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Assessment Of Cost Implication Of Green Building In Nigeria

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ABSTRACT
Globally, there is tremendous increase in the use of Green building due to the effects of global warming, ozone layer depletion and deforestation on human being worldwide. The study investigated on the cost implication of green buildings in Nigeria. The study focuses on the barriers to controlling cost in Green building, cost benefits of Green building and cost variables of Green buildings. The existence of Green building construction in Nigeria was the bases to considered FCT Abuja, Lagos and Rivers states. Both the qualitative and quantitative approaches were employed in generating preliminary data for field survey. The survey involved one hundred and eighty five participants in the FCT and other 2 states with notable volume of Green building construction and materials. Data collected were analyzed using mean score, relative important index and ranking factors. The study revealed that the general perception of Green building is costly and; most of the design professionals have little knowledge about the concept of Green building. The study concluded that the benefits of Green building and its capability of cushions the effects of global warming, ozone depletion and deforestation outweigh the high cost of Green building. The study recommends that government need to play a significant role in the application of Green building construction in Nigeria.

KEYWORDS: *Green-building, implication, deforestation, ozone-depletion, Cost-benefits, construction*

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I. Introduction

Recently, Green building has been recognized as a strategy to addressing and cushions the effects of global warming, declining in ozone layer and deforestation on human being since the industrial revolution in which the whole world witness incalculable technological achievement in the 21 century. Dahiru & Adejoh (2014) affirmed that environmentally friendly buildings popularly called Green Buildings (GB), sustainable or high-performance buildings, seem to satisfy the above mentioned effects. More efficient, green construction practices can have a substantial impact on environmental outcomes: buildings represent 30 percent of global carbon emissions and 40 percent of raw materials and energy consumption (Kahn, Kok & Quigley 2014 & Glaeser & Kahn 2010). The climatic change and its attendant effects on the built environment is now widely accepted as being a reality today and have become a very serious problem facing humanity, and in a bid to overcoming these challenges, the adoption of an environmentally responsible approach to building design, construction has become inevitable (Smith 2010). Adegbile (2013) stated that the adverse effects climatic change are extreme weather conditions being experienced, increase in rainfall, flooding, building collapses, increased thermal discomfort in buildings, water shortages and draught, increase in cost of building construction and operation amongst others. He further highlight that increase in research, technological advancement and economic growth, building construction has greatly increased and has been said to account for nearly half of all the greenhouse gas emissions and energy consumed owing largely to the energy used in the production and transportation of materials to building construction sites, and energy used to operate these buildings. Kolawole & Anigbogu (2005) opined that what is needed is a dynamic equilibrium which is production process that is friendly to the ecosystem. Sustainable and eco-friendly architecture is one of the main aims that humans for creating a better life have made as the ultimate model for all their activities. A green building has four main element or components on which it is designed: materials, energy, water and health to make green building more sustainable.

Green Building is the practice of creating healthy facilities designed and built in a resource efficient manner, using ecological based principles. Green Building brings together vast array of practices and techniques to reduce the impact of building on energy consumption, environment and human health. Globally, the trend towards green building practices have been accepted as a number of buildings have incorporated the principles (Nduka & Ogunsanmi 2015) Fischer (2010) views green building as integrated building practices that significantly reduce the environmental footprint of building in comparison with standard practices. While, Ahn, Pearce, Wang & Wang (2013) termed green building as healthy facilities designed and built in a resource

efficient manner, using ecologically based principles. Baruwa (2011) Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by: Efficiently using energy, water, and other resources; Protecting occupant health and improving employee productivity; and Reducing waste, pollution and environmental degradation. According to Alittaeia (2010) the issues of environmental sustainability, global warming/climatic change and greening the world economy have become terms in discussions on the subject matter about the effects of our economic and social activities on the environment. To this extent therefore, the issue of Climatic Change, Sustainable Development and a Green Economy (Green Housing) are all related to one another.

Numerous studies on sustainability and in particular green building have been conducted in Nigeria by some researchers: (Nduka & Ogunsanmi 2015; Uwazie, Igwemma & Okonkwo 2015; Olanipekun (2015); Dahiru, Dania & Adejoh 2014 & Nwokoro & Onukwube 2011) on Green Building practice, challenges and opportunity. (Adegbile 2013 & Baruwa 2011) study on green building rating system.. The cost implication of Green Building is paramount to investigate upon.

Some researchers have supported findings that green building can be cost-neutral or cost-saving, others have refuted this testimony. Isa, Rahman, Sipan, & Hwa (2013) affirmed that investors are attracted to invest in green office buildings due to higher investment returns and benefits expected. These include higher occupancy rate and market value, lower risks, higher cost savings from improved energy and water efficiency, and social and environmental benefits such as improved health and work productivity. Many in the building industry perceive green and/or Leadership in Energy and Environmental Design (LEED) certified buildings to be much more expensive than conventional buildings (Building Design & Construction [BD&C], 2003; McGraw-Hill Construction, 2005; Turner Construction, 2005). Langdon (2007) postulated that many projects are achieving LEED within their budgets and in the same cost range as non-LEED projects. He further stated that Construction costs have risen dramatically, but projects are still achieving LEED. Bond and Perrett (2012) stated that the issue of cost prevents the incorporation of sustainable features in developments. While some researcher claimed that high development cost of green building is the biggest barrier in green building construction (Esa et al., 2011; Sood & Peng, 2011; Zhang, Platten & Shen 2011; Zainul Abidin, 2010; & Shari, Jaafar, Salleh & Haw 2009).

The cost of green house depends upon a variety of factors and assumptions such as: Type and size of project; Timing of introduction of LEED as a design goal or requirement;
Level of LEED certification desired; Composition and structure of the design and construction teams; Experience and knowledge of designers and contractors or willingness to learn; Process used to select LEED credits; Clarity of the project implementation documents; and Base case budgeting assumptions In addition, the costs will vary, depending upon whether only capital costs are considered or if costs are calculated over the life of the building (Nalewaik & Venters 2007). The cost of green design has dropped in the last few years as the number of green buildings has risen. The trend of declining costs associated with increased experience in green building construction has been experienced (kats 2003) The Green Building is of vital importance to all because it deals with the survival of human species and almost every living creature on the planet whether relatively expensive or similar in cost with non-Green Building or there is no significant difference in average cost for green buildings as compared to non-green buildings or conventional building structure.

Cost for construction projects can be divided into three categories: land, hard and soft cost. Land cost will not vary regardless it is a conventional or green project; however, hard and soft cost are believed to be influenced by the choice to be green. Hard cost has been given much attention by scholars, but soft cost, which is also known as 'hidden' cost remain elusive in its contribution to green building cost increment. As such, this paper discusses the nontechnical aspects of project cost and their influence on the overall development from the developers' perspective (Nurul Zahirah & Zainul Abidin 2014).

II. Literature Review

Various studies on green building have used various terminologies to denote the concept of green building. Green building involves the practices that reduce the environmental impact of components of the built environment which include: green building, green architecture, sustainable building, high performance building and low impact development. This is clearly supported by assertion presented in Fischer (2010). The study points out the differences in meaning ascribed to green building from standard practices to those aimed of environmental impact. Green building employs a "life-cycle approach," estimating the cumulative environmental and social impacts of a building throughout its lifespan, from construction to use to demolition. This holistic approach to building is not new, but has only recently gained mainstream reputability (Baruwa 2011). Green building (also known as green construction or sustainable building) refers to a structure and using process that is environmentally responsibly and resource-efficient throughout a buildings life-cycle from sitting to design, construction, operation, maintenance, renovation, and demolition (Okafor 2016). Green architecture defines an understanding of environment-friendly architecture under all classifications, and contains some

universal consent (Burcu, 2015). It may have many of these characteristics: Ventilation systems designed for efficient heating and cooling; Energy-efficient lighting and appliances; Water-saving plumbing fixtures; Landscapes planned to maximize passive solar energy; Minimal harm to the natural habitat; Alternate power sources such as solar power or wind power; Non-synthetic, non-toxic materials; Locally-obtained woods and stone Responsibly-harvested woods; Adaptive reuse of older buildings; Use of recycled architectural salvage; and Efficient use of space.

Green Building Rating Systems (GBRS)

The basic aim of any building environmental assessment scheme is to set criteria against which to rate a building and then to provide a score or descriptive rating for that building. This rating can be used to show the building's environmental credentials and can have commercial value in terms of promoting a sustainable, eco-friendly image. In addition, a rating system allows a comparison to be made between the performances of similar building types (Adegbile 2013).

Globally, 7 variety of rating system have been developed around environmental and energy impact of buildings: BREEAM, CASBEE, GREEN GLOBES, GREEN STAR, HK-BEAM, IGBC Green Homes and LEED.

Cost of Green Building

Project cost can be divided into land cost, hard costs and soft costs. Land costs cover those expenses for land acquisition and development of the project such as land purchase, title transfer, site clearance and others. Hard costs refer to direct physical construction costs of the building. While soft costs refer to other various costs incurred to move the project forward. These are the additional cost stated in the green building index such as Green Building Consultancy Fee, Green Building Certification Registration Fee and Green Building Index Certifier's Cost. Emerging Professional's Companion Report (2013) defined, "Soft Costs include a variety of costs incurred by the owner to move the project forward. Design fees, management fees, legal fees, taxes, insurance, owner's administration costs, and a variety of financing costs fall into this category. In general, the cost of green building includes all cost incurs in non green building and additional 8 variety of financial costs. The 8 variety of financial costs are: Energy Cost; Sustainable Site Cost: Cost of Water Efficiency; Green Building Materials Cost; Green Building Certification Registration Fee; Green Building Consultancy Fee; Green Building Index Certifier's Cost; Cost of Innovation in Design; and Cost of Indoor Environment. In USA the cost premium for green building assessment is 2% while in Hong Kong is 0-4 %. Popularly acceptable cost premium for green building assessment is 1-5%.

Selection of Green Building Materials and their Faction

Wastiels & Wouters (2009) affirmed that material selection process is a complex process that is influenced and determined by numerous preconditions, decisions and considerations. They stated further that material selection is not about choosing the strongest, cheapest, or most obvious materials available, but considering a wide range of variables that affect the choice of materials during the design and selection processes. Baruwa (2011) opined that Green buildings may incorporate sustainable materials in their construction (e.g., reused, recycled-content, or made from renewable resources); create healthy indoor environments with minimal pollutants (e.g., reduced product emissions); and/or feature landscaping that reduces water usage (e.g., by using native plants that survive without extra watering). The materials for green building are generally consisting of renewable resources and environmental responsible due to the fact that their impacts are on project lifecycle consideration. In accordance with Cullen (2010), green building materials can be selected by evaluating characteristics such as re-used and recycled content, zero or low off-gassing of harmful air emission, zero or low toxicity, sustainable and rapidly renewable harvested materials, high recyclability, durability, longevity and local production.

Table 1: Materials for Green Building, Function and Location

Green building materials	Function	location	Source
Abaca	It is like banana plant and can be used in house in form of woven clothes and curtain to small furniture	Center and side tables as interior decoration	Bhushan (2013)
bamboo	Made to bathroom mat, floor, roof and wall panel	Floor finishes	Wikipedia (2020)
Banana leaves	Dried banana leaves are weaved to beautifying baskets, trays, picture frame	interior decoration	Bhushan (2013)
Coconut shield	To create house hold items likes curtains, wall decor, door mat and rug	interior decoration	Bhushan (2013)
corn	Corn composite board for furniture and construction	Ceiling finishes and interior decoration	Bhushan (2013)
Cord wood	Short round pieces of wood laid one	Walls of all kind to give good	Wikipedia (2020)

	above the other with special mortal mix in wall	appearance of the structure and strong environmental friendly	
Jute	Jute rugs , curtain and sack	interior decoration and storage	Bhushan (2013)
Hemp	Hemp fibers bound with lime to create concrete- like-shape that strong and light	Walls and columns construction	Bhushan (2013)
Intensive green roof	Lowering urban air temperature and mitigate the heat island effect, require more maintenance	Roof covering with minimum depth of 12.8cm	Vandermeulen et. al. (2011)
Extensive green roof	Lowering urban air temperature and mitigate the heat island effect, require minimal maintenance	Roof covering with minimum depth ranging from 2 - 12.7cm	Volder (2014)
Wall climbing green wall	Climbing plants cover the walls building with the help of trellis and supporting system	Wall finishes and exterior decoration for bungalow buildings	Wilmer (1990)
Hanging down green wall	Complete vertical green belt on multi-storey buildings	Wall finishes and exterior decoration for multi-storey buildings	Wilmer (1990)
Module green wall	Latest concept on vertical green belt on multi-storey buildings	Wall finishes and exterior decoration for multi-storey buildings	Jonathan (2003)

III. Research Methodology

A preliminary study using a qualitative approach was first conducted with experts from the building industry to understand the local context of cost elements in green building implementation. The research later employed the quantitative survey and the target population was the registered professionals in the built environment where notable green buildings were located in Nigeria. The sample was randomly selected from the lists got from their various professional bodies, especially, the ARCON and QSRBN. The areas covered in this research are: Abuja, Lagos and Rivers states where notable green buildings were available. A total of 185 participants were involved in the study. Data were collected through structured multiple choice questionnaire. The questionnaire was divided into two parts; part A contained personal data of the respondents, part B comprised the cost variables of green building; cost benefits of green building in Nigeria and barriers to controlling cost in green building construction in Nigeria. The survey respondents were asked to rate the applicability of the cost variables of GB on the 5-point Likert scale; where, 1 represents `Not applicable, 2 less applicable, 3 applicable, 4 highly applicable, and 5 very highly applicable. In terms of the importance of the cost benefits of GB and barriers to controlling cost of GB: 1 implied no importance, 2 = low importance, 3 = importance, 4 = highly importance, and 5 = very highly importance.

Data collected were processed using Microsoft Excel and Statistical Package for Social Science (SPSS 20). The ranking of the factors was determined based on the Mean Score (MS) which was calculated by the following equation:

$MS = \Sigma (R_{Pi}R_i)/n, (1 \leq ll \leq 5)$……..Equation (1)

Where MS = Mean Score, R_{Pi} = Rating Point I (range from 1 - 5)
R_i = Response to rating point, i and n = total responses = Summation of R_i from 1 to 5.

The analysis was done to determine the level of applicability of cost variables and importance of the cost benefits of Green Building and Barriers to controlling cost of Green Building.
MS was derived as the total score divided by the number of respondents for each variable /factor. A baseline of MS = 3.0, was used to determine the significance of the factors. Factors having an MS ≥ 3.0 were considered as significant while factors with a MS < 3.0 as insignificant.

IV. Data Analysis And Results

185 of 220 copies of questionnaire duly completed, returned and valid were used for the analyses. Descriptive analysis and mean score along side with the relative importance index methods were used for the analysis. The return rate of 84.09% indicated that the result can be relied upon

Assessment of the cost variables of Green Building

The agreement among professionals in the built environment especially the Architects and Quantity Surveyors on their perspective of the cost variables of Green Building in the study area indicates that further analysis on the data from the respondent groups can be combined for further analysis since they do not

significantly differ. The data were further analysed to determine the relative importance index (RII) of each of the variable based on the perception of the respondents. The result of the analysis is shown in Table 2.

Table 2: Cost Variables of Green Building

Variables	Mean score	RII	Rank	Remark
Energy Efficiency	4.85	0.1296	1st	Very highly applicable
Sustainable site Cost	4,76	0.1272	2nd	Very highly applicable
Water Efficiency	4.52	0.1208	3rd	Very highly applicable
Green building Materials Cost	4.45	0.1189	4th	Highly applicable
Green Certification Registration Fee	4.05	0.1082	5th	Highly applicable
Green Building Consultancy Fee	4.05	0.1082	5th	Highly applicable
Green Building Index Certifier's Cost	4.05	0.1082	5th	Highly applicable
Innovation in Design	3.60	0.0962	8th	Highly applicable
Indoor Environment	3.10	0.0829	9th	Applicable

The result in Table 2 shows that all the variables considered in this study have MS greater than the hypothesized MS of 3.0. This indicates that the respondents sampled believe that all of the cost variables of Green Building are significant and applicable in determine cost of green building, since all the variables have the MS ranging from 4.85 to 3.10. Based on the results of the study, the impact of these cost variables on green buildings indicates that cost of green building is higher than cost of similar non green building. This is in line with Bond & Perrett (2012) that the issue of cost prevents the incorporation of sustainable features in developments. Likewisely , it were Proven statistically that high development cost of green building has been largely cited as the biggest barrier in green building construction (Zhang et al., 2011; Sood & Peng, 2011; Zainul Abidin, 2010; Shari, et al., 2009). Also proven that generally, investing a higher capital for a green building does not appeal to developers when a cheaper alternative remains available (Zainul Abidin, 2010; Esa et al., 2011)

Out of the nine cost variables of Green Building considered in the study, the first three highly ranked of the variables and their respective MSs include: Energy cost with (MS=4.85), sustainable site cost with (MS=4.76), and water efficiency (MS=4.52). The least three variables are Green Building Index Certifier's cost (MS=4.05), Innovation in Design (MS=3.60) and Indoor Environment (MS=3.10). The very highly applicable variables have mean value > 4.50, column 5 shows that only three variables fell in this band. While the highly applicable variables have mean value range between 3.51 and 4.50, column 5 shows that only five variables fell in this band. The applicable variables have mean value range between 3.00 and 3.49; the remaining one variable fell in this category.

Ranking of the Cost Benefits of Green Building

Further analysis was carried out based on the data generated from the respondents to determine the importance of the cost benefits of green building. This consists of eighteen variable identified in the questionnaire administered to the respondents, details in the table 3 below

Table 3: Cost Benefits of Green Building

Cost benefit factors	**MS**	**RII**	**Rank**	**Remark**
Promote the use of renewable materials	4-95	0.0668	1st	Very highly importance
Enhance occupant comfort and health improve quality	4.90	0.0661	2nd	Very highly importance
Conserve and restore natural resources	4.87	0.0657	3rd	Very highly importance
improve overall quality of life	4.85	0.0655	4th	Very highly importance
Sustain employment opportunity	4.55	0.0614	5th	Very highly importance
Enhance and protect bio-diversity and eco-system	4.45	0.0601	5th	Highly importance
Improve air and water quality	4.30	0.0580	5th	Highly importance
Energy saving	4.25	0.0574	8th	Highly importance
Water saving	4.20	0.0567	9th	Highly importance
Create , expand and shape market for green building product and services	4.00	0.0540	10th	Highly importance
Encourage construction waste management	3.96	0.0535	11th	Highly importance
Design that considered existing cultural pattern and behaviors	3.92	0.0529	12th	Highly importance
Ensure financial affordability for intended beneficiaries	3.88	0.0524	13th	Highly importance
Pursue quality in creating the built environment	3.75	0.0506	14th	Highly importance
Prevention of pollution from construction activity	3.50	0.0472	15th	Highly importance
Design for flexibility and adaptability	3.35	0.0452	16th	Importance
Heighten aesthetic quality	3.20	0.0432	17th	Importance
Create local materials protection policy	3.20	0.0432	18th	Importance

Table 3 shows that all the benefit factors considered in this study have MS greater than the hypothesized MS of 3.0. This indicates that the respondents sampled believe that all of the benefits of Green Building are significantly important, since all the variables have the MS ranging from 4.95 to 3.20. Based on the results of

the study, the most highly ranked of all is Promote the use of renewable materials with MS=4.95 while the least is Create local materials protection policy with MS=3.20. Other factors such as: Enhance occupant comfort and health improve quality; Conserve and restore natural resources; improve overall quality of life; and Sustain employment opportunity were among the first five most significant benefits of green building. This implies that health wisely and other benefits of green building over similar non green building outweigh the extra cost associated with the green building. This is in agreement with Isa et al. (2013) affirmed that investors are attracted to invest in green office buildings due to higher investment returns and benefits expected. These include higher occupancy rate and market value, lower risks, higher cost savings from improved energy and water efficiency, and social and environmental benefits such as improved health and work productivity.

V. Conclusion And Recommendation

The study investigates the investigated on the cost implication of green building in Nigeria by focusing on the cost variable of green building and cost benefit of green building. A questionnaire was designed and distributed among the construction professional in charge of green building design and cost experts. Based on the results, the study concludes that the benefits of Green building and its capability of cushions the effects of global warming, ozone depletion and deforestation outweigh the high cost of Green building. Also, the perception of green building is expensive will soon be foregone with time. This might due to the fact that being relatively a new concept in construction industry and that the professionals might lack adequate knowledge require for green building. The study recommends that government should provide an enabling environment through its Support Initiatives and Policies for application of green building construction. Also government should full embank on using green building concept in public building projects in order to sensitize private sectors in application of green building in their construction projects. The study further recommended that all the professional bodies in the built environment should mandate their members to acquire adequate skills and knowledge require for green building for effective green building design and cost control through continuous mandatory retraining of their professional members.

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