

# Barriers to Implementation of Sustainable Construction Techniques

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**Abstract-**Sustainable construction efforts in the developing countries such Nigeria has been unsuccessful due to a number of barriers to its successful implementation. The barriers to sustainable construction were critically analysed and a framework to determine the challenges in a manner that is environment friendly, socially responsible and economically supportive was recommended. No attention has been renders to sustainable development agenda in the construction processes in Nigeria poses great danger to the future generations. Construction professionals are the stakeholders that play a key role in the design and implementation of construction projects. There is the need for cooperation and collaborative training between construction professionals in order to push forward implementation of sustainable construction in Nigeria. Present construction practices are unsustainable, and not in agreement with ideal sustainability principles. This paper reviews the existing barriers to sustainable construction and the construction management practices and processes to subdue the barriers in the developing countries such as Nigeria. Information will enrich the database for new professionals entering the construction industry; this research can be helpful to on-going projects and planning for future.

**Keywords:** Sustainable development, social-economic, environmental, home building, developing countries

## 1. INTRODUCTION

Sustainable construction development has led to significant changes in building delivery systems that meets the needs of the present without compromising the ability of future generations to meet their own needs and it is a prominent aspect of the socio-economic development of humans that mainly based on the buildings and the provision of safe and affordable homes for many countries of the world [1-3]. The contribution of buildings to Nigeria's development has not yielded the desired potentials this can be attributed to failed projects and currently their poor. Many a time building industry commonly referred to as an industry that is unfriendly and unkind to the natural environment [4]. Many researchers have expressed concern about the continued destruction and enormous impact of the construction industry on the environment. Nevertheless, to deal with this situation, sustainable construction has offers a guiding paradigm to develop a new kind of built environment: one that meets the needs of humans in the present without limiting the ability of future generations to meet their own needs. The sustainable construction concept has been introduced mostly in developed countries while less attention has been given to the concept in developing countries, where Nigeria is no exception [5].

Buildings that satisfied the acceptable standard for performance requirements enhance the national asset stock and Gross Domestic Product and are termed as sustainable buildings. They meet the requirement of the present and consequently contributing to future needs [6]. Many productive lives and properties have been lost to series of building collapse in Nigeria, and these losses, portent danger to future generations as well as the socio-economic status of its citizenry [7]. Many researchers have reported five elements of the principles of sustainable development which involves the selection of durable and sustainable materials that comply with acceptable requirement for standards; appropriate site selection; adoption of flexible and durable designs; proper planning and management of construction activities; and proper commissioning of building systems and equipment before occupation [8-10].

## II. SUSTAINABLE CONSTRUCTION

Sustainable construction can be described as green construction is concerned with the economic, social, and environmental impact of creating a usable structure. Sustainable construction requires designers and contractors to use building practices that will not have adverse effect on long-term on the environment. This type of construction is premised on the triple bottom line (TBL) tenets of "people, planet, and profit." Kibert [11] reported sustainable construction as 'the creation and responsible management of a healthy built environment pivoted on the prudent use of resources and ecological principles'.

Sustainable construction is conducted through all stages of a building's life from design to construction to maintenance and beyond. The initial work is supervised by a specialized firm that is familiar with the complexities of this kind of design. In the United States, any firm that is able to meet up with specific criteria earn Leadership in Energy and Environmental Design certification from the U.S. Green Building Council. The Green Building Initiative, another US sustainability organization, also offers certification programs for buildings, known as the Green Globes.

It has been found that some nations actively promote sustainable construction with rebates and other incentives to companies that practice it. It is also promoted through trade organizations that provide certifications to sustainable buildings that fall within the acceptable standards [11]. These organizations inspect buildings to determine whether or not they were built sustainably, and sometimes their certifications qualify buildings and companies which use green construction for awards, tax breaks, and other incentives.

### *A. Principles of Sustainable Construction*

Many researchers have reported six basic principles for sustainable construction such as minimization of resource consumption; maximization of resource reuse; use renewable and recyclable resources; protect and preserve natural environment; develop a healthy and non-toxic environment and quality control in developing built environment [12, 13]. These principles of sustainable construction cut across the whole life span of construction, starting planning stages to deconstruction. These principles also extend to the resources required to create and operate the built environment during its whole life span; land, building materials, water, energy, and ecosystems (Kibert, 2008).

### *B. Sustainable Construction in Developing Countries*

Du Plessis [14] reported that majority of developing countries are faced with the serious developmental challenges which includes housing and infrastructure shortfall, poor governance, high poverty rate, ineffective institutions, high rate of urbanisation, weak economy and poor human development index. Most of the developing nations of the world their construction activities are best described as paradoxical. Many a time there is an attempt to bridge the gaps in housing and infrastructure requirement for social-economic growth and these activities affected the environment adversely both socially and economically. With sustainability becoming a serious global issue, it is essential that the developing countries give the much needed attention to it,

With sustainability becoming a serious global issue, it is pertinent that the developing countries give urgent attention is required in order to alleviate the negative implications attributed to it. Thorpe and Ryan [15] found that there is paucity of information on the advancement made in sustainable construction by the developing countries of the world. Embanking on implement sustainable construction, a responsive, efficient and viable construction sector is important to drive the implementation process. In the actualisation of sustainable construction the stakeholders in the construction industry have key roles to play.

### *C. Implementing sustainable Construction*

Sustainable construction is described as any development that intended to meet the requirement and aspirations of the present without compromising the ability to meet those of the future generations [16]. The construction industry is client driven and level of awareness as well as adoption of sustainable construction by clients play an important role in the implementation. Construction professionals are the main stakeholders in actualizing sustainable construction [17]. The implementation process of sustainable construction has experienced serious drawback by most Nigerian construction firms owing to ignorant about the market value and possible losing clients since majority of the clients are negligent of the benefits. The greater percentage of clients was not aware of sustainable construction and the ones that aware are interested in initial cost rather than the long term benefits of sustainable construction.

Sustainable Development is a fulcrum for balancing environmental, social and economic goals [1] that comprises of the provision of safe and affordable homes [18]. It is pertinent to incorporate sustainable principles from the beginning of any project in order to achieve high-performance and low-environmental-impact buildings [2]. Venegas [9] stated five key elements of built environmental sustainability; the people, industrial base, resource base, natural environment, and the built environment. However Sev [8] found that sustainable construction can be classified base on the three dimensions of sustainable development which includes environmental, social and economic and these is based on three principles; resource management, life-cycle design and design for human habitation. There are many challenges to sustainable features that create balance between protecting ecology, societal interests and the economy. Information on the tenets of sustainability is still very poor based on this finding the best practices for implementation within the homebuilding industry remain passive.

### III. Barriers to Sustainable Construction

Despite the success of sustainable construction and the green building movement in the developed countries of the world Nigeria is still widely lagged behind but more entrenched traditional construction industry. However in defiance of these recorded successes in sustainable construction technologies practices in the developed countries are still faced with some barriers to more widespread acceptance. Development of sustainable construction in any country, the bottlenecks that hindered these practices have to be identified. Some of these challenges include; Clients reluctance, paucity of the right information, non availability of sustainable construction materials, inadequate capacity for execution of sustainable construction projects, inadequate expertise in sustainable designs, cost Implications, professional barriers. Many researchers have worked on different challenges to sustainable construction practices such as perceived cost implications, ignorance of its economic benefits, absence of appropriate building regulations, stakeholders' lack of consideration of sustainability, inadequate expertise in sustainable designs, clients' reluctance, a lack of the right information, non availability of sustainable construction materials, and lack capacity to enforce and execute policies on sustainable construction projects [19- 22].

According to the survey conducted in 2009, by the Liverpool John Moores University with the view of assessing factors best promote or prevent sustainable construction practices and establish the consistency of how sustainability is measured [23]. It was reported that the main drivers for sustainable construction are financial incentives and building regulations. Affordability by clients is a major constraint to sustainable construction, implied that sustainable construction is more expensive to implement as compared to standard practices [23]. The drivers and barriers of sustainable construction for developers are summarized below in Table 2.3.

Table 1. Drivers and Barriers to Sustainable Construction

<b>Drivers</b>	<b>Barriers</b>
Client awareness	Affordability
Building regulations	Building regulations
Client demand	Lack of client awareness
Financial incentives	Lack of business case understanding
Investment	Lack of client demand
Labeling/Measuring	Lack of proven alternative technologies
Planning policy	Lack of one labeling/measuring standard
Taxes	Planning policy

Djokoto et al. [24] reported some challenges encountered in the sustainable construction industry in Ghana as shown in Table 2. Zhou and Lowe [19] reported that sustainable construction is faced with some challenges such as the unaware of its economic benefits, lack of appropriate building regulations and planning policies that will make obligatory sustainable construction. It is believed that the cost of sustainable construction is higher compared with traditional approach in terms of capital has been seen as one of the major challenges to the implementation of sustainable construction [19, 20]. The erroneous outlook that sustainable construction will cost more reduces investors and construction organisations interest [19]. However, this perception is actually not true. However, the challenges acknowledged in the literature can be classified into four main categories as regard Nigeria’s perspective, this include; cultural, financial, Capacity or professional, and steering barriers.

**Table 2:** Barriers that affect sustainable construction in the Ghanaian construction industry

Item	Barriers to sustainable construction	Relative Important Index(RII)	Rank
1	Lack of Building Codes and Regulation	0.74	8 <sup>th</sup>
2	Lack of incentives	0.63	15 <sup>th</sup>
3	Higher investment cost	0.72	9 <sup>th</sup>
4	Risk of investment	0.76	7 <sup>th</sup>
5	Higher final cost	0.82	3 <sup>rd</sup>
6	Lack of Public awareness	0.79	4 <sup>th</sup>
7	Lack of Demand	0.90	1 <sup>st</sup>
8	Lack of strategy to promote sustainable construction	0.87	2 <sup>nd</sup>
9	Lack of Design and Construction team	0.56	7 <sup>th</sup>
10	Lack of Expertise	0.54	18 <sup>th</sup>
11	Lack of professional knowledge	0.44	8 <sup>th</sup>
12	Lack of database and information	0.63	16 <sup>th</sup>
13	Lack of Technology	0.52	19 <sup>th</sup>
14	Lack of Government support	0.78	5 <sup>th</sup>
15	Lack of a measurement tool	0.68	10 <sup>th</sup>
16	Increased Documentation	0.64	13 <sup>th</sup>
17	Extensive Pre-contract planning	0.65	12 <sup>th</sup>
18	Change Resistance	0.64	14 <sup>th</sup>
19	Lack of training	0.67	11 <sup>th</sup>
20	Lack of cooperation	0.77	6 <sup>th</sup>

Source: Djokoto et al. [23]

*A. Cultural Belief Barriers*

The Nigerian construction industry process has not experience major growth over the past decades and thus rendered itself as a sector which is very difficult to revolutionize especially with respect to construction methods practiced and building materials utilized. Construction in Nigeria ultimately favours the use of blocks and reinforced concrete which is professional termed wet construction, and disregards other forms of construction practiced in other parts of the world. Williams and Dair [20] also acknowledged that lack of sustainability measure by consultants as a major challenge as well as lack of demand by the client as a commonly recognized barrier. Lack of demand was also stated as one of the major challenges as building project cannot be execute along with sustainable lines without the owner or developer's "full support for sustainable concepts" [22].

*B. Initial Cost Perspective Barriers*

The negative perception of higher investment costs for sustainable buildings compared with traditional building and the risks of unanticipated costs are the major hindrance to the acceptability of sustainable buildings [17]. Many a time the implementation of sustainable building solutions may be hid because clients are much interested about the higher risk involved in the unfamiliar techniques, the lack of preceding experience, further testing, additional research and inspection construction, lack of manufacturer and supplier support as well as lack of performance information [25, 26, 27]. Hydes and Creech [26, 28] mentioned likely reasons for the higher costs which may due to increases in the consultant's fees, design team and contractors with sustainable building methods. Kats [29] reported that sustainable practices in construction are estimated to increase initial capital cost to the range of 1 - 25%, moreover, this can be offset through savings from operational costs. According to Baiden et al. [30] reported that sustainability will reduce life-cycle cost as well as enhancing the productivity of staff using such building.

*C. Technical know-How of the Professionals barrier*

Throughout the life of any construction project there involved many stakeholders. The uniqueness of work environment and culture of a construction project is different from most working conditions. A typical construction project consists of groups of people, normally from several organizations, that are hired and assigned to a project to build a facility [31]. One of the main barriers to sustainable construction is the lack of technical know-how of the stakeholders of the construction sector to actualize and implement sustainable practices [31].

Häkkinen and Belloni [17] asserted that sustainable buildings can be hindered by ignorance or a lack of common understanding about sustainability. Rydin et al. [32] stated that while designers demonstrate confidence in their ability to access and use knowledge in general, this confidence falls when sustainable building issues are addressed. This presupposes that professionals within the built environment have being identified to lack the technical knowledge and awareness and this has been extended to the clients, ignorance of awareness of benefits, lack understanding about sustainability, lack of education and proper perception in sustainable design as the main set back in the implementation of sustainable construction.

Williams and Dair [20] recommended the formation of an integrated team from conception to inception comprising of the developer/owner, project manager, contractor, architect, services engineer, structural engineer, civil engineer, environmental engineer, landscape consultant, cost planner and building surveyor. It is important that this team have access to the best available information on products and tools to actualize sustainable construction. Presently reverse is the case in Nigeria [20]. The workforce of every construction industry is its backbone hence it pertinent to involve professionals who are not only knowledgeable but can enhance sustainable construction working as a team. Some professionals are not well trained in the knowledge of sustainable construction and this should be well addressed in the education sector.

*D. Technical barriers.*

The effect of technical barriers on the success of sustainable construction was reported [30]. Many researchers have identified some of the major barriers to the implementation of sustainable construction which includes lack of environmentally sustainable materials, lack of sustainability measurement tools, lack of demonstration project, lack of easily accessible guidance, lack of technical know-how, persistent skills and labour shortages [32, 33]. These barriers are considered technical and they have direct impact on the success of implementation of sustainable construction principles (Rydin et al. [32] stated that some of the designers in the construction industry lack of confident on sustainable construction design especially in the developing countries like Nigeria. It is imperative for the professionals within the built environment to be acquainted with sustainable construction principles for proper implementation of its practice.

According to Tah [35] and Olajumoke et al. [36] the availability of locally sourced ‘green’ building products, such as advanced glazing systems, proved difficult for many sustainable construction projects. Products had to be imported from elsewhere in many cases, either directly by the project team or through a locally approved distributor. A lack of appropriate guidance appeared to exist for designers in the implementation of sustainable construction projects. It is important that technical information on sustainable construction is made available to design professionals in an appropriate format, and to the contractors ultimately responsible for implementing the design. Access to such information at an affordable rate was cited as a barrier to the use of such techniques [35-38].

*E. Steering Barriers*

A stream of individual engaged in the construction industry ranging from clients to the builder thus an efficient and effective steering or strategy will have to be involved to execute sustainable construction. A well organised steering enhanced sustainable construction. Steering barriers comprises of building codes, government policies/support and measurement tools and so on. Zhang et al. [39] advocated for a new kind of orchestrating and pioneering role of the building authorities and other public actors in the building sector.

*F. Inappropriate construction practices*

Appropriate construction practice when applied correctly, can reduce the overall construction burden on the environment and the society at large. Utilization of sustainable and recyclable construction materials will enhance overall sustainability to achieve cleaner and safer structures. The sustainable construction methods and materials are immensely important in a successful sustainable construction. For “practical” sustainable construction materials and methods, the waste and energy consumption and the overall life cycle impacts should be minimized. Sustainable construction materials are also much more efficient to recycle, requiring less energy and efforts in the recycling process.

**IV. SOLUTIONS TO SUSTAINABLE CONSTRUCTION**

*A. Proper awareness of sustainable construction*

There is no doubt that sustainable design is an imperative part of design education today. Tertiary Institutions in Nigeria both for Undergraduate and Post graduate level need to optimize sustainable design in their semester curriculum. It could include sustainable development, sustainable design processes, principles, policies and building regulations. This is going to build the mentality of the younger designers to be more conscious of sustainable development and construction. The lack of exposure to sustainable design in Tertiary Institution requires that this education needs to be obtained. To bridge the education gap, practitioners could utilise the services of a consultant or local resource centres. Primary data showed that other designers, unlike architects, are not familiar with building regulations that promote energy efficiency and environmental sustainability.

*B. Support of Government Policies*

Government policy should be made in favour of sustainable construction and energy saving. Regulations should be developed in Nigeria, which should assist the built environment in becoming more sustainable. Presently, there are no policies, regulations or bodies to sustainable development and promote environmental sustainability and energy savings. And there are, none have been implemented. Complete overhaul of planning and implementation policies such as building codes, that regulate performance standards for design and construction works based on sustainable principles be facilitated. Presently National Building Code of the Federal Republic of Nigeria [34] was not developed based on sustainable development but rather on persistence collapse of buildings; the paucity of reference design standards for professionals; and the use of unskilled professionals. However, total overhaul of the National Building Code that will incorporate sustainable construction is pertinent most especially for residential buildings. The development of bye-laws for major cities in Nigeria should be advocated and encouraged because of their strategic level of development. Governments (federal, state and local), through respective regulatory agencies, should play significant roles in reversing the trend of building failures and collapse.

*C. Products suppliers and manufacturers*

It is essential that product and material suppliers and manufacturers continue developing environmentally responsible products, and broadening their product ranges, as with greater selection, designers and clients are more likely to choose this alternative. In addition to this, and despite its difficulty, designers need to continually ask product suppliers and manufacturers about their raw materials, processes and the origin of products. With persistence, this would yield positive results [12-16].

*D. Client Education*

Barriers preventing clients from committing to a sustainable design approach are presently surplus cost, a selective use of materials, as well as education into the pressing need for sustainability. This results in clients not willing to consider the environmental responsibility, and lack of enthusiasm from designers to advocate sustainable design [12-17]. The higher educational background will enable clients to becoming better informed on the benefits of sustainable development/ design alternatives. This will consequently boost the client's awareness and thereby enhance level of acceptance. It will be eventually increase in demand for sustainable construction and cause a reduction in price of the sustainable construction materials and techniques [40].

*E. Use of tool rating*

Many scientists have recommended A Green Star rating system. It is important that international standard needs to be developed and managed by a Green Building Council. Application of rating tools aid for corporate will have positive influence on the projects sustainability status. This involved collaboration with other professional bodies such as developers, architect, contractors and built environment and all other stakeholders on a project with the aim of environmental sustainability. Based on this reason, a number of participants were sceptical about the tool [17-27].

*F. Introduction of sustainable construction in the educational institutions*

It is pertinent to introduce sustainable and green construction education into the curriculum based on the fact that every year, many people graduate from different educational institutions with degrees in construction and construction related fields. These fields of study also include various renewable resources and building sciences, technology, and design degree programmes. This will facilitate real-world practical experience into classrooms by the professionals and academicians to the students.

*G. Accessibility of information and intricacy of analysis*

Azapagic and Perdan [41], Singh et al. [42] and Yudelson [43] emphasised on the significant of accessibility of information and intricacy of analysis on the sustainable construction. It is a measure of qualitative, quantitative and progress of sustainable activities for the whole system. It provides a framework and a systematic approach to assess sustainability in construction. Information and intricacy of analysis guide the decision makers to appraise the selection process of construction equipment on the triple bottom line of sustainability

## V. CONCLUSION

This research was done to identify the various barriers to sustainable construction. Complete overhaul of the National Building Code that will incorporate sustainable construction is advocated most especially for residential buildings. It is pertinent to promulgate bye-laws for major cities in developing countries because this will enhance their strategic level of development. Governments at various levels should form regulatory bodies to play major roles in reversing the trend of building failures and collapse. The major constraints observed are related to low technical know-how on sustainable technologies, low level of sustainable awareness as well as expertise. There is need for improvement of skills in this sector. It is recommended that policies and regulations on sustainable development be taken seriously by government in view of their negative implication. Presently construction practices are unsustainable, and not in agreement with ideal sustainability principles. Improved levels of conformance to and compliance with sustainable construction principles by construction industry stakeholders is required to avoid further building collapse, hence enhancing capital and economic growth. The findings from this study will have positive influence on the industry because the graduates entering the construction industry are key factor to the successful completion of sustainable construction projects. More importantly in providing construction management companies with a basis for the latest practices and technologies because they are freshly graduated. Information will further enrich the database for new professionals entering the construction industry; this research can be helpful to on-going projects and planning for future projects.

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