in waste disposal in the study area are adults aged 31-40 years. Age plays a vital role in environmental issues, as maturity might affect the level of awareness of environmental health and waste management. Similarly, 14% of the respondents were single, 82% were married, and approximately 4% were divorced. A high proportion (82%) of respondents indicated that they were responsible for waste management and disposal. Additionally, approximately 15% of the respondents had no formal education, approximately 39% had secondary education, and 46% had tertiary education. This indicates that most of the respondents are educated and thus may be aware of the environmental impact of waste disposal. Longe, Longe and Ukpebor (2009) suggested that education level helps influence how much exposure, knowledge and perception a respondent has of waste generation and management in society. These findings are consistent with the work of Tadesse and Hadgu (2009), who noted that educated people contribute more significantly to bringing about a gap between the environment and development.

Table 1: Demographic and socioeconomic characteristics of the respondents

Gender	Component	Frequency	Percentage
	Female	311	51.8
	Male	289	48.2
Age	20-30	127	21.2
	31-40	258	43
	41-50	108	18
	51-60	107	17.8
Marital status	Single	85	14.2
	Married	492	82
	Divorced	23	3.8
Level of Education	No formal education	88	14.7
	Secondary education	14.7	39
	Tertiary education	278	46.3

As shown in Table 2, 50% of the respondents strongly agreed that there was inadequate awareness and education regarding waste disposal. Conversely, 98% strongly agreed that distance to disposal sites is a factor hindering waste disposal. Similarly, all the respondents strongly agreed that inadequate waste disposal facilities are factors contributing to poor solid waste disposal. Kabiru (2017) suggested that the distance to disposal sites is one of the major challenges faced by respondents in Kano city. He further noted that proper health education and sensitization within the community can improve individuals' level of knowledge of proper solid waste management. Knowledge of the nature of wastes is important for the waste management process. This approach can help waste managers deal with different types of waste in appropriate ways and reduce the potential negative impacts of waste handling and handlers (Nadi, Mahmud, Shariff and Ahmad, 2009, Shamshiry, Nadi, Bin Mokhtar, Komoo, Saadiah and Yahaya, 2011).

Table 2: Demographic and socioeconomic characteristics of the respondents

Components	Strongly agree (%)	Agree (%)	Neutral (%)	Strongly disagree (%)	Disagree (%)
Inadequate awareness and education regarding waste disposal	300 (50)	264 (44)	0 (0)	24 (4)	12 (2)
Distance to disposal site	588 (98)	12 (2)	0 (0)	0 (0)	0 (0)
Inadequate waste disposal facilities	600 (100)	0 (0)	0 (0)	0 (0)	0 (0)

Figure 2 shows the waste disposal methods used in the Jos urban area. Approximately 36% of the respondents dispose of their waste by roadside (Figure 3, A), approximately 4% dispose of it through burning/incineration within the compound, 56% dispose of it waste at nearby bushes (Figure 3, B), and 5% dispose of their waste at public dumpsites. Conversely, neither was involved in recycling the waste, and no waste collector collected the waste for disposal. This shows that most of the respondents dispose of their waste indiscriminately within the environment. However, indiscriminate disposal of solid wastes can affect the environment and public health directly or indirectly. The health impacts of poor solid waste disposal depend on the type of exposure, nature of the waste, and proximity of the disposal site to human settlements (Kabiru, 2017). These findings are consistent with the work of Aliyu (2008), Muktar (2011), and Pate (2012), who noted that solid waste disposal in many Nigerian cities is responsible for many environmental and health problems in cities such as Kano, Lagos, Abakaliki and Onitsha. Inappropriate garbage disposal of solid waste leads to toxic pollutants, groundwater

contamination and surface water pollution; odor emission; and breeding places for rodents and insects such as flies and mosquitoes (Kabiru (2017; Ofodeme, Elendu, Nnodim, Tokung and Mashi, 2022; Abir, Datta, and Saha, 2023). Aliyu (2008) reported that poor solid waste disposal is responsible for the transmission of diseases, especially to neighborhoods around solid waste dump sites. Aydin (2013) revealed that the impact of natural and human activities on solid waste disposal sites has a significant effect on water quality. According to the report of Sujauddin, Huda, and Hoque (2008), significant findings on the impact of solid waste dumpsite at Dandora on environmental pollution and impact on public health have been reported because the findings show traces of high levels of heavy metals and other contaminants.

The WHO (2018) reported that indiscriminate waste dumping could negatively affect environmental esthetics. Uncollected waste pollutes surrounding air, constituting a health risk and contaminating ground water, especially where the use of well water for drinking is common. Buried hazardous domestic wastes can filter down through the soil and contaminate groundwater. Hazardous liquids on the ground can poison soil and plants (EPA, 2004).

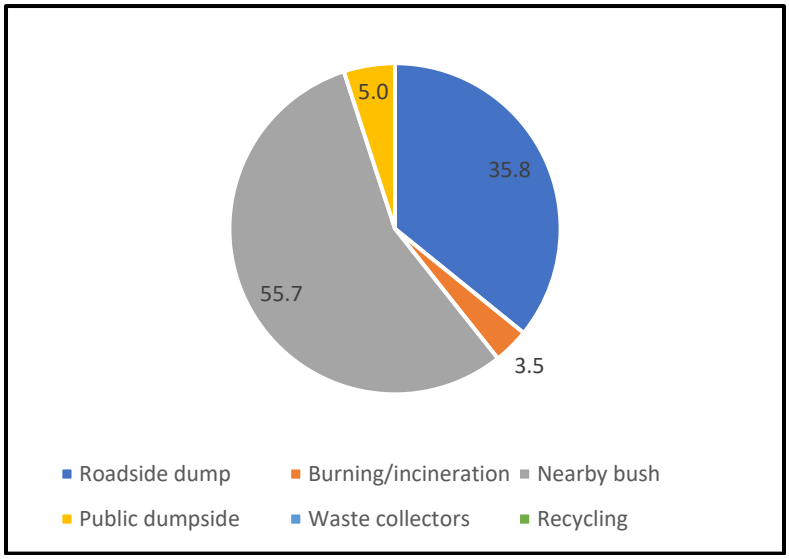

Figure 2: Waste disposal methods

From the analysis in Table 3, all (100%) respondents strongly agreed that poor solid waste disposal is related to diseases transmission, 98% strongly agreed that bad/offensive odors emanate from solid waste, hence polluting the environment, 99% strongly agreed that solid waste creates a dirty environment, and 80% of the respondents strongly agreed that poor solid waste disposal is responsible for pest infestations in the area. This indicates that respondents in the study area are knowledgeable about the impact of poor solid waste disposal on the environment and its health implications. These findings are consistent with Longe, Longe, and Ukpebor (2009) and Ogundele, Opeagbe and Abiodun (2018), who reported that respondents are aware of the effects of poor solid waste disposal related to disease transmission, such as malaria, cholera and diarrhea. This finding is in line with the results of Rhule (2008) on resident perceptions of poor solid waste disposal practices in the Sokoto metropolis in Nigeria. He highlighted that many residents who dispose of solid waste indiscriminately have a poor understanding of its implications. To overcome the solid waste crisis, individuals' conscience needs to be improved through environmental awareness and education on waste management (Aliyu, 2015).

Figure 3: Waste by roadside (A), and nearby bush (B).

Table 3: Perceptions of Respondents on the Environmental Impact of Poor Solid Waste Disposal

Component	Strongly agree (%)	Agree (%)	Neutral (%)	Strongly disagree (%)	Disagree (%)
Poor solid waste disposal is related to disease transmission	600 (100)	0 (0)	0 (0)	0 (0)	0 (0)
Bad/offensive odor	588 (98)	12 (2)	0 (0)	0 (0)	0 (0)
Dirty environment	594 (99)	6 (1)	0 (0)	0 (0)	0 (0)
Poor solid waste disposal is responsible for pest infestations	480 (80)	60 (10)	18 (3)	42 (7)	0 (0)

4. CONCLUSION

This study assessed the environmental impact and awareness of waste disposal in Jos Metropolis, Plateau State. The study revealed that females are more engaged in environmental management than males are. Inadequate awareness and education about waste disposal are noted among respondents despite their level of education. However, the distance to the point of disposal and inadequate disposal facilities are major factors limiting proper waste disposal in the study area. In addition, the findings indicate that respondents are knowledgeable that poor solid waste disposal creates a dirty environment, leads to pest infestations and spreads diseases among communities. Nevertheless, respondents are aware that bad and offensive odors pollute the environment and hence affect their health.

5. RECOMMENDATIONS

Arising Based on the findings of this study, it is recommended that the government and relevant stakeholders review and strengthen solid waste management policy to ensure the indiscriminate disposal of solid waste. Vigorous community mobilization of health education messages to community members should be planned and implemented regularly using media sources such as television and radio to increase awareness of the impact of poor solid waste disposal. Seminars should be organized by governmental and nongovernmental organizations for residents of the study area, as this would help them change their attitudes and behaviors toward proper waste management. In addition, regular environmental monitoring by the Ministry of Health and Environment should be used for physicochemical analysis of underground water closer to solid waste disposal sites to detect evidence of contamination. Consequently, monthly sanitation exercise should be reintroduced to curtail environmental contamination and indiscriminate the dumping of waste. Thus, strengthening waste collection and disposal infrastructure, promoting waste segregation, and providing adequate containers within communities can promote regular waste disposal and reduce the distance to disposal sites. Overall, authorities should promote recycling initiatives, encouraging both the government and the private sector to boost recycling, which would reduce waste in the community.

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