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Barriers and Aspirations for Sustainable Local Building Materials Selection in Nigeria

Architects and Designers Perception

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***Abstract*—The construction activities have an effect upon the environment; it is consumer of a wide range of nature and synthesized products or resources. Sustainable local building materials selection beset with organisational and procedural difficulties meant by the use of environmental friendly materials that can reduce impacts on environment. These hindrances can be reduced by learning what kind of decision-making stages, new tasks, actors, functions and communication. The research adopted mixed method (qualitative and quantitative). The finding shows the existing gap between awareness and implementation of sustainable local building materials selection in decision making process, suggest the barriers that are valuable and sustainable for use in practice.**

***Keywords*—Barriers, local building material, sustainable construction, Nigerian construction sector**

I. Introduction

Building and construction sector in Nigeria has being 'crucial' and 'essential' to her economy. "Ref.[1, 2]" identified building materials (BMs) as one of the principal factors affecting the effective performance of the Nigerian construction sector. The BMs sector is a major contributor to the construction sector because materials constitute the single largest input in construction often accounting for about half of the total cost of most or any construction products [1, 3, 4]. Sustainable local building materials (LBMs) selection in Nigeria had been isolated in the presence failure of an intensive examination framework to coordinate, plan and implement a strategy and national policy. Furthermore, no capable of being reproduced and clear institutional fight or protect to cover barriers, and create extend in one or more opportunities for regionals. In Nigeria, construction sector consumes a significant percent of the BMs entering the global economy, is responsible for the emission of almost half of the global greenhouse gases. Presently, the materials used in building construction accounting for; carbon dioxide emission is 30%, natural resource use is 40%, and waste for also 40%; while countries like UK, buildings account take up to 45% of the total energy use [5]. The use of low carbon materials and low carbon construction techniques is indigenous. For example, building earth is the traditional material for building construction in Nigeria. Some researches has been carried out in Nigeria, particularly, by NBRRI, CECTech and DFRRI [3], which has resulted in the use of some locally/regionally resourced materials like stabilized blocks for walling because it can offer low carbon answers or solutions. Model experiments have been conducted in Nigeria with the application of these materials in mass housing projects and the application of interlocking masonry for low cost housing using dry masonry technique for the urban poor in Nigeria [6]. Sustainable LBM practical application of science to sector (technologies) include products and concepts with the help of which important improvements can be achieved in terms of harmful emissions, the use of resources, life-cycle costs, building performance, and productivity. The assumption of this work is technologies and methodologies available for sustainable LBM, but full benefits are not achieved because these methods and concepts are not effectively used. The study is not only naming the barriers to sustainable LBMs, also attempts to make hints which could cover these barriers in order to reduce costs and energy during construction processes. This paper complements previous research on promoting sustainable construction sector activities: strategy for achieving sustainable development goals [7] and those that investigate the Perceptions on the Use of Indigenous Building Materials by Professionals in the Nigerian Building sector [8]. The study proceeds from an ongoing PhD research work with the aim of developing a decision support tool (DST) for sustainability integration and implementation in materials and assemblies selection and evaluation of building projects in Abuja of Nigeria. The paper concludes with some thoughts about how a new building sustainability assessment framework can be made an acceptable and integral part of the LBMs and building practice.

II. LITERATURE REVIEW

A. Selecting Sources and Processing of Available Local Building Materials

There are many locally available resources which can be apply or control to one's advantage including small-scale raw material deposits, agricultural products and residues, industrial wastes, low-cost and renewable sources of energy, unskilled and semi-skilled labour, and established technologies which can readily be applied to the local production of low cost materials. "Ref [3, 9]" identified sources of materials on which indigenous BMs have confidence and categorised them into three broad classes: naturally occurring raw material deposits; agricultural products and residues; and products of manufacturing process. Table 1 show some states in Nigeria where these materials be larger in number, quantity, power, status or importance. The properties, applications and deficiencies of these materials are documented in literature [3]. These materials can be used as building components and elements like structural elements, finishes elements, roof trusses, and alternative for reinforcement. In addition, application of these materials in region found will minimized the environmental impacts like fossil fuel consumption, global warming potential and air quality.

By "local" is pre-industrial and vernacular building materials, see Table 1. These materials are derived from earth and naturally absorbed by the earth as their lives end. It was affirming that, "In the last 60 years what we have done is to deal with knowledge of local materials that can be easily repeated, foolish-down knowledge of exchangeable constructed or manufactured goods" Butchart, 1986; Milani, 2005). The present business concerns for sustainable development have contributed in bringing again into activity and prominence, and tackling of traditional building practices using resources that are recyclable and natural [10]. He also mentioned that there is a perception that buildings constructed from such materials are environmentally pleasant and beneficial in nature. This perception is doubtful, as often no evaluation is attempted to assess the linked environmental impacts. According to [11, 12] the mutual interactions between the human hasten and its environment are becoming characterized by a high degree, thereby exerting increasing heavy pressure on their natural context. Also, [11] said that architects should now know more than ever before, be more allergic on effects such as consumption of energy, conceptualization of design and the use of environmental friendly materials that can reduce impacts on environment. As [13] discovered that, designers answer to the use of environmental friendly degradable building construction materials like earth, thatch, turf, stone and the application of traditional and vernacular methods which are in consonance with these materials or the use of being or relating to or derived from or having properties characteristic of living organisms forms and buildings with organic appearances that stimulate natural space and forms.

B. Sustainable Building Construction Materials

The most significant of giving careful thought in gaining with effort more sustainable construction is the overall performance of the building. Building construction materials act as a basic and fundamental character in enhancing the buildings sustainability and adding to the prosperity of economy.

Table I. Availability of Raw Materials in Nigeria

Material	States predominately found
Granite	Plateau, Ondo, Ado Ekiti, Bauchi, Abia and Ebonyi
Limestone	Anambra, Cross Rivers, Benue, Imo, and Bendel
Marble	Kwara, Bendel, Benue, Plateau and Kaduna
Laterite	All States
Clay	Cross Rivers, Ondo, Oyo, Sokoto, Gombe, Kano, Niger, Imo, FCT, Anambra.
Natural fibre	All States
Bamboo	Eastern Nigeria
Timber	Eastern and Western Nigeria

Source: [3]

Utilization of building construction materials have as a fairly large environmental impact, this is mainly because of the large amount of non-renewable resources with the possibility for taking away future generations of their use [14, 15] . Furthermore, all building construction materials have an effect upon the environment during their life cycle. Several forms of pollution are created from extraction of raw materials to disposal of demolition waste, which in turn has adverse effects on the water system, the atmosphere and the land. And these raw materials are usually processed before becoming appropriate for utilization within the building structure that involves large quantity of energy consumption. Nevertheless, these days environmental suitability materials is another significant component that construction practitioners acknowledged [16]. Therefore, the practitioners of building construction have commenced to pay more attention to correcting and controlling the damage of environment that is due to the building construction activities. But the building construction materials selection has directed towards examination. In the past decade, appearance, cost and availability are factors that are influencing the choice of building construction materials.

"Ref. [17]" summarise the search for environmentally responsible design by studying the degree to which architects are aware of the significances of their design decisions, and are utilizing the available information for material and practical methods so as to make suitable or appropriate choices. Building environmental impact knowledge has increased in the past decade. Various factors account for this [18], which include the efforts of professional institutions to increase the awareness

of their members through publications and best practice guides on material selection. As suggested by [19, 20] that, sustainable approaches focus on two questions: what are we using? How well are we using it? They note that sustainable building materials: work within the pattern of nature cycles, respect the limitations of non-renewable resources and inter-relationships of ecosystems, are made from recycled materials, are energy and water efficient and are recyclable.

"Ref. [21]" mention the characteristics of sustainable materials. These include;

- Deconstruction should be possible after building use.
- Provision of indoor air quality.
- Efficient use can save costs.
- Often affordable as perceived.
- Desirable third party certification of some product.
- Efficiency of energy for material application and production.
- Easy disassembled of materials.
- During the material's life, no permanent environmental contamination should occur.
- Consideration of all entire life cycle of material.
- Determination of acceptable environmental performance characteristics levels.

C. The Selection of Sustainable Local Building Material (LBM)

As it is estimated that by 2056, global population will have increased by over 50%, global economic activity will have increased quintuple, global energy consumption will have increased nearly three times, and global manufacturing activity will have increased at least three times [22, 23]. Therefore, the reduction in environmental impacts of materials and products in terms of their overall building performance, to optimize their longevity and production are significant, either in terms of reprocessing, or first life or via reusing. The step of sustainable application activities depend on the understanding, awareness and knowledge of the issues of individual activities [24, 25]. Being a member(s) of these is the environmentally responsible approach to the selection of building materials [26]. The selection of building materials is one of several factors that can impact the sustainability of a building project [27, 28]. Assert once again in the work of [29, 30], that an appropriate choice of materials for a design process plays a significant function or character in the building life cycle. Sustainable material selection is one of the most difficult tasks to undertake in a building project [31]. In character, it is because:

- Need evaluation of different materials and products, both as assembled building elements and individually.
- Inconsistent of assessment parameters across product categories or dissimilar countries origin.
- No universally agreed approach for materials and products evaluation.
- Manufacturing processes lack the quality of being clear and transparent.

Presently, distinct and individual manuals provide guidelines for selection of material. These include [20, 32-34]. As noted by [20], in selecting sustainable materials, the designers should aim to energy efficient, maintainability, maximize durability, and use of local materials to minimize the synthesize chemicals and the use of hazardous materials. However, [35] depict a systematic plan for the choice of building materials: building design to utilize as few resources as possible and be efficient, assign the use of recycled and renewable sources, to close the loop of life-cycle for materials and materials with least environmental impact throughout their lifetime should be selected.

III. METHODOLOGY

It was anticipated that different architects and designers would have different views about different challenges and motivations for pursuing sustainable outcomes; therefore, these views were explored through questionnaire and then analysed to determine the gaps that need to be bridged to promote sustainable building development and assessment in Nigeria, using LBMs. A sample size of 480 was considered, taking into consideration other issues such as outliers in the experimental data and missing values, with a respondent rate of 43.1%. The survey population and the targeted population are generally identified as the two kinds of population for a given study. [36] stress that the target population is a unit where information regarding the study can be obtained, the survey population is the unit in which the research study will be conducted. [37] stated that a targeted population could possess readily identifiable characteristics and uniqueness. The research population can also be referred to as "coverage", meaning the covered population in which the study under progress was carried out. Thus, the research population should cover the entire targeted population. The population of this study consists of professional architects and designers firms who are registered with Nigerian institute of Architects (NIA) and Architect Registration Council of Nigeria (ARCON) in the five Area Councils of Federal Capital Territory (FCT) of Abuja, Nigeria. The research population is referred to as a group of people having a similar characteristic in a defined geographical location or unit where the study is accomplished [38]. Clustering and stratified random sampling were adopted for this study. Architects and designers are registered member of Architects Registration Council of Nigeria (ARCON) and Nigerian Institute of Architects (NIA) and clustered by considering all the 5 Area Councils of Abuja. Therefore, the number of architects and designers in each particular area council field of study could be identified appropriately. The respondents were inquired to rank the barriers

that have an effect upon their sustainable construction practices (SCPs) in LBMs selection, on a 5 point Likert scale: 'extremely important', 'very important', 'important', 'fairly important', and 'less important' (ranging from 5= extremely important to 1= less important). The data collected were analysed, with the aid of SPSS and Excel using a variety of statistical techniques such as descriptive statistics analysis, relative index analysis and Kendall's concordance. Qualitative techniques were applied to make sense of meanings. Contextualizing strategy was used to correct statements, opinion and comments to provide a coherent picture. For this paper, the author has decided to present the Nigeria situation in tables.

Kendall Coefficient of Concordance and Chi-square tests was used to ascertain the level of understanding or agreement among the respondents in their rankings, Kendall's coefficient of concordance (W) was utilized. This coefficient provides agreement measure between respondents within a survey on a scale of 0 - 1, with '0' designating there is no agreement and '1' designating complete agreement or concordance. Using the rankings through each respondent, W was calculated by utilizing Equation 3.1 [39].

$$W = 12\sum \frac{R_i^2 - 3K^2N(N=1)}{K^2N(N-1) - K\sum T_j} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.1$$

Where

$\sum R_i^2$ = sum of the squared sums of ranks for each of the *N* objects being ranked;

K = number of sets of rankings (that is respondents number); and

T_j = correction factor needed for the jth ranks set for tied observations denoted by $T_j = \sum_{i=1}^{gj}(t^3 - t_i)$, where t_i is the tied ranks number in the jth ties grouping, and gj is the ties groups number in the jth ranks set.

In order to verify the concordance/agreement level did not happen by probability/opportunity, Kendall's coefficient of concordance (W) significance was tested, so as to disagree with the null hypothesis or null hypothesis being a complete agreement. The sampling distribution Chi-square (x^2) approximation which was given by Equation 3.2 with (N-1) freedom levels is utilized for the hypothesis testing at a given level for N>7 [39].

$$x^2 = k(N-1)W \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.2$$

IV. ANALYSIS AND RESULTS

After Results were however analysed in pictorial form and presented qualitatively. The threat or uses of forces are an expression of the real world in which building construction participants works or functions. For this paper, the author has decided to present the situation in tables. Normally they possess a main consequence on decisions of the design and, accordingly, understanding of these threat and forces will help the designers and the architects in creating or developing an architectural design that is better or good [40]. Therefore, an effort was made to recognize or discover the barriers sensed by the designers and architects as they attempted to employ the design that are sustainable most particularly in their choosing of LBMs. The summary of the results is shown in Table 2. The W (level or extent of agreement) between the architects and designers in ranking was calculated as 0.322 which was significant at ninety five percent confidence level. Therefore, there was significant agreement degree between the designers and the architects on the detected barriers for sustainable LBMs selection. For which the results are shown in Table 2.

The largest concern in sustainable LBM specification is the perception that materials which are sustainable cost more, with RI (relative index) of 0.87 for both the architects and designers, which was followed by lack of sustainable material information (RI 0.84); lack of all method and data to compare local material alternative (RI 0.82); sensing of extra time been liable (0.81) and Maintenance concern (RI 0.80) which makes the leading 5. The brief summary views of the leading 5 barriers are talked about below.

A. Barriers to the Use of Sustainable LBM

(a) *Extra Cost Perception being Liable:* This was first rated by both the designers and the architects. In reality or actuality, cost counted on conspicuously as an obstacle to achieving sustainability in most of the literatures reviewed [17, 40-42]. In most circumstances, there is funds limitation available for a building construction project. As once noted, that this limit possess main effect on order of the design decision like selection of material. According to [40] in a designers survey that was involved in a growth systems in England ascertained that in several examples, even though, in spite of the fact that cost derivatives had not been examined, the architects and the designers were definite that anything otherwise 'business as usual' would be much expensive or valuable. However, questioning architects and designers are fast to comment that the cost of sustainable buildings provisions is significantly greater than for standard systems but most were not very sure that there is far-flung demand for this particular building. Nevertheless, the CIEF - Construction Industry Environmental Forum, 2005 cited in [43, 44] believe likely that the practice still discovers it open to doubt or debate to be aware of how much it will cost to construct in a green or sustainable way. But the research of BRE and Cyril Sweett (2005) cited in [44, 45] confidently declared that it would cost between one and three percent additional to accomplish or attain an evaluation of *very good* on the EcoHomes scheme for a sustainable dwelling. The same study by Davis Langdon, a topping international cost consultancy, indicated that some sustainability measures possess a zero cost payment for insurance [44]. On top of analysis it was discovered that the evaluation for these research works focused considerably on the issues of environment instead the wider economic and social-cultural aspects of sustainable construction (SC). Nevertheless, there is lack of understanding on the expected hopefully or

awaiting costs of sustainability characteristics in a building construction project as for example RIBA, 2005 discovered that SC characteristics can possess only the least possible cost significances.

(b) *Lack of Access to Sustainable LBM Information:* The information lacking identification which was the largest barrier to sustainable materials and products specification for the designers and architects, the respondents are famous in lieu of the present documentary resources development associating to local building materials selection. The designers and architects have a responsibility to remain up-to-date with the present building codes and regulations, present construction building practices and growth in LBMs both existing and new innovative materials. Generally in practice, it demonstrates disputes, as building professionals make an effort to stay by the latest information or changes with information of material from sources that are diverse. The respondents possess trouble identifying what sustainable LBMs are available, as well as from what sources; information of expert or technical material and product; and the environmental certification of sustainable LBMs. Lack of reach or gain access to information is an expression of the actual world in which designers and architects works. Architects and designers possess main influence on decision-making of design. However in few instances, lacked the information they required for selections as regards to which material alternatives would be less or more green or sustainable. In other situation they were not aware of sustainable alternatives or lacked skillfulness by virtue of possessing special knowledge to implement them. On the other hand, where the designers missed information, they are normally selected for a *safe* answer or result [40]. In instances where sustainable LBM information is not available the architects and designers do continued with the conventional building materials that are well known or easily recognized by them. In the absence of promptly available information the respondents covered that many objectives of sustainability simply fell. Thus this obstacle suggests there is need for more information to force the use of sustainable LBMs forward.

Table II. Detected barriers in sustainable local building material selection

Obstacles	Architects		Designers		Overall	
	RI	*Rank*	*RI*	*Rank*	*RI*	*Rank*
Lack of sustainable material information	0.82	2	0.86	2	0.84	2
Uncertainty in final work liability	0.76	7	0.73	8	0.75	8
Maintenance concern	0.81	3	0.80	6	0.80	5
Building code restriction	0.74	6	0.69	11	0.72	9
Lack of all tools and information to compare material alternatives	0.79	5	0.85	3	0.82	3
Extra cost perception being liable	0.85	1	0.88	1	0.87	1
Extra time perception being liable	0.80	4	0.81	5	0.81	4
Percept that sustainable materials are low in quality	0.57	11	0.72	9	0.65	11
Aesthetically low pleasing	0.57	11	0.63	13	0.60	12
Possible project delay due to sustainability demand	0.64	9	0.71	10	0.68	10
Limited supplier availability	0.78	6	0.81	5	0.79	6
Less alternatives or substitutes flexibility	0.78	6	0.74	7	0.76	7
Unwilling to alter the conventional specifying way	0.63	10	0.67	12	0.65	11
Statistical test x^2 critical = (0.05) = 15.92, sample = 1778, Kendall's W = 0.505, df = 7						

(c) *Lack of all Tool and Data to compare Material Alternatives:* The issues of building materials careful thought when the material selections are being made recognized as being the degree of needed attributes of environmental impact. There are existing numbers of instruments for assessing the environmental analysis of building construction materials. As observed by [46], lots of existing assessing methods and choice models are sensed to be either lacking in largeness or hard to falsify or fudge. Rating of the instruments methodology disclosed lack of all demands in terms of indicators and factors or criteria associating to LBMs. The lack of comprehension of factors or criteria reflecting sustainability demerits or merits of dissimilar LBM alternatives entails that the architects and designers possess small reason for selecting a material over another. In addition, some authors or scholars fault the currently in existence rating methods for being marked by distress with troubles of fairness and subjective, since some crucial components did not get enough emphasis and less significant components are disregarded [47]. Therefore, trouble comes up on how most beneficial to use them.

(d) *Extra Time Perception being Liable:* One more design constraint is the time. Most suitable or right design, in comprehensiveness of its ability or power aspects, take time- and enough or adequate time is not often readily available to meet the located inward needs of the architect and designer. According to [48] which reported that time serves as a standard for the performance as well as cost of building construction project. No matter the building type, size as well as intricate and compounded of the design individual construction project would possess little constraint of time that is imposed on the project. Normally, the client needs a completed building construction project for a specific day of the month, which would, has effect on the time allocated to distinct or separate

stages of the building project. Therefore, sufficient time is needed to look at suitable materials and products as well as fix performance standards, organize information rendered or furnish by others, produce and communicate specification and also ascertain the errors and constituency of project documentation. The constraints of time also affect the process of taking up or using up sustainable material as showed by [49]. When a project needs to be completed speedily there was an enhancing trend to adhere to materials utilize on former building construction projects, therefore, do away with the time required to look for or explore for green selections.

(e) *Maintenance concern:* Architects and designers ranked maintenance as 3rd and 6th respectively and ranked it 5th overall as an obstacle for the process of sustainable LBM. It was also clarified from the study that there is sensing of unclearness surrounding the long term sustainable LBM maintenance. In addition the same research work covered by [50], ascertained that wide maintenance necessitated in the application of sustainable LBM still remain in the building construction stakeholders mind. This is not surprise acknowledged that non maintenance buildings are more and more search by clients, eagerly desirous to reduce the costs that are related with buildings. It is understood that maintenance possess a considerable impact on the building performance and maintenance associated troubles that happen throughout the building lifetime which could be reduced by using LBMs that need low maintenance as well as bear smaller replacement costs throughout the building lifetime.

V. DISCUSSION AND FINDINGS

The study has depicted on thorough qualitative and quantitative research attempted 207 architects and designers from various settings in the Nigerian construction sector. The study has named numbers of fundamental obstacles preventing progress and propositions for way forward, could help practitioners in mainstreaming sustainable LBMs selection.

Obviously, the first ranked obstacle by both the architects and designers is simply the extra cost perception being incurred. In most circumstances, there is funds limitation available for a building construction project. As once noted, that this limit possesses main effect on order of the design decision like selection of material. According to [40] in a designers survey that was involved in a growth systems in England ascertained that in several examples, even though, in spite of the fact that cost derivatives had not been examined, the architects and the designers were definite that anything otherwise 'business as usual' would be much expensive or valuable. On top of analysis it was discovered that the evaluation for these research works focused considerably on the issues of environment instead the wider economic and social-cultural aspects of SC. Nevertheless, there is lack of understanding on the expected hopefully or awaiting costs of sustainability characteristics in a building construction project as for example RIBA, 2005 discovered that SC characteristics can possess only the least possible cost significances.

The second most ranked obstacle is the lack of access to sustainable LBM Information, explaining that, the information lacking identification which was the largest barrier to sustainable local materials and products specification for the designers and architects, the respondents are famous in lieu of the present documentary resources development associating to LBMs selection. The designers and architects have a responsibility to remain up-to-date with the present building codes and regulations, present construction building practices and growth in LBMs both existing and new innovative materials. Architects and designers possess main influence on decision-making of design. However in few instances, lacked the information they required for selections as regards to which material alternatives would be less or more green or sustainable. In the absence of promptly available information the respondents covered that many objectives of sustainability simply fell. Thus this obstacle suggests there is need for more information to force the use of sustainable LBMs forward.

The issues of BM consideration when the material selections are being made recognized as being the degree of needed attributes of environmental impact. There are existing numbers of instruments for assessing the environmental analysis of building construction materials. The lack of comprehension of factors or criteria reflecting sustainability demerits or merits of dissimilar LBM alternatives entails that the architects and designers possess small reason for selecting a material over another. Therefore, trouble comes up on how most beneficial to use them.

One more design constraint is the time. Most suitable or right design, in comprehensiveness of its ability or power aspects, take time- and enough or adequate time is not often readily available to meet the located inward needs of the architect and designer. Therefore, sufficient time is needed to look at suitable materials and products as well as fix or put performance standards, organize information rendered or furnish by others, produce and communicate specification and also ascertain the errors and constituency of project documentation.

Architects and designers ranked maintenance as 3rd and 6th respectively and ranked it 5th overall as an obstacle for the process of sustainable LBM. It was also clarified from the study that there is perception of unclearness surrounding the long term sustainable LBM maintenance. It is understood that maintenance possess a considerable impact on the building performance and maintenance associated troubles that happen throughout the building lifetime which could be reduced by using LBMs that need low maintenance as well as bear smaller replacement costs throughout the building lifetime.

Clearly, most of the barriers mentioned so far are 'cost and knowledge-related'. This implies that there is

a skills and knowledge gap amongst architects and designers, which needs to be addressed with some urgency. In fact, this gap has not gone unnoticed in Nigeria and the government has a number of initiatives in place to offer training, professional development and information in environmental issues for various levels of society including built environment professionals.

However, there are also practical barriers related to the availability of sustainable LBMs and technologies that need to be addressed. The vast majority of these conventional products and technologies currently require importation, resulting in higher initial costs and perceived risks due to the lack of local technical support. Performance demonstration of such products is a major concern, as many of them do not offer a historic performance data set, are not familiar to consultants and practitioners, and/or demand substantial cultural or technological assimilation.

These demand intense coordination among local/foreign manufacturers to promote the use and virtues of these products and technologies. There is also a need to stimulate demand for such products in order to increase supplies and make such technologies more mainstream in the local context. Efforts should also be undertaken to make construction and demolition materials more marketable in Nigeria [51-53].

Related to this barrier is that of costs or perceived cost which is frequently pointed out as one of the major barriers for sustainable construction implementation within the country. It is argued in this research that in the Nigerian context, a sustainable LBM simply cannot cost more than a regular building. The current perception from the private sector, however, is that in most cases it does cost more, for many reasons [54]. Here, there is a need for better comparative information; otherwise, professional consultants or developers would be unlikely to take what they see as risks to achieve more sustainable outcomes.

VI. CONCLUSION AND SUGGESTIONS

These results offer some support to the notion that sustainable construction practices suffer wide gaps in developing countries like Nigeria, in which construction sector still maintains a large share in total domestic production; however, cannot afford sustainability at any cost [55]. The question remained is what measures might be effective to move the sector players to close the current gaps of sustainable LBMs selection practices and to reach significantly higher performance levels, and in a broader range of performance issues than just energy.

In terms of government-related actions, [55] argue that market-oriented policies or economic measures, such as incentives and taxes, are much more effective in delivering sustainable construction than those which involve legal regulation and impositions. In this regard, it is also argued that in order to reverse the current barriers related to the availability of sustainable materials and products in the local market, importation facilitation and financing local, low-cost development of non-available or high-cost products and technologies, until local supply capacity is fully achieved should be part of the solutions [56].

There are also substantial amount of suggestions related to the research and education sector. Majority of them urged for environmental awareness and responsibility to be incorporated into schools' and universities' curricula as well as into continuous education programmes for the construction sector players. Previous studies related to architectural education for instance, found that existing architecture curricula in local universities are not readily accommodative to sustainability issues and there is a lack of sustainability exposure among fellow educators especially those with first-degree qualifications [57]. With regard to the private sectors, most of the suggestions call for offering or creating demand for ecologically and socially responsible materials and services, and using more sustainable technologies and efficient building systems. In doing so, players on the demand side (investors and tenants) are suggested to be convinced of the advantages and need for improved building performance. All of the aforementioned actions will be an on-going matter of information and education.

From the foregoing discussion, it is sufficient to assert that it is not possible to use international assessment methodologies to assess sustainability and to encourage sustainable development locally. Certain development patterns from the developed world are not always applicable in the emerging/developing world [56]. Although emerging/developing countries have many conditions and issues in common, they have different climatic, cultural and economic conditions. This highlights the importance of regional characteristics to be reflected in assessment benchmarks and requirements, in order to make any assessment frameworks more socially acceptable and integral in the local construction industry.

Further research is now required to test the generalisation of the barriers in this research, and to identify strategies to overcome them. Unless the practical problems of implementing sustainable development policies are understood, a sustainable built environment is unlikely to be delivered.

Governments should make sure that appropriate institutions are established to properly co-ordinate sustainable LBMs. Political stability and effective legal framework that protects practitioners' interest and right to locally resourced materials are essential. There is need for governments to promote the use of appropriate technology and skills acquisition for construction using locally resourced materials. This could help in minimising the environmental impacts of building construction practices which may result from incidence of poor workmanship, weak structures and use of unsustainable materials that are prone to environmental pollution including high energy usage. Every practitioner should involve sustainable LBM

beneficiaries in the development process. Governments on the other hand should encourage and give incentives to the private developers and provide performance monitoring indicators for evaluating sustainability achievement of every building construction project. Governments should make sure that every practitioner in the sector acquires a full knowledge and understanding of the sustainable LBM requirements. This can be achieved through public enlightenment programmes, training, research and seminars including the provision of stakeholders' awareness booklets for: public officials, contractors, professionals and residents. These may lower quickly the general poor perception about sustainable LBMs.

Education for the clients or public at large about the principles and concept of sustainable LBMs was even more essential than technical training. For instance, an architect called for more education about "what sustainability means, how it relates to their lives and businesses and the benefits of demanding more sustainable LBMs options". Clients should monitor the costs, savings and other benefits and impacts resulting from purchasing and using more sustainable services and local products. This experience can then be used to motivate other clients to adopt procurement systems that demand sustainable construction and thus expand the LBM market.

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