APPRAISAL OF THE NEED FOR THE DEVELOPMENT OF GREEN BUILDINGS FOR ENVIRONMENTAL SUSTAINABILITY IN AWKA, ANAMBRA STATE, NIGERIA

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Abstract
The aim of this study is to appraise the need for the development of green buildings for environmental sustainability in Awka with a view to recommending measures to ensure its state wide adoption considering the attendant need. The study was conducted through a descriptive survey method where Ninety (90) well-structured questionnaires were distributed to built environment professionals practicing and residing in Awka while 85 copies were retrieved back. This study revealed that the level of implementation of the listed green building practices like have a very strong relationship with ensuring environmental sustainability in the study area.The study found out that there is a strong relationship between environmental sustainability and extent to which green building practices are implemented. The study recommends that, green building practices should be implemented on all construction sites to boosts environmental sustainability and that renewable energy resources should be mostly adopted out of all the green building practices.

INTRODUCTION

Nigeria as a developing country is faced with the growth of residential housing sector accompanied by huge power, water and material consumption due to increased urbanization. This urbanization is associated with loss of arable land, material and water crisis and serious environmental problems like air pollution, noise pollution and waste generation (Dalibi, Feng, Shuangqin, Sadiq, Bello and Danja, 2017). The destruction of the vegetation, energy, material waste and noise pollution constitute the most severe resultant impacts associated with construction projects in Nigeria (Anigbogu and Keftin, 2007). All are as a result of construction activities on the environment. Green building therefore is part of the larger concept of sustainable development as it enhances the environment against the negative side effect of construction activities (Dahiru*et al.*, 2013).The fact that most construction projects in the study area have not totally adopted green building principles is quite alarming.The level of implementation of sustainable construction practices in the Anambra state, Nigeria is very slow and practiced at a slow pace (Dalibi*et al* 2017). Only few housing developments like Victoria Garden City (VGC) and Crown Estate both in Lagos State are have been known to massively incorporate some elements of green building in their design. The reasons could be traced to the assumption that it costs more to build green, the lack of awareness of the market, the knowledge, the research, and resources, steep learning for professionals, outdated planning and building codes, poor government policies with respect to built environment, shortage of experienced professionals on operating green building systems and lack of incentives for owner investors as opposed to owner-occupants (Udechukwu and Johnson, 2008). However, little research has being done to examine the role of green building in sustaining the environment. This research is therefore, pertinent and is aimed at appraising the implementation of Green Buildings for environmental sustainability in Awka-South with a view to provide means to improve the level of adoption of green building practices within the study area. The hypothesis to be adopted will be;

H_0: There is no significant relationship between the implementation of green building practices and environmental sustainability.

Literature Review

Concept of Environmental Sustainability

According to Morelli (2011) Environmental sustainability is meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them, and more specifically, as a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity. Environmental sustainability is seen as an interaction with the environment to avoid depletion or degradation of natural resources and allow for long-term environmental quality. The practice of environmental sustainability helps to ensure that the needs of today's population are met without jeopardizing the ability of future generations to meet their needs. When we look at the natural environment, we see that it has a rather remarkable ability to rejuvenate itself and sustain its viability. For example, when a tree falls, it decomposes, adding nutrients to the soil. These nutrients help sustain suitable conditions so future saplings can grow. When nature is left alone, it has a tremendous ability to care for itself. However, when man enters the picture and uses many of the natural resources provided by the environment, things change. Human actions can deplete natural resources, and without the application of environmental sustainability methods, long-term viability can be compromised.

The 4 Rs of Sustainable Construction

The 4R Concept

The waste management practice of sustainable construction have been guided by a ‘‘3Rs’’ principle, which is also known as the hierarchy of Construction and Development (C&D) Waste Management (WM). The principle refers to the 3Rs of reduce, reuse, and recycle, which classify strategies according to their desirability (Peng, Scorpio, and Kitbert, 1997). The 3Rs is meant to be a hierarchy, arranged in ascending order of their adverse impacts to the environment from low to high. Aside the Rs is another form of waste management which is **Recovery** (Krajl and Markic, 2008). Hence the four Rs include: Reduce, Reuse, Recycle and Recovery techniques.

(a) **Reduction**: is considered as the most effective and efficient method for managing C&D waste. It cannot only minimize the generation of C&D waste, but also reduce the cost for waste transportation, disposal and recycling (Poon etal 2004).

(b) **Reuse**: means using the same material in construction more than once, including using the material again for the same function (Ling and Leo, 2000) and new-life reuse for a new function, for example, using the cut-corner steel bar for shelves; using the stony fraction for road base material (Duran, Lenihanand O’Regan, 2006).

(c) **Recycling:** When reduction and reuse become difficult, recycling is desired.Tam (2008) summarized that recycling can offer three benefits: reducing the demand for new resources; cutting down transport and production energy cost; and utilizing waste which would otherwise be lost to landfill sites. So far, in comparison with those of reduction and recycling, relatively fewer studies have been conducted to address issues on reuse

d) **Recovery:** is a method of taking an item, which may appear to have lived its useful life, and fixing it so that it can still be productive. It is also a way of taking some used components and some new components to "rebuild" an item. For instance, Toner cartridges are often used then sent to a manufacturer to be broken down and rebuilt.

Green Building and Environmental Sustainability

Green building also known as green construction refers to a structure using a process that is environmentally responsible and resource-efficient throughout a building's life-cycle from sitting to design, construction, operation, maintenance, renovation, and demolition (Gottfried, 1996). This requires close cooperation of the entire project stakeholders all project stages (Yan Ji, 2006). Although new technologies are constantly being developed to complement current practices in creating greener structures, the common objective is that 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 occupants' health and improving employee productivity and reducing waste, pollution and environmental degradation (United States Environmental Protection Agency, 2009).Green buildings can indeed use less energy and incur less cost than the convectional buildings, but he argues in his study that energy consumption costs does not necessarily make green buildings more economical. Further cite author Regosa (2009) argues that energy cost savings should not therefore be used to justify additional cost investment in new green buildings. According to Morelli (2011) Environmental sustainability is meeting the resource and services needs of current and future generations without compromising the health of the ecosystems that provide them, and more specifically, as a condition of balance, resilience, and interconnectedness that allows human society to satisfy its needs while neither exceeding the capacity of its supporting ecosystems to continue to regenerate the services necessary to meet those needs nor by our actions diminishing biological diversity. Creating sustainable working environments is not just about reducing carbon emissions. Truly sustainable buildings should be designed to improve the wellbeing of the people who work in them and the communities that surround them. "Going green" is the phrase referring to corporate and individual action consciously taken to curb the harmful effects on the environment through consumer habits and lifestyles. The following various approaches of green concepts in regard are water and energy efficiencies, materials and waste, sustainable sites, that are applied to enhance sustainability in buildings to ensure environmental sustainability. Some of the roles of green building according to (Rode, 2011; Gottfried, 1996; Environmental Protection Agency, 2016; Weizsacker, Smith, and Desha, 2009;Donough and Mbraungart, 2002;Thormark, 2006; Nationwide Construction, 2016)have been identified as:

1. **Use Natural Energies and Maintain Available Energy**: Utilizing renewable energy sources such as solar heaters, solar photovoltaic panels, wind energy, bio-energy and any other type of clean energy will be reflected in positive results, all of which contribute to the preservation of the environment as clean as possible.Use of passive solar building designs are other strategies that designers put in place to achieve energy efficiency
2. **Better Health:** Another goal of Green Building is to improve air and water quality within structures, as well as the productivity of their occupants. An Environmental Protection Agency (EPA) report states that indoor air pollutant levels are about two to five times higher than those of outdoor air. Some of these pollutants, such as radon gas, are attributable to natural conditions, while others such as second-hand smoke are a direct result of human behavior. However, many of these pollutants are a by-product of the materials used to construct or furnish the building. (Environmental Protection Agency, 2016).
3. **Low Maintenance and Operation Cost:** Green buildings incorporate unique construction features that ensure efficient use of resources such water and energy. For example, by using lighting strategy and a lot of daylight, green buildings vastly reduce the amount of power used in lighting systems; This allows users to save as much as a third of their water and energy bills. Given that operating and maintenance costs can account for as much as 80% of the lifetime costs of a building, reducing such costs significantly increases the earnings of building owners who collect rent from their buildings.(Nationwide Construction, 2016).
4. **Waste and Material Efficiency:**The criteria to be followed include resource availability, minimal environmental impact, embodied energy efficiency, potential re use and recyclability. Reducing the number of material components in products as well as separating natural from synthetic material allows higher rates of recyclability and reuse (Donough and Mbraungart, 2002).

Creating sustainable working environments is not just about reducing carbon emissions. Truly sustainable buildings should be designed to improve the wellbeing of the people who work in them and the communities that surround them. "Going green" is the phrase referring to corporate and individual action consciously taken to curb the harmful effects on the environment through consumer habits and lifestyles. Access to clean modern energy services is an enormous

challenge facing the African continent because energy is fundamental for socioeconomic development and poverty eradication. Today, 60% to 70% of the Nigerian population does not have access to electricity (Oyedepo, 2012). Security, climate change, and public health are closely interrelated with energy (Ramchandra, 2011). Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible, and environmentally friendly. The common Nigeria man does not understand the concept of "conservation of energy" and this is the guiding principle behind sustainability (Ramchandra, 2011).. That every home should be able to utilize energy, either water, air, electricity, etc. conservatively, without causing harm to the environment. The recent world's energy crisis is due to two reasons: the rapid population growth and the increase in the living standard of whole societies. The per capita energy consumption is a measure of the per capita income as well as a measure of the prosperity of a nation (Rai, 2004). Energy supports the provision of basic needs such as cooked food, a comfortable living temperature, lighting, the use of appliances, piped water or sewerage, essential health care, educational aids, communication and transport. Energy also fuels productive activities including agriculture, commerce, manufacturing, industry, and mining. In Nigeria today, most structures are constructed using cement based materials. Cement during its manufacture and use is responsible for the emission of greenhouse gasses which are harmful to the environment (Ramchandra, 2011).. The production of cement also causes the depletion of non-renewable natural resources. The incremental rate of construction has pervaded most urban centers in Nigeria, with most of such buildings inhabited with the barest facilities in place (Olufunto and Olatunde, 2013).

Methodology

The study was done in Awka-South local government area in located in Anambra state (Fig 1.2) is located at latitude 60°12N and longitude 7°21E. It comprises of nine towns namely Amawbia, Awka, Ezinato, Isiagu, Mbaukwu, Nibo, Nise, Okpuno and Umuawulu. The population of Awka was 301,657 as of 2006 Nigerian census. Awka is one of the oldest settlements in Igbo land established at the center of the Nri civilization which produced the earliest documented bronze works in sub-Saharan Africa around 800AD and was the cradle of Igbo civilization. The city is located 199.1 kilometers (123.7m), by road, directly north of Port Harcourt in the center of the densely populated Igbo heartland in south east Nigeria.The Economy of Awka south revolves round mainly government jobs, since there are a lot of federal and state institutions present in the area. Hence the presence of much construction related activities in the area.

The data for this research was collected from both primary and secondary sources. The primary source of data for this research is the use of questionnaire, while the secondary source of data includes journals, Textbooks, printed publications, online materials and other various unpublished works and write-ups. The questionnaire will be structured in a manner that suggested for immediate and easy response. A set of questionnaires will be administered through purposive random convenient sampling to Building Construction professionals, in Awka-South local government area. The research adopted descriptive research survey design in building up this research work. The choice of this research design was considered appropriate because of its advantages of identifying attributes or items by collecting data from the members of a population in order to determine their opinion regarding the subject matter under discussion. The sampling technique employed in the course of this research is Purposive randomly sampling. The data for this research was collected from both primary and secondary sources. To achieve the aim and objectives of this research work, certain tools were used which includes; percentage rating for Section A of the questionnaire and a 5-point Likert scale for the section B.To ascertain the relationship between green building practices and environmental sustainability in the postulated hypothesis. The dependent variable (Environmental Sustainability) was correlated with the independent variable (Implementation of Green Building Practices):

Result

Table 1: Questionnaire Response Rate

Questionnaires	**Frequency**	**Percentage (%)**
Number of questionnaires Shared	90	100
Number of questionnaires returned	85	94%
Number of useful questionnaires	85	94%

Source: Researcher's field survey, 2019.

From the result in table 1,a total of ninety (90) questionnaires were prepared and administered to the three categories of selected registered built environment professionals in the study area in Awka South, however, not all the questionnaires were retrieved. Out of the 90 that were administered 85 questionnaires which represents 94% were returned while 6% were not returned. This return rate indicates that there was a high rate of response from the respondents. (Fincham, 2008).

Table 2: Assessment on the Implementation of Green Building Practices in Awka-South

Green Building Practices	**Mean Score**	**Ranking**
Flexible Design of Building Spaces for Multi-Functional Purposes.	3.48	1
The use of Green Building Materials for Construction on Site	3.38	2
Water generation and Re-use through Grey-Water Plumbing Systems	3.24	3
Waste Minimization by Recycling and Reusing Materials	3.20	4
The Prefabrication of Construction Components	3.15	5
Use of Modular Construction ;Houses are Fabricated in Factories and Assembled on Site	3.04	6
Use of Renewable Energy Sources	3.00	7
Average Mean	**3.21**	

Source: Researcher's Field work, 2019

The respondents were questioned on the levels of implementing of the listed green building practices. Table 2 indicates that flexible design (3.48) is ranked as being the most implemented the most implement practice in the study area, which implies that there are competent professionals in the area of green building design. Use of green building materials, and grey water systems rank next in order of implemented green building practices, while recycling and reuse, prefabrication of components and use of modular construction ranks low in their implementation in the Awka-South Built Environment. This is because there is lack of technology and adequate training in this area,It is observed that use of renewable energy sources, has the lowest level of implementation (3.00). This is because there is lack of adequate funds and technology for the effective utilization and harvesting of renewable energy resources, which arises from awareness, training and interest from the appropriate quarters who shows interest in this area, such as the government and manufacturing companies.

Table 3 Assessing the relationship between the implementation of green building practices and environmental sustainability.

Variables	**X Roles of Green Buildings**	**Y Green Building practices**	**X**	**Y**	**X-y**
Efficient use of Natural resources	4.58	3.38	1	2	-1
Better Health of Building Occupants	4.39	3.48	2	1	1
Waste and Material Efficiency	4.08	3.20	3	4	-1
Water Efficiency	3.88	3.24	4	3	1
Low Maintenance and Operation Cost	3.74	3.15	5	5	0 1

Source: Researcher's Field work, 2019

$$R = 1 - \frac{-6\sum d^2}{n(n^2-1)}$$

$$\mathbf{1 - \frac{6(0)}{5(25-1)}}$$

$$\mathbf{1 - \frac{0}{120}}$$

$$\mathbf{1 - 0 = 1}$$

From table 3, the value of spearman co-efficient is **1** which means that there is a strong relationship between the level of implementation of green building practices like efficient use of Natural resources, better health of building Occupants**,** waste and material efficiency**,** water efficiency**,** low maintenance and operation costand environmental sustainability.

Conclusion

The hypothesis proves that the level implementation of the listed green building practices has a very strong relationship with ensuring environmental sustainability in Awka -South, it further summarises that there is a strong relationship between environmental sustainability and extent to which green building practices are implemented (Table 3);ultimately the study recommends that, Green building practices should be implemented on all construction sites as it boosts environmental sustainability and that renewable energy resources should be mostly adopted out of all the green building practices.

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