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Use of Bamboo and Earth Materials in Construction for the Provision of Affordable Building Structures for Sustainable Development at Kuje Area Council, Abuja

Kareem W. B[1], Okwori R. O[2], Hassan A. M[3], Mohammed B. M[4], Abubakar H. O.[5] & Dada J. A.[6]

[1, 2, 3, 4 & 6]Department of Industrial and Technology Education,
Federal University of Technology, Minna, Niger State
[5]Department of Building Technology,
Federal Polytechnic Nassarawa, Nassarawa State.
wahabami4u@futminna.edu.ng

Abstract: The study was carried out on the use of bamboo and earth materials in building construction in provision of affordable housing at Kuje area council Abuja. The purpose of the study was to determine the status of the use of bamboo and earth materials in construction at Kuje area council Abuja, identifying the factors limiting the use of bamboo and earth materials in construction at Kuje area council Abuja, examine the strategies that will improve the use of bamboo and earth materials in construction at Kuje area council Abuja. Three research questions and three hypotheses were formulated to guide the study. A population of 80 respondents, comprising of 20 engineers and 60 craftsmen was used for the study. A structured questionnaire was developed by the researcher and was used as an instrument for data collection. The instrument was validated by three lecturers in the department of industrial and technology education, federal university of technology Minna. The data collected was analyzed using mean and standard deviation, while t-test statistic was used to test three hypotheses at 0.05level of significance. The findings of the study revealed that there are limitations in the use of bamboo for building construction in the Kuje Area Council. Based on the findings of the study, it was recommended that the use of bamboo and earth materials in building construction should be introduced as part of the curriculum for

construction education at both undergraduate and postgraduate levels in order to sensitize the students to their potential uses and benefits. The government should employ a policy of adapting bamboo and earth materials that require minimal amounts of capital and foreign exchange and makes use of available raw materials and skills in small-scale operations and suggestion were also made for further research works.

***Keywords*:** Bamboo, Earth Materials, Building, Sustainable, Development.

1. Introduction

For a long time, local materials such as bamboo have served to build the dwellings of the local houses for the human habitat, livestock and to store crops. Skills in the use of this local material are transmitted from father to son and that enabled the construction of such buildings possessed satisfaction, qualities of comfort and durability to some extent. The history of housing is inseparable from the social, economic and politics of mankind. As stated by United Nations Development Programme (UNDP), housing and sustainable human developments are closely linked together, since housing can either enhance or degrade human development. Abiola (2000) identified building material as one principal factor affecting the effective performance of Nigeria construction industry. The problem of providing affordable housing has long been a concern not only to individuals but also to government. A decent home is the basis of the possibility for obtained security, as well as other basic needs such as privacy, health and social integration. This explains the essential role that affordable housing can play in the achievement of sustainable human development.

A recent word bank report noted that two of the most critical urban development issues facing Nigeria are the financing of urban infrastructure and the institutional arrangement for housing the delivery in urban centers. The provision of basic amenity particularly housing is partly responsibility of the government which has handicapped in recent times by declining financial resources, political instability and many other factors. Local building material (bamboo, mud, etc.) are available everywhere and exists in different compositions especially in Nigeria. It is most commonly used in developing countries for housing by higher percentage of the citizens. An earth lodge is a circular building made by some of the native of North America. They have bamboo post and beam construction and are done with shaped bamboo.

Bamboo and earth materials have a long and well-established tradition as a building material throughout the world's tropical and sub-tropical regions. It is widely used for many forms of construction, in particular for housing in rural areas. Bamboo is a renewable and versatile resources, characterized by high strength and low weight, and is easily worked using simple tools. It is widely recognized as one of the most important non-timber forest resources due to the high socio-economic benefits from bamboo based products. It is estimated million hectares area. Most of them grow in Asia, Africa and Latin

America. Bamboo is the world's fastest growing woody grows three times faster than most other species. Commercially important species of bamboo usually mature in four or five years' time, after which multiple harvests are possible every second year, for up to 120 years in some species and indefinitely in others. Bamboo also excels in biomass production, giving 40 tons or more per hectare annually in managed stands. It accounts for around one-quarter of biomass produced in tropical regions and one-fifth in subtropical regions. It has been used successfully to rehabilitate soil ravaged by brick making in India, and abandoned tin- mine sites in Malaysia. It shelters top soil from the slaughter of tropical downpours, preserves many exposed areas, providing micro-climate for forest regeneration and watershed protection. It is often introduced into the banks or streams or in other vulnerable areas, for rapid control of soil erosion; one bamboo plants closely matted roots can bind up to six cubic meters of soil. The advantages of local and indigenous building materials cannot be over emphasized. It includes, light, strong, versatile, environmental friendliness, easily accessible, self renewing resource, fast growing and highly productive, which can lead to improvement of productivity (Yekini et al 2018; Azeta et al 2017).

Bamboo is used as soil stabilization, wind break, urban waste water treatment and reduction of nitrates contamination, creating a fire line in traditional forests-due to the high content of silica and Removing atmospheric carbon. The shoots are also usable for buildings and constructions in small scale and cottage industries, for handcrafts and other products. It can also be used as wood substitutes in industrial products transportation industries, for making truck bodies and railway carriages. The use of locally available and indigenous earth materials has several advantages in terms of sustainability (Nwoke et al 2017). They are: Reduction of energy costs related to transportation. Reduction of material costs due to reduced transportation costs, especially for well-established industries. Ecological balance within the region needs to be maintained while efficiently utilizing bamboo resources.

For the purpose of this study, mud bricks are as walling unit produce from rammed sand and water. It is widely used in Nigeria for walling units. The quality of earth bricks is a function of the method employed in the production and the properties of the construction materials. Earth bricks are available for construction and structure of any types. Compress earth bricks (CEB) are one of the products that Nigeria building and road research institution (NBRRI) introduce into the construction industry due to the fact that laterite is readily available in Nigeria and that it required a very small quality of cement but still compress earth bricks (CEBs) are construction bricks made with rammed clay and other stabilizing ingredient. The earth mixture is poured into a hand-operated or motorize hydraulic made, compress earth bricks are uniform in size and shape. Nowadays, improved technology induced people to use

CEB as alternatives for earth bricks in building houses because they do not require much cement for bonding, the bricks during construction thereby further reducing the building cost and their mechanical cost, with a view to ascertaining which is more applicable in building affordable houses. It is on this basis that this study aims to determine the use of bamboo and earth materials in construction for the provision of affordable building structure at Kuje area council Abuja, Nigeria.

2. Statement of Problem

The major factors affecting the construction industries in developing countries is the selection of good building materials (walling materials) which has been influenced by cost, physical properties and compressive strength of the walling materials. The ever increasing building cost in Nigeria is a matter of serious concern that calls for the appraisal of the conventional building processes in seeking for alternatives building materials (walling unit). Currently methods and the cost of materials and labor is continually on the increase beyond the reaches of many Nigerians, Sustainable housing development especially to the medium and low-income group of the society has become huge challenge particularly because of the huge capital outlay required to build and own a house, frequent increase in price of conventional building materials across Nigeria has reawakened serious awareness to related research to production, in the use of bamboo and earth materials as alternative for the construction of functional but low cost dwelling in rural and urban area of Nigeria. Thus, acquisition of indigenous building materials by way of compressed earth bricks (CEB) and bamboo has been suggested as a way out.

Sustainability and durability is an issue of great important for the building sector and society. Most developing nations are facing a real housing deficiency (Harrison and Sinha, 1995). Therefore, it is mandatory to construct and build houses that are more sustainable and durable at low cost. Using Bamboo and Compressed Earth Bricks (CEBs).

3. Objectives of the Study

The objective of this research work is to determine the use of bamboo and earth materials in construction for the provision of affordable building structure at Kuje area council Abuja.

Specifically, the study is to determine;

I. The factors of the use of bamboo and earth materials in construction at Kuje area council Abuja.
II. The factors limiting the use of bamboo and earth materials in construction at Kuje area council Abuja.
III. The strategies that will improve the use of bamboo and earth materials in construction at Kuje area council Abuja.

4. Research Questions

I. What are the factors associated with the use bamboo and earth materials at Kuje area council Abuja
II. What are the factors limiting the use of bamboo and earth materials in construction at Kuje area council Abuja

III. What are the strategies that will improve the use of bamboo and earth materials in construction at Kuje area council Abuja

5. Hypotheses

The following null hypothesis was formulated and tested at 0.05 level of significance.

I. There is no significant difference between the mean rating of engineer and craftsmen regarding the factors associated with of the use of bamboo and earth materials in building construction at Kuje area council Abuja.

II. There is no significant difference between the mean responses of engineer and craftsmen regarding the factors limiting the use of bamboo and earth materials in building construction at Kuje area council Abuja.

III. There is no significant difference between the mean responses of engineer and craftsmen regarding the strategies that will improve the use of bamboo and earth materials in building construction at Kuje area council Abuja.

6. Methodology

6.1 Research Design

The research design used was descriptive survey because Borg & Gall (1989) describe descriptive studies as that which is aimed at finding out "what is", so observational and survey methods are frequently used to collect descriptive data. This method was successfully used by Kareem, Ma'aji, Ibrahim, Gazali and Shom (2014) in a similar research work.

6.2 Area of Study

This study was conducted Kuje Area Council of the Federal Capital Territory Abuja, Nigeria.

6.3 Population for the Study

The population of the study was eighty (80) respondents which made up of 20 engineers and (60) craftsmen who are specialists in local material in the study area. Since the population is manageable, there was no need for sampling.

6.4 Instrument for Data Collection

The instrument for data collection was a structured questionnaire developed by the researcher. It consisted of two parts (Part A and B); Part A indicate the Bio-data of the respondent and the part B was divided into three sections A, B and C. All items are to be responded to by indicating the appropriate perception using four point rating scale. Strongly agree = 4 points (SA), Agree (A) = 3 points, Disagree (D) = 2 points Strongly Disagree (SD) = 1 points. To ensure of the validity of the instrument, three lecturers in the department of Industrial and Technology Education, Federal University of Technology Minna validated the instrument.

Eighty (80) questionnaires were distributed twenty (20) to engineers and sixty (60) to craftsmen in building in area of study. Eighty-Three percent (83%) of the distributed questionnaire were returned and used for data analysis. The data collected were analyzed using means and standard deviation. The items mean ($\bar{x}$) and criterion mean (2.50) were computed and utilized to measure the level of agreement and or disagreement. The decision adopted was that if item mean ($\bar{x}$) is equal or more than criterion mean (2.50), the adoption is positively rated (Agree); but if otherwise, the adoption is negatively rated (Disagree).

7. Results

Research Question One: What are the status of the use of bamboo and earth materials at Kuje Area Council, Abuja?

Table 1: The current status in the use of bamboo and earth materials for building construction at Kuje area council Abuja.

S/N	Items on the status	Mean	SD	Decision
1	Bamboo and earth materials are used because it easily absorb water in water logged areas.	1.71	0.92	Disagreed
2	Bamboo and earth materials are not used because of low level of commercialization.	2.77	1.09	Agreed
3	Bamboo and earth materials are not used because of Poor engineering design	2.75	0.32	Agreed
4	Bamboo and earth materials are used because they are largely available in our locality.	3.29	0.95	Agreed
5	Bamboo and earth materials are not used due to poor inspection of building by building inspection agency	3.02	0.37	Agreed
6	Bamboo and earth materials are not used because of low patronage of bamboo and earth materials.	3.86	0.38	Agreed
7	Bamboo and earth materials are not used due to Government lukewarm attitude towards the use of local building materials	3.38	1.12	Agreed
8	Bamboo and earth materials are used because they are easily work upon and available in abundance using simple tools.	2.82	1.02	Agreed
9	Bamboo and earth materials are not used because of discrimination in using them	2.41	1.29	Disagreed

The data presented in Table 1 on the status of the use of bamboo and earth materials at Kuje area council Abuja, revealed that the respondent agreed with all the items with mean score ranging from 2.75 - 3.82 except items 1 and 9 which has mean score of 1.71, 2.41 respectively. This signifies that most of the respondents Agreed with the status in the use of bamboo and earth materials in building construction at Kuje area council Abuja as it is readily available.

Research Question Two: What are the factors limiting the use of bamboo and earth materials for building at Kuje area council Abuja?

Table 2: Identify the factors limiting the use of bamboo and earth materials for building at Kuje area council Abuja.

S/N	Items on the factors	Mean	SD	Decision
1	Bamboo and earth materials give Poor wall finishes.	2.57	1.12	Agreed
2	Local building materials like clay suffer shrinkage and cracking.	2.51	0.97	Agreed
3	Too many quack craftsmen.	2.84	0.99	Agreed
4	Doubtful durability and longevity lifespan of Bamboo and earth materials.	2.91	0.89	Agreed
5	Early deterioration decay of bamboo	3.16	1.05	Agreed
6	Deterioration of earth buildings as a result of Absorption of moisture content	2.69	1.20	Agreed
7	Local materials such as bamboo and clay absorb Water in water logged areas	2.59	1.08	Agreed
8	Bamboo and earth materials are cheap to acquire	2.85	1.15	Agreed
9	Small scale production of bamboo and earth materials	2.77	1.08	Agreed
10	Poor road networks to transport materials to the site	2.66	1.18	Agreed
11	Bamboo and earth materials are easy to find	2.21	1.18	Disagreed
12	Lack of precise design specification	2.34	1.12	Disagreed
13	Bamboo and earth materials are easily worked on	2.45	0.41	Disagreed

The data presented in Table 2 on the factors limiting the use of bamboo and earth materials for building at Kuje area council Abuja, reveal that the respondent agreed with all the items with mean score ranging from 2.51 - 2.91 except item 11,12 and 13 which has mean score of 2.21, 2.34 and 2.45 respectively. This signifies that most of the respondents agreed with the factors limiting the use of bamboo and earth materials for building construction at Kuje area council Abuja.

Research Question Three: What are the strategies that will improve the use of bamboo and earth materials for building at Kuje area council Abuja?

Table 3: Determine the strategies that will improve the use of bamboo and earth materials for building construction at Kuje area council Abuja

S/N	Items on the strategies	Mean	SD	Decision
1	Reduction in development of foreign building materials in construction sectors	3.79	0.89	Agreed
2	2 Effective mobilization of human resources	3.42	0.87	Agreed
3	Co-operative effort by government in the developing of bamboo and earth material to meet the housing need	3.10	1.11	Agreed
4	Encouragement of women in housing construction	2.26		Disagreed
5	Government should increase import duties on importation of building materials that can be sourced	2.88	1.14	Agreed

	locally			
6	Government should grant fiscal incentives to manufacturing of bamboo and earth materials	3.01	0.97	Agreed
7	Government should provide technical support and advice to entrepreneurs on production of bamboo and earth materials	3.91	0.28	Agreed
8	Development and propagation of indigenous technology in production of bamboo and earth materials	3.94	0.28	Agreed
9	Reduction cost of bamboo and earth materials since they are sourced locally	3.19	1.11	Agreed
10	Government should encourage large scale production of bamboo and earth materials.	3.77	0.39	Agreed

The data presented in Table 3 on strategies that will improve the use of bamboo and earth materials for building construction at Kuje area council Abuja, reveal that the respondent agreed with all the items with mean score ranging from 2.88 - 3.94 except item 4 which has mean score of 2.26. This signifies that most of the respondents Agreed with the strategies that will improve the use of bamboo and earth materials for building construction at Kuje area council Abuja.

8. Discussion of the Findings

The result obtained from Table 1 revealed that all the items identified except item 1 and 9, are the status of the use of bamboo and earth materials at Kuje area council Abuja. This is in line with view of De-Boer and Baries (2000) which postulated that bamboo is widely used as a construction material around the world with an estimated 800,000 people currently living in bamboo structure. The availability is in line with the study items.

The result obtained from table 2 revealed that all the items identified except item 11,12 and 13 are the factors limiting the use of bamboo and earth materials for building at Kuje area council Abuja. This is in line with view of Anand and Ramamurthy (2003) who stated that foreign materials require high technology and energy in their production, transportation and usage.

The result obtained from table 3 revealed that all the items identified except item 4 are the strategies that will improve the use of bamboo and earth materials for building construction at Kuje area council Abuja. Harrison and Sinha (1995) corroborates this finding that sustainability and durability is an issue of great important for the building sector and society. Most developing nations are facing a real housing deficiency Therefore, it is mandatory to construct and build houses that are more sustainable and durable at low cost (Adams and Agib, 2001).

9. Conclusion and Recommendations

Based on the findings of the study, it was concluded that there are limitations in the use of bamboo and earth materials for building construction in the study area. This is

because the water rising through clay and bamboo tends to reduce the service span of the building, poor road networks to transport materials to the site, unavailability of skilled craftsmen, local building materials like clay suffer shrinkage and cracking. It was therefore recommended that the study of indigenous building materials should be introduced as apart of the curriclum for construction education in tertiary institutions, a sustainability knowledge in construction should be harmonized and embedded in various document, and should be developed in an integrated way across geographical boundaries and the designers should be encouraged to prepare designs that reflects an awareness of all the relationship that exists between the natural resources utilized in construction.

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