Knowledge and practice of recycled plastic bottles (RPB) built homes for sustainable community-based housing projects in Nigeria

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Abstract: This study examined the knowledge and practice of the use of Recycled Plastic Bottles (RPB) for a sustainable community-based housing project in Ogun State, Nigeria. The study adopts the Diffusion of Innovation Theory (DOI), and Behaviour Change Theory (BCT) as the theoretical guide. Fieldwork was conducted in semi-urban and urban communities of Ogun State, Nigeria where a majority of individuals experience the challenge of affordable housing and environmental pollution concurrently. A total of 385 respondents were used as a sample for the study. This was determined through a sample size calculator developed by Raosoft Incorporation. Both qualitative (in-depth interviews) and quantitative (questionnaire) data were used to ascertain the level of knowledge and practice of RPB built homes, its challenges, prospects and the way forward in building sustainable homes and the environment in Nigeria and beyond. The findings of the study were

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PUBLIC INTEREST STATEMENT

The challenge of waste management and housing are among the issues of utmost concern in many African countries, Nigeria inclusive. This is because a reasonable number of people still face the problem of housing (in which hundreds of thousands of people lack access to a roof over their heads) as well as efficient waste collection and management system. However, in order to avert this double-headed social problem, this study revealed the level of knowledge and practice of recycled plastic bottles (RPB) built homes in Ogun State, Nigeria to be abysmally low due to some inhibiting factors like inadequate public awareness, education, and information, technical and human skills on the use of recycled plastic bottles for green construction. This discovery would give room for proper policy intervention and behavioural change towards achieving sustainable housing project as well as plastic waste management in the contemporary world.
discussed within the existing literature and recommendations were provided for policy action.

**Subjects:** Building and Construction; Development Studies; Population & Development; Sustainable Development; Development Policy; Environment & the Developing World

**Keywords:** green building; knowledge; plastic; recycling; waste management

**JEL classifications:** JEL Q01; JEL Q53; JEL21; JEL R31

1. **Introduction**

In recent times, the idea of using recycled plastic bottles (RPB) as a sustainable material for green building construction has been receiving scholarly attention among researchers, academics, policy-makers, and governmental and non-governmental organizations. This recent development is largely spurred by the increase in world population and shortage in housing for a significant proportion of the world's population (Pati et al., 2016; UN-HABITAT, 2010). It is also driven by the increase in the volume of plastic bottle waste which has negative impacts on the well-being of people, the environment and social institutions (Adbulkarim & Abiodun, 2012; Reffat, 2004; Sojobi et al., 2016; Solaja et al., 2017). Adequate knowledge and practice of RPB built homes can solve the problem of plastic bottle waste and homelessness in developing countries.

In Nigeria alone, about 17 million people (if not more than) live in slums or lack access to a roof over their heads as well as adequate basic facilities, like piped water, sanitation, schools, healthcare, etc., as at 2018 (Centre for Affordable Housing Finance in Africa [CAHF], 2018). The issue of housing deficit has been occurring in Nigeria for more than a decade now (see Ankeli et al., 2015; Olanrewaju, 2001; Olotuah, 2002; Olujimi & Bello, 2008; Omojimi, 2000) and it has invariably led to over congestion in homes and the expansion of slums, especially in Nigerian urban areas (see Ankeli et al., 2017; National Bureau of Statistics, 2016; Okafor, 2016). Housing is among the basic human needs (i.e. food, water, energy, clothing and healthcare) without which there will be no reasonable human and social development. In order to solve Nigeria's housing deficit by 2033, at least 1.2 million housing units must be produced annually for the next 15 years which amounts to N6 trillion - the equivalent of 16 billion USD (CAHF, 2018). With this huge amount of money involved in financing housing in Nigeria and the current economic situation in the country, it would be difficult to address her pressing housing needs by 2033, unless cost-cutting, timely and environment-friendly innovations are massively deployed. One of such strategic innovations is the use of recycled plastic bottles as alternative construction material for the production of green building, affordable housing and a safe environment (Bredenoord, 2017; Eneh, 2015; Gale Group, 2008; Rawat & Kansal, 2014; Shoubi et al., 2013; Sojobi et al., 2016; Young, 2009).

The use of recycled bottles in housing construction has been widely documented since 1902 when William F. Peck used ten thousand beer bottles to build the first bottle home in Nevada, United States of America (see Krepecio, 2007; Kusimwiragi, 2011; Seltzer, 2000a; Shoubi et al., 2013). However, in recent times, there have been a growing number of studies on the use of plastic or PET bottles as a workable building material. For instance, the studies conducted by Young (2009), Gale Group (2008), and Sojobi et al. (2016) revealed that plastic bottles can be used for extended-lifetime construction activities such as channels, insulation, fascias, damp proof membranes, water drainage, pipes and ducting, roof tiles, decking, fencing, road, bridge paving bricks and building blocks. In this context, Shoubi et al. (2013), Rawat and Kansal (2014), Eneh (2015), and Pati et al. (2016) carried out experimental studies to investigate the possibility and benefits of using recycled plastic bottles (RPB) as a partial replacement in the building of low-cost housing as well as addressing the issue of plastic waste generation, alternative energy and environmental sustainability. At the end of their experimental studies, it was submitted that plastic bottles can be more effective compared to some conventional building materials such as brick, concrete and ceramic blocks (Eneh, 2015; Pati et al., 2016; Rawat & Kansal, 2014; Shoubi et al., 2013; Schwartz, 2008).
Recycled plastic bottles (RPB) have been used in the construction of green buildings in countries like Honduras, Bolivia, Serbia, Taiwan, Argentina, India, and Nigeria (to mention a few) where various kinds of RPB homes have been built. For instance, extant literature revealed that eight thousand recycled plastic bottles were used in building ecological houses in Honduras; Bolivia, Serbia, and Taiwan respectively (Bredenoord, 2017; Rawat & Kansal, 2014; Andrews, 2010; Kim, 2011). Also, a thousand two hundred PET plastic bottles were used in constructing walls near Iquazu Falls in Argentina, while not less than eight thousand five hundred recycled plastic bottles were used in building a two-bedroom bungalow in Nigeria (Rawat & Kansal, 2014; Shoubi et al., 2013). Interestingly, some researchers observed that homes built with plastic bottles have extra features, like being bullet and fireproof, earthquake resistant, and maintain a comfortable interior temperature of sixty-four degrees Fahrenheit round the year (Bredenoord, 2017; Rawat & Kansal, 2014; Shoubi et al., 2013). Other benefits of RPB built homes are resistance to floods, cost-effectiveness, durability, energy efficiency and environmental compatibility (Eneh, 2015; Kharwade et al., 2017; Rawat & Kansal, 2014; Shoubi et al., 2013). These features of RPB built homes are significantly linked to the essential characteristics and qualities of plastic bottles (Nwachukwu et al., 2013). Plastic bottles are characteristically classified into thermosetting and thermoplastic, which are both manufactured from polyethene terephthalate- a hard, stiff, strong, and dimensionally stable material that absorbs very little water and also has good gas barrier properties as well as chemical resistance, except to alkalis which hydrolyze it- depending on the density of the plastic (Geiger, 2011; Nwachukwu et al., 2013; Saxena & Singh, 2013).

Due to the essential characteristics (i.e. high strength, thermostability, and transparency) of plastic bottles, most manufacturers of carbonated drinks, beverages, food items, and bottled water prefer to package their products in plastic resin materials (NAPCOR, 2011 as cited in Adulkarim & Abiodun, 2012; Nwachukwu et al., 2013) which has led to a gradual increase in plastic production, consumption and waste globally. Statistically, the global production of plastics has been increasing astronomically from 1.5 million metric tons in 1950 to 335 million metric tons in 2016 as shown in Table 1.

In addition to the information presented in the table 1, the global plastic export rate in 2017 showed that the top-ten plastic exporters were China (24.7%), Germany (12.4%), The United States (9.3%), Italy (4.2%), France (3.7%), Netherlands (3.1%), Japan (2.8%), Mexico (2.7%), Taiwan (2.5%) and Czech Republic (2.4%). In terms of the consumption rate by region (in kg/person) in 2015,

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### Table 1. Production of Plastics Worldwide from 1950 to 2016

| Years | Production volume in million metric tons |
|-------|------------------------------------------|
| 2016  | 335                                      |
| 2015  | 322                                      |
| 2014  | 311                                      |
| 2013  | 299                                      |
| 2012  | 288                                      |
| 2011  | 279                                      |
| 2010  | 270                                      |
| 2009  | 250                                      |
| 2008  | 245                                      |
| 2002  | 200                                      |
| 1989  | 100                                      |
| 1976  | 50                                       |
| 1950  | 1.5                                      |

Source: Adapted from [www.statistical.com](http://www.statistical.com).
NAFTA has the highest (139 kg/person), followed by Western Europe (136 kg/person), Japan (108 kg/person), Central Europe & CIS (48 kg/person), and Asia (excluding Japan) (36 kg/person), while the lowest consumption is in the Middle East and Africa (16 kg/person) as shown in Table 2.

The key concern about plastic production and consumption rate is the rising volume of the world’s plastic waste which is estimated to reach 111 million metric tons by 2030 (EcoWatch, 2018) due to the constant growth in the demand and supply of plastic as part of everyday life across the world. With this foreseen state of affairs, it is therefore paramount that sustainable and efficient ways of managing plastic waste are adopted, developed and utilized in contemporary societies. This is very important in ensuring that every country develops the needed technical and vocational capacities to manage plastic waste sustainably and without relying on another country for plastic waste management (PWM) assistance. To be sure that this thinking is not misplaced, China who is popularly known as the largest importer and user of global plastic waste has placed stringent policies on plastic waste importation into the country since 2017 (Brooks et al., 2018). This tactical shift in plastic waste trade by the Chinese government demonstrates that it is sensible for every country to develop a strategic way of dealing with the issue of plastic waste generation. Although there are effective national plastic waste collection systems and mandatory policies for the utilization of recycled plastic waste for closed-loop recycling in bottles, sheets, fibres, and other marketable products in most developed countries (i.e. Germany, Belgium, Netherlands, Japan, China, Canada, UK and the USA), rather unfortunately, many developing countries are yet to efficiently take such steps, which consequently makes governments’ decision on how to deal with the growing plastic bottle waste a big challenge. To substantiate this statement, the data on plastic waste generation and the share of plastic waste inadequately managed in Africa for the year 2010 was extracted from Jambeck et al. (2015) & World Bank (2015) and presented in Table 3.

An inference that can be made from Table 3 above is that a greater proportion of the plastic waste generated in Africa is inadequately managed. This scenario perhaps is the reason why Africa is ranked second to South East Asia in terms of plastic waste pollution in the world (Bafana, 2018; Butterworth, 2016). The information in Table 3 also supports the report that the available recycling and waste management facilities in African counties do not have enough capacity to deal with the volume of plastic waste production in Africa (Adbulkarim & Abiodun, 2012; Eneh, 2015; Nwachukwu et al., 2013; Sojobi et al., 2016). Thus, a greater proportion of the plastic waste generated in Africa ends up in landfills, the ocean or being incinerated, which has detrimental effects on the global environment, plants, animals and humans’ well-being. For a context, a majority of the social and physical problems (such as erosion, flooding, and pollution, loss of biodiversity, drainage blockage, and health issues) in most African countries have been attributed to the improper handling of solid waste, which includes plastic waste (Adbulkarim & Abiodun, 2012; Bafana, 2018; Butterworth, 2016; Eneh, 2015; Nwachukwu et al., 2013; Sojobi et al., 2016; Solaja et al., 2017). This situation prompted a number of environmental experts to predict that

| Table 2. Global Consumption of Plastic Material by Region 1980–2015 (In kg/person) |
|----------------------------------|--------|--------|--------|
| **Category**                      | **1980** | **2005** | **2015** |
| NAFTA                            | 46     | 105    | 139    |
| Western Europe                   | 40     | 99     | 136    |
| Japan                            | 50     | 89     | 108    |
| Central Europe & CIS             | 9      | 24     | 48     |
| Asia (Excluding Japan)           | 2      | 20     | 36     |
| Middle East & Africa             | 3      | 10     | 16     |

Source: Adapted from www.plasticsinsight.com
Africa will be the worst plastic polluted continent by 2050 if efficient plastic waste management efforts are not deployed urgently (Bafana, 2018; Butterworth, 2016).

In an effort to salvage this phenomenon from escalating into complex social problems, some countries, especially Kenya and Uganda, in the East African Community (EAC) placed a ban on the

| S/N | Country              | Plastic Waste Generation (in tonnes) per year | Share of plastic inadequately managed (in %) for the year 2010 |
|-----|----------------------|-----------------------------------------------|-------------------------------------------------------------|
| 1   | Algeria              | 1,898,343                                     | 45                                                          |
| 2   | Angola               | 528,843                                       | 71                                                          |
| 3   | Benin                | 144,382                                       | 83                                                          |
| 4   | Cameroon             | 335,305                                       | 81                                                          |
| 5   | Cape Verde           | 11,919                                        | 74                                                          |
| 6   | Congo                |                                               | 77                                                          |
| 7   | Cote d’Ivoire        | 766,988                                       | 82                                                          |
| 8   | Democratic Rep. of Congo | 1,059,795                               | 85                                                          |
| 9   | Djibouti             | 31,999                                        | 73                                                          |
| 10  | Egypt                | 5,464,471                                     | 67                                                          |
| 11  | Equatorial Guinea    | 49,990                                        | 30                                                          |
| 12  | Eritrea              | 72,120                                        | 77                                                          |
| 13  | Gabon                | 32,329                                        | 34                                                          |
| 14  | Gambia               | 29,646                                        | 84                                                          |
| 15  | Ghana                | 357,877                                       | 81                                                          |
| 16  | Guinea               | 118,196                                       | 84                                                          |
| 17  | Guinea-Bissau        | 30,666                                        | 83                                                          |
| 18  | Kenya                | 407,506                                       | 83                                                          |
| 19  | Liberia              | 121,050                                       | 84                                                          |
| 20  | Libya                | 324,250                                       | 23                                                          |
| 21  | Madagascar           | 123,526                                       | 84                                                          |
| 22  | Mauritania           | 52,987                                        | 82                                                          |
| 23  | Mauritius            | 104,971                                       | 51                                                          |
| 24  | Morocco              | 863,555                                       | 66                                                          |
| 25  | Mozambique           | 132,612                                       | 84                                                          |
| 26  | Namibia              | 114,222                                       | 66                                                          |
| 27  | Nigeria              | 5,961,750                                     | 81                                                          |
| 28  | Senegal              | 485,586                                       | 82                                                          |
| 29  | Seychelles           | 11,730                                        | 37                                                          |
| 30  | Sierra Leone         | 96,655                                        | 84                                                          |
| 31  | Somalia              | 237,569                                       | 85                                                          |
| 32  | South Africa         | 4,465,798                                     | 54                                                          |
| 33  | Sudan                | 1,292,740                                     | 80                                                          |
| 34  | Tanzania             | 386,998                                       | 84                                                          |
| 35  | Togo                 | 135,294                                       | 84                                                          |
| 36  | Tunisia              | 559,235                                       | 60                                                          |

Source: Jambeck et al. (2015) & World Bank (2015).
use of plastic carrier bags (Eneh, 2015). However, the on-going arguments on whether a plastic bag ban will actually fix Africa’s plastic waste problem (Butterworth, 2016); has made other African countries, including Nigeria, embark on a constant search for workable solutions that will help to address the challenge of plastic waste generation rather than placing a restriction on plastic consumption. In this context, one of the workable solutions to the plastic waste problem and housing challenge in Nigeria is the introduction of recycled plastic bottles (RPBs) built homes by the Eco-Tech Environmental Solution- a non-governmental organization founded in 1991 by Andreas Froese- a German environmentalist (http://www.ecotecenvironmental.com).

In the year 2011, Eco-Tech utilized eight thousand five hundred recycled plastic bottles in the construction of a two-bedroom bungalow in Yelwa, Kaduna State, Nigeria, which is also the first African green building (Rawat & Kansal, 2014; Shoubi et al., 2013). This innovation is considered a boost to the plan of providing affordable housing for the Nigerian populace by 2030. Evidently, the use of recycled plastic bottles (RPBs) for a sustainable housing project has been noted by scholars such as Shoubi et al. (2013), Rawat and Kansal (2014), Pati et al. (2016), and Bredenoord (2017) involving several processes starting from the collection of disposed plastic bottles, collection and screening of sand, filling of the collected plastic bottles with sand, sealing of the filled plastic bottles, linking together the plastic bottles at the neck by an intricate network of string, to the laying of the plastic bottles with a combination of mud and cement to construct a building. These processes are well-captured and demonstrated in the images extracted from https://www.pinterest.com/pin/447193437970046608/ as shown in Figures 1, 2, and 3.

Moreover, some scholars also argued that RPBs significantly reduced the risks associated with the end-of-life phase of plastic production and consumption in locations where RPB built homes had been embraced by the government and non-governmental organizations (Bredenoord, 2017; Pati et al., 2016; Rawat & Kansal, 2014; Shoubi et al., 2013). Based on this momentum, this study examined the knowledge and practice of the use of recycled plastic bottles (RPBs) for a sustainable community-based housing project in Ogun State, Nigeria. The specific objectives of the study are to;

(i) Ascertain the level of knowledge about RPB built homes among residents of urban and semi-urban areas in Ogun State, Nigeria
(ii) Examine the practice of RPB built homes among residents of urban and semi-urban areas in Ogun State, Nigeria
(iii) Examine the challenges of RPB built homes in Ogun State, Nigeria
(iv) Document the prospects of RPB built homes in a community-based housing project in Ogun State, Nigeria

Figure 1. Showing the laying of plastic bottle bricks in house construction.
Theoretical exposition

There are several theories that focus on the topic of the knowledge and practices of eco-friendly innovations over the last few decades. However, this study aimed to apply two of the more popular theories that give a full understanding of the factors influencing knowledge and practice combined.

Diffusion of Innovation theory

The Diffusion of Innovation (DOI) perspective has its origin in the theoretical production of Rogers (2003) who sought to explain how, why, and at what degree an innovation will be shared and adopted by other individuals and organizations across regions or geographical boundaries. According to Rogers, innovation is an idea, practice, or object that is perceived as a novel by an individual, group of individuals or other social units of adoption. The innovation-decision process, according to Rogers, is the process through which an individual (or other decision-making units) passes from the first knowledge of an innovation to forming an attitude toward the innovation, to deciding to adopt or reject, to implementing the idea, and to confirming this decision. Hence, the DOI theory holds that available information about the innovation itself, communication channel(s), time/period and the structure of the social system is essential in the innovation-decision process.
Based on the theoretical postulation of DOI, we can suggest that the knowledge and practices of the use of recycled plastic bottles in building affordable and eco-friendly homes in Nigeria depend largely on the function of the four influential components (innovation, communication channel, time and social system). These components may facilitate the quick acceptance and even practice of the use of plastic bottles for green building or otherwise. The DOI also affirms that there are five different categories of innovation adopters, which include the innovator (the first group of people to adopt, use or practice new innovation because they are the originators of such innovation); the early adopter (the second quickest category of innovation adopters); the early majority (the category of adopters who accept an innovation after a varying degree of time); the late majority (the category of people who decide to adopt an innovation after the average members of the society have adopted the innovation) and the laggards (the category of adopters who adopt an innovation after other categories of adopters have adopted the innovation). However, the inability of the diffusion of innovation theory to recognize the influence of behavioural factors on the knowledge and practices of green building or sustainable construction leads us to the behavioural change theory.

1.3. Behavioural Change Theory (BCT)

The Behavioural Change Theory focuses on the environmental, personal and behavioural characteristics that help to explain the nuances surrounding human behavioural change in a particular given situation, time and space (Ajzen, 1991; Bandura, 1986; Sharma & Romas, 2012). According to BCT, behaviour change is a process that unfolds over time through a sequence of stages bordering on individual attitude (beliefs and values about the outcome of the behaviour) and subjective norms (beliefs about what other people think the person should do or general social pressure). In this direction, BCT emphasized that behavioural change is a stable and open process in which not all the behavioural factors of a person can be changed. This postulation suggests that there are driving forces that facilitate changes in human behaviour as well as inhibiting forces that hinder changes in human behaviour. Consequently, Hruschka (1994) noted that the inhibiting forces for innovation adoption might include, for instance, lack of subsidies, corruption, poor environmental regulation, lack of machinery, and limited knowledge. Conversely, driving forces or forces conducive to a positive target might include, for example, financial assistance, technical advice, training, provision of inputs, and linkage with market outlets. On the whole, BCT proposes five stages (rejection, acceptance, behaviour modification, adoption, and implementation) which the behavioural change process must undergo. This means that the knowledge and practice of recycled plastic bottles built homes reflects that the people have transcended above the inhibiting forces.

2. Methodology

2.1. Research design

The study employed a descriptive design in which both quantitative and qualitative methods were used. The combined survey was chosen in order to explain the relationship between the variables under study.

2.2. Study area

The study was located in the semi-urban and urban areas of Ogun State, Nigeria. Ogun State is among the six states of south-western Nigeria. Ogun State was created in 1976 from the former Western region of Nigeria. It shares boundaries with Lagos State to the south, Oyo and Osun state to the north, Ondo State to the east and the Republic of Benin to the west. The 2006 census recorded a total population of 3,751,140 residents (NPC, 2006). Ogun State consists of twenty (20) Local Government Areas. Abeokuta is the capital and largest city in Ogun state. Other urban and semi-urban areas in Ogun State are Ijebu Ode, Sagamu, Ijebu Igbo, and Ota. The rationale for selecting these areas in Ogun State, Nigeria for the study area is based on the population, urbanization, housing as well as environmental challenges.

2.3. The population of the study

The population of this study includes the entire residents in the selected semi-urban and urban areas (Abeokuta, Ijebu Ode, Sagamu, Ijebu Igbo, and Sango-Ota) of Ogun State, Nigeria. The total population of the study is 1,307,179 (NPC, 2006).
2.4. Sampling size and techniques
In determining the sample size, an online sample size calculator developed by Raosoft (2004) was used at 5% confidence interval, and three hundred and eighty-five (385) respondents were obtained as the sample size. Based on the variation of the study area population, the table 4 below presents the sample size distribution.

The sampling technique for this study involved multi-stage sampling. This comprises the purposive, cluster, convenience and quota sampling techniques. Purposive sampling was used in selecting the study location as well as the semi-urban and urban areas in Ogun State, Nigeria. Cluster sampling was used to select strategic locations for the study. Furthermore, convenience sampling was used to select respondents in the study locations. The use of convenience sampling was based on the nature of the study which is a household survey. The number of respondents selected for the survey in each location was based on quota sampling. This technique was also used to select population categories such as civil engineers, students, landlords, teachers, and so on. Furthermore, purposive sampling was used to select participants for in-depth interviews.

| S/N | Selected Semi-urban and Urban Areas | Sample Size |
|-----|-------------------------------------|-------------|
| 1   | Abeokuta                            | 133         |
| 2   | Ijebu-Ode                           | 45          |
| 3   | Ijebu-Igbo                          | 84          |
| 4   | Sagamu                              | 75          |
| 5   | Sango-Ota                           | 48          |
|     | Total                               | 385         |

Source: Field Survey, 2018.

2.5. Method of data collection
The needed data was obtained through a primary source which involved the use of both a questionnaire and in-depth interviews (IDIs). The consideration for combining both the questionnaire and the in-depth interview is to fully capture the phenomena under study. The questionnaire consists of questions with options from which respondents are expected to pick responses as applicable (close-ended) as well as questions which allow respondents to freely express their opinion(s) on the subject matter (open-ended). In addition, thirty per cent of the questions is open-ended, while seventy per cent are closed-ended questions. Also, in-depth interviews with an average length of 15 minutes were conducted among some selected respondents. An interview guide containing a set of questions relating to the subject matter was used to keep the conversation focused on the subject matter while giving the interviewee room to freely express their perception on the content of the discussion. The interview guide variables were subjected to face and content validity.

2.6. Method of data analysis
The data collected were subjected to descriptive statistics (percentage and frequency distribution), mean score as well as qualitative content analysis to complement the survey findings.

2.7. Ethical consideration
Ethical consideration was emphasized throughout the fieldwork. First, respondents were educated about the essence of the study and its expected outcomes. Second, the participation of respondents in the study was based on informed and voluntary consent. The respondents were at liberty to discontinue their participation at any point during the exercise, their confidentiality and opinions regarding questions were fully respected.
3. Results
This section presents the data collected in the course of the fieldwork. A total of 385 copies of the questionnaire were administered out of which 19 were not duly completed hence; 366 copies of the questionnaire and 10 in-depth interviews were used in the study. Table 5 presents the socio-demographic profile of the respondents. Variables of interests include sex, age, marital status, educational qualification and place of residence. The sex distribution showed that a majority (56.6%) of the respondents were male, while 43.4% were female. The age distribution revealed that almost half (45.0%) of the respondents were 38 years and above, 19.9% were within the age bracket, 33–37 years, 16.7% were within the age bracket, 23–27 years, 13.4% were within the age bracket, 28–32 years and 5.0% were within the age bracket, 18–22 years.

Furthermore, the marital status of the respondents as depicted in Table 5 showed that a majority (57.6%) were married, 24.1% were widowed, and 11.2% were divorced, while 7.1% were singles as at the time of the survey. The educational qualification distribution revealed that all the respondents had at least primary education. Hence, all the respondents had a certain level of formal education, were literate, and could read and write. In addition, the majority (69.2%) of the respondents reside in urban areas, while 30.8% were from semi-urban suburbs.

Going by the thrust of this research, it becomes expedient to examine the knowledge of the respondents in relation to the use of recycled plastic bottles (RPBs) for sustainable construction as well as a housing project. In this regard, Table 6 below encloses the responses of the respondents on the knowledge of recycled plastic bottles (RPBs) built homes in Ogun State, Nigeria.

### Table 5. Socio-demographic characteristics of the respondents

| Variables                  | Frequency | Percentage (%) |
|----------------------------|-----------|----------------|
| Sex                        |           |                |
| Male                       | 207       | 56.6           |
| Female                     | 159       | 43.4           |
| Total                      | 366       | 100.0          |
| Age                        |           |                |
| 18–22 yrs                  | 18        | 5.0            |
| 23–27 yrs                  | 61        | 16.7           |
| 28–32 yrs                  | 49        | 13.4           |
| 33–37 yrs                  | 73        | 19.9           |
| 38 yrs and above           | 165       | 45.0           |
| Total                      | 366       | 100.0          |
| Marital Status             |           |                |
| Single                     | 26        | 7.1            |
| Married                    | 211       | 57.6           |
| Divorced                   | 41        | 11.2           |
| Widowed                    | 88        | 24.1           |
| Total                      | 366       | 100.0          |
| Educational Qualification  |           |                |
| Primary Education          | 51        | 13.9           |
| Secondary Education        | 122       | 33.3           |
| NCE/Diploma                | 63        | 17.2           |
| B.Sc/HND                   | 86        | 23.5           |
| M.Sc/MBA/professional qualification | 33       | 9.1            |
| P.hD                       | 366       | 100.0          |
| Usual Place of Residence   |           |                |
| Semi-Urban                 | 113       | 30.8           |
| Urban                      | 253       | 69.2           |
| Total                      | 366       | 100.0          |

Source: Field Survey, 2018.
The information presented in Table 6 shows that 77.3% of the respondents have heard about RPBs built homes before, while only 22.7% have never heard about it. Thus, it can be deduced that a majority of the respondents are aware of the use of RPBs for sustainable construction; however, there is still a need for more information dissemination about the subject matter. To buttress this point an interviewee affirmed that:

The use of plastic bottles to build sustainable homes is a relatively new innovation that is replacing the use of blocks in a housing project in Africa. The first African plastic bottle house was built in Yelwa village in Kaduna State, Nigeria in 2011 by the Eco-Tech Environmental Solutions, however, the spread of recycled plastic bottle built homes in Ogun State, Nigeria is somewhat slow due to the low level of awareness, education and information (IDI/Civil Engineer/Abeokuta/2018).

In a similar perspective, another respondent stated that:

| Have you heard about recycled plastic bottles built homes before? | Frequency | Percentage |
|---------------------------------------------------------------|-----------|------------|
| Yes                                                           | 283       | 77.3       |
| No                                                            | 83        | 22.7       |
| Total                                                         | 366       | 100.0      |

| How long have you heard about RPBs?                          | Frequency | Percentage |
|--------------------------------------------------------------|-----------|------------|
| Less than a year                                             | 217       | 76.7       |
| 1–5 years                                                    | 53        | 18.7       |
| 6 years and above                                            | 12        | 4.2        |
| Total                                                        | 283       | 100.0      |

| How did you know about RPBs built homes? Please tick as many as may apply. | Frequency | Percentage |
|---------------------------------------------------------------------------|-----------|------------|
| a) From friends, colleagues, and relatives                               | 58        | 20.5       |
| b) From the newspaper, radio, television or internet                      | 107       | 37.8       |
| c) From civil engineers, government officials, NGOs etc.                 | 51        | 18.0       |
| d) From school or educational institutions                                | 44        | 15.6       |
| e) From personal observation or research                                  | 23        | 8.1        |
| Total                                                                     | 283       | 100.0      |

| What is your level of knowledge on RPBs built homes?                 | Frequency | Percentage |
|---------------------------------------------------------------------|-----------|------------|
| a. Poor                                                             | 79        | 27.9       |
| b. Average                                                          | 112       | 39.6       |
| c. Good                                                             | 69        | 24.4       |
| d. Excellent                                                        | 23        | 8.1        |
| Total                                                               | 283       | 100.0      |

| Do you have enough education and training on RPBs built homes in Nigeria? | Frequency | Percentage |
|------------------------------------------------------------------------|-----------|------------|
| Yes                                                                    | 58        | 20.5       |
| No                                                                     | 225       | 79.5       |
| Total                                                                  | 283       | 100.0      |

Source: Field Survey, 2018.
The idea of building a house with recycled plastic bottles is still developing in Nigeria because many Nigerians are yet to know about the methods and techniques involved in the process ... there should be more education, training and public awareness on how to use recycled plastic bottles for housing as well as other construction activities (IDI/respondent/2018).

The statement above attests to the fact that the use of recycled plastic bottles in green building construction is a welcome innovation; however, there is an urgent need to promote the knowledge and practice of the innovation in Ogun State, Nigeria. Besides that, about 76.7% of those who indicated that they knew about the use of RPBs for green construction simultaneously claimed that they got to know about the innovation less than a year ago, while 23.3% confirmed that they got to know about the innovation more than a year ago, as at the time of conducting the study. This finding buttresses the fact that the use of recycled plastic bottles as a sustainable building material is still at the infant stage in Nigeria. It also shows that there is increasing sustainable environmental education in the study area.

Furthermore, the result in Table 6 revealed that 20.6% of the respondents got to know about RPBs built homes through their interaction with friends, colleagues and relatives; 37.8% got to know about it through the mass media (i.e. newspaper, radio, television and internet); 18.0% affirmed that they got to know about it through their relationship with civil engineers, government officials, and non-governmental organizations; 15.6% said they got to know about it through school activities or educational institutions; while 8.1% disclosed that they got to know about it through their personal observation and research. Hence, it can be inferred that the respondents heard about RPBs built homes from different sources of information gathering. To reinforce this assertion, one of the interviewees confidently stated that:

There are many sources of information dissemination (such as newspaper, radio, television, public seminars and interaction with friends) from which I have heard about the use of recycled plastic bottles for housing and other construction activities for more than a year now (IDI/respondent/2018).

Also, respondents were asked to rate their level of knowledge of RPBs built homes to which a majority (39.6%) of them responded average; while only a few (8.1%) claimed to have an excellent level of knowledge of RPBs built homes. Thus, there is a need for more awareness programmes, education, training and development on the use of RPBs for an affordable housing project. To support this assertion, a majority (79.5%) of the respondents disclosed that they don’t have adequate education and training on the use of RPBs in sustainable construction activities and housing projects in Nigeria, while only a few (20.5%) disputed this. Corroborative, an interviewee succinctly disclosed that:

... what I think is required to encourage the use of recycled plastic bottles for sustainable construction in Ogun State Nigeria is building technical knowledge and skills through proactive vocational education and training on the innovation (IDI/respondent/2018).

Similarly, another interviewee who seems to have in-depth knowledge about construction activities affirmed that:

Honestly speaking, the use of recycled plastic bottles in construction activities has increased globally. For instance, countries like China, India, Malaysia, Egypt and many other developing countries had increased the rate at which they utilized plastic bottle bricks in buildings and structures. However, the use of plastic bricks is still very low in Nigeria despite the fact that there are hundreds of thousands of plastic bottles littering the street corners, drainages, ocean bodies and dumpsites ... I think the reason for this underdevelopment can be partly linked with the problem of lack of sufficient trained and experienced civil engineers, building contractors and project management experts (IDI/respondent/2018).
From the above information, it could be inferred that the knowledge of the use of recycled plastic bottles (RPBs) for a sustainable housing project in Nigeria is somewhat low due to the lack of adequate public awareness, education, information, technical and human skills to foster the application of plastic bottle bricks for green construction and housing projects. Also, it can be gathered that the idea of using recycled plastic bottles for construction, particularly for housing, is relatively new and also commonly accepted in Ogun State, Nigeria, as depicted by the majority of the respondents. Moreover, the information on the respondents’ views on the practice of recycled plastic bottles (RPBs) built homes in Ogun State, Nigeria is presented in Table 7.

The information shows that a majority (62.0%) of the respondents disclosed that they have seen RPBs construction before, while 38.0% have not. Out of the respondents who claimed to have seen RPBs constructions, 17.6% said that they have seen the use of RPBs for walls, fences and pavements construction; 15.9% confirmed that they have seen the use of RPBs for window frames; 22.5% affirmed that they have seen the use of RPBs in bridges and roads construction, and 27.7% posited that they have seen the use of RPBs in the construction of buildings and houses, while 16.3% noted that they have seen RPBs used for street decorations in Ogun State, Nigeria. Hence, the bulk of the respondents have seen the application and utilization of RPBs for sustainable construction and green building. This assertion can be corroborated by the responses of the interviewees. For instance, an interviewee stated:

| Table 7. Practice of RPBs built homes in Ogun State, Nigeria |
|---------------------------------------------------------------|
| Have you seen any RPBs construction before? | Frequency | Percentage |
| Yes | 227 | 62.0 |
| No | 139 | 38.0 |
| Total | 366 | 100.0 |

| Which of the following RPBs construction have you seen before? | Frequency | Percentage |
|---------------------------------------------------------------|-----------|------------|
| (a) Walls, Fences and Pavements | 40 | 17.6 |
| (b) Window frame | 36 | 15.9 |
| (c) Bridges and Roads | 51 | 22.5 |
| (d) Buildings | 63 | 27.7 |
| (e) Street decorations | 37 | 16.3 |
| Total | 227 | 100.0 |

| Is there any RPBs built home in your current neighbourhood? | Frequency | Percentage |
|---------------------------------------------------------------|-----------|------------|
| Yes | 99 | 43.6 |
| No | 128 | 56.4 |
| Total | 227 | 100.0 |

| How would you rate the practice of RPBs built homes in your neighbourhood? | Frequency | Percentage |
|-----------------------------------------------------------------------------|-----------|------------|
| Very Frequent | 12 | 5.3 |
| Frequent | 39 | 17.2 |
| Occasionally | 102 | 44.9 |
| Never | 74 | 32.6 |
| Total | 227 | 100.0 |

| Do you have an intention of using RPBs for a housing project | Frequency | Percentage |
|----------------------------------------------------------------|-----------|------------|
| Yes | 166 | 73.1 |
| No | 61 | 26.9 |
| Total | 227 | 100.0 |

Source: Field Survey, 2018.
Recycled plastic bottles can be used as a sustainable material in construction activities. For instance, RPBs help to improve the properties of bituminous asphaltic concrete, coarse aggregates and supplementary cementing materials for road construction (IDI/respondent/2018).

Another interviewee affirmed that:

Yes, recycled plastic bottles are used for street decorations, especially during carnivals or festive periods. They are also used for constructing walls and fences for gardens and buildings ... at least I have seen things like that in some places in Nigeria (IDI/respondent/2018).

Further discussion with an interviewee confirmed that:

PET bottles are now being recycled and converted to plastic bricks which are later used for constructing homes, bridges and other sustainable structures in some places in Nigeria ... I have also visited the plastic house built in Yelwa to see how recycled plastic bottles are converted to bricks and they are eventually used for construction (IDI/respondent/2018).

The majority (56.4%) of the respondents indicated that there are no RPBs built homes in their current neighbourhoods, while only 43.6% were of a contrary view. This result simply means that some of the respondents had seen RPBs built homes before moving to their current neighbourhoods or they saw RPBs built homes outside their immediate neighbourhoods. It is also highly probable that some of the respondents might have seen RPBs built homes through social and mass media platforms. This submission can be supported by the response of an interviewee during one of the interview sessions;

I only saw the use of plastic bottles for construction activities on the television, newspaper and social media platform ... I am yet to see such innovation with my bare eyes (IDI/respondent/2018).

In addition, a majority (44.9%) of the respondents affirmed that the practice of RPBs built homes in their neighbourhoods is occasional; 32.6% claimed that the practice of RPBs built homes has never occurred in their neighbourhood; 17.2% said that the practice of RPBs built homes is frequent in their neighbourhood, while 5.3% disclosed that the practice of RPBs built homes is very frequent in their neighbourhood. Thus, we can deduce that the practice of RPBs built homes in the study area is abysmally low. Also, the majority (73.1%) of the respondents confirmed that they have the intention of using RPBs for a housing project, while others (26.9%) said the opposite. In addition, the perceived benefits of recycled plastic bottles built homes are shown in Table 8.

Table 8 depicts the level of agreement and the mean point on the perceived benefits of RPBs built homes in Ogun State, Nigeria. The result revealed that the perception that RPBs built homes last longer than the homes built with conventional bricks has the highest mean point of 4.14, followed by the understanding that RPBs built homes mitigate environmental pollution with a mean score of 3.98. Next to that is the perception that RPBs built homes are weather friendly or bioclimatic (4.05). The rest is that: RPBs built homes reduce construction cost (3.94); RPBs built homes are energy efficient (3.84); RPBs built homes are easy to build (3.78); and RPBs built homes help to save the time of building execution, with a mean score of 3.71. Therefore, it can be inferred that most of the respondents are very familiar with the benefits associated with recycled plastic bottles (RPBs) built homes. This is also evident in the respondents' views during the interview sessions, for example, an interviewee affirmed that:

There are lots of benefits that are attached to the use of recycled plastic bottles for a housing project. One of the benefits that I know is that it reduces the volume of plastic waste and environmental pollution in Ogun State, Nigeria (IDI/respondent/2018).
## Table 8. Perceived benefits of RPBs built homes in Ogun State, Nigeria

| Questions                                                                 | Level of Agreement | Mean |
|---------------------------------------------------------------------------|--------------------|------|
|                                                                           | SD F (%)           |      |
| RPBs built homes help to save the time of building execution             | 40 (14.1)          |      |
|                                                                           | D F (%)            |      |
|                                                                           | 23 (8.2)           |      |
|                                                                           | U F (%)            |      |
|                                                                           | 19 (6.7)           |      |
|                                                                           | A F (%)            |      |
|                                                                           | 98 (34.6)          |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 103 (36.4)         |      |
|                                                                           |                   | 3.71 |
| RPBs built homes are weather friendly or biodimatic                       | 11 (3.9)           |      |
|                                                                           | D F (%)            |      |
|                                                                           | 35 (12.4)          |      |
|                                                                           | U F (%)            |      |
|                                                                           | 09 (3.2)           |      |
|                                                                           | A F (%)            |      |
|                                                                           | 101 (35.7)         |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 127 (44.9)         |      |
|                                                                           |                   | 4.05 |
| RPBs built homes last longer than the ones built with conventional bricks | 06 (2.1)           |      |
|                                                                           | D F (%)            |      |
|                                                                           | 08 (2.8)           |      |
|                                                                           | U F (%)            |      |
|                                                                           | 14 (4.9)           |      |
|                                                                           | A F (%)            |      |
|                                                                           | 166 (58.7)         |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 89 (31.5)          |      |
|                                                                           |                   | 4.14 |
| RPBs built homes reduce construction costs                                | 27 (9.5)           |      |
|                                                                           | D F (%)            |      |
|                                                                           | 12 (4.2)           |      |
|                                                                           | U F (%)            |      |
|                                                                           | 35 (12.4)          |      |
|                                                                           | A F (%)            |      |
|                                                                           | 87 (30.7)          |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 122 (43.1)         |      |
|                                                                           |                   | 3.94 |
| RPBs built homes mitigate environmental pollution                         | 13 (4.9)           |      |
|                                                                           | D F (%)            |      |
|                                                                           | 19 (6.7)           |      |
|                                                                           | U F (%)            |      |
|                                                                           | 21 (7.4)           |      |
|                                                                           | A F (%)            |      |
|                                                                           | 139 (49.1)         |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 91 (32.2)          |      |
|                                                                           |                   | 3.98 |
| RPBs built homes are energy efficient                                     | 36 (12.7)          |      |
|                                                                           | D F (%)            |      |
|                                                                           | 24 (8.5)           |      |
|                                                                           | U F (%)            |      |
|                                                                           | 19 (6.7)           |      |
|                                                                           | A F (%)            |      |
|                                                                           | 73 (25.8)          |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 131 (46.3)         |      |
|                                                                           |                   | 3.84 |
| RPBs built homes are easy to build                                        | 22 (7.8)           |      |
|                                                                           | D F (%)            |      |
|                                                                           | 45 (15.9)          |      |
|                                                                           | U F (%)            |      |
|                                                                           | 11 (3.9)           |      |
|                                                                           | A F (%)            |      |
|                                                                           | 101 (35.7)         |      |
|                                                                           | SA F (%)           |      |
|                                                                           | 104 (36.7)         |      |
|                                                                           |                   | 3.78 |

Source: Field Survey, 2018.
Another interviewee said:

Recycled plastic bottles built homes are affordable, durable and environmentally compatible, time as well as energy-efficient (IDI/respondent/2018).

In addition to the views above, an interviewee affirmed that:

The use of plastic bottles as innovative materials for green building serves as an alternative to conventional materials (IDI/respondent/2018).

Arising from the responses above, it is clear that a majority of the respondents are familiar with some of the benefits and prospects of using recycled plastic bottles as sustainable construction material and green building in Nigeria. However, the Nigerian experience may not be as that of countries like Malaysia, China, India and Egypt where there has been increased application and utilization of recycled plastic bottles for sustainable construction activities. In this context, Table 9 also showed the perception of the respondents on the challenges of RPBs built homes in Ogun State, Nigeria.

The mean score results in Table 9 showed that insufficient human and technical capacity of the construction sector has the highest mean point of 4.29; followed by low level of knowledge and information on RPBs built homes (4.24); lack of adequate public awareness and education on RPBs built homes (4.07); paucity of research into sustainable construction and green building (3.76); low interest in the sustainability issue (3.63); unstable economic condition (3.60); stress of collecting and filling recycled plastic bottles with sand (3.05); and resistance to eco-friendly innovation with the least mean point of 2.92. This result tallies with the responses of the interviewees, evidenced by this interviewee’s statement:

... what I think is required to encourage the use of recycled plastic bottles for sustainable construction ... is building technical knowledge and skills through proactive vocational education and training on the innovation (IDI/respondent/2018).

Similarly, another interviewee corroborates the view by identifying:

... the problem of lack of sufficient trained and experienced civil engineers, building contractors and project management experts (IDI/respondent/2018).

In addition, one can deduce that majority of the respondents perceived that some factors (i.e. technical know-how, experienced personnel, and education and research, willingness, socio-cultural as well as an economic condition) hinder the practice and knowledge of RPBs built homes in Nigeria.

3.1. Theoretical discussion of findings

The theoretical postulations of the diffusion of innovation (DOI) theory, the technology-organization-environment (TOE) framework as well as the behavioural change theory (BCT) process can be understood in the context of the research findings. According to the findings of the study, the idea of using recycled plastic bottles for construction, particularly for green building is an innovation that is presently spreading across Nigeria and other developing countries of the world. Although the innovation is well-accepted because of it’s socio-economic, environmental and health benefits in Nigeria, the knowledge about the innovation is, however, is hindered by factors like inadequate public awareness, education, information, and technical and human skills to foster the application of plastic bottle bricks for green construction and housing projects. Hence, the practice of RPB built homes in Nigeria is at the infant or starter stage as revealed by the majority of the respondents. The theoretical knowledge that can be inferred from this reality is that the practice and knowledge of RPB built homes in Nigeria are likely to be found within the early
| Questions                                                                 | Mean | Level of Agreement |
|--------------------------------------------------------------------------|------|--------------------|
| Insufficient human and technical capacity of the construction sector     | 146(51.6) | A (41.0) |
| Unstable economic condition                                              | 155(54.8) | A (41.0) |
| Low level of knowledge and information                                   | 155(54.8) | A (41.0) |
| Low interest in the sustainability issue                                 | 155(54.8) | A (41.0) |
| Resistance to eco-friendly innovation                                    | 155(54.8) | A (41.0) |
| Resistance to eco-friendly innovation                                    | 155(54.8) | A (41.0) |
| Resistance to eco-friendly innovation                                    | 155(54.8) | A (41.0) |
| Resistance to eco-friendly innovation                                    | 155(54.8) | A (41.0) |
| Resistance to eco-friendly innovation                                    | 155(54.8) | A (41.0) |
| Resistance to eco-friendly innovation                                    | 155(54.8) | A (41.0) |

Source: Field Survey, 2018.

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majority and late majority innovation adopters (Rogers, 2003). This position further suggests that the majority of the people in Nigeria are slow in adopting new innovations and practices due to the observed inhibiting factors.

This phenomenon can also be situated within the purview of the Behavioural Change Theory (BCT) assumption that individuals or corporate organizations tend to perform certain behaviours which they consider profitable (Ajzen, 1991; Sharma & Romas, 2012). The findings of the study showed that majority of the respondents are currently in the behavioural modification stage (stage 3) of the behavioural change process which reinforces the need to bring about a complete change in the knowledge and practice of RPB built homes. These assumptions also stem from the information gathered from the in-depth interviewees, who revealed that in spite of the benefits of RPB built homes, there are still some challenges or obstacles that make the change in people's behaviour towards sustainable building construction a big challenge in the study areas. This evidence significantly showed that some individuals are yet to shift from conventional building practices towards adopting green or sustainable building practices. In this context, the theory of behavioural change considered those individuals to be at a state of equilibrium—implying that the driving forces and inhibiting factors of embracing green building practices are equal (Ajzen, 1991). Hence, it becomes very essential to challenge this state of affairs by increasing the level of public awareness, education, and training and human capacity development on the use of RPBs for an affordable housing project in Nigeria.

4. Conclusion and recommendations

The challenge of waste management and housing are among the issues of utmost concern in many African countries, Nigeria inclusive. The study has explored the possibilities of addressing the double-barrel problem of plastic waste pollution and the shortage of housing in Nigeria and beyond. The study showed that recycled plastic bottles (RPB) built homes is one of the proactive approaches to addressing the problem of the housing shortage in Nigeria by tightening the budget for a housing project and reducing the environmental impacts of construction as well as plastic waste generation. The study revealed the significance of building with recycled plastic bottles in today's sustainable development era. The study also gave theoretical and methodological insights on the knowledge and practice of sustainable green building and likewise revealed the factors inhibiting its growth as well as the challenges being faced by the stakeholders in its adoption, and the benefits derivable from embracing recycled plastic bottles built homes.

Based on the findings of the study, it was recommended that using plastic bottles in building eco-friendly and affordable homes in Nigeria will serve as an alternative method of annexing the economic potentials of plastic waste to promote social empowerment, training, housing and development, that engender the utilization of indigenous knowledge, innovation, creativity and local resources in accomplishing the goals of sustainable development in Nigeria and beyond.

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References
Abdulkarim, A. I., & Abiodun, O. A. (2012). A study of problems associated with pet bottles generation and disposal in Kano Metropolis. Academic Research International, 3(2), 56–65. http://www.savap.org.pk/journals/ARInt/Vol.3(2)/2012(3.2-06).pdf
Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T
Andrews, E. (2010). New homes to be built from 18 tonnes of recycled plastic. Retrieved October 18, 2018, from http://dailymail.co.uk/sciencetech/article-12534/Newhomes-built-18-tonnes-recycled-plastic.html
Ankeli, I. A., Dobar, I. D., Omothehinshe, J. O., Lawal, O. K., Odeyomi, F. G., & Adebowale, A. P. (2017). Affordable and acceptable mass housing delivery: A The panacea to The Nigeria housing problem. Conference of the International Journal of Arts & Sciences, 10(1), 31–38. https://www.researchgate.net/publication/317598292_AFFORDABLE_AND_ACCEPTABLE_MASS_HOUSING_DELIVERY_A_PANACEA_TO_THE_NIGERIAN_HOUSING_PROBLEM

Ankeli, I. A., Dobar, I. D., Oyeleke, O. O., Joshua, G., & Effuyayo, J. O. (2015). Housing condition and residential property rental values in Ede, Nigeria. Conference of the International Journal of Arts & Sciences, 08(1), 53–61. https://www.researchgate.net/publication/303550791_HOUSING_CONDITION_AND_RESIDENTIAL_PROPERTY_RENTAL_VALUES_IN_EDE_NIGERIA

Bofa, B. (2018) Marine waste is turning the earth into a plastic planet. http://www.ipsnews.net/2018/11/marine-waste-turning-earth-planet/index.html

Bandura, A. (1986). Social foundations of thought and action: A social cognitive theory. Prentice-Hall.

Bredenboord, J. (2017). Sustainable building materials for low-cost housing and the challenges facing their technological developments: Examples and lessons regarding bamboo, earth-block technologies, building blocks of recycled materials, and improved concrete panels. Journal of Architectural Engineering Technology, 6(1), 1–11. https://doi.org/10.4172/2168-9717.1000187

Brooks, A. L., Wang, S., & Jambeck, J. R. (2018). The Chinese import ban and its impact on global plastic waste trade. Science Advances, 4(6), 1–7. https://doi.org/10.1126/sciadv.aat0131

Butterworth, A. (2016). A review of the welfare impact on Pinnipeds of plastic marine debris. Frontiers in Marine Science, 3, 149. https://doi.org/10.3389/fmars.2016.00149

Centre for Affordable Housing Finance in Africa (2018). Housing Finance in Nigeria. Retrieved from http://housingfinanceafrica.org/countries/nigeria/

EcoWatch (2018). 2018: A year of fighting plastic waste https://www.ecowatch.com/2018-fighting-plastic-waste-2624606566.html

Eneh, O. E. A. (2015). Application of recycled plastics and its composites in the built environment. BEST: International Journal of Management, Information Technology and Engineering, 3(3), 9–16. http://doc.player.net/58128441-Aplication-of-recycled-plastics-and-its-composites-in-the-built-environment.html

Gale Group (2008). Solid foundation: The traditional uses of plastics in the building industry. Retrieved November 15, 2018, from http://golith.ecnext.com/coms2/ishi-9199-308451/solid-foundation-the-traditional-uses.html

Geiger, O. (2011). Recycled plastic block houses. Retrieved January 03, 2013, from http://www.motherearthnews.com/hands-on-andhow-to-recycled-plastichouses.aspx

Hruschka, E. (1994). Psychological basis of the consultation process. In H. Albrecht (Ed.), Insight as Agent of Action (pp. 5–24). Margrof Verlag.

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andardy, A., ... Law, K. L. (2015). Plastic waste inputs from land into the ocean. Science, 347 (6223), 768–771. https://doi.org/10.1126/science.1260352

Kharwade, M. A., Poli, H. S., Wagh, E. S., Ban, V. B., & Wade, H. D. (2017). Application of plastic bottle brick in green building construction. International Journal of Advanced Engineering and Research Development, 4(3), 424–429. http://www.ijared.com/papers/finished_papers/Application%20of%20Plastic%20Bottle%20Brick%20in%20Green%20Building%20Construction-IAERDVO410354092.pdf

Kim, S. J. (2011). Europe’s first bridge made from recycled plastic. Retrieved January 03, 2019, from http://www.smartplanet.com/blogs/designarchitecture/europes-first-bridge-made-from-recycled-plastic/1521

Krepcio, T. (2007). Kaleva bottle house. Retrieved March 11, 2011, from http://www.krepcio.com/vitreoosity/archives/bottlehouse/keval/ML.pdf

Kusimwirogi, K. (2011). Investigating the compressive strength of plastic bottles as masonry. An Unpublished report submitted in part requirement for the degree of Bachelor of Environmental Design with Honours, Faculty of the Built Environment, Uganda Martyrs University.

National Bureau of Statistics. (2016). Annual Report and Statistical Bulletin. NBS.

National Population Commission (NPC). (2006). Population and Housing Census. Population distribution by Sex, State, LGA, and Senatorial district. http://www.population.gov.ng/images/Vol%2003%20Table%203%20District-Florida%20-%20DSx%20LGAPop%20by%20SDistrict-PDF.pdf

Olawunmijo, D. O. (2001). Urban Infrastructure: A critique of urban renewal process in Ijora Badia. Habitat International, 25(3), 517–530. doi: 10.1016/S0197-4879(00)00042-4

Olutuah, A. O. (2002). An appraisal of the impact of urban services on housing in Akure Metropolis. Journal of Science, Engineering and Technology, 9(4), 4570–4582. https://www.researchgate.net/publication/280948228_An_Appraisal_of_the_Impact_of_Urban_Services_on_Housing_in_Akure_metropolis

Olujimi, J. A. B., & Bello, M. O. (2008). The effects of infrastructural facilities on the rental values of residential property. Journal of Social Sciences, 5(4), 332–334. https://www.academia.edu/18172623/Effects_of_Infrastructural_Facilities_on_the_Rental_Values_of_Residential_Property

Omobinjini, I. O. (2010, October 6–17): SINA technical workshop on housing co-operatives, Nairobi.

Pati, J. D., Homma, R., & Iki, K. (2016). Proposing the use of plastic bottle waste for low-cost housing under government guidelines in India. American Journal of Engineering Science and Technology Research, 4(1), 1–10. http://www.ajestr.com/AJESTR_Vol.4_No.1_March2016/Proposing.pdf

Raosoft (2004) Raosoft sample size calculator. Raosoft, Inc., Seattle. http://www.raosoft.com/samplesize.html

Rawat, S. A., & Kansal, R. (2014). PET bottles as sustainable building material: A step towards green building construction. Journal of Civil Engineering and Environmental Technology, 16(1), 1–3. https://www.krishianskriti.org/vol_image/03Jul20150307363.pdf

Reffat, R. (2004). Sustainable Construction in Developing Countries. In Proceeding of First Architectural
Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Saxena, S., & Singh, M. (2013). Eco-architecture: PET bottle houses. *International Journal of Scientific Engineering and Technology*, 2(12), 1243–1246. https://pdfs.semanticscholar.org/2152/64714dd39bb9c9b4ebcd5b721ff017fe9.pdf

Schwartz, A. (2008). Recycled plastic building material could replace concrete, steel and timber. Retrieved September 25, 2018, from http://cleantechnica.com/2008/10/23/recycled-plastic-building-material-could-replace-concrete-steel-and-timber

Seltzer, D. J. (2000a). Bottle houses. Retrieved March 11, 2011, from http://www.agilitynut.com/h/otherbh.html

Seltzer, D. J. (2000b). William F. Peck’s bottle house, [photograph]. Retrieved March 11, 2011, from http://www.agilitynut.com/p/ton2.jpg

Sharma, M., & Romas, J. A. (2012). *Theoretical Foundations of Health Education and Health Promotion*. London: Jones and Bartlett Learning.

Shoubi, M. V., Shoubi, M. V., & Barough, A. S. (2013). Investigating the application of plastic bottles as a sustainable material in the building construction. *International Journal of Science, Engineering and Technology Research*, 2(1), 28–34. http://ijsetr.org/wp-content/uploads/2013/07/IJSETR-VOL-2-ISSUE-1-28-34.pdf

Sojobi, A. O., Nwobodo, S. E., & Aladegboye, O. J. (2016). Recycling of polyetheneterephthalate (PET) plastic bottle wastes in bituminous asphaltic concrete. *Cogent Engineering*, 3(1), 1133480. https://doi.org/10.1080/23311916.2015.1133480

Seltzer, J. (2000c). Bottle houses. Retrieved March 11, 2011, from http://www.agilitynut.com/h/otherbh.html

Seltzer, D. J. (2000b). William F. Peck’s bottle house, [photograph]. Retrieved March 11, 2011, from http://www.agilitynut.com/p/ton2.jpg

Sharma, M., & Romas, J. A. (2012). *Theoretical Foundations of Health Education and Health Promotion*. London: Jones and Bartlett Learning.

Solaja, M. O., Onodehin, O. A., & Bodejo, A. B. (2017). Socio-ecologies of solid waste in Ijebu-Ode, Ogun State, Nigeria. Recycling and Sustainable Development, 10(1), 1–8. https://doi.org/10.5937/ror1701001S

UN-HABITAT. (2010). Urban land markets: Economic concepts and tools for engaging in Africa. Young, E. (2009). Plastics recycling preserves a valuable resource. Retrieved September 25, 2018, from http://constructionreviewonline.com/mar_supplement1_10.htm