



IMPLICATION OF CLIMATE CHANGE ON URBAN LIVABILITY IN NIGERIA: A PANACEA TO SUSTAINABLE DEVELOPMENT

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ABSTRACT

In recent times climate change has been a major environmental issue in contemporary Nigerian society. The aim of this study is to examine climate change as an environmental issue, its causes and effect on urban livability and sustainable development in Nigeria. Choosing Akure as study area, the causes of variation in climatic elements as well as the effect on sustainable development were determined. A total of 368 respondents were interviewed using a structured questionnaire. There are 11 residential wards in Akure and 3 residential wards were randomly selected, with systematic sampling technique of choosing every 5th building and picked as a sample unit. The data was analysed using both descriptive and inferential statistics. The study showed that smokes and dusts, closeness of buildings, forest fires, and concreted surfaces with Mean Weight Values of 2.98, 3.20, 3.05, and 3.17, respectively above the Gross Mean Weight Value of 2.98 were accepted as major factors that cause climate change in the area. The study also revealed that there is a significant effect of climate change on human comfort in Akure. The study concluded that managing and reducing the effects of climate change would require active environmental, socio-economic and population measures. With this, the study recommends proper environmental management through public participatory efforts and community monitoring to discourage incessant practices as these would ultimately promote a sustainable environment.

KEYWORDS: *Climate Change, Sustainable Development, Urban Livability, Environmental Management, Adaptive Measures.*

INTRODUCTION

Cities are increasingly seen as sites of strategic action on climate change. As sites of infrastructure provision and with immediate social and environmental concerns, cities have become central to the economic, environmental and social pillars of sustainability. The prominence of urban climate responses is particularly salient to developing countries, where the bulk of urban growth is projected to occur, and which are often the most vulnerable to climate impacts (Ogundare, 2017).

World Bank (2010) observed that cities are particularly vulnerable in that they are immobile. Such infrastructure as bridges, subway systems, buildings, and roads, the historic sense of place, and rootedness of residents are critical attributes of cities. These strengths of place can, however, become

liabilities if the local ecosystems that they are based on are unable to adapt to the serious threats to urban infrastructure, quality of life, and entire urban systems. Not only poor countries, but also rich ones will increasingly be affected by anomalous climate events and trends.

In recent times climate change has been a major global challenge, observational evidences demonstrated that the composition of the atmosphere and Earth's climate have undergone vivid changes which are caused by anthropogenic and land use changes. Scientific evidence confirms that climate variations are already taking place and that most of the warnings observed during the past fifty years were caused by human activities, Intergovernmental Panel on Climate Change (IPCC, 2001).

The reality of climate change is equivalent to its impact which is widely felt across Nigeria. The

global increase in temperature particularly from the 1960s and the tendency for further warming according to (Le Treut et al. 2007) has created concern for developing countries as it affects its urban livability and sustainable development. Climate change has also been implicated to cause chronic flooding which spreads diseases into the urban environment and disrupts cooling. The built environment has been found to escalate heat stress, particularly at night, during heat waves and provides preferential site for spreading vector borne diseases (Samuels, 2004; Svensson and Tarvainen, 2004).

In Nigeria, (Anyadike 2009) examined the effects of climate change which includes: changes in dates of onset and end of rainy season; reduced rainfall amounts in some areas and increased rainfall amounts in others leading to flooding as well as increase in intensity of atmospheric disturbances such as thunderstorms and line squalls. Anyadike (2009) also agreed that climate change may affect human livelihoods, increase the level of poverty of the people, and thereby cause discomfort in the urban setting. The direct impact he explained will manifest through loss of lives, livelihoods, assets, and infrastructure from climate extreme events. Ozor (2009) in listing the impact of climate change on national development of the country stated that variations in climate change have led to devastating consequences which have hindered sustainable development.

In quest for development there is a radical increase in human activities, which have added stress to the strained continent hence rise in temperature, heat waves, air pollution and poor coping strategies and infrastructures have added strains to the effects of climate change. With these impending climatic alterations and effects, it becomes pertinent to set sustainable development as a focus. Sustainable development is classified as the development that meets the needs of the present without compromising the ability of future generations (Shaker and Richard, 2015).

There is therefore a need for the study on effects of climate change in Nigeria cities. Akure metropolis, like many other cities in the world, is exposed to climate change induced dangers of erosion, flooding, increased temperature and other ecological problems considering the strong nexus between climate change and induced disasters which have hindered sustainable development. Therefore, this research will endeavour to examine the causes and effect of climate change on livability of inhabitants in Akure. This becomes more urgent because most of the earlier studies have focused on European and American cities.

LITERATURE REVIEW

Climate change is understood as an immediate threat, with early effects evident in climate shifts now occurring on a variety of scales across the planet (IPCC, 2007) In spite of recent controversies, the weight of

scientific evidence suggests that on-going changes in climates across global, regional, local, micro scales are primarily caused by human actions and that the effects of this phenomenon will be widespread and extremely harmful to both people and places (IPCC,2007) the majority of the world's population now lives and works within urban systems and the trend is increasing (UN, 2009)

Urban systems are understood as 'the constantly evolving spatial product of the flow of social, economic, infrastructural and ecological systems which grow and develop around an urban area', this settlement model tends to be extremely resource intensive and contribute hugely to increases in greenhouse gas emissions and consequently, climate change. In quantitatively terms, the impact of urban systems on climate change is illustrated by the fact that 75% of all greenhouse gas emissions are generated in the world's urban areas (UN, 2007); while only approximately half of the planet's population lie in closer settlements.

In other words, urban systems are a principal source of emerging climate threats (Gleeson, 2008). The very nature of urban systems contributes to climate change, as their functions require the burning of fossil fuels. Within urban systems, spatial functions include building structures to house people and commerce and the provision of space for social and economic interactions. Transport functions include the movement of people, goods and materials to, from and around cities. Supply functions include the provision of food, sanitation and clean water, as well as electricity light and heat. These functions and others ensure that urban systems contribute hugely to the demand for fossil fuels, which, in turn, contribute to climate change. Thus, there is a 3-direct causal relationship between the function of urban systems and climate change.

The specific effects of climate change on urban systems will vary depending on location, but may include reductions in potable water, more regular and severe weather events such as heavy rainfalls and cyclones, increased incidences of flooding, inland storm surges and an increase in extreme heat events. The nature and scope of these potential climate change threats means that the vast majority of urban systems and their residents are vulnerable to some degree. The extent of urban vulnerability can be increased by the concentration of people and commercial activities in small space and the demands this places on urban functions and infrastructure (Condon et al., 2008). Consequently, even minor climate change effects can affect large numbers of people and can have serious consequences for wider urban systems.

All urban systems will face some vulnerability to climate change effects. These effects may disrupts or even destroy a wide variety of urban systems. It is possible and indeed probable that urban features may exacerbate these impacts and the vulnerability of urban spaces. Such features include:

Asphalt, tarmac, concrete and other hard surfacing absorb heat from the sun, causing an 'urban heat island' effect, which adds to increased urban temperatures. Hard surfacing also reduces the absorption of rain water, which can overwhelm storm water systems and increase flood risks.

Population densities in urban areas can reduce or put pressure on green spaces that could reduce heat, water runoff and air pollution. Population densities can also put pressure on water supplies, leading to an increased potential for shortages (Shaw et al., 2007). As urban systems contribute significantly to climate change and stand to suffer heavily from its effects, it's posited that urban systems are currently locked in a negative feedback loop. It follows that adaptation in urban systems is necessary to reduce and manage the impacts of these effects. By implementing adaptive responses, urban vulnerability may be reduced and urban resilience improved.

Several researches have been carried out on the phenomenon of climate change from different perspectives. Yet the complexity of the field continues to expand. (Kalkstein and Smoyer (1993) and Greenwood (2006) examined the impact of climate change and predominance and concluded that there is indeed a direct relationship between climate change and prevalence of Cardio respiratory mortality and heat related diseases which have inhibited sustainable development. Santamouris (2001) and Arnfield (2003) looked at planning of built environment where high-rise building in the urban areas magnify the impact of the built environment, trapping heat and distorting air movement and inferred that the warning effects of climate change could affect significantly, the comfort and livability of the urban residents.

The impact of climate change to warming of planets, fluctuating paradigm in rainfall and extreme events such as droughts, floods, and forest fires have become more frequent and resulted to poor, unpredictable yields, whereby farmers are unpredictably vulnerable particularly in Africa. Eludoyin et al. (2013) examined air temperatures, relative humidity, climate regionalization and thermal comfort of Nigeria and concluded that thermal stress has increased in Nigeria from 2000 at most stations, especially in the south and north-western regions and that Nigeria thermal comfort climate is heterogeneous and require analysis of multiple thermal indices. Several researches also have shown that variation in the heat indices, principally temperature have significant relations with human mortality, predominance of certain diseases and unsustainable development (Kalkstein and Smoyer, 1993)

Thus, while much information is available on this climate change phenomenon and its effects on the people in the European and American countries (Kilbourne, 1989; Hajat et al., 2002), the effects of changing weather elements on Nigerian

cities have not been well documented, and little is known about changing weather patterns, its effects, the impacts on urban livability, urban infrastructures and sustainable development strategies, especially in Akure the expanding cosmopolitan capital of Ondo state, which forms the present focus of socio-economic growth in the state and Nigeria. The foregoing empirical evidence and concept reviewed indicate that various factors interplay to deteriorate the quality of environment regularly, thereby limiting sustainable development. World Health Organisation (2008) revealed that a variation in climatic elements which brings about climate change is as a result of anthropogenic activities and land use change. If probably sustainable development must be achieved to avert environmental issues, then conscious and continuing effort must be put in place to protect the environment.

STUDY AREA

The study area covers Akure South local government area. Akure South is a local government Area in Ondo State, with headquarters in the city of Akure. It falls within the central senatorial district of Ondo State otherwise known as Ondo Central Senatorial District alongside Akure North, Ifedore, Idanre, Ondo East and Ondo West local government area. It also forms a federal constituency along Akure North local government area (Figure 1).

Akure South local government area covers an area of 331km². The local government area is bounded to the north by Akure North local government area, to the South by Idanre local government area, and to the west by Ifedore local government area. The widely disputed result of the 2006 national population census put the population of Akure South local government area as 360,268 with 178,672 males and 181,596 females making it the largest local government area by population in Ondo State.

Akure the setting for the study is a traditional Nigeria city and like other traditional Yoruba towns in the country, existed long before the advent of British Colonial rule. Akure lies approximately 7° 15' North of the Equator and Longitude 5° 12' East of the Greenwich Meridian. Akure is a medium-sized urban centre and became the provincial headquarter of Ondo province in 1939. It also became the capital city of Ondo State and a Local Government headquarter in 1976. Consequently, there was heterogeneous massing of people and activities in the city (Ogunbodede, 1999).

Akure, experiences a tropical climate with distinct wet and dry seasons which can be better described as Koppen's 'A' Climate (Adebayo, 1993). The wet and dry seasons are associated with the prevalence of the most maritime south westerly monsoon winds from the Atlantic Ocean and the dry continental north easterly harmattan winds from the Sahara deserts respectively. The rainy season span

from April – October while the dry season (November – March).

It is located in the warm humid tropical climate, with average rainfall of about 1500mm per annum with a short August break. However, based on the 1980-2007 data from the Nigerian Meteorological Agency, the annual average temperatures range between 21.4 and 31.1^oC, and its mean annual relative humidity is about 77.1%.

The vegetation is the tropical rainforest type. The natural vegetation is the high forest, composed of many varieties of hardwood timbers such as *Melicia excelsa*, *Antaris Africana*, *Terminalia superba*, *Lophira procera* and *symphonia globulifera*. In the northern districts, the vegetation consists of woody savannah featuring such tree species as *Blighia saphida* and *parkia big lobsa*. An important aspect of the vegetation of the state is the prevalence of tree crops. The major tree crops include cocoa, kola, coffee, rubber, oil palms and citrus, cocoa being the most prevalent. Trees that are not native have also been introduced as forest plantations. These non-native trees have been used to replace large portions of harvested old forest reserves in the area. They include mainly *Tectons grsndis* (teak) and *Gmelina arbore* (pulp wood). The town is drained by River Ala and its tributaries. Other rivers such as Ero river, which originates from Igbara-Oke,

about 16 kilometres to Akure and Osun and Owuruwu rivers are major source of water runoff to Akure.

Akure is a city with varied, liberal religious leanings. Christianity, Islam and Traditional worship form the basis of faith for most residents. There is a preponderance of churches in the city. The Central Mosque, on the Oba Adesida Road, is a major landmark in the city. The city’s morphology has changed over time to assume its present status with its attendant transport problems, as experienced in similar medium sized urban centres in Nigeria. The increased relative political influence of Akure as a state capital since 1976 has greatly promoted its rapid growth and increased socio-economic activities.

The increase in landmass and population is evident in economic activities including daily trade in commodities carried out in a network of traditional and modern markets, service industries, government establishments, hotels and guest houses, which dotted the landscape of both inner and outskirts of the city. These activities have equally increased the number of traffic and travel volume in the city as people travel between their homes and different land uses and thus influenced climatic inconstancy being witnessed.

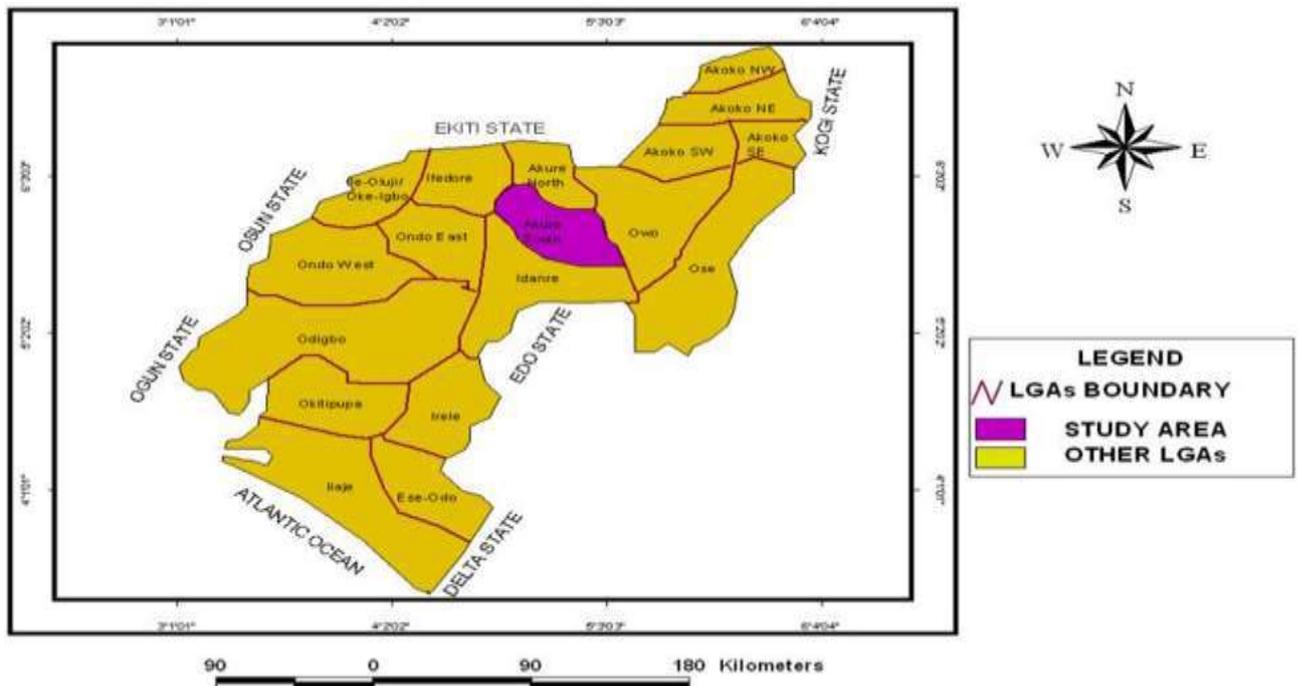


Figure 1: Ondo State showing the Study Area

Source: Ondo State Ministry of Lands and Housing, Akure (2005)

RESEARCH HYPOTHESIS

H0₁: *There is no significant impact of the causes of climate change on urban livability in Akure.*

H0₂: *There is no significant effect of climate change on human comfort in the studyarea.*

METHODOLOGY

The methodology involved the use of the political division of eleven wards into which Akure

is stratified. A random sampling of three wards form the sampling frame from where a systematic random sampling of every fifth house on a radius of 0 to 500 metres form the sampling unit in the selected wards. However, a total number of 368 represent the sample size of the study.

Data for this study were based on both primary and secondary data sources. Structured questionnaire was designed to elicit information from residents in the study area. In addition, other relevant materials and data were sourced from published sources such as the report of journal articles, State diaries, newspapers, textbooks, and internet sources among others. Appropriate statistical techniques including frequency tables and

percentages as well as chi-square analyses were used to explain the result of the study.

RESULTS AND DISCUSSION

Respondents' characteristic and classification

The Table below showed the analysis of the bio-data and personal characteristics of the respondents. Table 1 depicts the pattern of sex structure of the respondents as obtained from field investigation. Analysis of Table 1 shows that a high proportion of the respondents (88.6%) are males while the remaining 11.4% are females. The increase in the percentage of males over that of females can be attributed to the fact that, like elsewhere there are more male household owners or landlords than females.

Table 1: Sex of the Respondents

Sex	Frequency	Percentage (%)
Male	326	88.6
Female	42	11.4
Total	368	100.0

Source: Field Survey, 2019

Table 2: Age of Respondents.

Age (Years)	Frequency	Percentage (%)
Below 30 years	36	9.8
30- 50 years	127	34.5
Above 50 years	205	55.7
Total	368	100.0

Source: Field Survey, 2019

The information provided in Table 2 shows that majority of the respondents (55.7%) are above 50 years. 9.8% of the respondents are below 30 years of age while only 34.5% claimed to be between 30 – 50 years. This observation shows that the bulk of the

respondents falls within the active working age and are proud owners of their buildings.

Table 3: Educational Background

Educational Qualification	Frequency	Percentage (%)
No Formal Education	19	5.2
Primary Education	24	6.5
Secondary Education	131	35.6
Post-Secondary Educ.	194	52.7
Total	368	100.0

Source: Field Survey, 2019

Educational qualifications of respondents were sought for. The information revealed that about 5% of respondent had no formal education while 6.5% had primary school certificate. Respondents with secondary and post-secondary education constitute more than 80% of the total respondents. The few who had primary or no formal education are mostly aged landlords and landladies.

CLIMATE CHANGE AND URBAN LIVABILITY

Large urban areas are increasingly faced with global challenges that affect their efforts

towards achieving a higher quality of life for their citizens. Two of these challenges are the achievement of livability and sustainability. *Livability*, because as urbanization transforms human diversity and social stratifications, it impacts on society, cultural pluralism, crime and employment. *Sustainability*, for the overloaded urban ecosystem is often the focal point of many environmental problems that influence global sustainability.

The study take into consideration a variety of factors that characterize livability and

sustainability in the city as a result of climate change experienced. To test for the first hypothesis, six factors were considered to see how climate change impact has affected livability in Akure. Using a four-point Likert Scale and finding the Gross Mean Weight Value (GMWV), Table 4 revealed that the GMWV of 2.98 which is the cut-off point where values of factors higher than the GMWV is accepted and values of factors less than the GMWV are rejected form the basis of decision making. The table revealed that overpopulation with Mean Weight Value (MWV) of 2.90 and the use of firewood with MWV of 2.60 were rejected as factors inducing climate change on livability in Akure.

However, factors such as smokes and dusts with MWV of 2.98, closeness of buildings (3.20), forest fires (3.05), and concreted surfaces (3.17) were accepted as factors of climate change that threatens livability in Akure. There is therefore a significant

impact of the factors of climate change on urban livability in Akure.

From the findings it could be observed that the heats generated by closeness of buildings probably because of the size of the city and agitation for land are enough reasons why respondents believed that closeness of buildings induce climate change. Smokes and dusts from industries and from exhausts of cars also constitute threats to livability and induce climate change. With the incessant increase in the population of Akure and the fact that the city provides educational, employment, healthcare, and infrastructural facilities makes the city livable. However, livable cities offer green public areas that are safe, secure and clean; they enhance individual wellbeing through social inclusiveness, social justice, ecological sustainability, cultural vibrancy, economic vitality, long-term oriented policies and integrated governance processes.

Table 4: Factors of Climate Change on Urban Livability

S/N	Factors	SA	A	SD	D	MWV	Decision
1.	Overpopulation	544	342	124	56	2.90	Rejected
2.	Use of firewood	472	309	56	119	2.60	Rejected
3.	Smokes and dusts	580	378	82	56	2.98	Accepted
4.	Closeness of buildings	696	405	32	43	3.20	Accepted
5.	Forest fires	724	288	42	70	3.05	Accepted
6.	Concreted surfaces	612	384	168	03	3.17	Accepted

GMWV: $17.9/6 = 2.98$

Source: Field Survey, 2019

EFFECTS OF CLIMATE CHANGE ON HUMAN COMFORT

It is clear evidence that by placing many burdens on the population of a city, the quality of life of such a city is threatened (Ogundare, 2017). Cities are vulnerable systems, because their high human densities exposed to global socio-economic and

environmental changes. At the same time, these high densities exacerbate the probability and consequence of specific risks generally associated with cities.

In order to test the second hypothesis, data collected on the effects of climate change on human comfort were subjected to Chi-square analytical techniques. The summary of the results was presented in Table 5

Table 5: The summary of Chi-square Analysis

Variables	Degree of Freedom	Level of Significance	Calculated Value	Tabulated Value	Decision
There is no significant effect of climate change on human comfort	$(n-1)(m-1)$ (5) (3) = 15	0.05 or 5%	43.70	24.99	H_0 is rejected while H_1 is accepted

Source: Field Survey, 2019

Table 5 shows that at 15 degree of freedom and at 5% significant level of confidence, the computed X^2 value is 43.70, and this exceeded the tabulated (critical) value of 24.99. Since the calculated X^2 value is greater than the tabulated value, the null hypothesis that there is no significant effect of climate change on human comfort is rejected and the alternative accepted. Factors such as flooding, increased pollution, increased diseases, shortage of water supplies, excessive heat, and overcrowding of buildings are the main effect of climate change that

disrupts human comfort in the study area. However it was suggested that afforestation, use of city buses, sustainable use of urban infrastructure and organic fuel will improve livability in Akure.

PLANNING IMPLICATION AND CONCLUSIONS

Anthropogenic activities in terms of intense built up environment, overpopulation, use of fossil fuels that brings about greenhouse gas emissions, traffic congestion and indiscriminate disposal of waste over the years have altered the

climatic elements of the study area. Climate change is manifested in cases of increase in air temperature, increase in relative humidity, change in rainfall patterns, atmospheric constituents' alterations, and intense heat. All these changes have great implications on urban livability.

Effects of climate change on the study area is apparently increasing, as there is increase in mortality, crime rate, poverty, several diseases, rashes, eczema, genetic mutations and low crop yield. Increase in temperature increase expenses as populace in pursuit of a comfortable normal life go for more drinks, fans, and air conditioners. These, however, eat into household income. Ozone layer depletion, which is as a result of greenhouse gas emission cause excessive penetration of ultraviolet rays, and this causes genetic mutation, and increase the level of diseases and sicknesses. Heavy rainfall brings about flood and erosion cases that alters man's schedule, destroys crops and reduces environmental aesthetics. Indiscriminate sewage disposal also brings about air pollution with all its consequences.

These increasing implications of climate change on urban livability beg for attention, to attain sustainable development which involves the utilisation of resources for development with no adverse implication on the future. The state government should as a matter of urgency sponsor training courses that will enhance the awareness of Akure populace on issues of climate change and its implications on urban livability. To reduce the excessive emission of greenhouse gases government should develop a proposed budget for the purchase of big city buses that will convey Akure passengers at a subsidised rate, this way the numerous taxis that causes traffic congestion and gas emission will reduce in number, subsequently the climatic elements will be rescued from alterations.

The Federal government should reinitiate geography as a compulsory subject into the secondary school educational curriculum, these way students will have a knowledge and awareness of climate issues. Attention should be given to a forestation by both individuals and the government. This way the emitted carbon dioxide (CO₂) will be at a balanced level. Finally to control the increasing population in Akure- Ekiti, the federal government should spread more amenities like banks, higher institutions, organisational head offices, and social infrastructure to the neighbouring local government areas, as this will naturally lead to the emigration of some populace from already crowded area.

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