A CONCEPTUAL SHIFT IN ARCHITECTURAL DESIGNS IN NIGERIA TOWARDS CLIMATE CHANGE MITIGATION

By

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ABSTRACT

Over a period of time, Architectural design concepts in Nigeria have not taken into consideration the effects of climate change on the built environment. Therefore, the challenges of mitigating climate change have not come to play both in the studying and practicing of Architecture. Mitigation means the strategies or measures taken to help prevent or minimize, relieve, alleviate, reduce and ease the process leading to climate change. This study is carried out to initiate a conceptual shift in Architectural designs towards climate change mitigation through investigating the level of climate change in Nigeria, its effect on the built environment, and identifying the strategies that can be undertaken to mitigate these climatic changes in Architectural design. The research methodology used in this paper is a review of existing literature, after which some strategies for mitigating the effect of climatic change in Architectural design in Nigeria were recommended.

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INTRODUCTION

Architecture is the art and science of designing and managing the construction of buildings and other structures. According to the ARCON definition," Architecture is the art and science, in theory and practice of design, erection, commissioning, maintenance and management of allied professional inputs thereto of buildings or groups of buildings forming a comprehensive institute, establishment or neighbourhood as well as any other organized space, enclosed or opened required for human and other activities". In architectural design, the processes of analyzing existing structures and designing of new structures are closely linked; as an architect synthesizes experience, knowledge is built. In the process of designing a new structure in a particular area, the climatic analysis of that area is normally done in order to achieve effective outdoor and indoor air quality.

Climate is the statistics of weather over long period of time (Platon & Serge, 2013). Climate change is among the major global environmental problems threatening the survival of the entire human race. It is one of the global threats with serious implication on agriculture, natural ecosystem, water supply, health, soil and atmosphere, which are all elements that constitute the support for long-term sustainability of life on earth (Emeka, 2008). Climate change refers

to a deviation from the normal weather conditions of an area over time, whether due to natural conditions or as a result of human activities which results in degradation of an environment (Nwosu, 2012).

In Nigeria, there are evidences of climate change (Odjubo, 2010) and its impacts are diverse, from one geographical region to another (Building Nigeria's Response to Climate Change (BNRCC) 2011; Allu, 2014), largely because the country is transverse along different latitudes and longitudes; hence, there is need for climate change mitigation.

The aim of this study is to develop strategies for a conceptual shift in Architectural designs towards climate change mitigation. This could be achieved through the following objectives:

- Investigating the level of climate change in Nigeria and its effect on the built environment.
- Identifying the benefits of changing the Architectural design concepts towards climate change mitigation.

LITERATURE REVIEW

Architecture is a key profession that should be largely involved in reducing the effects of climate change, as energy use in buildings is one of the major emitters of greenhouse gases. Consequently, the main message of the Architects Council of Europe held in the European Parliament addresses the issue of the measures needed to ensure architects' role in the process of adaptation to climate change, especially during the period of economic crisis (EDUCATE, 2012). **Architecture** is both the process and the product of planning, designing, and constructing buildings or any other structures. **Design** on the other hand, is a plan (with more or less detail) for the structure and function of an artifact, building or system. A **Sustainable design** requires the use of sustainable principles to integrate factors of design strategies to produce the best sustainable product or building (U.S. GreenBuilding Council (USGBC), 2003).

Architectural Concepts provide a set of tools for supporting the overall lifecycle of a software development process, such as the requirements, design, implementation, deployment and testing, while coping with rapid changes in technology implementation. (LU, 2010). Concept is an understanding retained in the mind, from experience, reasoning and/or imagination; a generalization (generic, basic form), or abstraction (Mental impression) of a particular set of instances or occurrences (specific though different, recorded manifestation of the concept).

Conceptual change is the process whereby concepts and relationships between them change over the course of an individual person's lifetime or over the course of history. Research in four different fields – cognitive psychology, cognitive developmental psychology, science education, and history and philosophy of science - has sought to understand this process. Indeed, the convergence of these four fields, in their effort to understand how concepts change in content and organization, has led to the emergence of an

interdisciplinary sub-field in its own right. This sub-field is referred to as "conceptual change" research.

In architectural design, the processes of analysis of existing structures and design of new structures are closely linked, as an architect synthesizes experience, knowledge of builtwork, and other source material in order to imagine new buildings, with particular interest in the role of analytical drawings in this design process. Analytical drawings use existing structures as their subjects but, unlike documentary photographs or representative sketches, the point of analytical drawings is to understand a building (Julie 2001).

The need to initiate a change in architectural education that supports the implementation of considerations of sustainability in architecture is mainly triggered by the following factors: natural resource depletion, climate change, ecological damage, current building practices have been slow to respond to the need of enhancing sustainable environmental design within a creative architectural discourse; accreditation and qualification criteria established by professional bodies do not yet comprehensively contribute to the efficient promotion of environmental sustainability in building design; university curricula have proved to be sparsely effective in systematically integrating sustainable environmental design in the education of students of architecture.

Roaf, Fuentes and Thomas (2002) define Buildings as parts of complex interactions between people, the buildings, the climate and the environments. He stressed further that buildings are only parts of our habitat and are intimately linked to the local, regional and global environments that are all parts of our Ecological Niche. It is the responsibility of our generation to adapt to our buildings to ensure that we can stabilize climate change, that we can live without fossil fuels and that we do not unsustainably pollute the environments.

What is Climate Change? According to English Dictionary 2.7.3 Climate change is defined as the change in the earth's climate, especially those produced by global warming. Climate change presents us with a massive, unprecedented and multi-faceted challenge. To meet this challenge, the institutional framework for managing climate change must walk a delicate balancing act. It needs to balance short and long-term interests at the same time as embodying some broadly acceptable notion of fairness. Climate change, according to Nwosu (2012), refers to a deviation from the normal weather conditions of an area over time, whether due to natural conditions or as a result of human activities which results in degradation of an environment. It is the change in the state or patterns of the climate that can be proven through statistical data with changes in its mean and/or the variability of its properties, and which are persistent for extended periods that are typically decades or longer (IPCC, 2007). Climate change has also been defined as the variation in the statistical distribution of the average weather conditions over a prolonged period of time (Ikehi & Zimoghen, 2014). It refers to weather changes, including steady alteration in usual temperature (rise or fall), rainfall regime (pattern or intensity), wind, relative humidity and solar radiation over time. The importance of promotion

and application of climate change mitigation and adaptation strategies in architectural profession is also underlined (EDUCATE, 2012), while there is an on-going debate on the possible methods of architectural education which would merge theoretical and practical knowledge, facing the challenging reality of global warming (Roaf, et.al, 2009).

Mitigation: Mitigation means reducing risk of loss from the occurrence of any undesirable event. This is an important element for any insurance business so as to avoid unnecessary losses. In general, mitigation means to minimize degree of any loss or harm. In insurance contracts, various clauses and conditions are specified so as to ensure minimum losses to the insurer. Mitigation has been referred to as "the strategies or measures taken to help prevent or minimise the process leading to climate change" (Nyong et al, 2007). The mitigation measures, which are most important include: carbon sequestration, clean development mechanism, joint implementation and use of reusable and non-polluting sources of energy (solar, wind and geothermal energy sources) (Vijiya Venkata Raman et al, 2012). According to the Federal Emergency Management Agency (FEMA), Mitigation is the effort to reduce loss of life and property by lessening the impact of disasters. In order for mitigation to be effective we need to take action now—before the next disaster—to reduce human and financial consequences later (analyzing risk, reducing risk, and insuring against risk). It is important to know that disasters can happen at any time and any place and without adequate preparation, consequences can be fatal. Effective mitigation requires that every party involved understand local risks, address the hard choices, and invest in long-term community well-being. Without mitigation actions, safety, financial security and self-reliance are jeopardised.

- Disasters can happen at any time and any place, and their human and financial consequences are hard to predict.
- The number of disasters each year is increasing but only 50% of events trigger Federal assistance.
- FEMA's mitigation programs help reduce the impact of events—and our dependence on taxpayers and the Treasury for disaster relief.

Effective mitigation efforts can break the cycle of disaster damage, reconstruction, and repeated damage. FEMA's mitigation and insurance efforts are organized into three primary activities that help states, tribes, territories and localities achieve the highest level of mitigation: Risk Analysis, Risk Reduction, and Risk Insurance. Through these activities and FEMA's day-to-day work across the country, communities are able to make better mitigation decisions before, during, and after disasters.

The importance of climate to architectural design in Nigeria

Nigeria is the most populated country in Africa and obviously one of the most populated in the world (World Bank, 2003). In 2012 Nigeria's population stood at 167 million (National Population Commission, 2012) with an annual growth

rate of 3 per cent (Mu'azu, 2011). Despite potential economic value of having a sizable population, Nigeria, like most other African countries, appears not to be putting proactive measures in place to check Climate Change (Christensen et al, 2007; USAID, 2009; Onyekuru and Marchant, 2012; Pat-Mbano et al, 2012), thus, exposing its population to high risks and vulnerabilities associated with climate change.

Furthermore, the challenges of climate change are likely to accumulate based on two reasons. Firstly, Nigeria is projected to require about 40 million houses to meet its housing demands or deficit by 2020 (Ademiluyi and Raji, 2008; Ademiluyi, 2010; Ogu and Ogbuozobe, 2011). Secondly, given the impact of the built environment on climate change, unless these houses are sustainably designed, the impact of such a scale of housing buildings on the larger environment would be quite severe.

However, at the early design stage of buildings it is important that the right decisions are taken. Bogenstätter (2000) had noted that 20% of any design decision at the early phase of design has 80% consequences on the overall design. As such, early design decisions are of great significance to design outcomes (Allu et al, 2013). Earlier studies have suggested that, it is not an easy task for the design professionals (architects) to make these decisions without some form of guide (Anthienitis, 2010; Morszal, 2011).

Succinctly put, climate and weather are the major environmental factors which directly affect building forms and designs. Umoh (2000) stresses that this building of houses has long been recognized as a function of climatic regimes. In Nigeria, there are different climatic zones which dictate the different architectural design remedies.

Ogunsote (1991) identifies six climatic zones which are: the coastal zone, the forest zone, the transitional zone, the savannah zone, the highland zone and lastly the semi desert zone. These climatic zones help parade a wealth of traditional house forms in traditional architecture, reflect the lifestyle of people and are symbols of heritage of the people, Olotuah (2001) expatiates.

Mitigation in the building sector.

Basically, Cam (2012) suggests that, *"In the building sector, approaches to climate change mitigation must be in harmony with the wider sustainable development context".*

This demonstrates yet again that the emphasis is on the need for climate change mitigation, strategies to comply with sustainable development, since the building sector has been identified as a major emitter of greenhouse gases leading to climate change globally. Thus, a great potential lies therein in tackling climate change. However, some barriers associated with mitigation in the building sector have been identified and grouped by Cam (2012) to include, lack of awareness and access to technical knowledge, segmentation and fragmentation of the building sector, perceived financial disincentives and consumerism aspiration and rebound effect.

QUESTIONS

- To what extent does climate change affect the buildings or the built environment in Nigeria?
- What are the benefits of changing the Architectural design concepts towards climate change mitigation?

RESEARCH ANALYSIS AND RESULT

Climate change mitigation will be severely affected in developing countries like Nigeria as suggested by the barriers mentioned above due to constraints associated with, limited and lack of accurate data (Ademiluyi, 2010) and acquired foreign (European) taste and preferences by Nigerians (Ekeng and Ewah, 2010). Despite these challenges Cam (2012) posits that energy used in buildings can be reduced by 60 percent by 2050, if actions within the sector are taken immediately to reduce their emissions.

One of such actions taken is presented in a study by Urge-Vorsatz et al (2007) on **'mitigating CO_2 emissions from energy use in the world's buildings'**. It is also one of the few studies that covered residential buildings. Their study was carried out to unlock the potentials in residential and commercial buildings based on 80 national and regional studies that span five continents, grouped into three economic regions;

- Developed countries (US, EU-15, Canada, Greece, New Zealand, Australia, Republic of Korea, UK, Japan and Germany),
- Economies in Transition (Hungary, Russia, Poland) and
- Developing Countries (India, Indonesia, and the Middle East as a group).

They established and analyzed the Green House Gas (GHG) emission potentials for each group as shown in the Table below, and they concluded that emission cuts are possible through three basic means: reducing building consumptions, switch to lower carbon fuel and control of non-CO_2 GHG in new and existing buildings.

Further to the above, Urge-Vorsatz et al. (2007) in their conclusion suggested that, a huge reduction in CO_2 emission is achievable over the years with net negative cost. This recognizes the fact that in most societies, particularly the advanced economies, new housing stock is usually about 1% of the total housing stock; Thus, old buildings remain significant to carbon reduction strategy. They further suggested the need for continuous research, although noted that the greatest challenge lay with retro fitting existing buildings, were 80 percent reduction is possible with new buildings. They also suggested that relevant authorities should carry out standard enforcement through the provision of assistance to the building design process (guide) and support energy services against energy efficiency barriers.

Regrettably, the global outlook of Urge-Vorsatz et al. (2007) study is incomplete because of the obvious omission of Africa, for reasons best known to them.

Therefore, their study and data presented could be said to be lopsided within the context of global data on GHG emissions from built environment. When critically viewed, it could be as a result of the near absence of specific data relating to buildings in Africa as observed earlier in this thesis.

However, their study recommended further research to be done in order to provide assistance in the design process of buildings in form of design guides, thus, making this research project necessary, relevant and bridging the gap in their study.

Allu (2014) did further research and came up with some findings in Africa. Following a certain research methodology, the researcher succinctly outlined some contributions to existing knowledge generally and climate change in particular. Hence, developing a clear conceptual framework that will articulate the strategies needed to produce a new design guide and help professional practices across the three climate regions in Nigeria. These regions are;

- Highland Climate Region (HCR),
- Tropical Savannah (TSC) andthe
- Tropical Rainforest Climate Region (TRC).

Secondly, the research substantially contributes data about the subject of climate change and buildings in Nigeria within these three climate regions.

Given that Nigeria is the seventh most populous country in the world, and most populous in Africa, it makes any statistical findings from Nigeria relevant to the rest of the world. This sub-Saharan country is also faced with a huge yearly housing shortage of over ten million units and yet little is known on the efforts and actions taken by Nigeria to ensure that expected new buildings are sustainably designed in line with the global concerns.

Impacts of climate change	HCR REGION	TSC REGION	TRC REGION	REMARKS
	% Agreement	% Agreement	% Agreement	Selected design strate
Erosion	39%	77%	100%	Erosion control strategi
Drought/ desertificatio n	03%	54%	01%	Drought control strateg
Flooding	99%	87%	99%	Flooding strategies ar efficiency (usage & harv
Windstorm	46%	69%	34%	Building orientation, form,
Temperature increase	99%	99%	100%	Energy efficiency and ventilation mechanisms

Source: Allu (2014)

The result therefore, suggests that these climate change impact variables: Erosion, Drought/desertification and flooding have higher significance

differences, which means that these impacts have greater differences from one location to the order. On the other hand, the impacts of the other two variables (windstorm and increased temperature) have little significant differences value and hence, there is very little difference in their impacts across the three regions.

CONCLUSION /RECOMMENDATION

The process of mitigating climate change should be considered on the early design stage. Architectural design strategies should be checked using some parameters such as; ventilation system, insulation of heat, choice of using appropriate building materials to avoid carbon emission, amount of trees planted (since it makes use of carbon dioxide), energy efficient design-oriented forms/orientation of buildings and proper climatic analysis integrating both micro and macro climatic factors.

Most importantly, architectural designs and concepts in Nigeria should move towards climate change mitigation owing to the already mentioned facts that it could have negative effects if not properly considered. The effects of climate change on buildings and built environment in Nigeria has been mentioned as well as the benefits. Therefore, mitigating climate change should be considered firstly during the training of young prospective Architects; they should be made to understand the importance of it and should be one of the major design considerations; then secondly, during the practicing of Architecture, the Architects should be fully aware of this and should be able to carry along their clients, employees and other professionals involved during the design, with emphasis on how to design buildings for both climate and environment. Thirdly, the Nigerian Government is not left out. A policy on building design with considerations for climate change mitigation should be made, so that the approval agencies will be able to control and implement it. This will greatly help in mitigating climate change in Nigeria.

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