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# Housing and Climate Change in the Nigerian Built Environment

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**Abstract**
The effect of housing and climate change on the Nigerian Environment was assessed employing secondary sources of data. It revealed among other things that climate change is due to natural force and anthropogenic activities of man especially in the course of building his house. This alters the Natural equilibrium of the eco-system. The energy mostly used today in houses is produced from burning of fossil fuels which emits greenhouse gases (GHGs) into the atmosphere. These cause global warming and by extension climate change. The paper recommended adaptation and mitigation strategies through sustainable architecture as panacea. It concluded that climate will continue to change; however, man must only tap the natural resources for his survival in a responsible and sustainable manner.
**Keywords:** housing, climate change, built environment, adaptation, mitigation.

## 1. Introduction

Global warming is real. It has direct impact is on the climate and consequently on the environment, human life and socio-economic activities. Many countries of the world are experiencing extreme weather conditions and climate change associated natural disasters which scientists have concluded are being induced by human activities (Atilola, 2012). Scientists and major research centres in industrialised countries averred that human activities through the emission of carbon dioxide into the atmosphere is the single major cause of climate change and unpredictable weather conditions the world over. While the industrialised countries of the world, the major contributor to climate change, have the capacity to respond to the impact of climate change, most developing countries do not have adaptive capacity for global warming. They therefore need assistance from developed countries to combat the effects of climate change on their environment and economic wellbeing.
The environment consists of all physical, social and cultural factors and the surroundings which support the existence and development of man and other organism. Obas (2011) put it that the built environment depicts man made surroundings that facilitate human activity, including buildings, structures, landscaping, roads, signs, trails and utilities that underpin effective functionality of society to define its physical characteristics. Thus, the built environment is the part of the natural environment formed and shaped by mankind to suit its needs. Man, as a resource, is the most precious within the biosphere. At the same time, he is the most dangerous, as man's activities especially the exploitation of resources for sustenance and creation of wealth produce adverse effects on the environment. In all global warming and environmental issues, man is the problem and man is the solution. Without human activities the environment and nature will take care of the balance of the ecosystem in a sustainable manner. Therefore if man must continue to exist on earth, he has to use the natural resources in the most prudent and sustainable manner.
Housing is a fundamental need of man without which his very existence is under threat (Olotuah, 2005). Housing is one of the three basic needs of man and it is the most important for the physical survival of man after the provision of food (Akingbohungbe, 2002; Munonye, 2009). It has a profound influence on the health, efficiency, social behaviour, satisfaction and general welfare of the community. (Okedele et al, 2009) opined that, in the evaluation of man's comfort, growth and development, it is inevitable that housing be considered as a critical element. It is has been described as a sine qua none of human living (Yakubu, 1980), and as an index of the standard of living of a people.
Nigeria has a population of more than 140 million people (Preliminary census, 2006). According to the National Rolling Plan, the national housing requirement is between 500,000 and 600,000 units, considering the prevailing occupancy ratio of three and four persons per room (Ojenuwah, 2006). As Muoghalu (1999) puts it, the rapid population increase coupled with high rate of urbanisation has contributed in no small way to the shortage of urban housing in Nigeria. Also, a number of scholars have posited that an enormous backlog of housing shortage exists in Nigeria, particularly in the urban areas. For instance, the United Nations survey between 1991 and 2001 looked at Nigeria's urban areas and reported that an annual production of more than 700,000 housing units would be required to sustain the upward population trend (Onyebueke, 2002; Isimi, 2005). Increasing demand for housing as a result of recent population upsurge and the quest for economic development

in developing countries further push up energy consumption and release of more greenhouse gases from the housing sector (Ogwu, 2012). Adeleke (2011) remarked that if nothing is done, greenhouse gas emissions from houses will more than double in the next 20 years.

According to Munonye ( 2009), housing is synonymous with building and recent estimates of the United Nations Environmental Programme (UNEP) Sustainable Construction and Building Initiative (SCBI, 2009) assigns 30-40% of Global energy use to the building sector. This includes energy used in the production and transportation of materials to housing construction site, as well as the energy used to operate houses. The housing sector is the key source of demand for energy and materials that produce by product greenhouse gases. Moreover, there are the GHG emissions from deforestation when vegetation is cleared to make way for houses.

This paper therefore aims at highlighting the impacts of houses and climate on the Nigerian environment. The specific objectives are to:

i) Highlight the causes and effects of climate change in the built environment
ii) Impact of housing on the built environment
iii) Suggest strategies to be adopted in reducing their impacts on the environment.

## 2.0 Climate Change and Global Warming

The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as '' a change of climate which is attributable directly or indirectly to human activity that alters the composition of the global atmosphere and which in addition to natural climate variability observed over a comparative time period (IPCC, 2007). (Adekeye, 2011) defined climate change as '' the generally observable prolonged alteration in global weather pattern resulting in temperature increases, storm activity, flash floods, drought and rising coastal water level as polar ice melts because of global warming. Climate scientists have generally agreed that climate is changing and these changes are largely caused by human activities.

Global warming which has now become synonymous with climate change is the measurable increase in the average temperature of the earth's near surface air, ocean and land masses since the mid-20$^{th}$ century (Encarta, 2008). The Inter-governmental Panel on Climate Change (IPCC) concluded that most of the observed temperature increases since mid-20$^{th}$ century was likely caused by increasing concentration of greenhouse gases in the atmosphere resulting from human activities such as fossil fuel burning and deforestation (Wikipedia, 2010).

Greenhouse gases are gases in the atmosphere that absorb and emit radiation, the process being the fundamental cause of greenhouse effect. The main greenhouse gases in the atmosphere are water vapour, carbon dioxide, methane, nitrous oxide and ozone. Although the greenhouse gases are useful in making the earth liveable by keeping the earth surface conducive and warm for life to thrive, yet, when their concentration increases in the atmosphere, the earth's temperature rises above tolerance level. This is because more heat is absorbed and radiated to the earth surface and as the earth's atmosphere thickens with more greenhouse gases as a result of human activities, the earth gets warmer due to retention of more radiation (Obot, 2010).

Uncontrolled exploitation of the natural resources and activities that contribute to global warming are factors that could jeopardize the sustainability of the environment. Indeed climate scientists have warned that climate change may become catastrophic if global warming is not kept under 2$^{o}$C above pre-industrial level, which is the threshold above which the risk becomes dangerous (IPCC, 2007). The level is currently at 0.7$^{o}$C above the pre-industrial level (Obot, 2012). Therefore, actions need to be taken now to reduce the emission of greenhouse gases into the atmosphere, otherwise, the earth could warm by average of 6$^{o}$C in the next 100 years, the effect of which will be catastrophic to the human society, (Adeleke, 2008).

Collaborative efforts by governments around the world and non-governmental organizations are already on with the aim of reducing the greenhouse gas emissions. For example, the Kyoto Protocol, a supplementary treaty of the United Nations Framework Convention on Climate Change sought commitment from the advanced countries of the world to reduce the greenhouse gas emission by 5% below the 1990 levels commencing in 2008 and ending 2012 (Mastraindrea, et al, 2009). The protocol concerns itself mostly with greenhouse gases from vehicles, power generation and industrial plants. ( Obot, 2010) observed that '' in our quest to cut greenhouse gas emissions, we have worked extremely hard to reduce our energy consumption by lessening our dependence on fossil fuel and over looked the biggest source of energy consumption and thus greenhouse gas emissions: houses and the energy they consume each year''. In fact, the lion share of the pollutant that causes global warming attributable to housing (Energy Information Administration, 2010). It is therefore, logical that houses should be the vehicle for ecological reform. The possibilities are there as it is estimated that the housing sector worldwide could deliver emission reduction of 1.8 billion tons and a more aggressive policy could deliver over 2 million tons (UNEP-SBCI, 2007).

 

## 3.0 Impact of Housing on the Built Environment

Houses could be considered as instruments whose central function is to modify the environment in the favour of man. However, man by over exploiting the natural resources of the environment to provide his own comfort has initiated processes that jeopardize his own existence in the environment. Hence sustainable issues are becoming important factors requiring the attention of the architect in his approach to the design and production of houses.

The impact of the housing sector on the physical environment is so significant considering the fact that the materials and methods used to construct and maintain houses and the energy used to service them are enormous, coupled with 50 to 100 years life expectancy of houses (Bougdah and Sharpel, 2010). The enormity of the impact of the housing sector on the environment and climate can be better understood from the perspective of the design, material us, energy and water consumption.

### 3.1 *Design*

Every time we design a house, we set its energy consumption and greenhouse emission pattern for the next 50-100 years. Even, at the end of its useful life, the energy required for its demolition and the attendant waste generated are determined by the design. The life span of houses makes the housing sector more critical than the other sectors , say transportation sector on wheels whose turnover period is about 12 years (Mazria, 2012)

A conscious effort in achieving sustainability at the design stage by thorough analysis and coordination of the various factors like climate, culture, technology and so on will go a long way in saving the environment from the impending catastrophes.

### 3.2 *Material*

Houses are constructed from a variety of natural and manufactured materials, the exploitation of these natural materials and their processing impact adversely on the physical environment as they are resource intensive. For example in the Philippines, wood consumption by the housing sector had increased by 40% between 1990 and 2000. In Chile, 60% of all wood leaving Sawmill is consumed by the housing sector (Ebohon, 1996). This intensive consumption of wood results in deforestation with the attendant environmental degradation such as landslides, top soil erosion, desertification and so on. Of particular significance is the increased concentration of carbon dioxide in the atmosphere as less number of trees are available to convert carbon dioxide to oxygen through photosynthesis.

Cement production is a major source of carbon dioxide emission. It makes up 5% of global emission and 50% is directly from the chemical process and 40% from burning fossil fuel. Cement manufacture contributes to greenhouse gas emission directly through the production of carbon dioxide when calcium carbonate is heated. Its manufacture also causes the emission of air borne pollution in the form of dust, gases, noise and vibration when operating machinery, disturbance to the landscape and disruption of local biodiversity from quarrying of limestone, the raw material for cement (Adeleke, 2008).

### 3.3 *Energy*

Houses operate by using energy to heat, cool, light, ventilate and service internal spaces. In most industrialized countries like the United State of America, the energy used by houses is about 50% of the total energy consumption with transportation and industry sharing the rest of 50% equally (Energy Information Administration, 2010), most of this energy comes from burning fossil fuels. This, therefore, confirms the huge amount of carbon dioxide emission into the atmosphere by the housing sector which is put at approximately 50%. Other greenhouse gases emitted by this burning are 10% methane, 25% Nitrous oxide and 25% sulphur oxide (Salami, 2012).

The processing of natural resources into construction materials involves a lot of energy. The manufactured products embody huge energy resource which occurs during process of conversion from raw material to finished construction products. Embodied energy is the total amount of primary energy during the life time of a material from extraction to disposal. The unit is megajoule per Kilogramme of material. ( Ebohon, 2011) revealing the energy intensity of building material stated that the conversion stage of building material accounted for 75% share accounted for total energy consumed in the construction sector. For example, the embodied energy for a square metre of fire clay is 15 MJ, while a square metre of corrugated iron sheets require 605 MJ of energy to process. Apart from the huge amount of energy embodied in these products, massive amount of pollution occur during processing when toxic gases and effluent are discharged into the environment causing degradation and atmospheric pollution.

Transportation is a major component of embodied energy thus using local material and locally produced building materials can have significant impact. Equally, durable materials that will not corrode or rot quickly relative to

 

life span of the houses can help save large energy overhead during replacement. ( Salami, 2012) posited that in general, natural building materials, such as timber, stone, rammed earth and straw bales, have lower embodied energy than their manufactured equivalents.

### 3.4 *Water*

The housing sector accounts for 12% of all fresh water use (Adeleke, 2011). Although the housing sector consumes a lot of water, only 4% of the total is needed as potable water for drinking purpose. The rest are used in the following proportion; Washing-25%, toilet-18%, laundry-15%, garden-4%, dish wash-4% and other uses-6% (Bougdah and Sharples, 2010). This data is inductive that large amount of non-potable water such as harvested rain water could be used for services in houses. Rain water harvesting and other alternative ways of collecting and reusing grey water can help conserve usable water which is a scarce resource globally.

## 4.0 Impacts of Climate on the Built Environment

Climate change impacts are physical, ecological, social and economic. However, the impact most relevant to the housing sector is the physical evidence including increased warming, erratic and variable precipitation, accelerated sea level rise, coastal erosion, drought and desertification.

### 4.1 *High Temperature*

Odjugo (2010a) reported an average air temperature increase of 1.1$^{o}$C across Nigeria for the past 105 years. This confirms a steady increase in air temperature across Nigeria. The effect of this climate change indicator is increased urban heat Island around the urban centres which will result in increased demand for energy for comfort like air conditioning and ventilation to ameliorate the reduced thermal comfort in the built environment. It may also affect the life span and performance of certain building components. Soil movement and clay shrinkage resulting from this impact may damage building foundation and increase desertification.

### 4.2 *Erratic and Variable Precipitation*

Studies indicate that parts of Nigeria fall within the zone, where more intense and variable precipitation events with increased mean and peak precipitation intensities for tropical cyclones are likely to occur. Such events are expected to lead to increased runoffs and flash floods (IPCC, 2001; Ogbonna, 2011). We are all witnesses to these scenarios now in the country with flood in Lagos, Port-Harcourt, Yola, Katsina, and Ibadan at various times in the year, but within the raining season. The flood could cause damage to houses, civil works like roads, power line and sewage lines. Other effects include water supply shortage for industrial and domestic water plants.

### 4.3 *Shortage of Water Supply and Natural Resources*

Climate change will alter all aspects of hydrological cycle ranging from evaporation through precipitation, run off and discharge (McGuire et al. 2002). According to Odjugo (2009), global warming and decreasing rainfall together with the erratic pattern of rainfall produce a minimal recharge of groundwater resources, wells, lakes and rivers in most parts of the world especially in Africa thereby creating water crisis. Lake Chad and so many rivers in Nigeria, especially in the Northern Nigeria, are in the danger of disappearing. The water scarcity will create the tendency for concentration of users around the remaining limited sources of water. Under such circumstances, there is increased possibility of additional contamination of the limited sources of water and transmission of water borne diseases like cholera, typhoid fever, guinea worm infection and river blindness.

One major problem of agriculture in Nigeria due to climate change is the reduction of arable lands. While the sea incursion is reducing the arable land of the coastal plains, the desert encroachment with its associated sand dunes is depriving farmers of their agricultural farmlands and grazing rangelands. Moreover, the frequent droughts and lesser rains have started shortening the growing season thereby causing crops failure and food shortage.

### 4.4 *Accelerated Rise in Sea Level*

Odjugo (2010b) reported that in the coastal region of Nigeria, there is a sea level rise of 0.2 m and incursion of salt water into the coastal plains, 2016-34 square cm. This rise results mainly in storm/wave surge, coastal inundation, high water table, runoffs and flooding. The effect may cause significant damage to or complete loss of the houses. Other effects include temporary or permanent damage to civil infrastructure and compromising the quality of water supply.

 

### 4.5 *Wind Event*

Like thunder storm, hail and tidal waves have become common lately. For example in August, 2012, some villages near Dutsa in Jigawa state were affected by hail stones. Effect of these includes destruction of building elements, power lines and communication network, higher wind speed aggravates pollution.

### 4.6 *Climate-related Health Risks*

The human health impacts of climate change in Nigeria would occur in various ways and because of the poor health status of many citizens, the impacts could be devastating. The impacts could either be direct or indirect. Some of the indirect impacts of climate change on health in Nigeria would include deaths, stroke, illness and injury due to increased exposure to heat waves and effects upon respiratory systems. Indirect effects of climate change and sea level rise include altered spread and transmission of vector-borne diseases (including malaria) and altered transmission of contagious diseases like cholera, influenza etc.

## 5.0 Combating the Impacts of Climate Change

Mitigation and adaptation are two strategies used in combating the impacts of climate change. Mitigation refers to planned activities aimed at reducing the greenhouse gas emission and lessening demand on nature. Adaptation on the other hand refers to actions taken to manage the effects of climate change. Since houses contribute greatly to greenhouse gas emission, design decisions can equally help in reducing greenhouse gas emissions from the houses. Similarly, design of houses can provide adequate solutions that can reduce risks of damage from climate change. Both the mitigative and adaptive measures can be achieved through sustainable Architecture or (green architecture).

## 6.0 Sustainable Architecture

Wikipedia defined sustainable architecture as a general term that describes environmental conscious design techniques in the field of architecture. It is defined as a design philosophy that values the natural environment as an integral factor in creating new products and modifying old ones. The goal of sustainable or ‘’green’’ architecture is to create structures which are beautiful and functional but which also contribute to a sustainable lifestyle and culture. This can be achieved by creating optimum relationship between people and their environment and also the responsible management of a healthy environment that is resource efficient and ecologically balanced. The products of sustainable design and sustainable construction are sustainable houses (Okpoechi 2011). Sustainable houses have minimal adverse impacts on the built and natural environment (OECD, 1996).

## 7.0 Conclusion

In order to reduce the effects of houses and adverse effects of climate on the environment, the following are recommended.

i) Smaller houses: To reduce the impact on land and resources, the size of houses should be reduced. Houses should be rightly sized to avoid unnecessary energy consumption.
ii) Use of recycled and local materials manufactured locally to minimize the energy required for their transportation.
iii) Use of sustainable harvested material, for example the construction industry should use timber which can easily be replaced through afforestation to reduce impact on forest.
iv) Water catchments system: water is a greatly wasted resource and the use of rain water can reduce the impact on wells or water treatment plant.
v) Recycling of houses: A commitment to salvaging existing structures and adaptive re-use of houses.
vi) Preservation of the natural environment: This should be an important consideration when building a house in any location.
vii) Energy efficiency: Use of diverse sources of energy, passive solar, wind power, water power etc to reduce dependence on fossil fuels.
viii) Waste management: A focus is needed on the on-site use of waste, for example grey water system and food waste composing.
ix) Access to public transport: Houses should be positioned close to public transport to reduce the use of private vehicle.
x) Houses orientation and strategic placement of window around elevation of the houses.

Sustainable or ‘’green’’ housing techniques use designing, constructing and operating houses and landscapes to

 

incorporate energy efficiency, water conservation, waste minimization, pollution prevention, resource efficient materials and indoor environmental quality in all of a building life (SMART e, org, 2009). Applying these principles is like killing two birds with one stone in combating the causes and effects of climate change as it concerns the housing sector.

Man cannot stop building houses despite their impact on climate and the environment. He has to fell trees, excavate soils, mine iron and so on if he must build his house. There will also be need to build more houses as the population increases. The implication of this is that climate will continue to change and the adverse effects of this will continually be felt. However, man must utilize the natural resources in a responsible and sustainable manner.

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