Chapter

Exploring the Factors Hindering the Use of Green Architecture in Nigeria

Auwalu Faisal Koko and Muhammed Bello

Abstract

The construction industry in Nigeria has continuously witnessed rapid development as a result of massive investments in infrastructural projects such as housing. The continuous growth of this industry and the conventional approach to construction practices in Nigeria have negatively affected the environment and the wellbeing of the populace. Therefore, the concept of green architecture, also known as sustainable architecture, is a new approach in Nigeria's construction industry that strives to achieve environmental sustainability. However, various factors have hindered its adoption and utilisation. This study, therefore, examined the various factors hindering the use of green architecture through various literature reviewed and administered questionnaires to built environment professionals in Nigeria to ascertain their perception of those identified factors. Data gathered from the questionnaires were analysed using descriptive statistical tools and ranked according to each factor's mean index score and relative importance index. The results of the study revealed the most prominent factors hindering the utilisation of green architecture in Nigeria. Hence, findings from this study suggest that more efforts such as public enlightenment and the provisions of incentives are needed to be done by the government, built environment professionals, and other stakeholders in Nigeria's construction industry for the promotion of green architecture.

Keywords: built environment, green architecture, green buildings, sustainable buildings, zero-energy

1. Introduction

The term 'Green Architecture' and 'Sustainable Architecture' are often used interchangeably. Green Architecture refers to an architecture that is environmentally friendly and resource-efficient throughout the building life cycle from siting to design, construction, operation, maintenance, renovation, and demolition [1, 2]. Green Architecture practice complements the current building concerns of economy, utility, durability, and comfort. Even though new technologies are continuously being developed to improve the current practices in creating a sustainable built environment. The practice of green architecture allows for the improvement of the general living standard without causing damage to the resources needed for our survival as humans [3]. Green architecture helps

conserve natural resources, reduce pollution, and prevent environmental degradation [4]. The primary aim of green architecture is to reduce the overall impact of the built environment on human health and the natural environment. Green architecture principles often lead to the lowering of the operational cost of buildings through reduced utility from energy and water use. It also leads to a reduction in building maintenance costs. The green approach to architecture has been in existence for years, and it is not a new approach in trying to reduce the environmental impact of architecture. According to Brenda and Robert, what seems to be new is the recognition that green approach to natural and built environment involves a holistic approach to the design of buildings; with consideration to all the resources that go into a building, such as materials, fuels and the contribution of the users [5]. In Nigeria, the concept of green architecture, its principles, as well as its advantages to the environment, is hardly put into consideration when designing new buildings or renovating buildings. The result presented by Otegbulu revealed inadequate satisfaction of building users, which is often as a result of neglected green building principles during design, construction, and maintenance phases of building construction [6]. Therefore, Green Architecture seeks to meet the needs of humans for food, shelter, natural resource, transportation, and effective waste management while preserving and protecting the quality of the environment as well as the natural resource base, which is essential for future life and development [7, 8]. This concept recognises that meeting long-term human needs will be impossible unless the earth's natural, physical, and the chemical system is conserved [9], which is in line with the concept of green architecture. There is no doubt that the principles of green architecture are important for the construction industry in Nigeria, particularly the real estate sector, which has grown steadily and rapidly in the last two decades. Figures indicate that the real estate sector as a major component of the construction industry witnessed one of the highest growth rates and contributed tremendously to Nigeria's national income in 2018 with more than ₦1.26 trillion [10]. As such, the adoption of the principles of green architecture will not only enhance but also protect communities in Nigeria. This study, therefore, seeks to explore the concept, principles, and factors hindering the use of green architecture in Nigeria.

2. Concept of green architecture

Green architecture, also referred to as sustainable architecture, is a philosophy of designing buildings to comply with the principles of social, economic, and ecological sustainability. Green architecture uses a conscious approach to energy and ecological conservation in the design of the built environment [11]. It approaches building construction from the conceptualisation at the design and construction stage to the material usage at the finishing stage and throughout the entire lifespan of the buildings in order to minimise the harmful effect on human health and the environment [12]. Elshimy defined green architecture as the design and construction practices that considerably reduce or eliminate the undesirable effect of buildings on the environment and its occupants [13]. Similarly, the Integrated Waste Management Board, as cited in Kadiri, defined green architecture as an architecture that is designed, constructed, renovated, operated, or used in an ecological and resource-efficient manner [14]. It involves a trans-disciplinary approach to building construction and takes into consideration the environment as a vital factor in the design process [15]. Therefore, the concept of green architecture strives to minimise the negative environmental impact of buildings by enhancing efficiency and modernisation in the use of materials and energy, as well as conservation of the

environment [16–20]. However, despite the several benefits of green architecture, the conventional architectural practice in Nigeria often overlooks the interrelationships between a building, its materials and components usage, and the environment. This makes the buildings consume more resources causing an undesirable effect on the environment and creating a tremendous amount of waste. It subsequently results in buildings that are expensive to operate in terms of energy and water consumption and also contribute to buildings having poor indoor air quality. Therefore, it is of paramount importance that various stakeholders of the construction industry adopt the principles and practice of green architecture as a possible way of creating an environment that is friendly with resource-efficient buildings and reducing the operation and maintenance costs associated with built environment design in Nigeria.

It is against this background and the possible way of encouraging the use of green architecture in Nigeria that this study explores the various factors hindering its usage and provides possible measures to overcome these challenges.

2.1 Factors hindering the use of green architecture

Despite the numerous advantages of green architecture practice as it is related to sustainable site design, water quality and conservation, energy and environment, indoor air quality as well as material and resource conservation. The practice of green architecture is still faced with various factors that hinder its acceptance and usage. Choi et al. and Issa et al. identifies the various factors hindering the use of green architecture to include capacity barriers, the high initial cost of construction, and lack of proper awareness and enlightenment [21, 22]. Hamidi believes that the lack of green architecture expertise to initiate its concepts and principles from the early stages of building design and planning hinders the utilisation of green architecture [23]. Another factor identified by Issa et al., which hinders the development of green architecture, is the slow recovery of long-term costs [22]. Also, Means identified the various factors which hinder the use of green architecture to include low priority for the sustainability agenda in the education system, lack of urgency surrounding the practice of sustainability; lack of enforcement by the relevant authorities, and lack of government intervention through policies and incentive [24]. Other factors include financial constraints, the belief that sustainable buildings are economically not viable as they add to project costs, the belief that sustainable construction is an academic pursuit and not viable in practice, and most important is the lack of political will. In summary, the various factors hindering the use of green architecture, as identified from various literature, are categorised and discussed below.

2.1.1 Technology/capacity barrier

Various studies by different researchers have identified technology and capacity barriers as one of the main factors that hinder the development of green architecture. In a study conducted by Robichaud and Anantatmula, it identified a lack of knowledge about green architecture practices, lack of training, and education as the main barriers to the implementation of green building practices in developing countries [25]. This is further stressed by Du Plessis, Hakkinen and Belloni, and Opoku and Ahmed as a barrier due to the shortage of expertise in green architecture practices and its sustainability [26–28]. Rydin et al. argued that not only are professionals supposed to be knowledgeable, but also need to form an integrated team comprising of the developer/owner, project manager, contractor, architect, services engineer, structural engineer, civil engineer,

environmental engineer, landscape consultant, cost planner, and building surveyor [29]. This view is further supported by International Labour Office, who believes that the main reason for labour shortages and lack of industry skill in the construction industry is skill requirements change [30]. This is due to the introduction of green building designs, technologies, and practices, so previously satisfactory skill sets are no longer adequate. As a result of this, Opoku and Ahmed recognised the importance of building capacity as being an essential factor in the development of green architecture practices [28]. Therefore, built environment professionals need knowledge and technology that are better adapted to the natural resources to actualise the implementation of the various principles of green architecture. It is also essential for built environment professionals to adequately understand green architecture practice to be able to ensure that their decisions and actions regarding construction reduce the burden on building users and the environment.

2.1.2 Cultural and social resistance

There is a common lack of concern about green architecture and the high tendency of maintaining conventional construction practices by the various stakeholders of the construction industry in most developing countries [31]. This neglect of green architecture practice is experienced differently through various stakeholders such as the built environment professions, design approving authorities, ministries of lands and housing, as well as local development authorities. Also, the construction industry in most developing countries is dominated by contractors and developers that are not interested in green technological changes that involve risks and extra costs [27, 32]. In such cases, construction favours the use of conventional practices and discourages other alternatives like the use of green architecture construction methods. The construction industry in Nigeria favours the use of sandcrete blocks and reinforced concrete, which is professionally termed wet construction, and neglects other forms of sustainable construction practiced globally. Another factor determined by Du Plessis to be hindering the use of green architecture is the low interest in sustainable construction practice by clients and other stakeholders in the construction industry [27]. This is caused as a result of ignorance by clients as it relates to the long-term advantages of utilising green architectural practices. Therefore, in order to revolutionise the current construction practice, especially as regards to construction methods and materials used. The various professionals of the construction industry must enlighten clients, and other stakeholders on the competitive advantages of utilising green architecture practices for building construction.

2.1.3 Higher perceived cost associated with green architecture

Various studies have identified the fear of higher investment costs for sustainable buildings as compared to conventional buildings and the risks of unforeseen costs as one of the barriers to the utilisation and practice of green architecture [26, 32–34]. The added cost of incorporating green architecture features into building projects, which mainly depends on local factors such as climate, building customs, and labour skill levels, often serves as a significant barrier to having green buildings in most developing countries like Nigeria. Hydes and Creech believe that the high cost of green architecture practice is mainly due to overestimating energy efficient cost measures, increased consultancy fees, and underestimation of cost-saving measures [35]. This high cost usually discourages the practice of green architecture. Therefore, in order to promote the practice of green architecture. Shi et al. suggested the incorporation of Life Cycle Cost (LCC) in all construction projects by

built environments professionals to ascertain the cost implication and competitive advantages of green architecture usage [36].

2.1.4 Lack of incentives that promotes green architecture

The construction industry in most developing countries seems to be lagging in terms of the provision of incentives to contractors who meet green building ratings and consultants who incorporate principles of green architecture into their designs [37–39]. This aligns with the assertion of Chan et al., Darko and Chan, as well as Darko et al., who identified the lack of government incentives as a critical barrier affecting the adoption of Green Building Technologies [40–42]. Therefore, in order to encourage the utilisation of sustainable architecture, the government needs to establish effective financial incentives and non-financial incentives schemes that would help to ease the high initial costs associated with green architecture. Arditi and Yasamis, Serpell et al., as well as Sodagar and Fieldson, believe that the provision of incentives can be used for promoting green buildings in construction contracts in order to reduce contract costs, minimise contract duration, and maintain an acceptable level of health and safety [43–45]. This will subsequently lead to productivity, technological progress; innovation; management efficiency; and satisfactory quality of construction. Therefore, the provision of incentives will undoubtedly reduce the high start-up cost associated with green architecture and promote its usage and development.

2.1.5 Limited knowledge and information regarding the economic benefits and prospects of green architecture

Inadequate knowledge and information regarding the economic benefits and prospects of green architecture also serve as a barrier to the utilisation of green architecture. The availability of information as regards to the competitive advantages the use of green architecture offers is considered to be worrisome in most developing countries [46–48]. William and Dair and Azeem et al. identified a lack of knowledge, understanding, and information as a significant barrier to the successful delivery of sustainable architecture [37, 49]. Similarly, Alabi observed a low level of awareness regarding the concept of sustainability among most construction stakeholders in Nigeria [50]. Therefore, for green architecture to be widely accepted and used for construction projects, there is an urgent need for public awareness regarding the financial, economic, and environmental benefits of green architecture to society. Also, the numerous advantages of green architecture must be documented and communicated to all relevant stakeholders in order to expand and its use. Furthermore, there should be platforms which help built environment professionals to quickly disseminate information regarding the benefits of green architecture to the general public.

2.1.6 Unavailability of green building materials

Another barrier to the adoption and use of green architecture is the scarcity of green products and materials in the building construction industry. Various studies highlighted that most construction projects in developing countries faced difficulties in sourcing green products locally [49, 51–53]. Environmental friendly products that impact less on the environment and are needed for the utilisation of the principles of green architecture are not easily and readily available for use in the building construction industry. Even when these products and materials are available in developing countries such as Nigeria, the delivery time is usually lengthy.

S/No	Factors hindering the use of green architecture	Sources
1.	Technology/capacity barrier	[25–28]
2.	Cultural and social resistance	[27, 31, 32, 54]
3.	High perceived cost associated with green architecture	[25, 26, 32–34, 55]
4.	Lack of incentives that promotes green architecture	[21, 37, 40, 56]
5.	Limited knowledge and awareness regarding the economic benefits and prospects of green architecture	[37, 47–50, 57]
6.	Unavailability of green building materials	[49, 51–53]
7.	Insufficient support from the government	[41, 42, 44, 45, 58]
8.	Preference for other conventional building practices	[25, 51]

Table 1.
Factors hindering the use of green architecture.

It takes a long period to deliver because most of these green products and materials are usually imported. Similarly, Davies and Davies submitted that the unavailability of green building materials and products locally in countries such as Nigeria serves as a major barrier to the adoption of sustainable architecture [51]. As such, built environment professionals find it impossible to relinquish the conventional methods of building construction. Therefore, indigenous companies that manufacture green building products and materials are needed for the growth and development of green architecture.

The various factors hindering the use of green architecture identified from the numerous literature reviewed above are summarised in **Table 1**.

3. Research methodology

The research primarily employed the deductive method to achieve the research aim. Data obtained from secondary sources such as textbooks, journals, workshops/seminars/conference papers, magazines, newspapers and internet sources, etc. were used to review works of literature on sustainable architecture and develop a structured questionnaire that identifies the various factors hindering its use. The questionnaire was piloted on four respondents who are the Architects, Builders, Engineers, and other construction professionals to establish the various factors inhibiting the use of green architecture in Nigeria. Comments and observations from the preliminary survey were incorporated into the final questionnaire. The study employed a structured questionnaire administered to various built environment professionals in Nigeria. The structured questionnaire contained two parts. The first part presented the respondents' profile, made up of educational background, years of experience, and experience level with building construction. In contrast, the second part presented eight factors hindering the use of green architecture in Nigeria, which were deduced from literature. The various responses on each factor were placed on a five-point Likert scale. At the same time, the respondents were asked to indicate their degree of agreement with the factors on the Likert scale in which *Five (5) represents strongly agreed, four (4) represents agreed, three (3) represents undecided, two (2) represents disagreed, one (1) represents strongly disagreed,* and their values were ranked in order of importance to outline the level of significance of each factor. The frequency, percentage count, mean item score, and the relative importance index (RII) were used for data analyses and to indicate

the relative importance of each variable, contributing to the factors. The relative importance index (RII) was computed as established by [59] in Eq. (1) below:

$$RII = \frac{5n5 + 4n4 + 3n3 + 2n2 + n1}{5(n5 + n4 + n3 + n2 + n1)} \quad (1)$$

where
n1—number of respondents who responded with 'strongly disagree'.
n2—number of respondents who responded with 'disagree'.
n3—number of respondents who responded with 'undecided'.
n4—number of respondents who responded with 'agree'.
n5—number of respondents who responded with 'strongly agree'.

4. Results and discussion

4.1 Respondents' profile

The Primary data for this research work was obtained through online and manually distributed questionnaires to build environment professionals in Nigeria's construction industry, and the responses gathered were presented in **Table 2**. A total of 200 questionnaires were randomly distributed to various professionals in Nigeria's construction industry, out of which only 112 responded. 38.39% of the respondents are architects, 18.75% are builders, 32.14% are engineers, while 10.71% had other educational disciplines in the construction industry. The results revealed the average years of experience of the respondents to be between 5 and 15 years, implying that all the respondents have significant years of experience in the construction industry.

4.2 Perception of respondents on factors inhibiting the use of green architecture in Nigeria

Table 3 presents the assessment of the various factors hindering the use of green architecture in Nigeria based on a 5-point Likert scale.

The factors hindering the use of green architecture, as identified from the literature and corroborated by various built environment professionals, were ranked according to their Mean Index Score (MIS) and Relative Importance Index (RII) as indicated in **Table 3** and **Figure 1**, respectively. The findings of the empirical analysis revealed that the most significant factors that hinder the adoption and use of green architecture in Nigeria are strongly linked to cost, whereas the least significant factors are closely linked to knowledge and technical capacity. Results from the study further revealed that about 70% of the respondents agreed that lack of financial and non-financial incentives that promote green architecture hinders its adoption and use in Nigeria, whereas 64% of the respondents agreed that insufficient support from the government hinders the adoption of sustainable architecture in Nigeria. The result is consistent with the assertion made by Ndihokubwayo et al. and Chan et al., who believed that most construction industries in developing countries are lagging in terms of providing support and incentives that encourage the incorporation of green architecture concepts into practice [39, 40]. As such, it is now evident that with the outcome of this study, Nigeria is not an exception. Therefore, the active participation of the government in the provision of incentives will undoubtedly encourage the promotion and adoption of green architecture for use in Nigeria. The finding of this study further supports the claim of Ametepey et al. and Du Plessis,

	Frequency	Percentage (%)
Sex		
Male	89	79.46
Female	23	20.54
Total	112	100
Profession		
Architect	43	38.39
Builder	21	18.75
Engineer	36	32.14
Others	12	10.71
Total	112	100
Education history		
Polytechnic (HND)	18	16.07
University (B.Sc.)	62	55.36
University (M.Sc.)	32	28.57
Total	112	100
Years of experience		
Less than 5 years	33	29.46
5–10 years	46	41.07
10–15 years	17	15.18
15–20 years	10	8.93
More than 20 years	6	5.36
Total	112	100

Table 2.
Respondents' profile data.

who claimed that the majority of built environment professionals are not interested in green technological changes [27, 32]. This results consequently in cultural and social opposition due to the general lack of demand from clients and other construction industry stakeholders. Therefore, the progress of green/sustainable architecture in Nigeria depends heavily on the willingness of built environment professionals and other construction industry stakeholders to be fully committed to green technological change and to work towards the acceptance of its principles in Nigeria. Other factors that were found to hinder the use of green architecture in Nigeria are high perceived costs associated with green architecture and preference for traditional building practices, with 57 and 56% of respondents agreeing with such factors. This result correlates with the submission of Hakkinen and Belloni and Ametepey et al., who believe that the cost of sustainable architecture is high with higher investment costs than conventional construction [26, 54]. As such, it results in conventional construction methods being preferred. The three least significant factors hindering the use of green architecture as perceived by the respondents include Technology/Capacity barrier among built environment professionals, Limited knowledge and awareness regarding the economic benefits and prospects of green architecture and the Unavailability of local Green building materials having a Mean Index Score (MIS) of 3.27, 2.93 and 2.56, respectively. This suggests that most respondents believe that Nigeria has the capacity and knowledge of green architecture, as well as

S/N	Factors	Responses					Total (N)	ΣW	Mean (ΣW/N)	RII	Rank
		Strongly Agreed	Agreed	Undecided	Disagreed	Strongly Disagreed					
1.	Technology/capacity barrier among built environment professionals	26	35	12	21	18	112	366	3.27	0.65	6th
2.	Cultural and social resistance by various stakeholders	28	41	9	19	15	112	384	3.43	0.69	3rd
3.	High perceived cost associated with green architecture	25	39	14	20	14	112	377	3.37	0.67	4th
4.	Lack of financial and non-financial incentives that promote green architecture	36	42	9	15	10	112	415	3.71	0.74	1st
5.	Limited knowledge and awareness regarding the economic benefits and prospects of green architecture	20	27	11	33	21	112	328	2.93	0.59	7th
6.	Unavailability of local Green building materials	13	18	15	39	27	112	287	2.56	0.51	8th
7.	Insufficient support from the government	38	34	7	19	14	112	399	3.56	0.71	2nd
8.	Preference for conventional building practices	27	36	10	22	17	112	370	3.30	0.66	5th

Table 3.
Perception of respondents on factors hindering the use of green architecture in Nigeria.

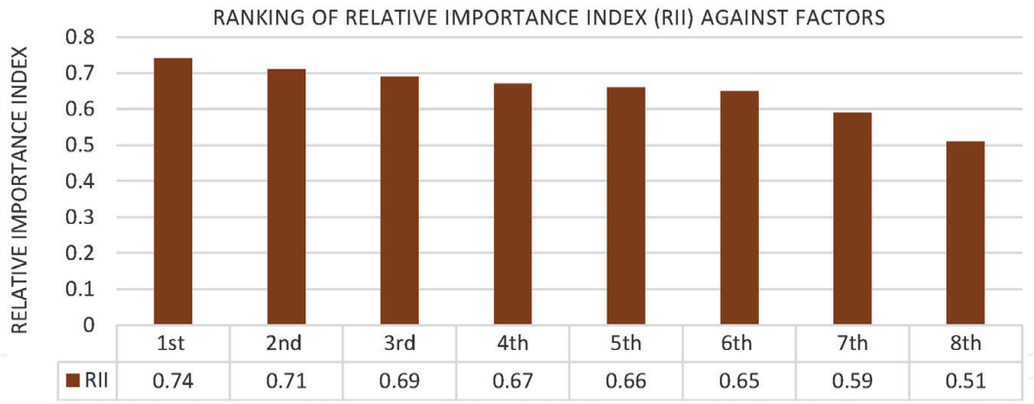

Figure 1.
Ranking of factors hindering the use of green architecture. 1st, lack of financial and non-financial incentives that promote green architecture; 2nd, insufficient support from the government; 3rd, cultural and social resistance by various stakeholders; 4th, high perceived cost associated with green architecture, 5th, preference for conventional building practices; 6th, technology/capacity barrier among built environment professionals; 7th, limited knowledge and awareness regarding the economic benefits and prospects of green architecture; 8th, Unavailability of local Green building materials.

available green building materials locally. However, other factors identified above inhibit its adoption and usage.

5. Conclusion

The concept of green/sustainable architecture is relatively new in the building construction industry and has been asserted as a way of achieving environmental sustainability. However, the adoption and utilisation of its various principles in a developing country such as Nigeria are still quite low, with various factors identified to be hindering its usage. Therefore, these factors need to be addressed in order to promote the adoption and utilisation of green architecture. For that reason, this study examined the various factors hindering the use of green architecture in Nigeria. In order to achieve this aim, a comprehensive empirical review of related literature was conducted, and questionnaires administered to various built environment professionals. Findings from this study revealed that the three most significant factors hindering the use of sustainable architecture in Nigeria are lack of financial and non-financial incentives that promote green architecture, insufficient support from the government as well as cultural and social resistance by various stakeholders. This study, therefore, recommends that since lack of financial and non-financial incentives that promote green architecture and insufficient support from the government, which are government-related are the most significant factors hindering the adoption and use of the various principles of green architecture in Nigeria. Therefore, the active involvement of the government is necessary for overcoming these challenges. This can be done through the introduction of laws, the provision of incentives, and the development of a framework that encourages the implementation of sustainable architecture practices in the building construction industry. This study was not only able to contribute and fill existing knowledge about green/sustainable architecture in Nigeria, but also provides the most significant factors that hinder its acceptance and use. The findings of this study will substantially help to mitigate the challenges of green/sustainable architecture adoption in Nigeria and subsequently contribute to environmental sustainability.

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Author details

Auwalu Faisal Koko[1*] and Muhammed Bello[2]

1 College of Civil Engineering and Architecture, Zhejiang University, Hangzhou, China

2 Kaduna Polytechnic, Kaduna, Nigeria

*Address all correspondence to: faisal.koko@yahoo.com

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