

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 8, August 2017

Sustainable Architecture and Climate Change in Nigeria

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ABSTRACT: The developmental stride in terms of industry, agriculture, science and technology is actually boomeranging in form of environmental deterioration can not be over emphasised. One of the developmental strides is the provision of shelter and other human activities. Architecture is one single sector that involves many complex processes and as such affects negatively to the environment to that extent. The general term “sustainability” as applied in the context of built environment is fashioned out to address the multiple “externalities” caused during the period of building design, construction, use and re-use. Architecture is actually a key player in terms of the amount of natural resources consumed, the amount of pollution created, the amount of energy wasted and the amount of waste generated (Emmitt 2002). This paper tends to take a step further by examining the main factors that contribute to climate change and how sustainable architectural practice can positively affect the environment using the concept of adaptation or mitigation. The conclusion and recommendations highlight the urgent need for man to be conscious of the negative effect of his various activities and take all necessary precautions in his developmental stride to checkmate the high rate of climate change which leads to environmental deterioration.

KEYWORDS: Environmental Deterioration, Climate Change, Sustainability, Externalities Mitigation, Adaptation, Deforestation, Desertification.

I. INTRODUCTION

The word sustainability as applied to both architecture and the environment emerged as a result of conscious effort to find solutions to the negative effects of human activities on the environment. Almost all activities on earth has its negative impact on either the immediate or remote environment. These negative impacts could be in form of pollution, degradation and reduction or total extinction of one specie of plants/animals or the other. As recorded in Awake Magazine, “the earth summit on the environment held in June 1992 in Brazil, the emphasis was on the level of deterioration of our environment by our actions and in-actions. One of the scholars of that conference in his editorial said: “Now more than anything else the threat to humanity comes from the destruction of the earth’s environment. And it needs a movement of planetary dimensions to arrest the holocaust(1). Still stressing the same point, An American scientist, Al Gore in an article titled “Respect the land” published in American Time, had this to say; the consideration of the subject as sweeping as the environment, the emphasis should not be on only the tangible aspects like the air we breathe, the water we drink, the food we put on the table. Though these things are critically important but the environment is also about something less tangible though no more less important. This aspect is about our sense of community – the obligation we have for each other, and to future generations to safeguard God’s earth (2). The publication released by International Energy Agency (IEA) estimated that existing buildings are responsible for more than 40% of the world’s total primary energy consumption and 24% of global carbon dioxide emissions (3). Also, it has been discovered that architecture alone is responsible for about 45% of carbon dioxide (greenhouse gas) emissions in the UK (4). These facts not only call for sustainable and ecological design but also poses a very big challenge to architects. The concept of sustainable architecture is the conscious efforts by professionals in the building industry to reduce or mitigate the negative environmental impact of building processes. This is achieved through the consideration of ecological sustainability, efficiency and moderation in the use of materials, energy and development of

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space (5). This paper shall examine the effect of some human activities on the environment which ultimately lead to climate change. It analyzes sustainable architecture especially in the tropics in line with environmental sustainability.

Various human activities and climate change

Many years ago some warning voices have been raised on the climate change. One of those voices has this to say, "Over the last few decades, mankind has become conscious of the fact that human activities are having a dangerous impact on the environment" (1). Excessive deforestation is affecting a lot of species of animals and plants and this invariably leads to the destruction of forest and reduction in the earth's capacity to convert carbon dioxide into life-sustaining oxygen.

The human activities that affect our environment are direct function of population, technology and industrialization especially in developing countries like Nigeria. For instance, during the pre-colonial period in Nigeria, development objectives were essentially materialistic and relatively limited to subsistence level. On this basis and as at that time the impact of man's activities on the environment were quite limited and also most insignificant. As at that time population was sparse with mostly farmers, fishermen and hunters.

But however, the situation gradually changed during the colonial era, which witnessed devastation of the natural environment. This period incidentally coincided with early industrial revolution in Europe. And so development in the country was almost synonymous with increasing the raw materials as much as possible to feed the factories in Europe and other developed countries of the world. The subsequent extraction of mineral resource and other raw materials needed for industries marked the beginning of high rate of human activities with negative consequences and externalities on the environment. With the increasing level of industrialization and technology today, the threats to our environment are clearer and much greater in scope and complexity. All over the world today, climate change, deforestation, holes in the Ozone layer and air pollution are growing source of concern (2). The greatest challenge is to find new ways to address this problem that is threatening our corporate existence on earth.

Human activities like farming and other infrastructural constructions have also been identified as causes of global warming. Both of these activities can change the reflectivity of earth surface leading to local warming or cooling (6) in (7). The emission of aerosols (which reflects or absorbs sun's energy) and the depletion of Ozone layer has been linked to global warming. Ozone layer which shields the earth's surface from direct ultraviolet rays from the sun is rapidly being eroded by certain substances released into the atmosphere through human activities such as industrial activities, space rocket and satellite launching, nuclear weapon testing (8,6).

Sustainable Architecture and the Environment

The term "sustainable Architecture" was coined out of the curiosity to mitigate the adverse effect of building processes on both the immediate and remote environment. Environmental Impact Assessment (EIA) is one of the tools used by decision-makers during design process to envisage and visualize the negative environmental consequences of the structure. The European Union's first Directive on Environmental Assessment (Directive 85/337 EEC) was introduced in 1985 and approved for implementation in 1988. (10). Generally, the main objectives of EIA is to provide decision-makers and designers with an indication of the consequences of their actions and this could importantly form an essential design aid for the development team. One of the most cardinal goals of sustainable architecture is the energy efficiency over the entire life cycle of a building including the building process. (11). To ensure the maintenance of ecological system especially during the design state is to exploit local environmental resources and influence energy-related factors such as daylight, solar heat gains and ventilation by proper and adequate site analysis. Design considerations that guarantee sustainable development and tolerable climate change are; embodied energy, energy in use and pollution prevention.

Embodied energy is the measure of the energy consumed in the production of a particular material for which comparative charts are available to aid the designer (10). According to some authors, there is strong link between embodied energy and embodied carbon dioxide (CO₂). Energy in use is highly connected with the thermal efficiency of the building and the way and manner the occupants use it. Passive architectural strategies which have been adopted as design measures are also involved in energy analysis. Some of these include but not limited to the arrangement of rooms, size and position of windows, the general orientation of the facades and the ratio between building heights and street widths (12). Orientation of any building affects the ventilation, thermal efficiency and lighting. But however and unfortunately, in Nigeria and other countries of the tropics, building orientation is highly influenced by the position of Main Street instead of the geographic cardinal points. Furthermore, it is an established fact that architects are very much aware that buildings can be designed to operate with far less energy than today's average worldwide and at no

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additional cost. Actually this may be achieved through proper site selection, building form, glass properties and location, materials selection and incorporating natural heating, cooling and ventilation strategies (13).

Research has shown that the combination of annual energy required to operate residential, commercial and industrial buildings along with the embodied energy of industry-produced building materials like carpet, tiles, glass and concrete, exposes buildings as the target energy consuming and greenhouse gas emitting sector (13). The demand in building sector include energy used in the production and transportation of materials to building construction sites as well as the energy used to operate buildings. The implication is that buildings and their construction activities account for nearly half of all the greenhouse gas emissions and energy consumed worldwide annually. Therefore, if we must get it right in terms of reducing the amount of greenhouse gas emissions and subsequent climate change, then we must concentrate more on the building sector. Figures 1,2 and 3 simply show the percentage of the total energy generated that is consumed by building sector as compared with other sectors of the economy worldwide.

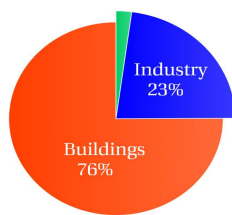


Fig 1: 76% of all power plant generated electricity is used just to operate buildings.

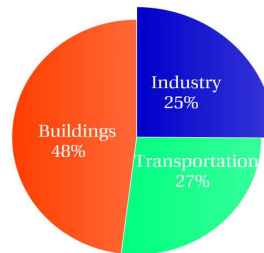
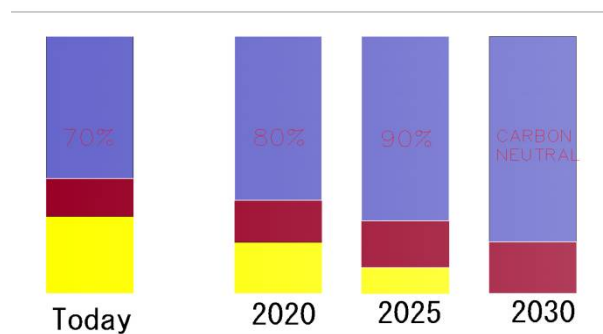


Fig 2: Combining the annual energy required to operate residential, commercial, and industrial buildings along with the embodied energy of industry-produced building materials.



■ Fossil Fuel Energy Reduction
 ■ Renewable
 ■ Fossil Fuel Energy Consumption

Fig. 3 Source: 2015–2030 Inc/Architecture 2030

This implies that the fossil fuel reduction standard for all new buildings and major renovations shall be increased to

- ▶ 80% in 2020
- ▶ 90% in 2025

and finally carbon-Neutral in 2030 (ie using no fossil fuel GHG emitting energy to operate.)

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In an editorial titled: “Architects and Climate Change” the American Institute of Architects (AIA 2015), highlighted the following points;

- a. Building sector is biggest source of emissions and energy consumption in the world
- b. Building sector is the major source of global demand for energy and materials that produce greenhouse gases that is poised to fuel the world’s rush towards climate change.

Major Objectives of Green Architecture.

Green Architecture is viewed in African context as the indigenous approach of building practices with the goal of sustaining the ecosystem (14). Generally the aim of green architecture is to minimize harmful effects on human health and environment as a result of building activities. It attempts to as much as possible to conserve environmental elements such as air, water, energy and earth by employing eco-friendly building materials and construction practices. The construction and operation of buildings require more energy than any other human activities (15). The International Energy Agency (IEA), estimated in 2006 that buildings used more than 40% of primary energy consumed globally, accounting for roughly a quarter of the world greenhouse gas emissions.

Furthermore, the high rate of urbanization trends in developing countries like Nigeria, are accelerating the growth of this sector in connection to residential buildings. Minimizing these greenhouse gas emissions from building activities is therefore a cornerstone intentions and responsibilities if green building initiatives and sustainable architecture. Sustainable building is the outcome of a design which emphasizes on increasing the efficiency of resource, use-energy, water and materials. The focus here is to reduce the negative building impacts on human health and environment especially during operation and possibly during removal processes.

Sustainability in architecture entails mainly improving energy efficiency and by extension includes improving energy efficiency throughout the global economy (IEA, 2008). The idea of sustainability or ecological design is to ensure that our actions and decisions today do not obstruct the opportunity of the future generations (17). Sustainable architecture may be described as all-inclusive in that it seeks to minimize the negative environmental impacts of building by efficiency and moderation in the use of materials, energy and development space. Environmental sustainability and greenhouse gas emission reduction are the two major fronts through which the objectives of sustainable architecture can be achieved.

Environmental sustainability; Green buildings are designed with the issue of environmental management in focus. It takes appropriate measures to reduce wastage as well as environmental degradation to barest minimum (14). It also takes into consideration the comfort of the end-users and the sustainability of the eco-system.

Greenhouse gas emission reduction; As already stated, the built environment contributes to more than 40% of greenhouse gas emissions and ultimately to global warming. Therefore, the idea of **Green Architecture** is an initiative of improved technologies, to contribute significantly to mitigating global climate change.

Conclusion and Recommendations

It is clearly established from this study and other researched papers that global warming is on the increase. This global warming causes a lot of climate changes which affects human comfort, the ecosystem and ecological balance, desertification, depletion of the Ozone layer, total extinction of different species of plants and animals etc. Hence to mitigate against some of these effects the following actions are suggested;

- a. Encourage and promote sustainable design which must include resource conservation to achieve a minimum 50 percent reduction from current level of consumption of fuel used in assembling and operating new and renovated buildings.
- b. Ensure the sustainability of these reductions through creating building performance standards in building codes of individual nations.
- c. Encouraging and supporting government action to use incentive –based regulatory means to reduce greenhouse gas emissions. The main objectives should be to achieve stabilization of greenhouse gas concentration in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
- d. Extended and continued scientific research should be encouraged on this issue because climate is a very complex system whose patterns are likely to continue changing.

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- e. As rightly recognized by International Conventions on Climate Change, developed and industrialized nations have the largest and historic emission records. Therefore, these nations should take the lead and burden of helping to reduce harmful effects and cut down greenhouse gas emissions (16).

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