



Assessment of the Use of Locally Available Materials for Building Construction in Ado-Ekiti Nigeria

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Abstract

The potentials and benefits of local building materials (LBM) remain untapped and seem to progress at a slow rate in the Nigerian building industry. This research examined the availability and level of usage of LBM in Ado-Ekiti, South-Western Nigeria. Further, it considered hindering and helpful factors for the use of LBM in the study area. Based on the extensive review of literatures, ten (10) LBM were identified and examined in the study area. One hundred and fifty (150) professionals closely involved with building construction in Construction companies that are fully operational in Ado-Ekiti were investigated for this study. The Relative index analysis of the frequency in the use of LBM available for building construction in Ado Ekiti revealed that the following LBM are available and in the following order, in the study area: Stone(1) with RII 0.95 , timber(2) RII 0.93, laterite(3) RII 0.92, clay and mud(4) RII 0.91, bamboo(5) RII 0.90, leaves and barks of trees(6) RII 0.88, Palm kernel shells (7) RII 0.85, wild coconut trees(8) RII 0.79, animal wastes (9) RII 0.76 and dung(10) RII 0.74. However, the level of usage of these materials is still very low. Considering the economic, socio-cultural and environmental benefits of LBM, this study recommended more awareness campaign and sensitization of the public on LBM in order to promote its social acceptability. In addition, it recommended that Federal and State governments should facilitate more research in the use of the available local materials for building construction. Availing funds specifically for research and development of LBM will also promote its use.

Keywords: Affordable Housing, Building Materials, Construction, Local knowledge, Nigeria.

1. Introduction

Building materials often constitute the single largest input to housing construction in most developing country cities particularly in Africa (Ugochukwu and Chioma, 2015).

It accounts for about 35% to 37% of the construction cost component and in a standard low income housing unit, the cost of building materials alone can take up to 70% (Windapo and Iyagba, 2007; Ugochukwu and Chioma, 2015). It therefore remains a major reason for the high cost of building construction (Taiwo and Adeboye, 2013). Local Building Materials (LBMs) are materials sourced locally, either occurring naturally or manufactured with locally sourced raw materials (Omole and Bako, 2013). Such materials are within reach and when compared to imported materials, they are cheaper

and more affordable in cost (Oloruntoba and Ayodele, 2013).

Africa in general, and Nigeria in particular is endowed with abundant natural resources that can meet their building materials production. However, they still depend largely on imported building materials in order to meet the construction needs (Ugochukwu and Chioma, 2015). For example, the study of Iwuagwu, Onyegiri and Iwuagwu (2016) revealed that fibrous tree (used to produce good structural members for roof, wall, lintel, ceiling and bridges construction) is found mainly in the Savannah region (Middle Belt) of Nigeria. Furthermore, grasses found in abundant measures in the Middle Belt and Northern region of Nigeria are used for the purpose of construction in the Nigerian traditional Architecture (Oruwari and Opuene, 2002).

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Taiwo and Adeboye (2013) affirmed a gradual decline in the use of locally manufactured building materials, as well as massive importation of building materials in Nigeria thus, greatly widening the gap between imports and exports. There are several factors militating against the use of LBMs for building construction in Nigeria. Omole and Bako (2013) noted legal acceptability, social acceptability, doubtful durability, technology to handle setting, uncertainty of cost, double standard on the part of the government, lack of standards and specification, problem of mass production, uncertainty about the demand and uncertainty about the strength of material when compared with their imported counterparts.

Vying the abundant availability of LBMs and its under-utilization in Nigeria several studies have been carried out but there is yet to be a focused one in towns or cities in Nigeria to consider in specific terms, the availability, level of usage and problems associated with the adoption in specific towns or cities in South-Western Nigeria, in order to promote the usage. This study bridged this gap. It focused on Ado-Ekiti, an indigenous city in South-Western Nigeria which also doubles as the State Capital of Ekiti State. The City has several building construction companies and building projects (on-going and completed) and is endowed with abundant natural resources.

2. Literature Review

2.1 Research Work on Local Building Materials (LBMs) in Nigeria

There are two Research Institutes that are presently sourcing for all functional materials in Nigeria i.e. Raw Materials Research Institute (RMRI) and Nigeria Building Road Research Institute (NIBRRI) (Madedor, 2002). The major role of these Institutes has to do with the selling-out of information on local materials through seminars, conferences and workshops. NIBRRI is specifically required to research into all forms of construction materials. Oloruntoba and Ayodele (2013) gave insight to the potentials of LBM as an alternative to imported building materials at different stages of building construction. According to them, stones and rocks with laterite can be utilized jointly to form a very strong strip foundation that will stand the test of time. Similarly, laterite when reinforced with bamboo or coconut palm, can be used as bamboo reinforced terracrete which is as good as concrete slab.

Timber, when well treated and impregnated with liquid preservation can be used to achieve good timber board flooring. In the same vein, Bamboo floor and foist provide good building flooring when polished and treated to form Bamboo floor and foist. Cow dung when properly mixed with clay screening produced strong and good looking floor. This can be improved with the addition of fermented leaves and bitumen to further improve the flooring having a reasonable damp resistance.

Furthermore, Brick with laterite joining forms a good building wall with good conductivity advantage over the hollow concrete block. Also, Stone jointed with laterite mortar or lime stabilized mortar produces a desirable building wall with high compressive strength while

Coconut palm, bamboo and Timber treated as stakes inside earth form a desirable building wall.

Earth when required to mix cement, conserves the volume of cement used because of its cohesive properties. Earth wall can also be reinforced with some additives (Vegetable, stems, reeds and straws) to achieve desirable strength and check cracking in walls. Laterite reinforced with bitumen for wall will have in addition to the strength the ability to act as a repellent to ants and rodents. Clay and bricks stand out among other materials for building walls. Bolaji (2000) submits that clay products are significant areas that need to be explored urgently considering such advantages that go along with its usage. e.g. (Durability, aesthetic, cost effectiveness and fire resistance).

Oloruntoba and Ayodele (2013) asserted that Bamboo in particular has a meaningful tensile strength depending on the specie. The ultimate tensile strength of some species of bamboo has been found to be about the same as that of steel at its yield point-Average 1,400kg/cm to 2 2,800kg/cm (Fadamiro and Ogunsemi, 1996). Such remain a very good local material option for building roof. Similarly, Sun-dried earth block bricks have also been used in the construction of vault and domes; the procedure involves laying and bonding the masonry units over a wooden framework which is to be removed when the vaults or domes becomes dried (Popoola, Ayegbokiki and Gambo, 2015). Clay and bricks stand out among other materials for building walls according to (Oloruntoba and Ayodele, 2013). For finishes and fittings, Earth stabilized with cement forms a good plastering material. Stones can be used as stone facing on the walls while timbers are good cladding.

2.2 Utilization of Local Building Materials and Technologies

Many African countries, despite the abundant natural resources that can meet their need for building materials production, still depend largely on imported building materials and technologies (Ugochukwu and Chioma, 2015). It is pertinent to note that a key benefit of the use of LBMs in housing delivery is cost reduction and enhancing of foreign exchange (Omole and Bako, 2013). Other benefits of LBMs include affordability, availability, biodegradability, energy efficiency, re-usability and ozone friendliness (Oloruntoba and Ayodele 2013).

2.3 Challenges in the use of Local Building Materials in Nigeria

Taiwo and Adeboye (2013) noted that some existing locally produced building materials are capital intensive to manufacture locally, as their production is based on sophisticated technologies.

In the same vein is the findings of Omole and Bako (2013) that technology to handle the setting and uncertainty of the cost is a major challenge facing the production of locally produced building materials. In addition to this is the problem of legal and social acceptability and doubtful durability. Other criticisms of local building materials in the Nigerian context are lack of standards and specification, lack of organizational and institutional framework, problem of mass production, uncertainty

about the demand and uncertainty about the strength of material when compared with their imported counterparts. Ikechukwu and Iwuagwu (2016) also identified the problem of acceptability with the public, durability and low strength, deforestation, civilization, frequent maintenance and challenges with the use for tall buildings as other factors affecting the use of LBMs in Nigeria.

3. Research Methodology

The area investigated for this study is Ado-Ekiti, the capital of Ekiti in South-Western Nigeria. The city and the rural settlements at its fringe now exist and function as a Local Government Area (LGA)- a single regional entity with a population of 308,621 (Gazatte, 2007).

Using a survey approach, this study considered the availability and level of usage of LBM for building construction in Ado-Ekiti. Further, it investigated the hindering and helpful factors to the usage of LBM as well as strategies to promote the use of LBMs for building construction in the study area.

Respondents for the study include Professionals involved directly and indirectly with Construction activities- Builders, Engineers, Surveyors, Architects, Project and Facility Managers in Construction companies that either has a branch or its headquarter in Ado-Ekiti.

A total of one hundred and fifty (150) questionnaires were administered. One hundred and nine (109) of these were returned, valid and useable, representing 72.7% of the sample population. The data presented and interpreted are based on responses from the set of questionnaires administered.

A semi- structured questionnaire designed on the basis of extensive literature review on LBM was used to capture the various types of LBM that can be available in the study area. Information on level of usage, was also included in the questionnaire while a section was dedicated to the hindering factors and suggestion strategies to promote usage of LBM. The Relative Importance Index (RII) method was used to analyze data obtained based on the set of questionnaires administered. One hundred and fifty (150) questionnaires were distributed out of which one hundred and nine (109) were usable and valid, which represents (72.7%) of the sample population, were returned.

4. Data Presentation, Analysis and Interpretation of Results

Prior to the survey, the review of literatures helped in identifying the common local building materials used in

the Building construction industry in Nigeria. After this analysis, a total of ten (10) LBM were shortlisted for this study. These identified LBM were presented to respondents in the questionnaire so as to determine their level of availability and usage in Ado-Ekiti, Nigeria.

As shown on Table 1, Stone was found to be the most available indigenous building material in Ado-Ekiti, Nigeria. 76% of the respondents stated that stone is always available for use as a LBM in Ado-Ekiti and its environs. Thus, it ranked first, having a Relative Importance Index (RII) of 0.95. This availability of stone could be as a result of the numerous hills and mountains found in Ekiti State, Nigeria. Respondents ranked Timber as the second most available LBM for building construction in Ado-Ekiti. This is shown by its Relative Importance index (RII) of 0.93, with 68% of the total respondents agreeing that timber is always available for use for building construction.

Laterite, with a RII of 0.92 as shown on Table 1 was rated third by 60.6% of the respondents. Clay and Mud was also found to be very available in Ado-Ekiti, this availability is largely due to the nature of the soil found in some parts of Ekiti state, especially areas where artisanal mining activities is frequent. This is further supported by about 60% of the respondents who stated that clay and mud is always available for building construction. In some villages and settlements in Ekiti State, there are still today, several houses built with clay and mud, as a result of the poverty level in these villages.

As shown Table 1 the respondents rated Bamboo as fifth in terms local building materials availability in Ado-Ekiti. About 57% of the respondents stated that Bamboo is always available while about 2% agreed that Bamboo is not available at all in Ado-Ekiti; with RII of 0.74. From this study, Dung was found as the least used LBM in Ado-Ekiti. Most respondents stated that dung is usually used as manure or decomposed to serve as other source of energy. Besides, Ekiti state is not known for cattle rearing and has very few ranches, which is further aggravated by a recently passed anti-grazing bill in the state.

Table 1 also shows that leaves and bark of trees, palm kernel shell, wild coconut trees, animal waste and dung are other identified LBM available in Ado-Ekiti. These were ranked as 6th, 7th, 8th, 9th and 10th with RII scores of 0.88, 0.85, 0.79 0.76 and 0.74 respectively. As available as these LBM are, they are not yet fully utilized. Some key factors have however been identified as constraints to the realization of the full potential of local materials in Nigeria, these include according to Oladapo and Oni (2012) include poor quality of product and inappropriate use of LBMs in construction (Sanusi,1993).

Table 1: The Relative Importance Index (RII) of available LBM in Ado Ekiti

Local Building Materials	Percentage of respondent scoring					RII	Rank
	1	2	3	4	5		
Stone	0.0	0.0	0.9	22.9	76.1	0.95	1
Timber	0.0	1.8	0.0	30.3	67.9	0.93	2
Laterite	0.0	0.9	0.0	38.5	60.6	0.92	3
Clay and Mud	0.0	0.0	3.7	36.7	59.6	0.91	4
Bamboo	1.8	0.0	3.7	37.6	56.9	0.90	5
Leaves and bark of trees	1.8	1.8	3.7	38.5	54.1	0.88	6

Palm Kernel Shell	0.0	0.9	11.1	48.6	39.4	0.85	7
Wild coconut trees	1.8	1.8	22.9	45	28.4	0.79	8
Animal waste	1.8	1.8	26.6	54.1	15.6	0.76	9
Dung	1.8	0.9	33.9	49.5	13.8	0.74	10

Source: Researchers' Field Survey (2017)

This study also assessed the level of usage of LBMs in the study area. This study found timber as the most widely used LBM in Ado-Ekiti. About 73% of the respondents stated that timber is mostly used for building construction in the study area, with the RII of 0.93. Timber in Ado-Ekiti is mostly utilized for flooring and roofing truss members thus, making it to readily replace ceramic tiles and steel trusses that are alternative imported materials according to the studies of (Oloruntoba and Ayodele, 2013).

Although it was the most available in the study area, Stone was found to be the second mostly utilized LBM in the study area. This is shown by its RII of 0.92 ranked as very high. About 72% of the respondents stated that stone is very frequently used in building construction, 22% asserted that it is frequently used while 6.4% stated that it is moderately used. Stones and rocks in the study area are alternative building materials to Sandcrete blocks and Fibre glass which are imported and used at sub-structure (foundation) and for structural frame and walls respectively. This study confirmed the findings of Oloruntoba and Ayodele (2013), on the use of stones and rocks as alternative building materials.

As shown on Table 2, laterite is adjudged to be the third most utilized LBM in the study area with a RII of 0.90, ranking very high. About 64.2% of the respondents stated that laterite is very frequently used, 21.1% affirmed that it is frequently used while 14.7% of the respondents stated that laterite is moderately used in the study area. As pointed out by Arayela (2000), laterite bricks contributed increasingly to housing stock in Nigeria. Despite the fact that it has been used in numerous places throughout the

world since pre-historic times it seems that today, this material is in need of some re-evaluation in processing.

As further shown on Table 2, laterite stabilized block was ranked as the fourth most used local materials in the Nigerian built environment. 49.5% of the respondents stated that laterite stabilized blocks are very frequently used as an indigenous building material, 27.5% stated that it is frequently used, 16.5% stated that it is moderately used while 1.8% of the respondents stated that it is not used at all. This is ranked to be high in terms of the level of usage. In addition, the respondents reiterated that the use of laterite stabilized blocks can be improved upon if there is adequate technology.

Bamboo and interlocking bricks were ranked as fifth and sixth in terms of the level of their usage. This is shown on Table 2 with RII scores of 0.782 and 0.692 respectively. 38.5% of the respondents stated that Bamboo is very frequently used as an indigenous building material while 13.8% stated that interlocking bricks are very frequently used as local building material in Nigerian construction industry. Bamboo in the study area readily replaces steel reinforcement and structural steel for flooring in the study area. Fired/unfired clay bricks in the study area readily replaces the hardboard imported materials for Structural frames and walls.

Clay and mud, Fire Clay bricks and Grasses, with RII 0.634, 0.616 and 0.616 respectively are moderately utilized in the study area. Wild Coconut Tress, Leaves and bark of trees and Animal wastes, with RII 0.450, 0.384 and 0.380 respectively are poorly used in the study area. This is because they are not available in large quantities in the study area.

Table 2: Relative Importance Index (RII) of usage of LBM in Ado-Ekiti, Nigeria

Local Building Materials	Percentage of respondent scoring					RII	Remark
	1	2	3	4	5		
Timber	0	2.8	6.4	18.3	72.5	0.930	Very High
Stone	0	0	6.4	22	71.6	0.922	Very High
Laterite	0	0	14.7	21.1	64.2	0.900	Very High
Laterite stabilized blocks	1.8	4.6	16.5	27.5	49.5	0.836	High
Bamboo	0.9	9.2	24.8	26.6	38.5	0.786	High
Interlocking bricks	0.9	7.3	50.5	27.5	13.8	0.692	High
Clay and Mud	0.9	23.9	44	19.3	11.9	0.634	Moderately High
Fired clay bricks	1.8	16.5	59.6	15.6	6.4	0.616	Moderately High
Grasses	30.3	39.4	21.1	4.6	4.6	0.616	Moderately High
Wild Coconut Tress	26.6	37.6	22.9	10.1	2.8	0.450	Low
Leaves and bark of trees	37.6	38.5	18.3	5.5	0	0.384	Low
Animal waste	37.6	41.3	14.7	6.4	0	0.380	Low

Source: Researchers' Field Survey (2017)

Table 3 below reveals the strategies to promote the use of LBM in the study area. There is need for vigorous advertisement of LBMs in the study area. This strategy was ranked first as shown (Table 3) with a RII score of

0.804. Most construction stakeholders are not familiar with the inherent cost-benefits in the use of local building materials, hence its avoidance. This may be largely due to lack of awareness of the LBM potentials to stakeholders

in the Building industry. In addition, promulgating an enforceable National Housing Policy which promotes the production was ranked 2nd with RII of 0.782. Although the policy exists already in the Nigerian local context, it is not always in motion.

Increasing research in this area is also found to be one of the critical factors in promoting the use of LBMs as this was ranked by 3rd (RII = 0.778). Government should support research and encourage the use of LBM in construction of buildings particularly to overcome the challenges in technology and its use.

Respondents added that LBMs are not always used due to its poor quality, which can be improved on through intensive research conducted in this direction. This is in agreement with the assertion of Hammond (1984) that the overall effect of the technical deficiencies of locally produced building materials creates acceptability barriers.

Furthermore, some of the respondents stated that LBM are not being well patronized due to the ignorance of the construction workers. Respondents believed that the outcome of researches conducted by research institutes should be published as construction manuals for local

building materials. This proposed strategy will help in promoting the use of local building materials. This strategy is ranked 4th with RII of 0.776 (Table 3). Training of manpower and increase in the use of local building materials by professionals in the industry were also identified as strategies for promoting the use of local building materials in Ado-Ekiti with RII of 0.760 and 0.754 respectively. Respondents opined that if intensive training of manpower, on the use of local building materials, is carried out effectively, indigenous building materials will be well appreciated. In addition, the adoption of local building materials by construction professionals and government agencies will also motivate and promote local building materials use.

Promoting the use of LBM in the construction of public buildings was ranked the least by respondents, with RII 0.754. Public buildings are usually characterized by astounding solidity and some respondents thought that the use of LBM may compromise this. However, with improved processing, the Government can also play a critical part in encouraging the use of LBM.

Table 3: Relative Importance Index (RII) of strategies needed to promote use of LBM for building construction in Ado-Ekiti, South-Western Nigeria

Local Building Materials	Percentage of respondent scoring					RII	Rank
	1	2	3	4	5		
A vigorous advertisement of the materials	2.3	4.7	18.6	37.2	37.2	0.804	1
Promulgate an enforceable National Housing Policy to promote the production and utilization of local building materials at the national level	4.7	4.7	20.9	34.9	34.9	0.782	2
Increase research on the properties of local building materials	2.3	14.0	14.0	30.2	39.5	0.778	3
Production of construction manuals on local building materials	4.7	7.0	16.3	39.5	32.6	0.776	4
Training of manpower	11.6	0.0	16.3	39.5	32.6	0.760	5
Increase use of local building materials by the professionals of the Industry	0.0	7.0	25.6	51.2	16.3	0.754	6
Government should promote the use of local materials in the construction of public buildings.	2.3	16.3	16.3	34.9	30.4	0.754	7

Source: Researchers' Field Survey (2017)

4.1 Hypothesis Testing

The study's hypothesis is to test whether local materials are frequently used for building constructions in Ado Ekiti or not. The statistics shown below is the chi square test result, to test the frequency in the use of local materials for building constructions in Ado Ekiti. The statistical results show that the estimated Chi-square statistic is significant at the 99% level (because Significant value (p = 0.000 < .01), so the null hypothesis, H0: Local materials are not frequently used for building constructions in Ado Ekiti, can be rejected and the alternate hypothesis H1: Local materials are frequently used for building constructions in Ado Ekiti, accepted.

Table 4: Chi square test result, for the use of local materials for building constructions in Ado Ekiti.

Chi-Square	26.978
Df	1
Asymp. Sig.	.000

5. Conclusions and Further Research

This study considered the availability, level of usage and strategies to promote the use of LBM in the Nigerian building construction industry, using Ado-Ekiti, Ekiti State as study area. The study confirmed that LBM is available as an alternative source of building materials to imported materials. The three most available LBM in the study area are: Stone (1), Timber (2) and Laterite (3) However, imported or foreign materials are still competing favorably with locally manufactured materials for building construction. Although LBM are available in large quantities in the study area, they are not yet utilized to their full potentials. This is in line with some other studies and key findings of Taiwo and Adeboye (2013); Olorunfoba and Ayodele (2013) and Omole and Bako (2013); Ikechukwu and Iwuagwu (2016).

This study contributed to local knowledge in the area of Building construction and Construction business noting among other things that the key constraints to the

realization of the full potentials of local materials in the study area include, technological constraints and poor quality of

product which is as a result of non-compliance with standards. This is in line with the study of Oladapo and Oni (2012) and Ikechukwu and Iwuagwu, (2016).

Because of its economic, social-cultural and environmental benefits, it is essential to invest in the promotion of LBM using various means. The key strategies for the promotion of LBM are: a vigorous advertisement of the materials; promulgating an enforceable National Housing Policy to promote the

production and utilization of local building materials at the national levels and increased research on the properties of LBM.

Further studies on LBM can consider focusing specifically on Professional builders or building contractors who have the sole responsibility for building projects. In addition, local manufacturing companies of LBM can also be thoroughly examined to understand their limitations in the production of LBM so that it can favorably compete as alternatives to foreign building products.

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