Environmental Literacy and Solid Waste Management in the Jos Metropolis, Nigeria

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ABSTRACT

The need to understand environmental systems, connections, patterns and root causes and evolve practicable solutions to environmental degradation has brought to the fore the relevance of environmental education and literacy in environmental management. Yet, the systematic study of the level of environmental education and literacy among urban dwellers in Nigeria is minimal. This study, therefore, examines the use of environmental education and literacy for solid waste management in Jos, Nigeria. Using a stratified random sampling technique, a sample of 1200 respondents was drawn from the three local government areas that formed the Jos Metropolis for questionnaire survey. Survey questionnaire elicited information on socio-economic and demographic characteristics of respondents, the level of awareness, knowledge, understanding, attitude and skills in solid waste management practices and factors responsible for such practices. Percentages, mean and mode were used to summarize the data. Results revealed a yawning gap between environmental knowledge and practice as over 70.0% of respondents claimed awareness of the environment but only 65.9% claimed to be knowledgeable about the environment while only 30.0% had translated the awareness, knowledge and skills into concrete solid waste management practices. Furthermore, variations in the applications of the environmental education in solid waste management across the three LGAs were observed. It is, therefore, important that future environmental education focuses on translating knowledge into action in order to achieve the goal of environmental sustainability.

Keywords: Environmental education and literacy, Environmental literacy ladder, Solid waste, Environmental management, Environmental sustainability.

1. INTRODUCTION

For several centuries, the environment has provided habitation for humans and numerous organisms but the insatiable needs of humans have driven humans to devise different means for survival and adaptation. Several of these survival strategies, notwithstanding the opportunities and benefits that they offer, especially technology, have had direct and indirect negative consequences on the environment and have resulted in the degradation of the environment (Arora, Fatima, Mishra, Verma, Mishra & Mishra, 2018). Many of today's environmental problems are increasingly the result of individual actions, personal consumer decisions and the activities of small and large businesses all of which contribute to make the health of the world's economy and that of its people to be inextricably bound to the health of the environment (Awan, 2013). This implies that now, more than ever before, there is a greater need to understand systems, connections, patterns and root causes of environmental degradation. A very strong tool for understanding the 21st century environmental problems which are becoming almost intractable is environmental education.

Environmental Education (EE) is a process that leads to responsible individual and group action (Hungerford, 2005; Akintunde, 2017). More often than not, EE should enhance critical thinking, problem solving, and effective decision-making skills and should engage, enable and motivate individuals to weigh various sides of an environmental issue so as to make informed and responsible decisions (US EPA, 1992). A classic and highly regarded definition of sound

environmental education comes from Hines, Hungerford, and Tomera (1987). They maintain that environmental education provides a working knowledge of environmental issues; specific knowledge of approaches to address those issues; the ability to make appropriate decisions and possession of certain affective qualities (attitudes) that make people care about pay more attention to become literate about and develop a mastery of environmental conditions within their communities. In essence, the goal of environmental education is environmental literacy.

The concept of Environmental Literacy (EL) has been evolving (to advance a better understanding of EE) since it was developed in 1969 (Roth, 1992). Environmental Literacy is thus not only the ability to read and write about the environment but also an intimate connection with and a mastery of the environment that influences actions and affects conscious and subconscious behaviours (Hodgen, 2010). Environmental Literacy can, therefore, be defined as the ability to possess knowledge about the environment and issues related to it; capable of, and inclined to enhance self-directed environmental learning and/or action (WEEF, 2011). Similarly, Environmental Literacy could be perceived as the knowledge of environmental concepts and issues; the attitudinal dispositions, motivation, cognitive abilities, and skills, and the confidence and appropriate behaviours to apply such knowledge in order to make effective decisions in a range of environmental contexts. Individuals demonstrating degrees of environmental literacy are willing to act on goals that improve the well-being of other individuals, societies, and the global environment and are able to participate in civic life (Hollweg *et al*., 2011; Hogden, 2012).

The 1978 Tbilisi Declaration suggests that environmental education programmes do not only build knowledge but also facilitates positive behaviour, attitudes and skills which people need to address environmental problems. Sometimes, environmental education provides the knowledge and skills to take action immediately, with programmes building behavioural changes which directly enhance educational intervention. Environmental education programmes aim to instil a stewardship ethic and promote learning, caring, and skills that will lead to future pro-environmental behaviours. This longer-term perspective of environmental education aims at creating a citizenry that is prepared to deal with a variety of environmental issues they will face not just at the moment but also in the future (Ardoin, Heimlich, Braus & Merrick, 2013). Coyle (2005) asserted that even among the most literate and influential members of society, surveys show a persistent pattern of environmental ignorance. He stated further that the society is moving past the time when we can rely on a cadre of environmental experts to fix the myriads of societal environmental problems. With most environmental issues becoming more complex and difficult to manage, and with the preponderance of pollution shifting toward problems caused by irresponsible environmental behaviours of individuals and small entities (such as in their homes, workplaces, and communities), a stronger and wider public understanding of environmental science and related issues is a growing necessity. Thus, the usage of Environmental Education and Environmental Literacy in addressing environmental problems, particularly solid waste management, could prove to be a grand breakthrough in the management of solid waste.

Solid waste can be defined as garbage, refuse and other discarded materials including waste resulting from industrial, commercial and agricultural operations and from community activities, or waste that are normally solid, discarded as useless or unwanted (Tchobangolus, 1983; Abur et al., 2014). The solid content is technically known as refuse while the liquid substances are called effluent (Ahmed, 2002). According to Environmental Protection Department Air Management Group, EPDA (2001), waste involves categories of household, municipal, commercial and industrial wastes, some hazardous and toxic and each category generates its own colony of wastes. For example, commercial stores, hotels, restaurants and markets generate paper, cardboard, plastics, wood, food wastes, glass, metals and special wastes (Tchobanoglous *et al*., 1993; Abur et al., 2014). These items are regarded as waste because no-one appear to have a use for them. Improper solid waste management and its impact on human health remain issues

of great concern in developing countries (Adeboye, Lateef, Hammed, Akintunde, 2023). Waste is not just a serious problem; it is also a growing problem as exemplified by economic development and rising living standards, industrial diversification and the provision of expanded health-care facilities which have added substantial quantities of industrial hazardous waste and healthcare or biomedical waste into the waste stream with severe environmental and human health consequences.

Accordingly, there are two fundamental classes of waste, namely, general waste (municipal waste) and hazardous waste (health care risk waste and certain industrial waste) (Muzenda, 2014). Unfortunately, these two classes have been most prevalent in Africa, particularly in Nigeria, as observed by the 2009 UN Report (p.2) which reported that:

> *poor waste management practices, especially, widespread dumping of waste in water bodies and uncontrolled dump sites is very common; waste management infrastructure is largely non-existent in rural areas of Africa; the gap between waste management policy and legislation and actual waste management practices is widening owing to perennial capacity constraints and lack of waste management facilities for various waste streams; the fast growing use of ICT and rapid turn-over in technology (particularly computers and mobile phones) is creating a growing e-waste stream, for which there is no waste management capacity yet and; changing lifestyles and rising consumption patterns of the growing urban middle class, in particular, is increasing the composition and complexity of waste streams in Africa (UN, 2009, P. 2).*

This 2009 report typifies the situation in most capital cities of Nigeria as witnessed in Jos, the Plateau State capital Unfortunately and as observed by Agbola and Mabawonku (1996), while most nations of the world seek innovative ways to solve their enduring and contemporary environmental problems, Nigeria seems to be overwhelmed by the sheer magnitude of her environmental problems, the most noticeable being the abysmal lack of sanitation, general unkemptness of the urban environment and irresponsible environmental behaviour and waste disposal practices manifesting in heaps of uncleared refuse on the streetscapes, open spaces and storm water infrastructure.

Fortunately, however, general waste does (and should) not pose a significant threat to public health or the environment if properly managed (Muzenda, 2014), rather it carries with it socio-economic and environmental benefits and it is for this reason that EL and EE have become indispensable. For example, sustainable waste management practices (borne out of EE and EL) include the 3R concept (Reduce, Recycle and Reuse), as echoed by Dijkema *et al*. (2000), that a substance is a waste only when it is experienced as or labeled as a waste. Waste, therefore, is a subjective concept, or rather a qualification of a particular substance or object, which does not vanish after disposal. This qualification, however, may change since what is considered a waste today can be a resource in the future. The waste of one plant can be the feedstock of another; MSW can be converted into liquid and gaseous biofuels for production of heat and power or be used as a transport fuel. This new paradigm encourages society to put the highest value on source reduction and extended producer responsibility through a waste conversion process that recovers materials and energy from wastes (either directly or via production of biofuels) and /or the production of compost (Rogoff, 2013). Rapidly growing population, rapid economic growth, and rise in community living standards have accelerated the generation rate of municipal solid wastes thereby causing its management to be a major worldwide challenge (Al-Khatib *et al*., 2010; El Bilali & Ben 2020) especially in the absence of a responsible behaviour. Current global MSW

generation levels are approximately 1.3 billion tonnes per year, and are expected to increase to approximately 2.2 billion tonnes per year by 2025 (Sharma & Jain, 2020).. This represents a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per person per day in the next fifteen years. In sub-Saharan Africa, waste generation is approximately 62 million tonnes per year (World Bank, 2017).

This is why McConney and McConney (1995) asserted that heightened public awareness has not prepared society to deal with the complexity and scope of environmental problems as there is, as yet, limited action toward sustainable environmental solutions in the form of "responsible environmental behaviour" (Dunlap, 1989; Hungerford and Volk, 1990; Zoller, 1990; Rosenbaum, 1991; Finger, 1993, 1994; McConney and McConney, 1995). Furthermore, the literature (Hungerford & Volk, 1990; Hines *et al*., 1986-87; Coyle, 2005; and Volk and McBeth, 2010) indicate that gaps exist in many areas of research in environmental literacy and sustainable waste management and these include research and or studies in environmental education that (i) lead to environmental literacy and studies of environmental knowledge that translates into behavioural change; (ii) cover very large samples of a specific population while incorporating broad sets of environmental literacy components such as those of sustainable waste management; (iii) propose universal linear path to various environmental behaviour, as well as a unified theoretical framework of environmental literacy and environmental behaviour; (iv) evaluate the influence of socio demographic characteristics in pro environmental behaviour.

There is, thus, a need for environmental education that aids understanding of the appropriate variables such as awareness, knowledge, attitude, skills, and participation, reduce, reuse, and recycle, and the link amongst them. Without a better understanding of these factors and the relationships among them, particularly the ones that influence environmental behaviour, it may be difficult to have an adequate knowledge base for the development of effective environmental education (McConey, 1995). Similarly, according to Agbola (1993), cultural derivatives, beliefs, perceptions and attitudes are learned response sets. They can be modified or changed through education. This points to the fact that people's unconcerned attitudes towards solid waste can be changed for the better through education. This then is the rationale for the study on which this paper is based. The objective of this paper is to examine and analyse the pattern of Environmental Literacy (EL) and usage of Environmental Education (EE) in the management of solid waste in Jos, Nigeria.

The paper is divided into four main parts. The first section introduces and provides a background to the study. The second section provides the context for the paper after which the data collections processes are discussed in the methodology. The third section presents the research results and discussions while the fourth section presents some recommendations and conclusion. The study was carried out in Jos, the capital of Jos Plateau State in Nigeria (Fig.1). Plateau State is located in Nigeria's North Central with an area of about 26,899 square kilometres and a 2022 projected population of 4,717,300 people (Brinkhoff T. (2024). It is located between latitude 8^0 and 10^0N, longitude $10^0$and 15^0 east. Jos, the capital is located between 9°56′N and 8°53′E and is divided into three local government areas (LGAs) namely Jos North, Jos South and Jos East (Fig.1), for ease of administration. For contextual clarity, the topography, geology and administrative structure of the three LGAs are similar while the climate shows some differences between Jos North and South LGAs, with Jos south having lower temperatures during harmattan. It is, however, necessary to highlight some significant differences amongst the three LGAs that will aid the understanding of the methodology and research results.

Jos North covers a total land area of about 291km^2, lies between longitude $8^0$32' to $9^0$24' E and latitude $8^0$22N to $10^0$24'N (Fig. 1). The LGA has 14 wards and these are: Abba na Shehu, Ali Kazaure, Gangare, Garba Daho, Ibrahim Katsina, Jenta Adamu, Jenta Apata, Jos Jarawa, Naraguta 'A', Naraguta 'B', Sarkin Arab, Tafawa Balewa, Tudun wada-Kabong, Vanderpuye.

Jos North L.G.A has a projected population of 576,273 in 2016. Jos South LGA, on the other hand, has an area of 510 km² and a projected population of 410,430 in 2016. The LGA is inhabited by the Berom who form the main inhabitants of the town. Other ethnic groups are the Hausa, Magavwul, Ta'rok, Ngas and host of other groups who are mostly settlers. The major religions are Christianity and Islam. It houses the Governor's office in Rayfield and can thus be described as the de facto capital of plateau state. Its headquarters is in the town of Bukuru. Jos East LGA of Plateau State, is located between 9°55′N 9°06′E, it has an area of 1,020 km² and a projected population of 116,385 in 2016 (INEC, 2015; National Population Commission, 2013).

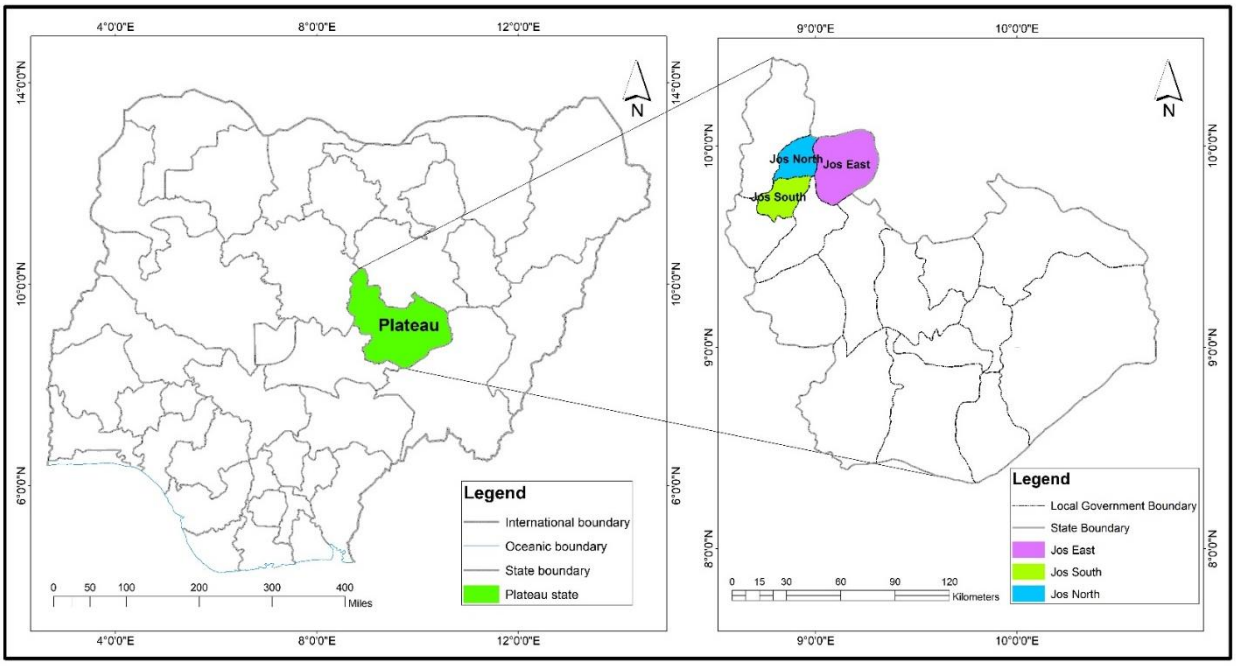

Figure 1: Plateau State in Nigeria; Jos North, Jos South and Jos East in Plateau State.

Source: Geographic Information Science Lab; University of Jos, 2020

2. MATERIALS AND METHODS

The data used for this study were obtained from secondary and primary sources. The secondary data sources included publications relevant to the study such as text books, published information in bulletins, manual reports, journals, thesis, dissertations, technical reports, seminar and conference papers, credible publications from the internet and ward maps of the study locations. The 2006 population data was obtained from the National Bureau of Statistics (NBS) and used to estimate population distribution of the LGAs for sample selection, while data on the population aged 18 years and above was obtained from the National Population Commission (NPC) and the Independent National Electoral Commission (INEC). Data on environmental literacy were also extracted from published and unpublished documents, particularly from the National Environmental Education & Training Foundation (NEETF). Data on solid waste management practices were obtained from the Plateau State Environmental Protection Agency (PEPSA), the Plateau State Waste Management Board, Local Government Ministry of Environmental Health, Ministry of Environment and the National Bureau of Statistics (NBS) in order to evaluate the content of EL in solid waste management practices and factors responsible for such practices.

The research design adopted in collecting primary data for this study was the survey method. The outcome of the survey provided information on socio-economic and demographic

characteristics of respondents, the content of EL in solid waste management practices and factors responsible for such practices. The questionnaire contained sections that addressed the five stages of environmental literacy; (awareness, knowledge, understanding, attitude and skills) as well as sections on solid waste generation, disposal and management within the milieu of reduce, reuse and recycle.

In order to identify the environmental education programmes undertaken in the LGAs, a key informant interview of directors and administrators of government-owned environmental and waste management agencies was conducted. These included: Plateau State Environmental Protection Agency (PEPSA); National Environmental Standards and Enforcement Agency (NESREA); Jos North Department of Environmental Health and Sanitation; Jos South Department of Environmental Health and Sanitation; Jos East Department of Environmental Health and Sanitation; Ministry of Environment; Jos Metropolitan Development Board (JMDB) and; Ministry of Land, Survey and Town Planning

A multistage sampling technique was adopted for data collection in the study. Firstly, Senatorial districts in the state capital were purposively selected. This was followed by the selection of the Local Government Areas within the senatorial districts and then the wards as evident in Table 1. Out of the three senatorial districts in Plateau State, one senatorial district was selected. This was because majority of the wards in these Local Government Areas were located within the state capital where waste management problems were most pervasive. This is the Senatorial District C (Plateau North) made up of 6 LGAs. Three (3) of the 6 LGAs in the district were selected on the basis of their location in the state capital and the pervasiveness of waste management problems in these areas. In addition, these Local Government Areas have a representation of the entire population of the state capital (NPC, 2006).

Probability sampling was employed for the selection of participants. This included stratified random sampling and the simple random sampling techniques. The stratified random sampling was adopted to consider important populations of this study such as students of tertiary institutions, residents in high, middle and low income earning environments. The simple random sampling helped ensure that each element of the population had an equal probability of selection and each combination of elements had an equal probability of selection. This was done with the aid of the table of random numbers to select households and individuals from the various wards in the Local Government Areas.

Only one household was interviewed in each house and one person not below the age of eighteen (18) years. In order to determine the appropriate sample size for this study, a scientific method of determining sample size was employed. The following formula by Miller and Bewer (2003) was used to select the sample size for the study:

Sample size: $n = \frac{N}{1+N(\propto)^2}$ ....(1)

Where n: Required sample size

N: given population size

$\propto$: Level of significance or margin error (5%)

A minimum of two hundred and fifty (250) respondents were drawn each from the high density areas, One hundred (100) respondents from the medium density areas and fifty (50) respondents from the low density areas. Sample drawn from Jos north was 420 respondents, Jos South, 413 and Jos East, 412 bringing it to a total of 1230 respondents for the three LGAs.

Table 1: Sample Distribution

HIGH DENSITY		MEDIUM DENSITY		LOW DENSITY		Total
		JOS NORTH				
Old Lamigo road	*25*	Fudawa	*30*	Race course	*12*	
Angwan Rogo	*20*	Farin Gada	*30*	Unijos Snr, Staff Qtr.	*13*	
Angwan Rimi	*20*	Naraguta/Babale	*20*	Government Quarters	*10*	
Gangare	*20*	Perm Site Qtrs	*12*	Student Hostel	*10*	
Nassarawa/Tina	*22*	Ibrahim Katsina	*11*	Liberty Boulevard	*10*	
Jenta Adamu	*20*					
Jenta Apata	*20*					
Jos Jarawa	*20*					
Angwan Rukuba	*45*					
Rikkos	*20*					
Sogele/Gadan bako	*20*					
Total	***252***	**Total**	**113**	**Total**	**55**	***420***
		JOS SOUTH				
Rukuba Road	*40*	Zarmanganda	*20*	Rayfield	*15*	
Gyel	*20*	Rantya	*22*	Gold and Base	*15*	
Tudun Wada - Kabong	*55*	Zawan	*20*	Maiadiko	*13*	
Abbatoir/Giring	*30*	Sabon Bariki	*20*	Chams	*13*	
Bukuru	*60*	Behind Grand cereals mills	*20*			
Dadin Kowa	*30*					
Du	*20*					
Total	***255***	**Total**	**102**	**Total**	**56**	***413***
		JOS EAST				
Federe	*30*	Lamingo	*55*	Gwafan Lamingo	*15*	
Angwari	*65*	Fobur 'A (opp dam)	*30*	Shere (seminary)	*20*	
Maijuju	*35*	Shere A	*20*	Fobur B (Haske qtrs.)	*17*	
Fursum	*30*					
Jarawan Kogi	*35*					
Mai Gemu	*30*					
Zandi	*30*					
Total	***255***	**Total**	***105***	**Total**	***52***	***412***

Source; INEC (2015) & National Population Commission (2013)

3. RESULTS AND DISCUSSION

If we take EL (Environmentally Literacy) as the condition of understanding and being knowledgeable on and about the environment, then it would mean that an environmentally literate person is someone who, both individually and together with others, makes informed decisions concerning the environment; is willing to act on these decisions to improve the well-being of other individuals, societies, and the global environment and would participate in civic life. Research results from this study show that those who are environmentally literate with respect to waste management display the knowledge and understanding of a wide range of waste concepts, problems, and issues; have a set of cognitive and affective dispositions; possess a set of cognitive skills and abilities; and have the appropriate behavioural strategies to apply such knowledge and understanding in order to make sound and effective decisions in a range of waste management contexts.

3.1. Respondents' Perception about Literacy Levels of Respondents

The study investigated whether or not the respondents were sufficiently literate on the issues of solid waste management. While 57.0% of the respondents claimed to be sufficiently literate, 43.0% were not. Some of the reasons given for the perceived levels of literacy of the 57.0% respondents include disposal of waste in appropriate and authorised site; some homes and areas within the communities were clean, while others were dirty; community members readily turned

out for environmental sanitation exercises when required; individuals did not dump waste indiscriminately or just anywhere; members promptly responded to government announcement and sensitization jingles on the need for responsible waste management behaviour among the citizens; every morning people cleaned the surroundings of their houses before going out; every last Saturday of every month respondents engaged in general sanitation as required by government; it was rare to see dirt around the environment; and individuals were involved in sweeping the road side in front of their houses. The converse was the reasons adduced by the 43.0% who claimed not to be sufficiently literate on SWM issues. Some respondents alluded that indications for bad behaviour for environmental illiteracy would have been curtailed if waste management facilities were provided and sufficient literacy programmes carried out by both the government and stakeholders in solid waste management; especially since some claimed they were unconscious about how and where they dispose solid waste.

3.2 Teaching of and Learning about Environmental Education and Environmental Literacy

If the cleanliness of the community is perceived to be significantly dependent on environmental education and environmental literacy as deduced in 3.1, this study then sought to know at what stage it would be beneficial to start the teaching and or learning about environmental issues and especially solid waste management.

Findings revealed that environmental literacy and environmental education were important at all levels of education. Respondents were of the opinion that the most appropriate stage to be taught waste and environmental management is at the nursery school (41%), followed by primary (35.8%), secondary (4.1%), tertiary (1.2%), and at all levels (17.5%), while 0.3% opted for non-formal and adult class (Figure 2). The School environmental program primarily designed to meet students' need can impact on environmental knowledge, attitude and behaviour of adults which include: parents, teachers and local community members through the process of intergenerational influence (Marchini and Macdonald, 2020). Findings agreed with the assertions of Adeboye, Lateef, Hammed, & Akintunde, (2023) that the school system represents an important outlet for waste generation and advancement of knowledge on waste management.

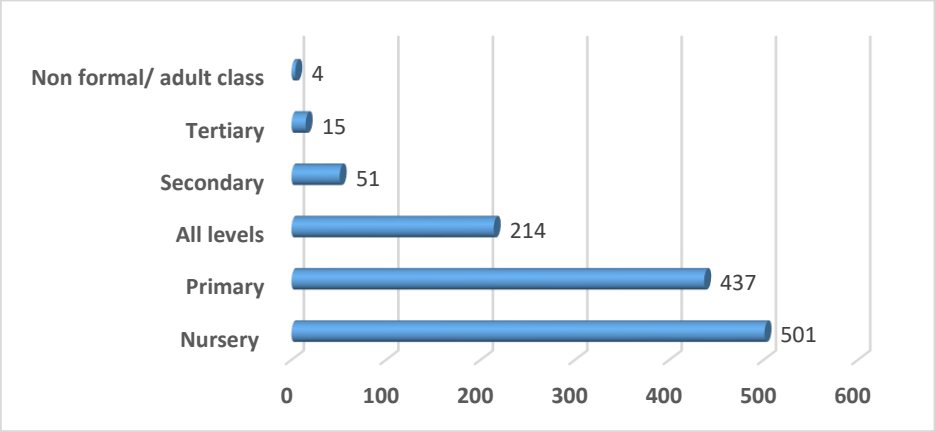

Figure 2: Level of Education most Appropriate to be Taught Waste and Environmental Management

When Environmental Education (EE) is attained from an early stage, there is a great probability that the child will grow with such knowledge (Akintunde, & Akintunde, 2023). Some 17.5% respondents were, however, of the opinion that environmental education and literacy should not be limited to any stage and should be engaged in at all the stages of education. For example, while research attention has been focussed on parents' ability to shape the behaviour of their children (Lopez, 2004; O'Connor and Scott, 2007; National Academies of Sciences, Engineering, and Medicine, 2016) far less attention has been paid to the ways that this more

traditional dynamic can be turned around with children shaping the behaviour of their parents. When EE is taught from an early stage, there is a great probability that the pupil will grow with such knowledge acknowledged 76.8% respondents. Several reasons given for why EE should be taught at an early age or in nursery school focus on the children's ability to learn fast, easily and grow with such knowledge, learn cleanliness early and if he/she gets married later in life, will extend it to their offspring, retain lots of information in their memory because at that level, they are very impressionable, learn by observing and practicing what others do and contribute to waste management since they contribute to its generation.

As to a particular time that a child should be taught, however, many respondents stated that the best time was immediately a child starts speaking. Other reasons given include the difficulty of training a mature person and that many of them were products of such waste management lessons learnt as children. Those who stated that the primary school was more appropriate gave the following reasons: at the nursery school, children may not comprehend enough despite repeated emphasis whereas at the primary school level, children are wise enough to comprehend what is being taught and are able to learn and do many things at this stage of development. At this level, the brain is still receptive, in the formative process and wards can be disciplined properly. Since they also contribute to waste accumulation, they are able to easily pick their waste as schools insist. Some 38.0% respondents claimed that they taught their children at that age and it had been effective for them while 22.0% claimed it was in the primary school they were taught and it helped them. Some 12.0% respondents felt that EE should be taught at the secondary level because, at that stage: individuals are mature enough to know what is right and what is wrong; the child is able to think and reason on his own; it is a stage of freedom to take decisions; there is a better comprehension than earlier levels and; some 7.0% claimed it was in the secondary school they were taught and they still carry on with the lessons till date.

Respondents opined that EE should be taught at all levels because: maintaining a clean environment was everyone's responsibility; everyone was prone to health risks; learning is a continuous process and thus should not be limited to a particular age or stage and a frequent reminder was the only way to keep people informed about the dangers of negative waste management practices. It is also expedient that teaching at all levels is encouraged for the purpose of emphasis for those who already had such knowledge and to fill in the knowledge gap for those who did not.

3.3 Constructing the Solid Waste Literacy Ladder

The paper went further to interrogate respondents as to what they thought should be taught or be the general contents of such education and literacy knowledge. The result is presented in Figure 3 which outlines five essential components of environmental literacy. It is designed to be a loose hierarchy from the simple to the more complex, each building on the step below. However, as with many models, the steps overlap in real life because waste management literacy cannot be achieved without all the steps of the ladder as achieving any one step alone is inadequate and may not result in literacy.

The Solid waste literacy ladder, figure 3, indicates a high level of awareness as 74.2% of the respondents had general awareness of solid waste management. Awareness is easily obtained since it is largely generated from information. In tandem with previous studies, some had gained this awareness from their immediate families, communities, through the print and electronic media schools and market centres (Agbola, Olurin, & Mabawonku, 1998; Akintunde, Wahab, & Agbola, 2019). Findings thus show that there was a relatively high and acceptable level of solid waste awareness among the respondents.

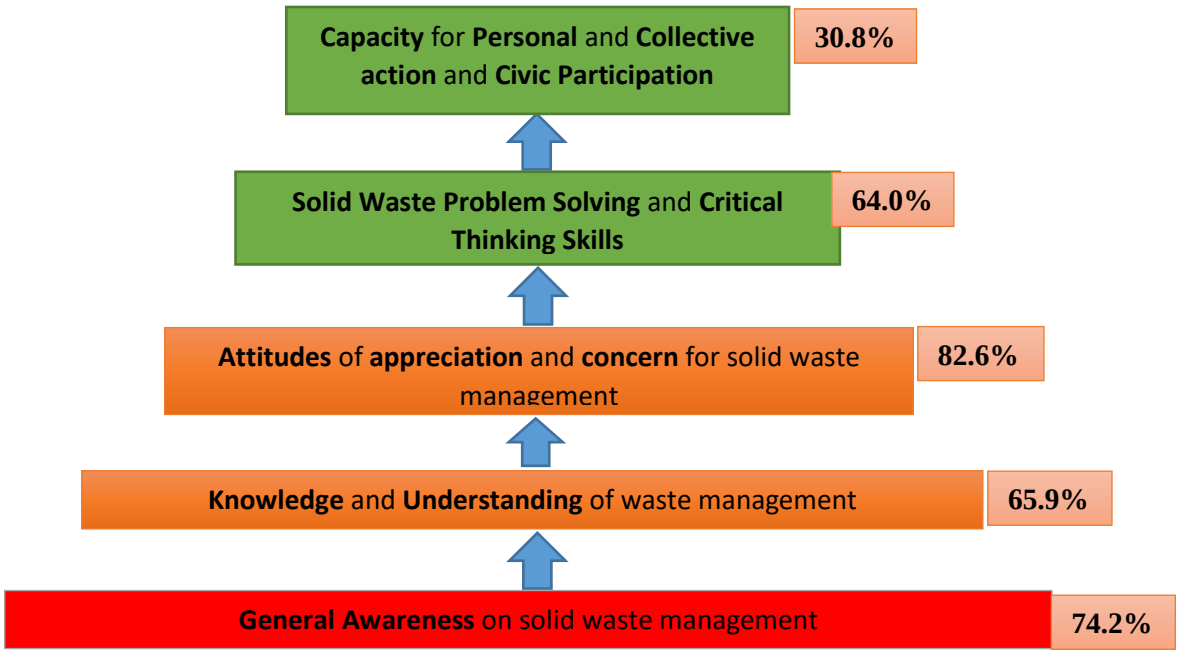

Figure 3: Solid Waste Literacy Ladder

Knowledge goes beyond awareness. Some respondents were aware but did not possess: the knowledge and understanding of waste management (25.8%); knowledgeable about reduction of solid waste from point of generation; and awareness of the management practices associated with each waste types (19.5%). The level of knowledge slightly dropped below that of awareness from 74.2% to 65.9%. Findings align with Coyle (2005) who affirmed that a higher level of environmental knowledge correlates significantly with a higher degree of pro-environment behaviour. But increased knowledge, by itself, has real limitations. Increased environmental knowledge works best for simple, easy information and behaviours (Coyle, 2005)

The next level on the literacy ladder is the attitude of appreciation and concern for solid waste management. This level deals with the belief, opinion, feeling or thinking, either conscious or unconscious, towards solid waste management. Findings showed that majority of the respondents, 82.6%, had positive attitude and disposition towards solid waste management. However, the positive disposition did not translate to possession of skills or having an ability to initiate individual and collective actions.

Environmental Education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution (Stapp *et al*., 1969; Stern 2005). On the penultimate stair of the ladder, solid waste problem solving and critical thinking skills, the results showed that 64.0% of the respondents possessed skills to critically think and solve problems of solid waste. However, when it came to actual individual and community actions and taking pragmatic steps in solving solid waste problems, only about 30.8% translated their skills to actions, a wide contrast to the 74.2% who demonstrated awareness of solid waste management. This aligns with the NEETF/Roper (2005) survey which established that environmental awareness by itself has limited lasting effect on environmental stewardship attitudes (although it can reinforce existing sentiments) and by itself has little effect on environmentally-friendly behaviour. Results showed that there was no linear path to measuring environmental literacy as one step of the ladder did not determine if an individual progressed to the next level of the literacy ladder.

Only 30.8% of the respondents could be considered to be environmentally literate when measured in relation to the assertion of Hollweg *et al*. (2011) that environmental literacy is knowledge of environmental concepts and issues; the attitudinal dispositions, motivation,

cognitive abilities, and skills, and the confidence and appropriate behaviours to apply such knowledge in order to make effective decisions in a range of environmental contexts. These individuals demonstrated degrees of environmental literacy and were willing to act on goals that improved the well-being of other individuals, their societies and were able to participate in civic life as prescribed by Hollweg *et al*. (2011). The findings thus show that a citizen can be adjudged environmentally literate and educated when he/she has gone through a sequenced series of learning steps that results in a thorough understanding of the subject and its dynamics, including developing skills and learning how to apply them in a real world setting. This aligns with the assertions of Schneider (1997) that the objective for an environmentally literate society is not the unattainable goal of detailed knowledge of content rather, the values an individual holds and the action he or she takes is an outward display of understanding these core concepts.

3.4: Variations and Interrelationships in Literacy Levels across Jos North, Jos South and Jos East LGAs

The extent to which solid waste has been managed effectively is dependent on the society at large and likely to vary across the three local governments. This paper examined the spatial variation and interrelationships in environmental literacy measures; capacity for pro waste management actions, possession of skills for MSWM, awareness level, knowledge levels, dumping practices, sustainability assessment of SWM practices amongst residents of Jos North, Jos South, Jos East LGAs. Knowledge levels across the three LGAs were similar, with those with high knowledge much more than those with little knowledge on municipal solid waste management. Jos South and Jos East recorded the highest knowledge levels at 68.6% and 68.7% respectively, while Jos North recorded the least at 60.4% (Fig. 4). However, it should be noted that possession of high knowledge does not necessarily translate into pro-waste management actions (Akintunde, 2017). Coyle (2005) added that low-levels of knowledge about the environment are a signal that members of the public will be unprepared for increasing environmental responsibilities in the coming years. Jos South had the highest awareness level out of the three LGAs (Fig. 5) and, thus, responsible for the relatively lower level in indiscriminate dumping and disposal and the high possession of capacity to initiate pro-waste management actions. Waste management awareness level was also high in Jos east with 78.3% having a high level of awareness and Jos north recorded the least level of awareness, 66.0%.

Indiscriminate dumping is any disposal of solid waste in an undesignated or unapproved location. This practice was common in the three local government areas in varying degrees. Jos East predominated the other two LGAs in indiscriminate dumping 86.1%, while Jos South had 71.4% the least record of indiscriminate waste disposal among the three LGAs (Fig.6).

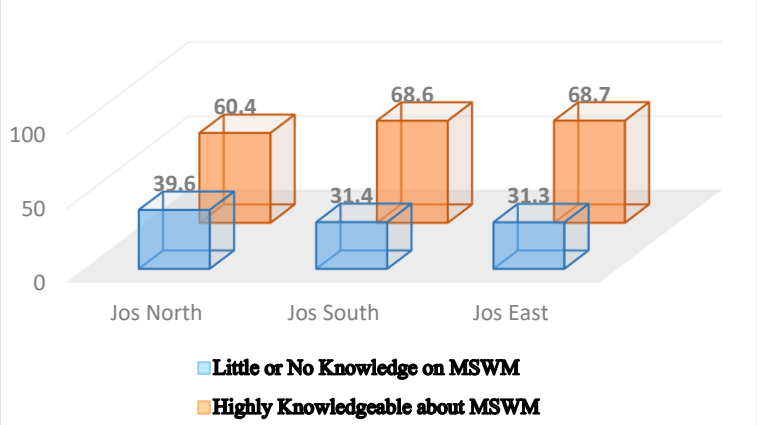

Figure 4: Knowledge Levels across LGAs

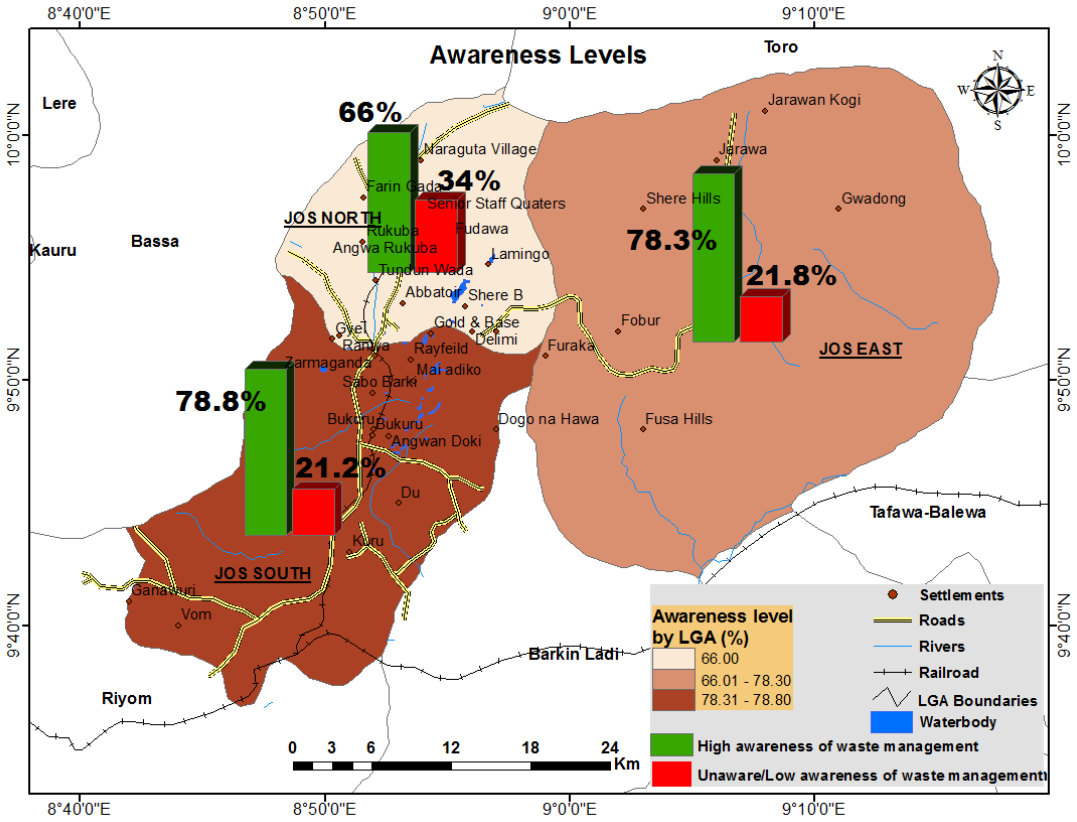

Figure 5: Awareness Levels

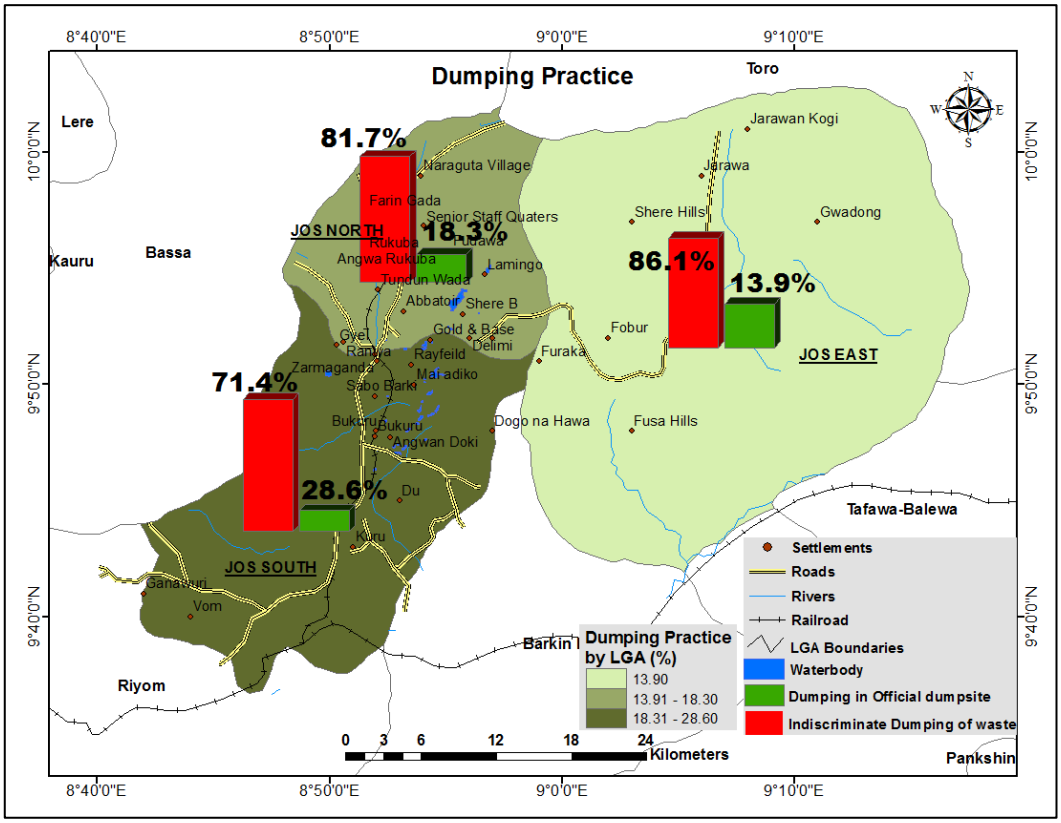

Figure 6: Waste Dumping Practice

4. CONCLUSION

EE and EL are potent tools for sound and sustainable environmental management. Findings from this study showed that environmental literacy education is important at all levels of human growth and development. However, for progressive growth in knowledge, the most appropriate stage to be taught solid waste and environmental management should be at the nursery school, followed by primary, secondary and tertiary.

The solid waste literacy ladder indicated a high level of awareness of MSWM as over 70% of respondents were generally aware. Knowledge goes beyond awareness. Knowledge is familiarity and understanding, a clearer awareness of information. The level of knowledge in the literacy scale slightly dropped below that of awareness to 65.9%. Being high up on the literacy ladder can lead to more sustainable waste management practices. The more the level of environmental literacy, the more sustainable the solid waste management practised. There were variations in the usage of EE in the management of solid waste between the three LGAs in the knowledge, attitude, skill and action towards municipal solid waste management.

5. RECOMMENDATIONS

Arising from the findings of the study, the following recommendations are suggested. Government at all levels should initiate and enforce solid waste management education and instructions in schools at all levels with more attention given to attitudes, skills and actions to enable individuals translate their knowledge to positive action. Adequate number of health workers should be enlisted and sufficiently equipped in facilitating environmental literacy since they have easy and direct access to members of the community on most occasions especially the women and expecting mothers. Governments at all levels should also introduce out of school involvement of young people and adults in practical solid waste management and environmental conservation activities. The mass media, social media and local/indigenous communication practitioners should be adequately mobilised and encouraged to promote varieties of awareness and education programmes on solid waste management education for members of the public in the local languages.

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