

Impact of Environmental Education on Solid Waste Management in Karu Metropolis, Nasarawa State, Nigeria

Oruonye ED^{1*}, Menwo Ukechi Osigwe¹, Ahmed YM¹ and Joy Etumonu²

¹*Department of Geography, Taraba State University Jalingo, Nigeria*

²*National Open University of Nigeria, Nigeria*

***Corresponding Author:** Oruonye ED, Department of Geography, Taraba State University Jalingo, Nigeria.

Received: September 04, 2019; **Published:** October 31, 2019

Abstract

Waste management is one of the major challenges of every developed and developing cities of the world. The management of solid waste has become increasingly a difficult task locally and globally with increase in population and high consumption pattern among urban dwellers in Nigeria. The adverse impact of waste on the human health and the environment cannot be overemphasized. Thus, this study examined the impact of environmental education solid waste management in Karu Metropolis. Four research questions were structured to guide the study. In collecting the data, the study employed questionnaire as its instrument. The sample of the study constituted two hundred residents from four wards of the Local Government Area (LGA). Simple percentage was used to analyze the data collected from the respondent. Major findings revealed that there is high level of influence of environmental education on the attitude of the inhabitants; there is moderate level of understanding on collection, disposal and management of waste in the study area. The study therefore recommended that the government should put more effort in sensitizing, funding, enforcing laws and monitoring the collection, disposal and management of solid waste in the study area.

Keywords: *Developing Cities; Environmental Education; Human Activities; Karu Metropolis; Waste Generation; Waste management*

Introduction

Population growth, increasing urbanization and industrialization and rising standards of living have all contributed to an increase in both the amount and variety of wastes generated in most countries. The management of waste is one of the major problems encountered in many countries especially developing ones like Nigeria [1]. Wastes are inevitable consequences of human activities. They include all unwanted and economically unusable materials that result from human activities discarded purposefully or accidentally into the environment [2].

Waste can be solid, or semi-solid, liquid, gaseous or radioactive (e-waste). They are produced everywhere and at any time in homes, offices, schools, market, commercial centers and industries. They can result to disastrous consequences of serious health and environmental damages if left unchecked. Majority of household and veterinary practice waste is considered "solid waste" regardless of whether the waste is actually solid in physical form [3]. The U.S Environmental Protection Agency (2015) defines solid waste as any garbage or refuse, sludge from a waste water treatment plant, water supply treatment plant or air pollution control facility and other discarded materials including solid, liquid, semi solid or contain gaseous materials resulting from industrial, commercial, mining, agricultural operations and from community activities. Waste management is generally seen as the collection, transfer, storage, separation, recovery, recycling

and final disposal of waste materials usually produced by human activities in an effort to reduce their effect on health or local aesthetic and environmental damages. Obeka [4] defines waste management as the collection, transport, processing, recycling, or disposal and monitoring of waste materials for sustainable development. He went further to say that the waste management usually relates to materials produced by human activities and process generally undertaken to reduce their effects on health, environment and aesthetics.

The management of solid waste has become increasingly a difficult task locally and globally with increase in population and high consumption pattern among urban dwellers in Nigeria. In most urban cities, solid wastes are thrown away indiscriminately in any available space without care of the negative impacts it has on the environment. This poses serious threat to human health and environment. Improper management of solid waste defaces the environment, spreads disease and contaminates surface and underground water, air and land quality.

The social status of people plays important role in determining the type of solid waste generated in the area from time to time. For instance, the residents in quarters which are dominated by upper class/elites and middle class resident are quite different from cluster areas, because of the difference in terms of income, education, type of food and storage of food. The settlement of the area also determines effective waste management. A well planned town or estate must have planned proper waste management of the area which helps in efficient and effective sanitation of such area.

Karu metropolis is one of the populated area council in Nasarawa State and the town is among the satellite towns adjoining the Federal Capital Territory (FCT). The indiscriminate dumping of waste and nonchalant attitude often exhibited by residents of the area prompted this study. Despite the fact that the people are aware of dangers of indiscriminate dumping of waste, they still go ahead and dump waste anywhere they chose to do so, without any conscious effort to removing them. Thus, endangering the health of the general public and polluting the environment as well. The general purpose of this study is to assess the impact of environmental education on solid waste in Karu metropolis in Nasarawa State, Nigeria. The specific objectives of the study include: an assessment of the impact of environmental education on peoples' attitudes towards solid waste collection, disposal and management in the study area.

Materials and Methods

Description of study area

The Karu Urban Area is an urban area in North Central part of Nigeria. The urban area is located in Nasarawa State of Nigerian. Karu Local Government Area of Nasarawa State is located between latitude 8°05'N to 10°42'N and longitude 7°54'E to 9°25'E of the Greenwich Meridian (Figure 1). It has some parts of it stretching into the boundaries of the Federal Capital Territory (FCT). It has an area of 40,000 hectares (400 km²) and an estimated population of about 2 million. It is one of the fastest growing urban_areas in the Nigeria, with a growth rate of 40 percent recorded annually. It consists of towns that developed as a result of urban_sprawl from Abuja.

The area has an estimated population of 10,000 in 1991 and is believed to have grown rapidly to an estimated population of 50,000 and 130,000 by 2001 and 2010 respectively; due to continuous migration of people from other parts of the country to this area. Its current population is estimated at 205,477 [5]. From west to east, the urban area includes towns like Kurunduma, New Nyanya, Mararaba, New Karu, Ado, Masaka and newer, fast-growing towns such as One Man Village (which contains over 1 million people) and Gidan Zakara. Since the beginning of the 20th century, these districts have grown together into a large urban area and a major commercial centre of central Nigeria.

Karu is cosmopolitan in nature with various ethnic groups living together in harmony. The major indigenous ethnic groups in the area are Gbagyi, Koro, Yeskwa, Gwandara and Gade. There are many settlers comprising of Mada, Eggon, Hausa-Fulani, Igbo, Tiv, Yoruba who migrated to take advantage of the economic potentials in the area [5].

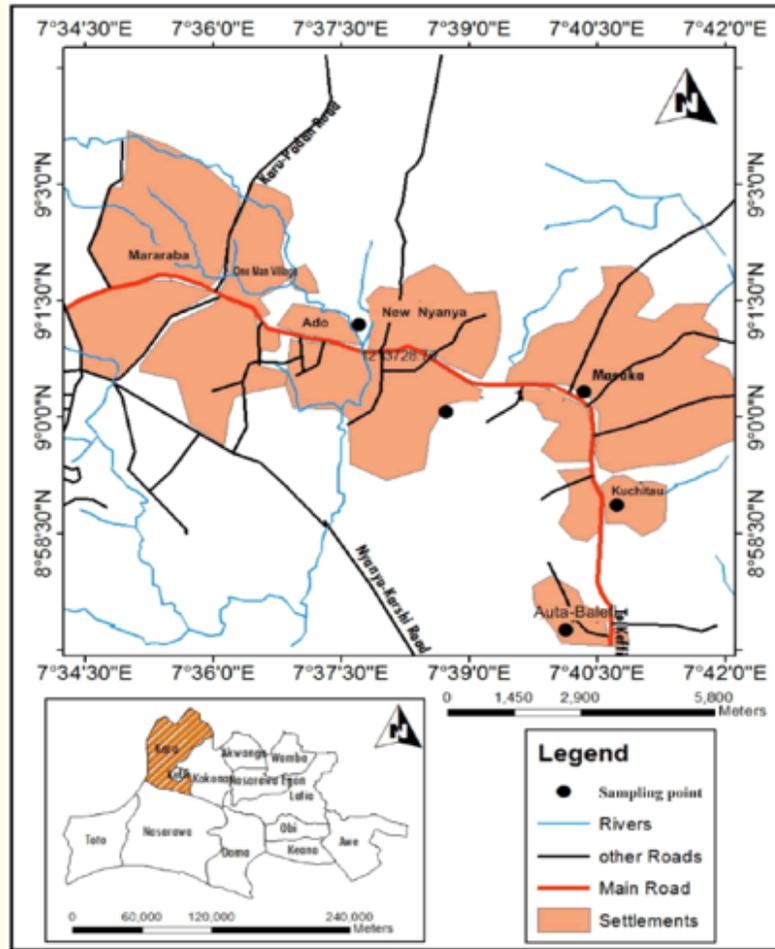


Figure 1: Map of Karu showing the area of study.
 Source: Muhammad., et al, 2015 [5].

Research design

The study adopted a descriptive survey design method. The instrument used in this study is the questionnaire. The questionnaire was drawn in two parts, (section A and B). Section A dealt with demographic data while Section “B” constitutes structural and unstructured opinion questions to elicit information from the respondents with regards to the research questions. The mode of response adopted in research was Yes or No format. The items in the questionnaire were drawn in relation to the research questions formulated for this study. Before using the instrument, the items developed were given to the another scholar for content validation. Corrections were made as suggested and the validated instrument was used for the study. Questionnaires were administered personally on the respondents. The sample of the study constituted of 200 residents drawn from 5 towns. A proportional sampling techniques was used to select the sample of the study. A total of 200 questionnaires were administered and all was collected. The population of the study comprised of 300 residents from 5 towns, 60 persons per town, the sampled wards are;

- a) New Nyanya
- b) Mararaba

- c) New Karu
- d) Ado
- e) Masaka

The data collected was analyzed using descriptive statistics such as tables, frequencies and percentages.

The respondents were purposively selected based on evidence of poor waste disposal as shown by proximity to waste dumpsites that are indiscriminately disposed and poorly managed.

Result of the Findings

The results of the demographic characteristics of the respondents are presented in. The table shows that 55.5% of the respondents were males, while 44.5% of the respondents were females. The table also shows that 7.5% of the respondents were under the age range of 15 - 20years, 57% of the respondents are between the ages of 21 - 25 years, 17% between 26 - 30 years and 18.0% were 31 years and above. The study findings also reveal that 58% of the respondents are married while 42% are singles.

Gender		
Gender	Frequency	Percentage (%)
Male	111	55.5
Female	89	45.5
Total	200	100
Age		
15 - 20yrs	15	7.5
21 - 25yrs	114	57.5
26 - 30yrs	34	17.0
31yrs and above	37	18.0
Total	200	100
Marital Status		
Married	84	42.0
Single	116	58.0
Divorcee	00	00
Widow	00	00
Total	200	100

Table 1: Demographic characteristics of respondents.

Source: Fieldwork, 2019.

Demographic Characteristics of Respondents

Influence of environment education on the attitude of people towards waste management

The result of the findings in table 2 indicates that 92% of the respondents agreed that environmental education makes people to dispose their wastes at the designated points while 8% disagreed. On whether environmental education inculcates positive attitude, skills, values and concern towards the environment, 95% of the respondent agreed to this, while 5% of the respondents disagree. Also, 82% of the respondents agreed to the fact that environmental education predisposes citizens to participate actively in the segregation, reduction, recycling and composting of waste, while 18% of the respondents disagreed. On whether, environmental education helps to reduce the rate of improper waste management, 95% of the respondents agreed, while 5% of the respondents disagreed. Also, 92% of the

respondents agreed that environmental education decreases the spread of diseases in the environment while 8% disagreed. The findings of study show that 81% of the respondents agreed that environmental education enhances policy implementation while 19% disagreed.

S/N	Items	Responses					
		Yes	%	No	%	Total	Total
1	Environmental education makes people to dispose their wastes at makes the designated points.	184	92	16	8	200	100
2	Environmental education inculcates positive attitude, skills, values and concern towards the environment.	190	95	10	5	200	100
3	Environmental education predisposes citizens to participate actively in the segregation, reduce, reuse, recycling and composting	164	82	36	18	200	100
4	Environmental education helps to decrease the rate of improper waste management	190	95	10	5	200	100
5	Environment education decreases the spread of disease in the environment	184	92	16	8	200	100
6	Environmental education enhances policy implementation	162	81	38	19	200	100

Table 2: Influence of environment education on the attitude of people towards waste management.

Source: Field Survey, 2019.

Method of wastes collection, disposal and management

The findings of the study as presented in table 3, indicates that 64% of the respondents agreed that the adopts simple emptying method as a technique of waste collection, disposal and management, while 36% disagreed on the use of this technique. Also, 50% of the respondents agreed to use of exchange method in waste collection while 50% disagreed on use of this method. The study also shows that 64% adopts curbside collection of waste, disposal and management method, while 36% of the respondents disagreed on the use of this method. The study also shows that 59% of the respondents agreed to use of special collection method while 41% disagreed to the use of the technique. The table also indicates that 62% of the respondents agreed to the use of landfill disposal process while, 38% disagreed. On the use of incineration method, 63% of the respondents agreed to use of this method, while 37% of the respondents disagreed. Also, 53% of the respondents agreed to the use of pyrolysis method of waste management while 47% disagreed. 64% of the respondents also agreed to the use of 3Rs technique of waste management, while 29% disagreed.

S/N	Items	Responses					
		Yes	%	No	%	Total	Total
	Methods of Waste Collection						
1	Simple emptying	128	64	72	36	200	100
2	Exchange method	100	5	100	50	200	100
3	Curbside collection	128	64	72	36	200	100
4	Special collection	118	59	82	41	200	100
5	Land filling	124	62	76	38	200	100
6	Incineration	126	63	74	37	200	100
7	Pyrolysis	106	53	94	47	200	100
8	3Rs technique (reduce, reuse & recycle)	142	71	58	29	200	100

Table 3: Methods of waste collection, disposal and management.

Source: Field Survey, 2019.

Attitude of residents towards wastes collection, disposal and management

The results in table 4, indicates that 76% of respondents packages their waste in bag/container while 24% do not do so. In terms of disposing their wastes at designated points, 70% of the respondents agreed to doing this, while 30% do not. Also, 51% of the respondents agreed that they burn their wastes in an incinerator; while 49% claimed they do not burn their waste. The study findings revealed that 54% of the respondents admit that they throw their waste into rivers, culvert and uncompleted buildings, while 46% of the respondents disagree to this. The table also indicated that 65% of the households agreed that they participate in waste disposal while 35% did not participate in the process. The result also shows that 52% of the respondents agreed that the household’s waste disposal is sponsored by some individuals/institution/organizations while 48% disagreed. 51% of the respondents agreed that household’s sort their wastes while 49% of the respondents claimed otherwise. The findings reveal that 66% of the respondents agreed to contribute/start sorting their wastes while 34% are not willing to engage in sorting their wastes.

S/N	Items	Responses					
		Yes	%	No	%	Total	Total
	Attitude of Resident						
1	I package all my household wastes in bag/container	152	76	48	24	200	100
2	I dispose my wastes at designated points.	140	70	60	30	200	100
3	I burn my waste in an incinerator	102	51	98	49	200	100
4	I throw my wastes into rivers, culverts, uncompleted buildings	108	54	92	46	200	100
5	My household participate in waste disposal	130	65	70	35	200	100
6	Someone is currently paying for your waste disposal system via containers public/private	104	52	96	48	200	100
7	My household sort garbage e.g. scrap metals, plastics, papers, organic etc.	102	51	98	49	200	100
8	I will continue to sort my garbage in future or I intend to start sorting	132	66	68	34	200	100

Table 4: Attitude of resident toward waste collection, disposal and management.

Source: Field Survey, 2019.

Problems of waste collection, disposal and management

The findings of the study presented in table 5 reveals that 79% of the respondents agreed that poor funding by government pose problem to waste management in their locality, whereas 21% disagreed. The table also shows that 77% of the respondent agreed that high population constitutes a problem to waste management in their locality, while 23% disagreed. Furthermore, the results indicated that 81% of the respondents agreed that lack of trained managers is one of the problem of waste managements while 19% disagreed. 81% of the respondents also agreed that lack of effective monitoring by government agencies is a problem to waste management in the area while 19% disagreed. The table also revealed that 69% of the respondents agreed that embedded cultural practice is one of the problem to waste management in the area, while 31% disagreed. The study also revealed that 76% of the respondents agreed on the shortage of vehicles, containers and personnel as constituting a problem of management in the area while 24% disagreed.

Discussion of Findings

Items in table 2 above were structure to determine the influence of environmental education on the attitude of people towards wastes in the study area. Findings of the study revealed that there is high influence of environmental education on people’s attitude. This is in agreement with the opinions expressed by Stevenson [6], Jia-nan [7], Stapp, *et al.* [8], Anijah obi [9], who all concurred on the immense potential impacts of environmental education on the inculcations of positive attitude on wastes management and other environmental related problems.

S/N	Items	Responses					
		Yes	%	No	%	Total	Total
	Problem of Wastes Collection						
1	Poor funding by government	158	79	42	21	200	100
2	High population growth	154	79	42	21	200	100
3	Lack of trained managers	162	81	38	19	200	10
4	Lack of effective monitoring	162	81	38	19	200	100
5	Embedded cultural practices	138	69	62	31	200	100
6	Shortage of vehicles, containers, and personnel	152	76	48	24	200	100

Table 5: Problem of wastes collection, disposal and management.

Source: Field Survey, 2019.

Current Situation in the Study area

Items in table 3 were designed to identify methods of wastes collection, disposal and management. Findings of the study revealed there is high level awareness on waste management methods in which respondents identify simple empty collection method of waste collection which is in line with concept of Mbalisi [10], in which he mentioned the major methods of wastes collection i.e. simple empty method, exchange method, curbside collection and special items. In table 4, residents have high positive attitudes towards waste management and are willing to improve toward attaining healthy and sustainable environment, which is also in line with assertions of Mbalisi [10], in enumerating the immense potential influence of environmental education in molding/modification of people’s attitudes with regards to their immediate environment. Items in table 5, revealed lack of monitoring, lack of trained managers, population increase, shortage of vehicles and poor funding as the major challenge to waste management which is in line with Aliyu (2004) report, who noted the rapid increase of population by both the satellite towns and shantytowns in the Karu municipal as it overstretched the carrying capacity of the allocation of funds, personnel and equipment for managing wastes in the area.

Method of waste collection, disposal and management

Waste collection plays an important role in waste management processes. It is also a wide and complex subject. It involves diverse elements such as collection systems, special equipment, personnel requirement and the layout of collection routes as well as loading and unloading activities. It starts at the moment where filled waste containers or garbage bags are loaded in waste trucks. Waste collection represents almost 50% of the total cost of waste disposal (Tchobanoglous., *et al.* 1993). Management arrangements include municipal services to franchised private companies and informal groups in developing countries.

There are several methods that can be employed for waste collection [9]. Among them are:

1. Simple Emptying Method: standardized containers are mechanically emptied into a collection vehicle and then returned at the source.
2. Exchange Method: containers are replaced by others. This technique is often use in handling high volume waste such as construction debris and waste in industrial areas.
3. Curbside Collection: It involves picking up garbage bags placed on the sidewalk or the specific locations. The collection is generally manually handled.
4. Special Collection or Non-Systematic Collection: it involves picking up bulky waste and other voluminous items. This service is generally provided upon request.

In developing countries, the informal collection of recyclable goods from household and at other locations plays an important role in the overall waste management system. Informal collection involves individuals organized or not into structured groups who target valuable goods for reuse or retailing purposes [10].

Waste generation in Karu is quite high due to the economic status and population density in the area. Households generate high quantities of plastic waste from food containers and beverage packaging. Increase in waste generation period is during the raining season due to increase in agriculture waste production [11]. In Karu, wastes composition is heterogeneous and mixed; non-degradable materials and degradable materials. The waste is not segregated at source and comprise of hazardous and non-hazardous waste. The hazardous components usually consist of household cleaning agent and left over chemicals from renovations. In Karu, wastes bulk usually consists of plastic, paper, glass, metal and other recyclable components. The degradable portions of the waste consist of food waste and yard waste.

The Nasarawa State Environmental Protection Agency [12] has provided containers for quarter residents which vary in types and sizes and some purchase the waste bags for storage while in the nucleated areas, there is no provision for bags or waste bins. There are three private companies contracted for waste collection with various weekly collection at different areas in Karu. Collection in quarter ward is periodically consistent while in others, it is not. Influencing factors such as insufficient collection vehicles, insufficient number of staff, unplanned neighborhood and high cost-field survey and interview with residents.

The study findings revealed the presence of estate where the residents dug pits for their wastes collection and burning thereafter. The residents did not separate their wastes since Nigerian system of waste management does not enforce it for easy waste recycling and treatment. House to house waste collection is carried out with home owners being responsible for placing their waste bins in front of their house, while in some parts, curbsides waste collection was most common.

The study findings show that Karu market wastes are dumped in the middle of the market and this place has turned to dumpsite because the quantities of waste dumped inside the market is more than the waste dumped at Mararaba and Masaka dumpsites. This revealed that environmental, social and health impact assessment was not carried out before construction of the market and monitoring program to checkmate the level of compliance to waste management policies in the market. Furthermore, abattoir wastes are collected and managed in the market. Wastes from animals are easy and cheap to recycle because of its organic wastes. The animal faeces are collected, dried and transported to farm lands as organic manure, while the bones, horns and hooves are processed and used as food nutrients for poultry and fish food production.

In general, the most appropriate waste collection method is the one which best serves the need of a community and take into account, factors of efficiency, health and environmental requirements, physical demand and zoning parameters. The methods previously mentioned carry both advantages and disadvantages. Weingarten indicates for instance, that the simple emptying method which requires special vehicles, standardized wastes containers and road access can be viewed as a drawback in developing communities, whereas curbside and informal collection, which have been both proven to alleviate poverty, despite their high physical demand on personnel (2003) are more suitable to developing countries.

Alternative Methods of Waste Management

The apparent end of the waste management system is disposal which can be carried out through any of the following methods; landfill, composting, thermal treatment and recycling. The common practice of waste disposal in most countries is land filling which entails waste burial. Land filling method of waste disposal is in two forms sanitary land filling and composting, which are permanent means of disposals as other means just basically reduce the volume of waste. Biodegradable wastes which constitute the largest group of waste are most suitable for landfills [13]. In the sanitary landfill, waste is compacted in layers of about 3 meters with the aid of earth moving equipment and covered with thin layers of soil which is also compacted before another layer of waste is brought. Another method of waste

disposal is thermal treatment which involves the application of heat. The two most common forms of this method are incineration and pyrolysis. In incineration, which can be on a small scale, the application of combustion is employed as waste items are burnt converting them into heat, gas steam and ash. In pyrolysis which is also known as destructive distillation, solid waste is decomposed by chemical means through the application of heat in an atmosphere with reduced oxygen content to produce a gas stream basically of hydrogen, methane, carbon monoxide, carbon dioxide and various other gases and inert ash, determined by the organic characteristics of the waste constituents. The use of this method is, however, controversial due to issues such as emission of gaseous pollutants [14]. Recycling is an age-old process which involves the recovery of reusable items from the waste and consist of different form with increasing number through continued development. In recycling, raw materials may be extracted or calorific content may be converted to electricity. Some of the recycling methods available today are shredding, magnetic separation of metals, air classification that separates light and heavy fractions and screening.

Majority of the waste composition consist of materials that can be recycled, but the Abuja Environmental Protection Bureau (AEPA) doesn't recycle waste. Recycling is usually carried out by the informal sector and scavengers. Paper, aluminum cans and glass are sorted out as some recycle waste collectors go from house to purchase recyclable from home owners especially E-waste. In terms of disposal there is presently no sanitary landfill in Karu. The Area council has three waste dumpsites which include Mararaba, Ado and Masaka. The dumpsites are characterized by indiscriminate dumping on ground surface without completion efforts. Wastes in the dumpsites are continuously set on fire in order to reduce the volume of the waste. There is no landfill regulation or standard that provide a basis for compliance and monitoring.

The solid waste management techniques are reduction, reuse and recycling. This is referred to as the 3R's of waste management. It is represented by the waste management hierarchy designed by Waste Aware Business (2009). The most favored option being waste reduction (waste prevention and minimization). The least favored option is sending wastes to landfills. Solid wastes segregation techniques which enables individuals to segregate waste at the source of generation is also an important technique that should be developed in individuals in other to attain effective management of wastes in Nigeria. Solid waste disposal methods which are mostly preferred and considered as environmentally friendly in waste management business are incineration, composting, dumping in approved dumpsites and land filling. However, littering, open burning and open dumping of solid wastes which are practiced by many individuals are not environmentally friendly because the laid in the spreading of diseases and the pollution of the environment.

The three R's are commonly used terms in waste management; they stand for 'reduce, reuse and recycle' As waste generation rates have risen, processing costs increased and available landfill space decreased, the three R's have become a central tenet in sustainable waste management efforts [15]. The concept of waste reduction, or waste minimization involves redesigning products or changing societal patterns of consumption, use and waste generation to prevent the creation of waste and minimize the toxicity of waste that produced [16]. Common examples of waste reduction include using a reusable coffee mug instead of a disposable one, reducing product packaging and buying durable products which can be repaired rather than replaced. Reduction can also be achieved in many cases through reducing consumption of products, goods and services. The most effective way to reduce waste is by not creating it in the first place and so reduction is placed at top of waste hierarchies [17]. (USEPA, 2010). In many instances, reduction can be achieved through the reuse of products. Efforts to take action to reduce waste before waste is actually produced can be termed pre-cycling [13].

It is sometimes possible to use a product more than once in its same form for the same purpose; this is known as reuse (USEPA). Example include using single-sided paper for notes, reusing disposable shopping bags, or using boxes as storage containers [13]. Reusing products displaces the need to by other products thus preventing the generation of waste. Minimizing waste through reduction and reuse offers several advantages including: saving the use of natural resources to form new products and the wastes produced in the manufacturing processes; reducing waste generated from product disposal; and reducing costs associated with waste disposal [17].

Not all waste products can be displaced and even reusable products will eventually need to be replaced. It is inevitable that waste will be created as a by-product of daily human living [18], but in many cases it is possible for this waste to be diverted and recycled into valuable new materials. Glass, plastic and paper products are commonly collected and reformed into new materials and products. Recycling products offer many of the benefits of waste reduction efforts (displacing new material usage, reducing waste generated and the costs associated with disposal) but recycling requires energy and the input of some new materials, thus placing it lower on the waste hierarchy than reduction and reuse [13,17].

Many waste management frameworks seek to incorporate the three R's in some capacity. In the UK, North America, throughout Europe and in parts of Asia, waste hierarchies are being incorporated which promote the adoption and use of "reduce, reuse and recycle" initiatives [19]. Waste management hierarchies places the highest priority on waste prevention, reuse and then waste. Recovery, disposing materials in a landfill is the least desirable of the options [20].

In some instance, additional R's can be added to the basic three. Some organization have chosen to add a fourth R. [13]. The fourth 'R' can represent different words including re-buy [13] (UC Davis, 2008) rethink and recover (FNQLSDI, 2008). The concept of re-buy refers to consumers purchasing decision s. consumers have the ability to take steps to improve waste management by helping to close the loop in waste management system by purchasing products which have been recycled or used [13], rethink is added to the three 'R's by some because changing our behavior and our actions can lead to improvements I waste management. Changing consumption pattern and considering the impact of our action can lead to decrease of production of waste and even a reduction in waste management and waste minimization efforts (Concordia University, N.D.).

Recover can refer to methods which use and process waste so that it is used rather than disposed of (which would include reuse and recycling); however, it can also include recovering energy form of waste before it is disposed. Waste can be processed into a fuel and to produce a usable form of energy (FNQLSDI, 2008). Examples include incinerating waste to generate electricity, breaking waste down with (high temperature) plasmolysis to produce usable sources of fuel, or breaking down organic matter with anaerobic digestion to produce biogas.

These additional concepts do not need to be limited to 4 R's. El-Haggar [15], proposes that to achieve sustainable waste management, a 7R method should be adopted: Reduce, Reuse, Recycle, Recover, Rethinking, Renovation and Regulation. Renovation refers to taking action to develop innovative ways to process waste, while regulation is added in recognition that it is a driving force behind ensuring the implementation of responsible waste management practices [15].

Waste management methods cannot be uniform across regions and sectors because individual waste management methods cannot deal with all potential waste materials in a sustainable manner [21]. Conditions vary; therefore procedure must also vary accordingly to ensure that these conditions can be successfully met. Waste management systems must remain flexible in light of changing economic, environmental and social conditions [22]. In most cases, waste management is carried out by a number of processes, many of which are closely interrelated; therefore, it is logical to design holistic waste management systems, rather than alternative and competing options [21]. A variety of approaches have been developed to tackle waste issues. A well designed framework can help managers address waste management issues in a cost-effective and timely manner. It can spur the improvements of existing plans or aid in the design of new ones [16].

Importance of environmental education to wastes collection, disposal and management

Environmental education and awareness creation on solid waste management is a key to solving the problems associated with waste management and it enhances better practices of managing wastes. Some of the importance that accrues from education and awareness creation on solid wastes management by Mbalisi [10] are:

1. Development of knowledge about solid wastes and its associated problems when managed improperly.
2. Inculcation of positive attitudes, skills, values and concerns towards the environment in all the citizens and authorities responsible for managing wastes.
3. It predisposes the citizens and the Agencies to participate actively in segregation, reduction, reuse, composting and recycling of solid wastes, development of appropriate skills needed for segregation of solid wastes at source as this is key to proper waste management.
4. It decreases the rate of improper management of wastes and consequently the spread of diseases in the environment.
5. It enhances the protection and conservation of public health, the environment and natural resources.
6. It enhances policy implementation by decision makers on waste management.
7. Consistency in education and awareness creation on solid waste management are factors that can only improve better management of solid wastes in Nigeria, Use of city waste collection services by the public and private sectors, funding for waste management from local elected officials, Adoption and enforcement of local waste management polices by local elected officials, support for local-level activities from national governments and public participation in organic diversion and recycling programs. Each of these outcomes can contribute to a city's efforts to reduce the impacts of waste management on health, the economy, the environment and society.

The problems of waste collection, disposal and management

There are many barriers to city's waste management activities and the benefits of proper solid waste management. These barriers, which vary by stakeholder type, include.

Lack of adequate funding and excessive population

Waste management is by nature both capital and economic intensive. This requires huge capital outlay. Many state governments spend a good percentage of their funds on waste management. It is that the fund available or at least earmarked for waste management is grossly inadequate, to fund the public agencies and other private sector participants (PSP). Ahiamadu [23], posits that Nasarawa since its establishment as a state has experienced a huge population growth. Population explosion in Nasarawa owes primarily to labour migration, which resulted from the movement or relocation of headquarters of private and public organizations to the city. According to official estimates of the African Journal of Urban and Regional Geography (2014), Nasarawa has been growing at 20 - 30% per year.

Urban Development problems in Nasarawa could therefore be viewed from both socio economic and environmental perspective. As noted earlier, the location and relocation of government and private companies' headquarter have forced majority of workers to become resident in Nasarawa. The increasing socio-economic opportunities made available by the fact that the city is still under construction, facilitate ever increasing number or influx of young, unemployed men and women into Nasarawa State. This development has spurred high economic cost of most services and over stretching of the already existing social amenities available in the city. Cost of renting or leasing houses, shops, offices and space are higher in Karu than anywhere else in Nasarawa increasing population in Karu has resulted in the proliferation of slums and shantytowns, most especially in adjoining villages. Therefore, squatter settlements and shanty-towns spread rapidly in and outside the city limits. The proliferation of these shantytowns results in the unwieldy expansion of the city, which poses, drainage and sewage systems among other infrastructure, proves very difficult. Furthermore, shantytowns cause increases in the incidence or urban poverty, diseases and epidemics, environmental pollution, urban conflicts and crime.

Although the Karu Area Council and other councils in Nasarawa including the Nasarawa State Environmental Protection Agency (NASEPA) have devoted considerable attentions to waste disposal and the attainment of healthier environment in Nasarawa State, a lot

still needs to be done. Daily wastes disposal vehicles are deployed to the different districts to collect and dump wastes or refuse in the three landfills available in the city. As Aliyu, (2014) noted, currently in Nasarawa State, a lot of heterogenous waste is generated and the volume and type have been on the increase both in the residential and business areas. NEST (1999) estimated that of the 4.5 million tonnes of wastes generated in Nigeria in 1999, a little below 1.5 million tonne was generated by each of Lagos, Abuja, Kaduna and Kano. In another study, NEST estimated that about 40 million tons of waste would be generated in Nigerian between 2005 and 2010. What this translates to mean in the case Nasarawa and other major urban centers in Nigeria is that waste generation in Nasarawa State a year to the expected estimated date, would be in the region of 3 or 4 million tons. Given 3.5 percent estimated annual population growth rate, the tendency is that the estimate for the major cities and Nigeria at large may exceed projection.

Lack of trained/professional waste managers

There are just a few sanitation and environmental Engineers in Nigeria. In fact most private sectors operators in waste management are mainly party stalwarts; know little or nothing about waste management

Lack of effective monitoring and control

The waste regime in the UK provides a quintessence of a system that makes for effective monitoring of domestic waste prior to disposal and the steps to be taken on disposal. The regime distinguishes between controlled and special waste. Under section 30 of the EPA, 1990, waste authorities in charge of waste administration have three basic functions: regulation, collection and disposal.

Waste disposal authorities are to award waste disposal contracts through competitive tendering and are to make contracts with waste disposal contractors who may be private sector companies or companies set up by the local authority which must be at arm's length from the waste authority. The waste regulation authority is responsible for issuing a waste management license. Under the regime, controlled waste may not be deposited, treated, kept or disposed of without a license. The licensing method issued as a means of controlling waste. Section 33(1)(a) of the EPA provides that it is an offence to "treat, keep or dispose of controlled waste in a manner likely to cause pollution of the environment or harm to human health" The offence is notable for its breadth". Pollution of the environment" is defined in section 29 to mean the release or escape of the waste into any medium so as to cause harm to man or any other living organisms supported by the environment. "Harm" is further defined to mean "harm to the health of living organisms or other interference with the ecological systems of which they form part and in the case of man includes offence to any of his sense or harm to his property" thus the offensive smell of a waste tip would be covered; as presumably would its unattractive appearance. The offence can be committed whether or not the offender has a license. So, the offence focuses on environmental protection, not with enforcing the licensing regime. The penalties are quite prohibitive. Again the duty of care principle under the EPA, designed to satisfy the European ideology on the environment that the polluter pays is an important form of liability on producers of domestic waste. The producer is responsible for the proper disposal of the waste. This means that the producer must ensure it is transferred to a responsible carrier. The producer cannot escape liability simply by passing the waste onto anyone else who could include the fly-tipper. This unbroken chain of waste transmission ensures that indiscriminate dumping and disposal is eliminated. The waste management regime in Nigeria is far from what is described above, so that the house-holder-producer of domestic waste is not deterred. Most items of domestic waste are controlled waste i.e. they can easily be managed, treated and disposed off. Three defenses are provided for the commission of this offence: due diligence, emergency and acting on employer's instructions; see Malcolm (2003). And we may add, the deposit of waste by householders in the neighborhood on unoccupied/undeveloped land of another, for it constitutes harm to property. Six months and/or a fine up to € 20000 in the Magistrates' courts, two years and unlimited fine in the crown court. Malcolm (2003), op.cit p.204 - 205 by any form of sanctions, because mostly, waste management agencies or contractors hardly exist in many places in Nigeria nor is monitoring and monitoring authorities effective.

Peculiarity of the Nigerian's attitude

The government-does-everything philosophy of many Nigerians contributes to the domestic waste management problems in Nigeria. A careless attitude permeates the thinking especially, those living in cities and towns. Self-help methods of domestic waste disposal are available and could be explored by individuals and institutions. Domestic incineration, landfill system is practicable, but most Nigerian's would take to the easy way of depositing waste along the highway and corners of street for "government" to pick up. Some have founded this attitude on illiteracy but this would be a fallacy. Traditionally, as is still illiterate, residents are very conscious of the importance of having a clean environment and this is evidenced by the sanitation arrangements in force in these societies.

Lack of modern technology/lethargy in implementing efficient waste

Management Methods: Different efficient ways of domestic waste management have been in use in many developed countries.

Embedded cultural practices, behavioral norms and beliefs

The belief that waste has no value, which is a challenge for effective source separation and recycling programs and lack of familiarity with the economic opportunities associated with waste management [24-52].

Conclusion

This study has investigated the impact of environmental education on solid waste collection, disposal and management in Karu Metropolis, Nasarawa State, Nigeria. Data were collected from the respondents using structured questionnaire and analyzed using simple frequencies and percentages. Finding from the study show high level of the influence of environmental education on the attitudes if people towards waste collection, disposal and management. The study revealed low level of compliance on waste management policies especially in public established institutions like the market. Some of the challenges to efficient waste collection, disposal and management in the area include lack of sensitization programs on waste management and other environmental related problems, lack of documented data on waste management activities, inadequate funding by government, lack of effective monitoring and overpopulation in the area.

Environmental education is the only tool for combating negative attitude of people towards wastes management as it's a collective responsibility, since it adhere to inculcate environmental consciousness, values, skills and ethics government should recommend it at various level of education in other to have a holistic orientations for our future leaders, politicians, planners, economist, scientists, technologists, industrialists, agriculturalists and decision makers in our country, with this adequate funding, effective monitoring and compliance of environmental policies can be achieved.

Recommendations

Based on the finding of the study, the following recommendations were made:

1. Effective implementation of integrated solid waste management system to ensure that management of solid waste is always controlled and environmentally safe, flexible and economically viable under conditions.
2. Government should make environmental laws known to every citizens and enforce any law violations and published to the media in order to serve as deterrent to others.
3. Public places such as markets, schools, fuel station, hospitals and other institutions should be compelled to comply in the implementation of environmental, health and social impact assessments. Development and moderation of collections points to eliminate illegal dumping of solid wastes
4. Public enlightenment on waste management practices through distribution of leaflets, posters and mass media support. All the parties (i.e. government, households, service holders, students, day labour, businessperson, etc.) spontaneous participation and

involvement should be ensured to manage and dispose solid wastes properly in order to maintain clean and health environment. Seminars and workshops should be organized for wastes management personnel, waste generators in order to meet the global standard of waste management.

5. Provision of alternative systems for the processing, re-use and recycling of solid wastes in order to promote resource conservation, enhance carbon foot print initiative and to minimize the disposal of solid waste fill. Treatment of hazardous and medical wastes should be put into practice. Fund should be made available by government to various agencies responsible for implementation of this policy.
6. Introduction of environmental education at various levels of education in order to inculcates positive attitude from the roots and environmental awareness among residents, business and institutions.

Bibliography

1. Nasarawa Citiserve. "Estimates of Waste Generation Volumes and Income Potentials in Nasarawa State". DFID: 00 0512A SLGP Consultants' Report Number 805 (Original Number 174) (2004).
2. Encarta Dictionary Premium DVD Application. Federal Ministry of Environment Report, L.I, (2004). Integrated Waste, Household waste management. Sustainable Development 3.3 (2009): 91-102.
3. AVWA, Initial. Practice Management (2005).
4. Obeka V. "Waste management, problems and prospects" Conrad Publication Plc Karachi (2001).
5. Muhammad Isma'il, *et al.* "Urban Growth and Housing Problems in Karu Local Government Area of Nasarawa State, Nigeria". *Global Journal of Research and Review* 2.1 (2015): 45-57.
6. Stevenson J. "Environmental education in the 21st century". Goudgis-printing press London (2007).
7. Jia-nan C. "Contributions of Environmental NGOs to Environmental Developments in the Middle East". Shiangxi lee printers. Shanghai Province (2012).
8. Stapp, *et al.* "Strategies of environmental management in the sub-Saharan African Countries". Ged publisher, New York. (1997).
9. Anijah-Obi FN. "Fundamentals of Environmental Education and Management". Calabar: Clear Lines (2001).
10. Mbalisi FO. "Methods and materials for environmental adult education". Unpublished manuscript. University of Port Harcourt (2009).
11. Bamisaiye J. "Effects of mobile Elements in F.C.T Environment". Blacks law dictionary 2nd edition (2013).
12. Nasarawa State Environmental Protection Agency (NASEPA) Nasarawa State.
13. UC Davis. The 4R's of waste reduction UC Davis. (n.d). College and University Waste reduction and Recycling Manual (2008).
14. Huang JYC. "Solid Waste Disposal". Microsoft Encarta 2009 (DVD) (2009).
15. El-Haggar SM. "Sustainable industrial design and waste management: Cradle-to-cradle for sustainable development" (2007): 424.
16. U.S Environmental Protection Agency. Decision-makers guide to solid waste management, volume II. Washington, DC (1995).
17. U.S Environmental Protection Agency. Reduce, Recycle. Wastes Resource Conservation (2010).

18. Kim SJ. "Korean waste management and eco-efficient symbiosis – a case study of Kwangmyong City. *Clean Technologies and Environmental Policy* 3.4 (2002): 371-382.
19. Allwood JM., et al. "Material efficiency: A w/White Paper". *Resources, Conservation and Recycling* 55.3 (2011): 362-381.
20. ECOTEC Research and Consulting Ltd. Beyond the: The economics of waste management options. (2000).
21. Staniskis J. "Integrated Waste Management: Concept and Implementation". *Environmental Research, Engineering and Management* 3.33 (2005): 40-46.
22. McDougall FR., et al. "Integrated solid waste management: A life cycle inventory (2nd edition)". Blackwell (2001): 544.
23. Ahiamadu NM. "The Challenges of Municipal Solid Waste Management in Nigeria". Proceeding of 8th International Conference. Waste Management, Environmental Geotechnology and Global Sustainable Development, in (ICWMEGGSD'07-Gz'07)" Ljubijana, Slovenia (2007): 28-30.
24. Ayotamuno JM and Gabo AE. "Municipal solid waste management in Port Harcourt, Nigeria: Obstacles and Prospects". *Management of Environmental Quality an International Journal* 15.4 (2004): 389-397.
25. Babayemi JO and KT Dauda. "Evaluation of solid waste generation, categories and disposal options in developing countries: A case study of Nigeria". *Journal of Applied Sciences and Environmental Management* 13.3 (2009): 83-88.
26. Bamgbose OA., et al. "Assessment of urban solid waste management practices in Lagos, Nigeria". *African Science* 1.1 (2000): 23-31
27. Brennan A. "Towards an effective environmental management St. Luis Printing House, U.K (1979).
28. CSL (Cygnet Services Limited), Technical and Commercial proposal Education in China. IERI Procedia, 2 (2002): 901-906.
29. Dana LE. "How can sustainable solid waste management be achieve in Srilanka? An enquiry into the role of education and awareness building through grassroots efforts (2006).
30. Education. Tbilisi (USSR), Final Report. Doc. EDMD.49. UNESCO. Paris (1977).
31. EPA US. Environmental Protection Agency US. United States (2012).
32. Glenn AV. Proximity to environmental hazards and reported illness in periurban households of the Dominican Republic (2009).
33. Jalil A. "Sustainable development in Malaysia: A case study on household waste management". *International Journal of Sustainable Development* 3.3 (2010): 91-102.
34. Kan Miranda. Municipal Waste Management. A-Z Printing press London (1999).
35. Manaf LA., et al. "An Intelligent System for Integrated Solid Waste Management". *Journal of Sustainable Development* 1.2 (2008).
36. Mc Millan EE. "A method for evaluating the impact of an introductory environmental studies class on the values of students". *Applied Environmental Education and Communication* 2.2 (2003): 91-98.
37. Obeka SS. "Environmental Education Reform on Solid Waste Management in Nigeria". The Case of Zaria Municipal of Kaduna State 52nd Science Teachers Association of Nigeria Annual Proceedings. HEBN Publishers plc (2011): 269-279.

38. Olarewaju OO and Iemobade A. "A Waste to Wealth: A case Study of the Ondo State Integrated Waste Recycling and Treatment Project, Nigeria". *European Journal Sciences* 8.1 (2009): 7-16.
39. Oreyomi MK. "Selected Topics on Environmental Health". Lagos: Kinson press (1998).
40. Ogu VI. "Private sector participation and municipal waste management in Benin City, Nigeria". *Environment and Urbanization* 12.2 (2000): 103-117.
41. Owen R. "Preparing a recommendation to governments on cleanup options for the Sydney Tar Ponds and Coke Ovens sites: An evaluation of environmental decision-making tools" (2003).
42. Pires A., *et al.* "Solid waste management in European countries: A review of systems analysis techniques". *Journal of Environmental Management* 92.4 (2010): 1033-1050.
43. Santra SC. "Environmental Science". (Edition) New central book Agency, (p) Ltd, London (2005): 981-988.
44. U.S Environmental Protection Agency, Introduction to Universal Waste (2005).
45. World Health Organization. Safe Management of Wastes from Healthcare Activities. Tech. Pep. Ser. No. (1971): 484.
46. Zamorano M Molero E., *et al.* "A planning Scenario for the Application of Geographical information Systems in Municipal Waste Collection: A case of Churriana de la Vega (Granada, Spain)". *Resources,-Conservation and Recycling* 54.2 (2009): 123-133.
47. Zotos G., *et al.* "Developing a holistic strategies for integrated waste management within municipal planning: Challenges, policies, solutions and perspectives for Hellenic municipalities in the zero-wastes, low-cost direction". *Waste manage* 29.5 (2009): 1686-1669.
48. Techobanoglous G HTheisen and S Vigil. "Integrated Solid Waste Management: Engineering Principles and Management issues interaction". In: Clark J and BJ (Edition) McGraw-Hill, Singapore (1999).
49. Tanskanen JH. "Strategic planning of municipal solid waste management". *Resources, Conservation and Recycling* 30.2 (2000): 111-133.
50. UNESCO. Intergovernmental Conference of Environmental Education (1978).
51. United Nations. Tbilisi Convention on Environmental Education (1979).
52. UNEP. Developing Integrated Solid Waste Management Plan Training Manual: ISWM Plan. United Nations Environmental Programme 4 (2009).

Volume 5 Issue 11 November 2019

©All rights reserved by Oruonye ED., *et al.*