

LAND USE PLANNING AS AN ADAPTATION STRATEGY FOR COMBATting CLIMATE CHANGE RISKS AND VULNERABILITIES IN AWKA CAPITAL TERRITORY (ACT)

Leonard N. Muoghalu¹, Innocent C. Ezeomodo²

^{1, 2} Department of Environmental Management, Chukwuemeka Odumegwu Ojukwu University

Email: ¹lnmuoghalu@gmail.com; ²ic.ezeomodo@coou.edu.ng

Abstract

Climate change has become the most significant worry of the globe today. Although an appreciable level of knowledge has been available concerning its causes, risks and vulnerabilities, there is the problem, especially in the developing countries of the world, of effectively confronting strategies to mitigate the severity of its consequences or even their prevention. Problems abound with adaptation to its associated disasters, especially in settled areas. This paper addresses this by looking at how effective land use planning in Awka Capital Territory of Anambra State, which suffers from annual flooding caused by its topographic features, population growth, improper urban land use planning, deforestation and rapid land cover changes, misuse of wetlands, poor road development and poor urban governance practice can help to mitigate the consequences of flooding and help people adapt to it when it occurs. Against the current unsustainable land use planning practice, recommendations were made as to the critical issues that should be considered to achieve sustainable mitigation and adaptation to flooding in the Territory.

Keywords: Climate change, mitigation measures, adaptation, flooding, land use planning

INTRODUCTION

Doing nothing about climate change is far more expensive and riskier than taking strong pro-active and immediate measures (Sir. Nicholas Steen, 2006).

Most of the available researched sources on climate change in Nigeria have dealt with establishing the period climate change started in Nigeria (Odjugo, 2009; Ekpo & Nsa, 2011; Adefolalu, 2007). Some of these measured the quantum increase in average surface temperature from the 1970s. (Odjugo, 2010). Ekpo and Nsa (2011) showed the effect of climate on rainfall pattern, rainfall characteristic, onset and cessation. Yet some measured the effects of climate change events on socio-economic features, such as human fatality; infrastructure, drought, rivers, biodiversity, water bodies, (such as the Lake Chad) (Odjugo, 2011); land degradation-resulting in gully erosion and desertification and their effects on food security (Muoghalu, 2019); issues in sustainable flood management in Nigeria (Akintola & Ikwuyatum, 2012) and flood early warning systems in Nigeria (Onafeso & AKintola, 2012). Odjugo (2011) worked on climate change, evidence, impacts and

adaptation strategies in Nigeria, while Olorunfemi & Onwuemele (2011) researched on climate change vulnerability and disaster risk and their implications for human security in the Niger Delta, Nigeria.

The missing link in all these is that research on the link between land use planning and climate change mitigation and adaptation has been scarcely addressed, especially in urban areas where the effects of climate change are very obvious. This paper fills that gap. The aim of the paper is therefore to explore the link between land use planning and climate change in Awka Capital Territory of Anambra State. The objectives are to delineate the concepts relevant to study; explore the causative factors that exacerbate climate negative impacts; x-ray the climate change reality in Nigeria; examine current urban land use planning practice in Awka Capital Territory and finally in view of lapses and inadequacies in current land use planning come up with recommendations to make land use planning responsive to climate change mitigation and adaptation.

LINK BETWEEN LAND USE PLANNING AND CLIMATE CHANGE

Land use and Climate change are interrelated. Improper land uses are the primary causative factors of climate change (Pawan Thapa, 2021). In the past few centuries land use change has had significant effects on ecological variables and climate change. Researchers and stakeholders understand that these are close linked (Freeman, 2015; Schmidt, Falk, Sigmund-Schultze & Spangenberg, 2020, Thapa & Dhulikel, 2019). Land-use change is a process by which human activities transform the natural landscape; it refers to how the land used had transformed economic activities (Rudel, 2009). It is responsible for increases in human population, deforestation, food types and energy and fibre demand. On the other hand climate leads to global warming, precipitation, natural disasters like floods, storms, and drought (Seldom, Chausson, Berry, Giradin, Smith and Turner, 2020). Land-use impacts climate through deforestation and rapid population growth, whereas climate change impacts land use through unpredictable heavy rainfall and increasing temperature. If the above is true, it follows that proper land use planning can serve as mitigating and adaptation measure for combatting climate change. The rest of the paper consists of area of study, method of study, conceptual clarification, importance of incorporating climate change in land use planning, current land use planning in ACT, and issues in integrating land use planning with climate change and conclusion.

AREA OF STUDY

This study is focused on Awka Capital Territory (ACT) of Anambra State (Figure 1), a territory of 10km radius covering approximately 317.36km². It is made up of 24 communities in six local government areas consisting of the whole of Awka South and parts of Awka North, Njikoka, Dunukofia, Anaocha and Orumba North Local government areas (Figure 1). The major feature of

the territory is the Awka-Orlu cuesta, consisting of swells and valleys (Figure 2). Most of the area is below 300 metre above sea level with the highest point at Agulu. The escarpments provided settlement sites during the pre-colonial days, while the valley or plain surrounding the cuestas hosts Awka, Amawbia, Umuokpu, Nibo, Mbaukwu and Umuawulu towns.

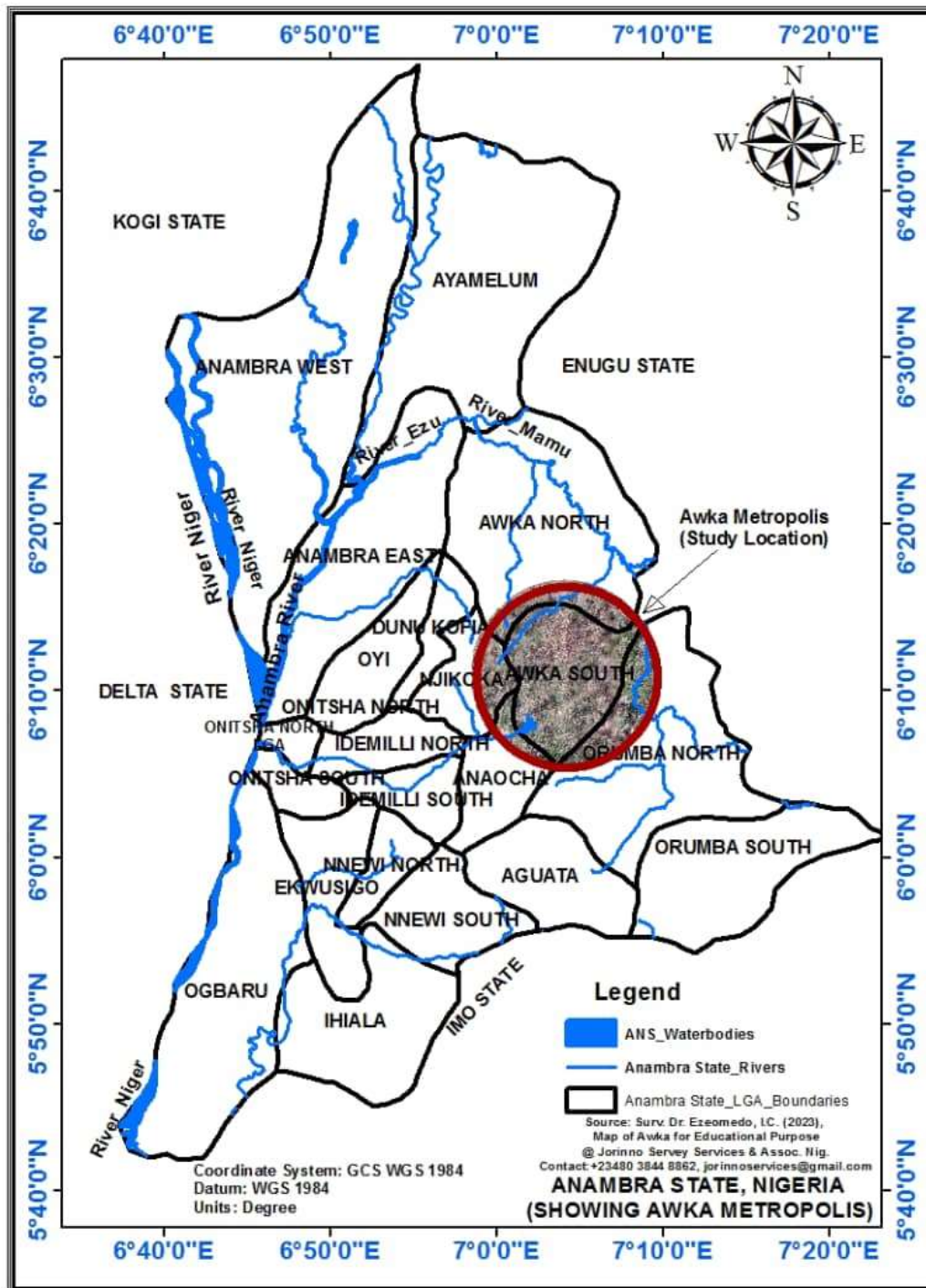


Figure 1: Map of Anambra State showing Location of Awka Capital Territory

Geologically, a thick sequence of shale and sandstones, products of the Paleocene era, underlie most of territory. Seams of lignite cover these strata. Overall quaternary sediments dominate Anambra State. Soil types consist of loamy clay and fine white sands along with lateritic soils of red and brown colour poorly cemented with moderate permeability (UN-HABITAT, 2009). The ACT falls within the tropical climate zone with wet and dry seasons. It has 8 months of rainfall and 4 months of dry season. The rainy season is under the influence of tropical maritime winds, while the dry season is characterized by the harmattan dry and dusty wind, the continental tropical air mass from November to February. The territory experiences high temperatures between 27^o- 28^oC, reaching a peak of 35^oC between February and April (Ofomata, 1975, p. 16). The ACT is characterized by high humidity and rainfall. Between 1979 and 1989 mean annual rainfall was 1,485.2mm for the territory with mean monthly figure of 50mm and an absolute daily mean maximum figure of over 200mm between June and August. (UN-HABITAT, 2009, p. 21).

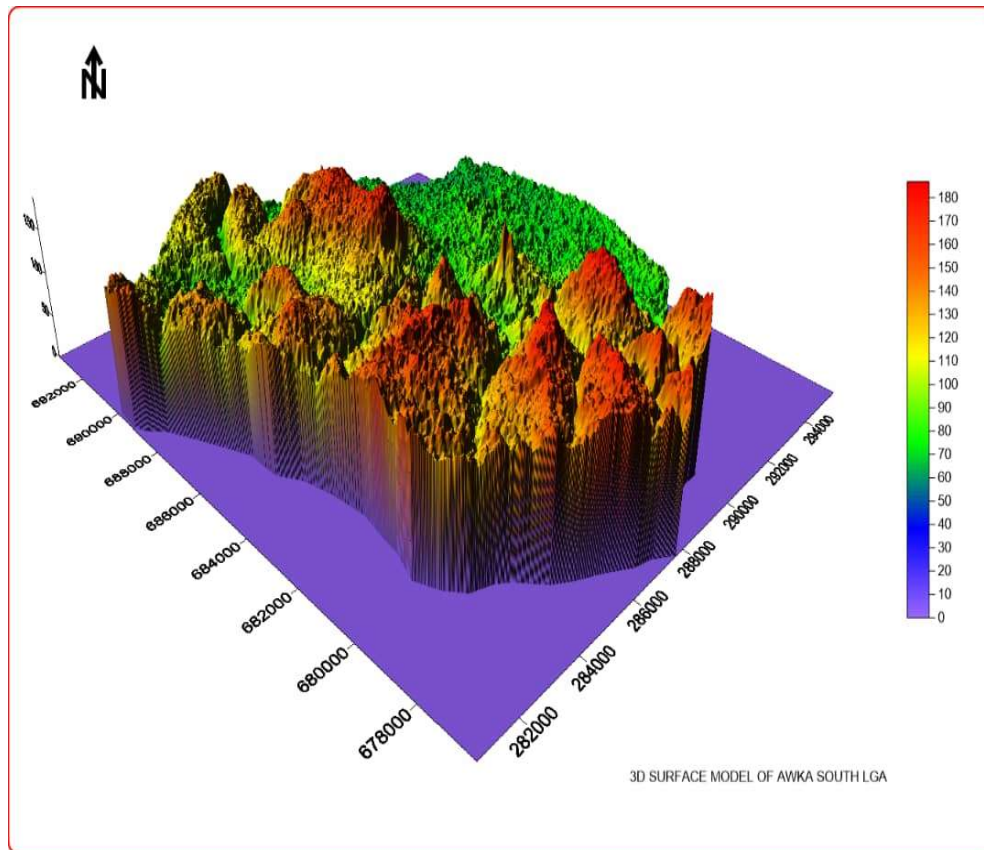


Figure 2: Topography of Awka Capital Territory

The vegetation of ACT was originally rain forest, but modern pressures on land due to agriculture, commerce, urbanization, infrastructural development and poor land management have reduced the vegetation to mixed or Guinea Savana. However, original vegetation can still be found along stream-courses and few preserved areas (UN-HABITAT, 2009, p. 21).

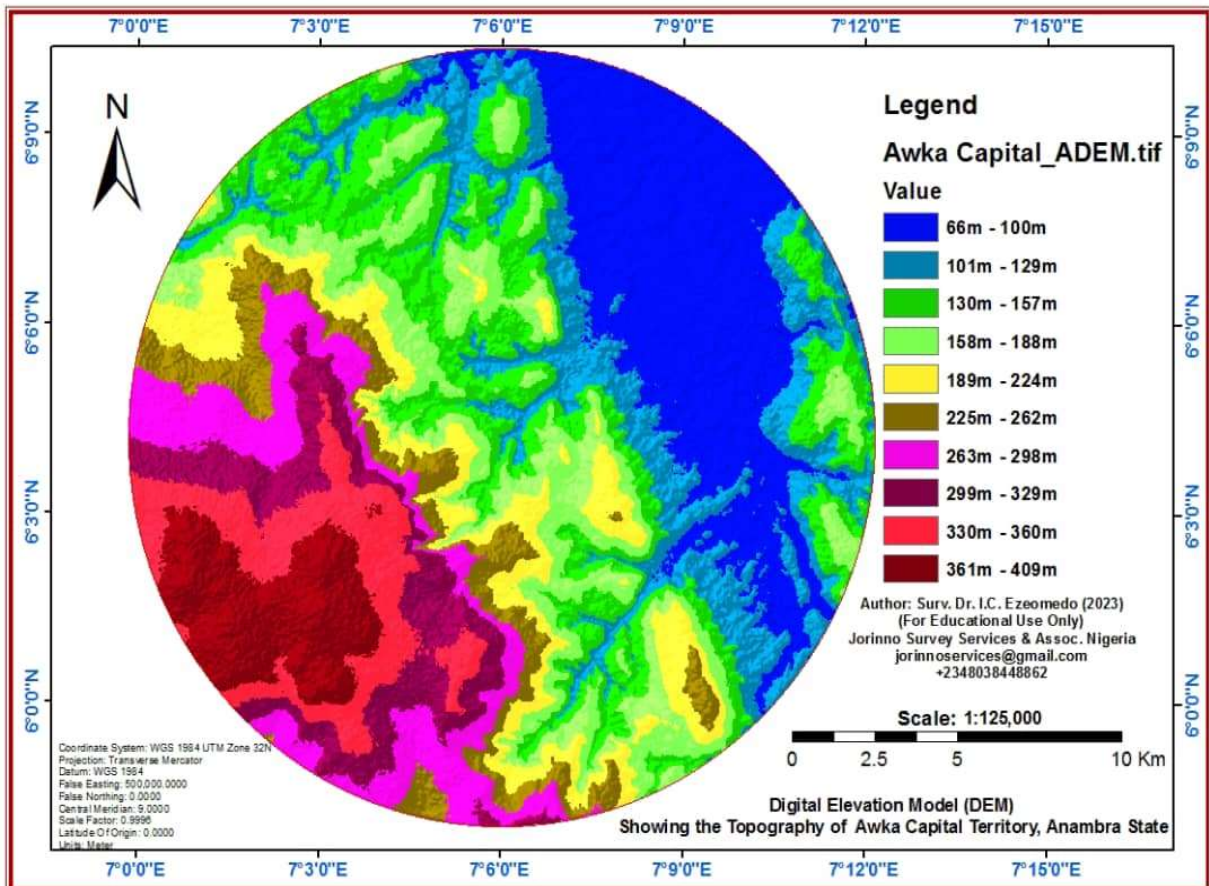


Figure 3: Digital Elevation Model showing the Topography of Awka Capital Territory

CONCEPTUAL CLARIFICATION

Land Use Planning

Land use planning has been an important instrument for pollution prevention and control; for the formulation and implementation of strategies to reduce deforestation and forest degradation, thereby contributing to both climate change mitigation and adaptation (FAO, 2017). On the other hand, conflicting interests and competition over land and resources are major driving forces of forest conversion, with increasing pressure due to population growth, degradation of lands,

economic interests and the impact of climate change. Land use planning refers to the process by which society through its institutions, decides where, within its territory, different socio-economic activities such as agriculture, housing, industry, recreation, and commerce should take place. It includes protecting well-defined areas from development due to environmental, cultural, historical or similar reasons, and establishing conditions/provisions that control the nature of development activities.

The provisions determine features such as plot areas, their land consumption or surface ratio (including setbacks), their intensity or floor-area ratio, their density, or units of that activity (or people) per hectare, the technical standards of the infrastructure and buildings that will serve them, and related parking allowances. In connection with pollution prevention, land use provisions should include, as circumstances permit, levels of gas emissions, light radiation, noise, water, solid waste discharges and on-site or pre-disposal treatment of pollutants. It is necessary to emphasize that all these provisions should be in the agencies or jurisdiction's land use or zoning code or development control manual. The code is thus a legal guide for landowners, developers, citizens and authorities.

On the other hand, land use planning can be seen as a process of regulating the use of land by a central authority to promote a more desirable social and environmental outcomes and a more efficient use of resources. More specifically the goals of modern land use planning often include environmental conservation, restraint of urban sprawl, minimization of transport costs, prevention of land use conflicts and reduction in exposure to pollutants. In planners' view, land use planning is expected to change the patterns of human behaviour.

According to GIZ (2011) land use planning tools can reduce climate risks in various ways including limiting development in hazard-prone areas; ensuring that the built environment can withstand a range of natural disasters; helping to preserve natural ecosystems, protecting communities against hazards (such as dunes that buffer coastal storm effects); promoting nature-based measures to adaptation, and educating stakeholders and decision makers about risks and opportunities and fostering dialogue about adaptation.

Climate Change Adaptation

This concept means an adjustment in natural or human systems in response to actual or expected climate change effects, which moderates harm or exploits beneficial opportunities (UNFCCC, 1992). It is "the ability or potential of a system to respond successfully to climate change variability and change, and includes adjustments in both behaviour and in resources and technologies" (Hirokawa & Rosenbloom, 2012). It is necessary to add that climate change adaptation is contextual and that governance, leadership, foresight and flexibility are all drivers of adaptive capacity.

Climate Change Mitigation

Climate change mitigation interventions or policies aim to reduce the emissions or enhance the sinks of greenhouse gases (GHGs) which contribute to climate change (UN, 1992). It means to moderate or make it less severe. For climate change, it refers to actions that will reduce the amount of greenhouse gases emitted into the atmosphere. (Schmidt & Wolfe, 2008).

Vulnerability and Risk Assessment

Vulnerability can be defined as “the extent to which a community, structure or geographical area is likely to be damaged or disrupted by the impact of a particular hazard (e.g. flooding) on account of their nature, construction, and proximity to hazardous terrains or a disaster-prone area” (Kapoor, 2012).

Vulnerability is of two types: physical vulnerability and socio-economic vulnerability: The former includes notions of whom and what may be damaged or destroyed by natural hazards, such as flooding, physical conditions of people and an element at risk, such as buildings, infrastructure are major factors governing vulnerability. It depends on their proximity and location which can be addressed by land use planning and on the nature of the hazard. It is affected by the technical capability of buildings and structures to resist the forces acting upon them during a hazardous event. Socio-economic vulnerability depends not only on the physical components of vulnerability but also on the socio-economic conditions. The socio-economic conditions of people will determine the intensity of the impact. For example, poor people have greater vulnerability to adapt to climate change impacts (Kapoor, 2012) and constitute one of the props for poverty alleviation.

Risk

Risk is a deviation from what is expected, a combination of the likelihood of an event and its consequences. It represents the source of danger, harm or loss and the possibility of suffering these effects. To Kapoor (2012), risk is a measure of the expected losses due to a hazard event occurring in a given area over a specific time period. Risk is a function of the probability of a particular hazardous event and the losses it would cause.

The magnitude of risk is a function of the nature of the hazard, the vulnerability of the elements affected and the economic value of these elements. Therefore, land use planning is disaster risk management, which includes all measures which reduce disaster-related issues of life, property or assets either by reducing hazards or vulnerability of the element at risk.

METHOD OF STUDY

This study was done through field observation, direct computation of data collected from field and use of historical data. Existing sources on the study area were also reviewed for relevant information. Interviews were conducted with officials of Anambra State Physical Planning Boards (ASPPB), Awka Capital Territory Development Authority (ACTDA) and relevant departments and agencies. Extensive field study was undertaken to record land use planning, land management practices, transport routes and flood tracks and water poundage zones. GIS and Remote Sensing were used in map production, rate and pattern of growth of settlements.

IMPORTANCE OF INCORPORATING CLIMATE CHANGE IN URBAN LAND USE PLANNING IN ACT

There are compelling reasons for employing land use planning as adaptive and mitigating climate shift challenges.

Rapid population growth

Rapid population growth is causing enormous ecological imbalance through unbridled ecosystem destruction and fragmentation which is causing biodiversity destruction and extinction. Urbanization Research Nigeria, (2015) shows five categories of urban centres with annual growth rates of 4.05% for Lagos mega city with 16.17m; 6.83% for the second category of urban centres of Abuja, Benin City, Ibadan, Kano and Port Harcourt with populations ranging from 1 to 5million; 3.73% for 14 towns, including Onitsha, Nnewi, Aba and Enugu with populations ranging from 500,000 to 1 million people and 4.14% for the fourth category of 18 towns, including Abakiliki, Sokoto and Umuahia with populations of between 300,000 and 500,000. The fifth category of towns have populations below 300,000 and growth rate of 3.98% annually. All these towns increased in absolute terms from a total of 69.44 million in 2010 to 108.7 million in 2020, an increase of 56.54% in a decade.

Within Anambra State many non-recognized rural communities have spiked also in population. These include Agulu (104,808), Ozubulu (77,904), Uli (83,714), Ogidi (76,717), Nimo (54,686), Igbo Ukwu (99,777), Ufuma (51,441), Amichi (55,637), Uga (93,623), Okija (81,540), Umunze (52,659) and Ukpok (77,017). Some of these communities such as Ogidi, Igbo Ukwu and Okija, are already part of sprawling recognized urban centres. The disturbing thing about the population of Anambra State is that with a 2006 population of 4,171,641 (National Population Commission, 2006) and a total land area of 4,865km² (National Bureau of Statistics, 2008), it has a population density of 857 persons/km², one of the most densely populated states in the country. It is expected that if the structure plans prepared by UN-HABITAT for Onitsha, Nnewi and Awka in 2009 were to be implemented a total of 1,235.35km² or 27.343% of total state land would be given over to urbanization. If the Federal Government of Nigeria's proclamation of all local government

headquarters as urban centres is accepted in Anambra State, then a total of 2,739.25km² of total state land with a 2006 census population of 2.996m will become urban areas and urban population respectively (Muoghalu, 2014). Urbanization is therefore consuming a disproportionate share of Anambra landmass.

The effect of urbanization is that it has replaced vegetative ecosystems with constructed ecosystems of synthetic surfaces that facilitate flooding; created urban heat islands; removed land from agriculture and primary production and distorted biodiversity.

Physical and Topographic Features

A major feature of the territory is the Awka-Orlu cuesta made up of swells and valleys/lowlands. Most of the area is below 300m above sea level and tilts very gently towards the Mamu River. The escarpments trending North-South generally and in some places East-West, determine the intensity and direction of the flood that menaces the territory. The highest point of the cuesta is in Agulu within the ACT. A minor cuesta runs North-South from Ifite-Awka to Amenyi in Awka (Figure 1). The valley or plains consequent on the cuestas host Awka, Amawbia, Umuokpu, Nibo, Mbaukwu and Umuawulu Communities (Figure 2) and these settlements bear the brunt of flooding, gully erosion and landslides (UNHABITAT, 2009).

In addition, the ACT is characterized by a sequence of shale stones, rich beds of sand and clay, and quaternary sediments predominate in Anambra soils providing moderate permeability and an easily eroded landscape (UN-HABITAT, 2009).

Climate Change Reality in Nigeria:

Enough evidence exists to show that climate change is already here with us. In Nigeria evidence is strong and includes changing rainfall patterns, increasing mean surface temperatures, floods, intensified gully erosion, desertification, prolonged droughts, increasing ocean surges, heat waves, the disappearance of Lake Chad, siltation of streams and rivers (Ajadike, 2015; Odjugo, 2009; Ekpo and Ansa 2011, Adefolalu, 2007). In a study spanning 105 years, Odjugo (2010) showed that the mean surface temperature in Nigeria up to 1950 remained steady, but from the late 1960s a steady gradual rise has continued up till today. In his study of rainfall trends, he discovered a decline of 81mm from 1901 to 2005. In a study of Sokoto by Ekpo & Ansa (2011), it was discovered that rainfall for the town declined by 8.8% of the long term mean from 1915 – 2008, and that there is late onset and early cessation and a long break within the rainy seasons. Rainfall varied in total amounts for all regions of Nigeria and was quite erratic posing real problems for planning and adaptation. Studies by Odjugo (2010) and Baudi and Ahmed (2006) showed that rainstorms killed 199 people and destroyed property worth ₦85.03 million between 1992 and 2007. Other studies showed that the number of rainy days in Northern Nigeria in the last 35 years has dropped by 53% in the northeast, while the coastal areas have noticed a drop of 14%. The double

rainfall maxima have shifted southward, while the “little dry season”, usually experienced in August is now experienced in July (Odjugo, 2010). The most spectacular evidence of climate change impact is the Lake Chad straddling Nigeria, Chad, Niger, and Cameroon, whose surface area diminished from 25,000 km² in 1963 to just 1,350km² today. This is attributed to the prolonged Sudano-Sahelian drought of the 1970s and 1980s, the high evapotranspiration rate in the region, and the construction of dams on the upper reaches of rivers flowing into the Lake (Muoghalu, 2023).

Severe flooding has been experienced in Nigeria intermittently in national and localized areas. The national flooding episode of 2012 affected 27 states, with 600 fatalities, and an estimated ₦11trn loss in property and assets. Another one came in 2017 with less cost and again in 2019 and 2022. Localized flooding in Sokoto, Gusau, Lagos (Victoria Island), and Ibadan, destroys settlements, farms and infrastructure. Nigerian Institute of Meteorology’s records show that average surface temperature (T°) ranged from 0.4°C to 1.5°C above the long-range average in the Sudan-Sahel zone, while the average increase in the rain forest area was 0.2°C and 0.3°C per decade (Ewa, 2011). Table 1 gives the indicators for measuring the impacts of flooding in Nigeria from 2012 to 2019.

Table 1: Indicators for Measuring Impacts of Flooding in Nigeria (2012 – 2019)

	2012	2018	2019
Affected Population	NA	1,921,026	130,934
Number of Deaths	363	204	126
Number Internally Displaced	2.1m	210,206	48,114
Number of Houses Destroyed	NA	82,376	29,356
Property Lost	₦1trn	₦246bn	₦176bn
Number of Hectares of Agricultural Land Destroyed	NA	156,672	NA

Source: National Institute for Hydrological Services (2020) Annual Flood Outlook

Flooding is caused by deforestation, lack of effective legal instruments, urbanization, nature of geology and physical pattern of an area, poor or no storm drainage infrastructure, excessive rainfall, blocking of drainage channels, settlement in flood plains, poverty and the nature of slope.

The greatest impact of extreme weather events in Anambra State is gully erosion. Osuji, (1983) estimates that Nigeria has more than 60% of its remaining valuable agricultural land impoverished by erosion and Anambra State is the gully-erosion capital of Nigeria. In the South Eastern geopolitical zone Anambra State had 700 gully erosion sites, Enugu 600, Ebonyi 250, Imo 450 and Abia 30 as at 2008 (Igbokwe, J. I., Akinyede, J. O., Dang, B., Alaga, T., Ono, M. N., Nnodu, V. C., and Anike, L. O. (2008). In 1993 an estimated 70% of Anambra land was being ravaged or

threatened by gully and soil erosion at various stages of development and maturity, while over 20% had been lost to Hadesian gullies (Egboka, 1993). A complex network of gullies was advancing towards 30% of the highlands in the state, while the rest of the state was being ravaged by massive sheet, rill and channel erosion. Landslides are common during prolonged heavy rains of high intensity, and heavy particle size in areas of 4° slope incidence and above.

Flooding is caused by anthropogenic activities, population explosion, problems arising from the execution of large/small-scale industrial and engineering nature, changes in the composition of soils or rocks, irrigation schemes, major road networks, small/large scale dams, indiscriminate opening up of rural roads, indiscriminate bush burning, urbanization, deforestation, poor agricultural practices, engineering construction across flood ways, overgrazing, non-implementation of legal provisions in urban areas (Muoghalu, 2023).

Deforestation

Anambra State previously belonged to the rainforest belt in Nigeria, but pressures of spiralling population growth, urbanization and demand for land for agriculture, infrastructure and facilities development have transformed it into mixed Savannah land. Forests can only be found along river courses with Iroko, soft wood with domesticated tree species like oranges, mangoes, oil palm trees, and coconut trees. Pressures from urbanization are degrading watersheds, rendering them vulnerable to gully erosion. Of the total land area of 4,865 km² for Anambra State only 321.34 km² is forest reserve, an infinitesimal 6.61%. Meanwhile almost all the watersheds have been stripped of their vegetation leading to the silting of the rivers and streams in the state; the streams have also been heavily polluted. When stock is taken that 62% of the Anambra population currently lives in urban areas, making it the second most urbanized in Nigeria, as well as the second most densely populated state in Nigeria, urban afforestation must assume the pride of place (Muoghalu, 2015).

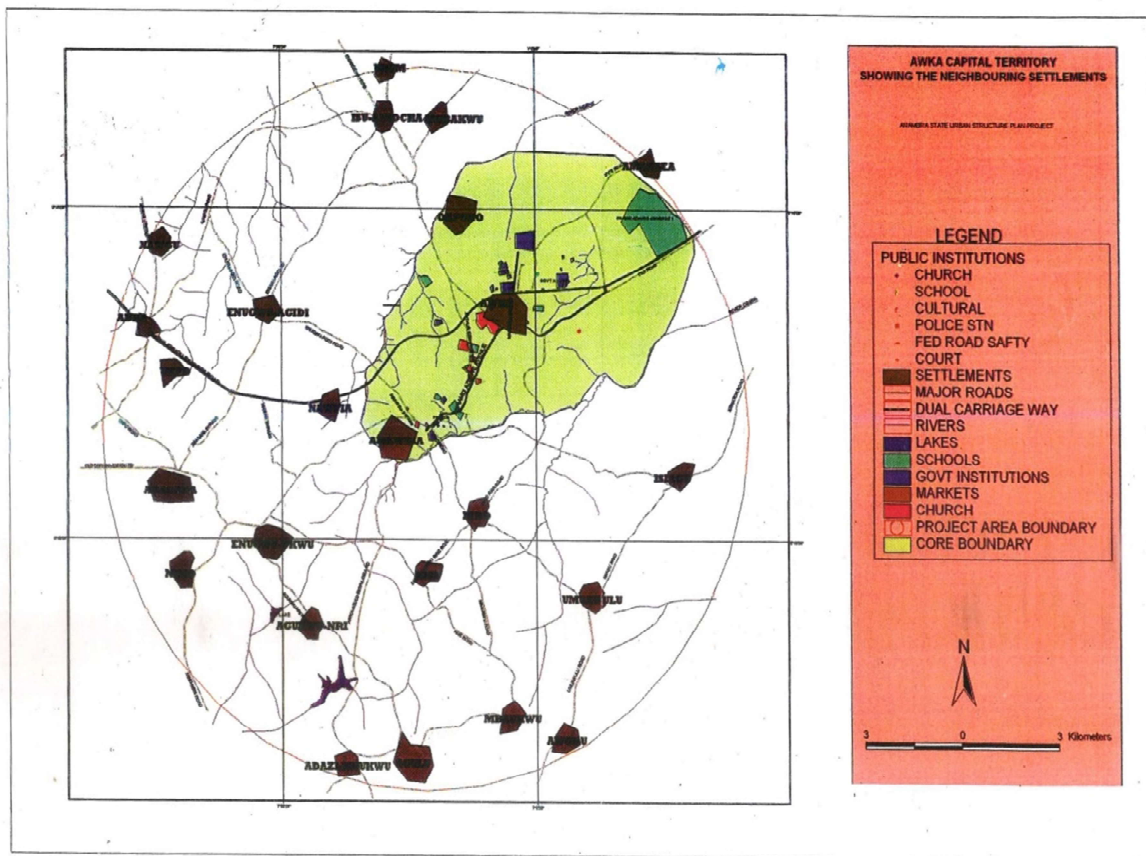
CURRENT LAND USE PLANNING IN ACT

A major drawback in planning in ACT is that Anambra has been operating an old planning law it inherited from the former Anambra State in 1991 on its creation. It ought to be using the more robust Urban and Regional Planning Law of 1992 passed by the Federal Government which accommodates the planning needs of the Federal government, State Governments and Local Governments. The Ministry of Lands, Survey and Urban Planning, which oversees land use planning set up the Anambra State Urban Development Board (ASUDEB) with four zonal offices without decentralizing planning activities to local government levels. ASUDEB has been replaced by the Anambra State Physical Planning Board (ASPPB). A further complication has been the setting up of Awka Capital Territory Development Authority (ACTDA) which is incharge of planning a 10 km radius of territory involving the whole of Awka South Local Government Area

and parts of Awka North, Dunukofia, Njikoka, Orumba North and Anaocha Local Government Areas.

In addition, the Anambra State Housing Development Corporation, which is assisted by the Ministry of Lands, Survey and Urban Planning in land acquisition, is responsible for its land use planning. Anambra State Home Ownership Company Ltd, a semi-mortgage institution, developed its housing estates, but has been liquidated by the Federal Institution (NDIC) supervising banks. The ASPPB's law requiring developers to plant at least three trees inside their lots exists in the breach.

Figure 4: ACT and existing Land Use



Source: ACTDA (2009)

To date, there is no master plan for planning and the structure plans developed by UN-HABITAT in 2009 have been there on paper. Awka Capital Territory made up of 24 communities is supposed to be planned for by the Awka Capital Territory Development Authority (ACTDA). However, the ACTDA and Anambra State Physical Planning Board are embroiled in a conflict over who should plan for Awka and are simultaneously doing development control. While ACTDA has come up

with a development control manual (ACTDA, 2014), covering such areas as environment, housing, sheltered dwellings, traffic and transport, commercial developments, community development, outdoor installations, physically challenged, planning and development permits and standards, all its recommended prime investment projects are stalled by lack of funds and conflicts with ASPPB. Its planning proposals include Agriculture City, Millennium City, Health City, Education City, Executive Business District, etc. Since Awka has been in existence long before colonial intervention and since the town has been without physical planning, the first stage in the development of ACT would have been the renewal of old Awka city before embarking on the new Capital Territory (Figure 3).

This will mean massive urban renewal scheme through infrastructural development and the installation of modern public utilities including construction of stormwater drainage channels. Considering the topography of Awka, physical planning in Awka must contend with flood drainage networks. As of today, only one major flood drainage channel has been constructed in Awka which does not evacuate the flood emanating from old Awka town. As a result, the whole of Amikwo Awka, Ikwodiaku Layout and Umukabia Layout, the lower part of Obunagu, greater part of Umudioka are permanently under water every year, submerging houses and cars.

Because of lack of meaningful land use planning and improper implementation of the Land Use Act of 1978, communities sell their land, parcellate them into plots, without regard to planning regulations, create roads without setbacks, built-up space, and stormwater drainage plans. Yet prospective developers scramble for the land and sub-division as done by families and communities who own the land. On account of the absence of land use plans all wetlands, irrespective of their enormous ecological benefits are sold off for construction of living houses. This is an invitation to perennial flooding. This explains why a great part of Ngozika Housing Estate (belonging to the Anambra State Housing Development Corporation), and Ikwodiaku Layout are flooded yearly. The wetland between Awka and Nibo into Nise along Amawbia-Ekwulobia road has been sold off for housing development, while the entire watershed has been deforested leading to severe soil erosion eroding and carrying soil to the valley.

The transport sector is not spared. Whenever a heavy rain falls Zik's Avenue, (which divides traditional Awka town into two) constrains traffic from its junction with Igwebuikwe Road and Umuogbunu Road. The High Court Road as well as Obunagu Road become deep pools of flood water. North of Enugu-Onitsha expressway corridor from Okpuno to Mgbakwu, Isuanaocha, Urum, Ebenebe, and Amanuke (all areas towards which Awka is developing), has no single land use planning. What Anambra State Physical Planning Board and ACTDA are doing is development control only in relation to housing structure.

In concluding this section, it is necessary to emphasize the constraints in present-day land use planning in ACT. There are no legal specifications as to who is in-charge of ACT, the poor governance in ACT physical planning, the non-consideration of climate change implications in the planning enterprise, the absence of government's minimal control of land in the urban area, little or no attention paid to the necessary urban renewal perspective in old Awka and pervading mass

illiteracy in environmental issues are constraints to land use planning. In the next section, we address critical issues in aligning land use planning to climate change.

ISSUES IN INTEGRATING LAND USE PLANNING WITH CLIMATE CHANGE IN ACT

A consideration of these issues will ensure enough or some mitigation to avoid the unmanageable consequences of global warming, and ensure enough adaptation to manage the unavoidable impacts. Certainly, Nigeria is tossed between and betwixt by the severe devil of drought and desertification in the north and the deep sea of floods in the South. The problem of ACT is flooding with its accompanying offspring of impacts. Unless real continuous and consistent actions are taken, the ACT will come to nothing. The impact of climate change will be extremely difficult to handle. Only better planning to reduce risks from disasters that will affect various sectors of our socio-economic life can withstand changing climate and help to mitigate the impacts if done wisely and properly. Environmental degradation is increasing because the ACT is consistently losing its biological, physical and chemical capabilities. More importantly, environmental problems keep rising in pace with ever-advancing technology, urbanization, rising population, increasing poverty, increasing automobility thereby distorting ecological balance day by day (Urey, M. et al, 2016; AL Gore, 1992).

Political Will

To embark on the plan to integrate climate change into urban land use planning, there must be the political will and ability to confront this inevitable necessity. It is this political will that will recognize that our basic needs for food, water, fuel, clothing and shelter will be met from the limited supply of land. As the population continues to rise, land becomes increasingly a scarce resource. Land use must change to meet user demands and exigencies. Conversely change brings new conflicts between competing uses of the land and between the interests of individual land users or communities selling their land and the common good. For example, land allocated to new settlements or industries is no longer available for agriculture. In the same manner new farmland competes with forestry, water supplies and wildlife. As the size of the area, the number of people involved and the complexity of the problems increase, so does the information and rigorous methods of analysis and planning. It is this political will that is lacking in ACT.

The Ngige administration (2003-2006) came in to modernize old Awka and met with stiff resistance from indigenes who feared demolition of their structures and so he concerned himself with the construction of major Anambra roads. When his successor came, he bypassed the renewal of old Awka and looked towards Okpuno where the town was witnessing structural change through internal road construction, as well as constructing the State Secretariat. He later invited UN-HABITAT who produced the structure plans for Awka, Onitsha and Nnewi, as well as developed the concept and plan for the New Awka city (the Millennium City), the administrative complex,

the Police Barracks and Offices, the new Awka market and industrial zone all aimed at encouraging development towards Isiagu located South of Enugu-Onitsha Expressway Corridor. His regime combined planning at the regional level and the local level. The former concentrated on vigorous road construction in other areas of the state including Nnewi and Onitsha, while the latter was the planning of ACT. An innovation he brought into planning was the Anambra State Integrated Development Strategy (ANIDS), a pari-passu development of all sectors apparently to achieve the Millennium development goals. (MDG). He looked away from the development of the three Arms zone- the Secretariat, Judiciary complex and the Government house-apparently because of the crises arising from that Executive Business District. The regime, however, laid the foundation for a land information system in the Ministry of Lands, Survey and Urban Planning.

The Obiano regime looked away completely from land use planning and concerned itself with road markings, road construction, development of effective revenue collection information system, construction of state cargo airport, an international conference centre, the rehabilitation and equipping of the science and technical schools and relieving traffic chaos at major junctions along the Enugu-Onitsha Expressway through the construction of flyovers.

Planning involves anticipation of the need for change (such as climate change) and reactions to it. Its objectives are set by social or political imperatives which must take account of existing conditions, in our case nil or little planning given catastrophic global warming. The existing conditions cannot continue because the environment, the source of our sustenance is threatened by human practices whose risks and vulnerability, such as clearing forests on steep lands, overgrazing of pastures land and industrial, agricultural and urban activities that generate pollution. It must be known that degradation of land resources may be attributed to greed, ignorance, uncertainty of lack of an alternative, but we must realize that it is, above all a consequence of using land today without investing in tomorrow. The warning is that a community that destroys its land, forfeits its future and that is the danger into which Anambra State is getting, if it does urban planning without climate change in view.

Vulnerability and Risk Assessment

Planners of ACT need to begin with the assessment of risk and vulnerability of the territory. The assessment is useful in directing and balancing efforts and costs associated with attempts to adapt to climate change. Possible impacts of a changing climate on ACT will entail the use of climate models which predict ACT's future climate and ways the region will be affected. When anticipated changes are assessed, the impacts of those changes might be for example increased flooding, soil and gully erosion, siltation of surface streams, deforestation because of city and population growth.

The next thing is to determine the risks associated with the impacts and the level of vulnerability of those risks, such as vulnerability of the natural environment, infrastructure and health and safety of citizens to weather-related events. This will reveal the degree of loss or damage that may arise

from severe weather events. Then in the examination of resilience of existing systems and the capacity to confront changes, problems such as the following will be raised:

- 1) whether the service area can in its current context accommodate existing weather patterns and changes in climate;
- 2) are there constraints to the service area's ability to accommodate changes in climate; and
- 3) whether the service area is already strained in ways that will diminish its ability to handle future climate changes.

Then the information gathered will be applied to land use planning, bearing in mind the risks and opportunities associated with the changes and local vulnerabilities. The vulnerability and risk assessment will help to:

- a) determine opportunities to facilitate the development of new services and products
- b) enhance reputation with stakeholders
- c) protect community investments
- d) improve quality of life

Climate change adaptation should pervade all planning stages and processes whether from the long-term perspective or the specific implementation tools, establishing a vision, setting goals, developing or implementing policies and consultation and review.

Urban Governance

Urban governance means inclusiveness and transparency in how urban entities are managed in terms of harmonization of sectoral law and policies (FAO, 2017). It is about increasing the capacity of urban management authorities, their local governments, NGOs, parastatal organizations in-charge of various utility provisions, ministries, national and international donors, women organizations and the entire urban communities in delivering liveable urban environments. Applied to ACT it is about how ACTDA involves the multiplicity of stakeholders who have anything to do with the achievement of a functional, liveable and sustainable ACT in synergy and not creating a tower of babel. It involves building partnerships, mobilizing support for capacity building and institutional strengthening, knowledge management, focusing on experiences gained and developing good urban governance toolkits, such as participating in urban decision-making. The relevance of integrating good urban governance and urban poverty reduction, and for this paper the critical centrality of integrating climate change into urban land use planning cannot be side-lined.

The essence of the above is that ACT as an inclusive city should be a settlement where everyone irrespective of their economic status, gender, race, ethnicity or religion should contribute to make ACT a melting pot that enables and empowers all to participate fully in social, economic, political and environmental opportunities ACT has to offer. In this way ACT can key into regional and global institutional strategies and "flagship products" (internet). Good urban governance is a prerequisite for economic efficiency and effective administration because it is based on the concept

of subsidiarity. In confronting good urban governance in the ACT, it should be borne in mind that the security of individuals and their living environment is a cardinal principle that improves the security of communities against natural and human-induced hazards in terms of designing and dissemination of information on disaster, mitigation, preparedness, response, recovery and rehabilitation tools.

As poverty incidence spikes in Nigeria, ACTDA has to make capital of women's involvement in decision-making and poverty alleviation through inclusiveness. Delivering good urban governance is imperative in the ACT, especially as Anambra State is the second most urbanizing State in Nigeria. Besides, urbanization trend is irreversible. It is imperative as cities have tremendous potential

“as engines of growth, economic and social development, creating jobs and generating ideas via economies of scale and creative and innovative civil cultures. In the same way, cities can also generate and intensify social exclusion, denying the benefits of urban life to the poor, to women, to youth and to religious or ethnic minorities and other marginalized groups” (United Nations Human Settlements Programme, UN-HABITAT, 2002).

Good urban governance needs to recognize the people in planning: land users, decision-makers and the planning team. People's needs drive the planning process. Local farmers, other land users and the wider community who depend on the land must accept the need for change in land use- because they will live with its results. Local acceptability is most readily secured by local participation in planning. This applies to the zoning process because people accept more readily development opportunities they have participated in than those imposed on them. Effective public participation can be achieved through local discussions, broadcasting and newspaper articles, town hall meetings, technical workshops and extension services.

Decision-makers are the implementers of planning decisions, who guide the planning on key issues and goals and also decide whether to implement plans and determine which of the options presented to implement. These are the ACTDA members and the State Governor. Decision makers have the responsibility of encouraging public participation through their willingness to express their decisions and how they are reached to the public.

The planning team's essential duty is to treat land and land use as a whole. This requires a multi-disciplinary approach by bringing all professionals in the built environment needed to work as a team. The Nigerian Urban and Regional Planning ACT of 1992 (amended in 1999 and 2012) provided for professionals who should be on State Planning Boards (lawyers, architects, urban and regional planners, land surveyors, estate valuers and surveyors, quantity surveyors, builders and environmental managers). Unfortunately, the Anambra State government has not adopted this law. By way of conclusion the governance of ACT should incorporate strong community relations and a complete set of instruments for land use planning and development for the benefit of the people.

Managing Growth

As the population of Awka Capital Territory grows and since population growth is relevant to increasing greenhouse gases, ACTDA must be concerned with the growth potentials of ACT. In 2017 the National Population Commission (NPC) projected the population status of some communities within ACT such as Abagana (63,040) Nimo (54, 686) and Awka (123, 176) at a 2.9% growth factor. The UN-HABITAT projected the population of ACT to 1,205,000 by 2015; 2,360,000 by 2025 and 2,875,000 by 2030. In the 2006 census the population of the 24 Communities in ACT was 565,735. The ACT should allocate population and employment growth to increase the intensification and density in order to develop compact, mixed-use and transit-supportive communities. This is to diminish the senseless consumption of land in a land-hungry and gully-erosion ravaged state.

Urban Agriculture

The ACTDA must identify and protect prime agricultural lands, as well as achieve economic viability of farming through land use planning given the rate at which urban expansion and housing construction are invading hitherto agricultural lands and as flooding and deforestation enable the development of soil and gully erosion. These activities constrain food productivity, availability, accessibility and nutritional balance. It is because of this that ACTDA must review the expansion of residential land use into Mgbakwu, Isuanaocha, Amanuke, Urum and Ebenebe in Awka North and Isiagu in Awka South. This translates to developing all types of urban agriculture in boundary territories inside the ACT. Such agriculture may include neighbourhood and community farms or farm operations, as well as creating incentives to enhance their economic viability. The UN-HABITAT (2009) showed that there is a self-employment level of 58% and that the development of urban agriculture has an awaiting workforce. The proposed Ethanol project by the NNPC (Nigerian National Petroleum Corporation Limited) at Ebenebe will boost massive cassava production. NNPC has a 1 km² of land for cassava farming in Ebenebe. ACTDA had in its 2017-2020 budget provided for the development of an Agro city building, farm settlement and infrastructure for mechanized/commercial agriculture with a value chain at the College of Agriculture, Mgbakwu under private-public intervention, but the government did nothing with it, while residential housing development is eating up land there.

Regarding forestry, the Mamu Forest Reserve, which provided timber for Awka sawmills, though exploited and abused by foresters managing it, should be extended and properly managed with the community deriving livelihood from it. New forest reserves need to be established especially in all wetlands and river watersheds to guard against the ravaging gully erosion, as well as reckless residential developments along them. All severely gullied erosion sites should be declared disaster zones and afforested.

Transportation

Efforts should be made to improve public health and reduce GHG emissions through sustainable active modes of public/private, transit, cycling, and walking- infrastructure, which do not exist at the moment. A situation of uncontrolled automobility, the flourishing tricycle and shuttle buses are encouraged by the non-determination of the city form for Awka Capital Territory (Twin City, Single Core City, Multi-Nuclei City and Core-Multi-Nuclei City), the non-implementation of the UN-HABITAT Structure Plan for Awka, the absence of effective planning law for Anambra State, the approval by government of two planning bodies (ACTDA and ASPPB) without proper demarcation of planning roles and total disempowerment of local governments and by implication local planning authorities create planning confusion.

Apart from a few link roads connecting the Enugu-Onitsha Express highway and Zik's Avenue, since 1991 emphasis by the government has been on the construction of existing link roads between Awka and settlements in the Capital Territory.

The workable option is for the government to send a bill to the State House of Assembly accepting the structure plans as a basis for physical land use planning, amending or rejecting sections as necessary. ACTDA as of now has no master plan, but is inclining towards the structure plan. Such an act of the State Assembly will enable ACTDA to produce a master plan, an overall state-of-the-art remotely sensed impression of the territory and determine the phases of development as it applies to the capital city and the 24 communities in the territory. Short of government acceptance of the structure plan a laissez-faire attitude prevails in the adoption of the status quo before the creation of Anambra State in 1991.

As of now road development implicitly reflects a single core city in which all emphasis is on the core. This will lead to traffic congestion at peak hours and during festivals such as Easter and Christmas, which is already happening. The autonomous communities will lose their identities as movement from them will be to the Awka core area for employment and a host of urban services. Operating a single core city will entail massive prohibitive costs in the redevelopment and re-organization of the CBD in terms of dislocation and relocation of indigenous people within the CBD in terms of compensation and hardship with attendant resistance.

The current regime's rehabilitation and renewal of core traditional settlement is already generating resistance to the widening of traditional narrow lanes of pre-colonial Awka town. As of today, all the roads in the territory have fallen into disuse both within the core city centre and the arterial roads of Arthur Eze Avenue, Awawbia Enugu-Agidi Road, Amawbia-Ekwulobia Road, Aroma-Ifite Awka -Amansea Road. Many of the roads have no stormwater drainage channels and the flood arising from them has not been properly connected to the only big stormwater drainage in Awka from Court Road in the core city across the Onitsha-Enugu Expressway to the North-Western part of the territory.

Water Resources

Ideally ACTDA should protect water resources following a master plan through watershed planning, and consider the risk and vulnerability to public infrastructure. Climate change impacts on water quality include change in water salinity, water nutrient content, concentration of pesticide and pollutants, water chemistry and pH balance (Bates et al, 2008). There has been no public water supply in Awka since the 1990s, while the workers in the State Water Board have been owed salaries and wages since then. The urban population depend on local streams for suspicious water quality, boreholes, and rainwater storage.

The major source is borehole water, supplied by water vendors and tanker drivers. The geology of Awka, underlain by shale in places is favourable to harvesting good potable water supply. But underground water supply is not available in Ifite where boreholes drilled reach as deep as 500m, without striking water. State governments misapplied funds from the European Union and UNDP for water supply in Awka- from the 1990s to the early part of the 21st century. Regional water schemes by the government such as the Obizi water scheme, have been frustrated by the government. There are several streams and lakes in the territory, but their benefits have been frustrated by the government, while some have been silted by flood.

A study on the incidence of under-five childhood diseases in the territory (Muogalu & Ndigwe, 2012) indicated a higher level of attendance at hospitals in Awka than in the rural areas. Of the 18 childhood diseases studied the most prevalent were malaria, urinary tract infections (UTI) fever, gastro-enteritis, cough, bronchitis and febrile convulsion and these were fairly endemic in the rural areas than in Awka. The causative factors were lack of awareness of health facilities, income, use or non-use of treated mosquito bed nets, accessibility, unfriendliness of hospital staff, poor public funding and poor water supply. The best option is to provide water from boreholes and surface streams through damming of the latter and reticulating within the territory, especially in high-density poor neighbourhoods.

Energy

To achieve mitigation of climate change, there is a need for a switch to energy efficient-alternatives and conservation through renewal energy (including district energy), green development standards, electric vehicles, switch to gas utilization in supplying domestic electricity instead of fuel or diesel. For the moment electric energy supply from public supply is erratic because of electric distribution companies' reluctance to utilize all the power transmitted to them, reluctance to meter households, loss of power during transmission, and high cost of energy. Few wealthy middle and top-income classes have started using solar energy. The State government should provide LNG/CNG-powered buses for mass transit.

Catalytic converters should be installed in vehicles. With the declaration by the Federal Government that states should start their energy generation, state government, given the fact that

Nigeria is sitting on a gas province, can generate their energy on the district level. Electricity is the key to industrialization. The switch to alternative energy and energy efficient-bulbs will tone down the emission of carbon monoxide and particulate matter into the air environment.

UN-HABITAT (2009) recommends that Awka requires a total of 170 KVA as against 400KVA existing distribution transformers in 2009. Non-availability of energy is hurting small and medium-scale entrepreneurs. Attempts have been made to electrify major streets and radial roads in the territory. Load shedding is the order of the day.

National Hazards

ACTDA should address impacts related to surface water, groundwater and flooding and increase resilience through low-impact development and green infrastructure stormwater approaches. Here the provision of gutters in road construction enough to carry away flood water is a necessity. In this regard, special attention should be paid to the portion of Zik's Avenue at the Post Office close to the building materials market along Arthur Eze Avenue, along the High Court Road, Ikwodiaku, Umukabia layouts and Ngozika Housing Estate and the entire Ifite Awka slum area down to UNIZIK and Amansea. Slope incidence is the driver of flooding. The desilting of drains should be borne by the government and community as in most cases it is people who dump waste into drainage channels. There is a need for the creation of awareness in the people to change their attitude and behaviour from environmental degradation to environmental responsibility and stewardship. As stressed earlier, there is the need to afforest (as a healing device) severely gullied sites, watersheds and wetlands to enhance underground water regeneration through recharging groundwater sources.

ASWAMA and private sector operators should be encouraged and recycling should start to reduce resource exploitation and attendant environmental degradation. The embarkation on private afforestation by individuals now common in Nnewi South Local Government Area should be adopted statewide. State-organized and supported tree planting should be stepped up, especially in areas vulnerable to severe gully erosion, including Abagana, Amaenyi Awka, Okpuno overlooking the EBD and behind the Judiciary Complex.

Adoption of a single core city centre will mean that the ACT should be surrounded by a green belt to stop urban invasion of rural areas. By the same token, each of the 23 remaining communities/settlements in the ACT should also be surrounded by green belts to preserve their cultural identities and reduce "urban heat island" effects.

Natural Heritage

All historic, architectural and places of cultural significance should be preserved including pre-colonial religious shrines; the so-called evil forests should be maintained and restored to enhance

the diversity and connectivity of natural features, such as forests and rivers in the ACT for the long-term protection of ecosystems and public health.

Health

Climate change has implications for human health (USAID, 2019). The source shows that by 2030, 800,000 people will be at risk of flooding from inland rivers. Flooding has direct and indirect effects on health, ranging from fatality to disruption of food production, water contamination, and increased risk of vector and/or waterborne diseases. Cholera outbreaks are attributed to flood water linked to contaminated septic overflows entering water supplies. Generally, Nigeria's water and sanitation efforts in the MDGs were not prepared to handle the projected increase in precipitation. In rural areas, only 44% of the population had access to good sanitation and 39% had access to potable water. The proportion of diarrheal mortality attributed to climate change is projected to rise to 14% by 2050.

Climate change will exacerbate health issues related to respiration infections already responsible for 19% of deaths in Nigeria/as air pollution will expectedly worsen with rising temperatures. About 120,000 deaths are attributed to household air pollution from indoor burning of cooking fuel. Extreme heat intensifies ground-level ozone, which combines with fine particulate pollutants (soot and dirt from diesel engines or fires) and chemicals like carbon monoxide or sulfur dioxide to reduce air quality, especially in the ACT. The Anopheles mosquito, responsible for malaria, is highly sensitive to extremes of high temperature leading to the contraction of malaria. (Ogunyemi, 2017; USAID, 2018, WHO, 2015) Afforestation of urban areas and construction and management of stormwater channels will take care of some of these impacts. Health is an asset for healthy living and a productive workforce. Provision of primary health care services is shared by local and state governments. ACTDA should ensure that all layouts and estates have at least a well-equipped and staffed primary health centre for pregnant, lactating mothers and children to cut the cost of long treks to medical facilities.

These should be manned by qualified nurses and midwives, while medical doctors may come once a week to deal with patients with more challenging cases. The constraint is the payment of exorbitant medical fees, but the Soludo regime has declared free treatment for pregnant and nursing mothers.

CONCLUSION

This paper has demonstrated the relevance of integrating climate change in land use planning in ACT by examining factors that will pose serious constraints in realizing this integration. Against this backdrop we x-rayed the current land use planning in terms of integrating climate change. The conclusion is that such integration has not been addressed sufficiently. Given this, we selected relevant issues that must be considered in achieving the desired level of integration.

In conclusion, we observe that the way we treat nature today means that we are devaluing where we come from. Our objective is to emphasize the need to green our minds towards the future in the sense that the future will belong to the nature-smart, those individuals, families, communities, businesses and political leaders who exhibit a deeper understanding of the transformative power of the natural world and who balance the virtual with the real (Richard, Louv (2010), Omuogun, Egboniyi and Onnoghen, 2016).

A first attempt to evaluate and monitor the environment is to know the extent and nature of the effects of climate change on the environment. The paper calls for knowledge of the parameters that define the environment and the natural inter-relationship which helps to maintain a balanced ecosystem so that we can start to put in place measures to ensure the maintenance of the initial balance by warning of human activities, cooperating and taking measures to check some of the adverse consequences of some natural occurrences on man and the environment.

The paper warns that actions must be consistently taken to respond to ever-increasing environmental challenges and to plan proactively rather than connecting distortions of existing physical development planning in Awka Capital Territory. Maybe that was the rationale for Governor Obi doing the structure plans for Awka, Nnewi and Onitsha.

There is a need for legislative and policy prescriptions that will enable the realization of a purposeful environment, and sustainable planning in a climate-changing context. There is a need to enable ACTDA to discharge its responsibility through funding and conflict-free legislation for SMART (specific, measurable, attainable, realistic and time-bound) city planning.

Land use planning should aim at a balanced use of analysis of the existing conditions and constraints, extensive public engagement, practical planning and design and financially and politically feasible strategies for implementation. It must be stressed that every portion of land has a certain capacity for supporting human, animal and vegetative life in harmony. Upsetting this balance has dire consequences for the environment. A SMART urban city approach in land use planning involves designing sustainably and governing responsibly to embark on nuisance abatement. That is focusing on more sustainable and less environmentally damaging forms of development. It is the responsibility of the Anambra State government to ensure all these with the full participation of citizens.

REFERENCES

- Adefolalu, D.O. (2007). *Climate Change and Economic Sustainability in Nigeria*, Paper Presented at an International Conference on Climate Change, Nnamdi Azikiwe University, Awka.
- Ajadike, J.C. (2015). Some Verifiable Evidence of Climate Change with Special Reference to Nigeria, *UNIZIK Journal of Geography, Meteorology & Environment*, vol. 1, pp. 75 – 85.

- Akintola F.O. & Ikwuyatum, G.O. (2012). Issues in Sustainable Flood Management in Nigeria in Matt F.A. Ivbijaro & Festus Akintola (eds) *Sustainable Environmental Management in Nigeria*, Ibadan: Book Builders, pp. 197- 208.
- Al Gore (1992). *Earth in the Balance: Ecology and the Human Spirit*, Boston: Houghton Mifflin Company.
- Bates, B.C, Kundzewicz, Z.W.S. & Palulikaf, J.P. (eds.) (2008). *Climate Change and Water: Technical Report of IPCC on Climate Change*, General.
- Baudi, P.V. & Ahmed, A.N. (2006). The Impact of Wind-Related Hazards in Southern Cameroon, *Journal of Physical Sciences*, 3(2): 82 – 88.
- Egboka, B.C.E (1993). *The Raging War/Erosion, Gullies and Landslides Ravage Anambra State*, Awka: Government of Anambra State.
- Ekpo, I.J. & Nsa, E. (2011). Extreme Climatic Variability in North Western Nigeria: an Analysis of Rainfall Trends and Patterns, *Journal Geography and Geology* 3(1): 51 – 62.
- Ekpo, I.J. (2009). *Climate, Society and Environment*, Calabar: St. Paul’s publishing Company.
- Ewa, O.E. (2011). *The Role of Satellite Technology in the Mitigation and Adaptation to Climate Change in Nigeria*, a guest lecture by the Hon. Minister of Science and Technology at the 2nd Climate Change Conference Organized by the Environmental Management Association of Nigeria (EMAN) on 15 Dec, 2011.
- Food and Agriculture Organisation (2017) *Land Use Planning for REDD+*. www.fao.org/3/a-i15937e.pdf Accessed Sept 2, 2023.
- Freeman, R.E. (2015). *Stakeholder Theory*, Wiley Encyclopedia Management, pp. 1 – 6.
- GIZ (2023). *Land Use Planning: Concept, tools and applications*, published in Climate – ADAPT <https://climate-adapt.eea.europa.eu/en/metadata/adaptation-options/adaptation-of-integrated-land-use-planning>.
- Hirokawa, Kaith & Rosenbloom, Jonathan D. (2012). Land Use Planning in a Climate Change Context. *Research Handbook on Climate Adaptation Law*, p. 2.
- Igbokwe, J. I., Akinyede, J. O., Dang, B., Alaga, T., Ono, M. N., Nnodu, V. C., & Anike, L. O. (2008). Mapping and Monitoring the Impact of Gully Erosion in Southeastern Nigeria with Satellite remote sensing and Spatial Information Science in International Archives of Photogrammetry, *Remote Sensing and Spatial Information Sciences*, vol. 37.
- Kapoor, G.P. (2012). *Disaster Management*, New Delhi-110002 APH. Publishing Corporation.
- Muoghalu, L.N (2019). Climate Change and Food Security in Nigeria, *COOU African Journal of Environmental Research*, vol. 2, No. 1, pp. 146-166.
- Muoghalu, L.N. & Ndigwe, Oby (2012). A Comparative Analysis of the Incidence of Under-five Childhood Diseases in Awka Metropolis and its rural hinterland, *Benin Journal of Social Sciences*, vol. 20, No. 1, pp. 209-219.

- Muoghalu, L.N. (2014). Urban and Regional Planning in Anambra State: Approaches to solving Urbanization Problems in the State. In Nkoli Nyigide, et al (eds) *The Eagle of Igbo Literature a Festschrift in Honour of Professor G.O. Onyekonwu*, Nimo: Rex Charles & Patrick Ltd, pp. 671-688.
- Muoghalu, L.N. (2015). The dire necessity for the revision of Anambra Forestry Law in Oby Akaegbobi et al (eds) *Excellence in English Language, Research, Teaching and Learning: a Festschrift in Honour of Mentor Extraordinaire Professor Joy Eyisi*, Awka: SCOA Publishers, pp. 699-713.
- Muoghalu, L.N. (2023). *Human Activities and their Impacts on our Environment. Erosion/Flooding Menace in Anambra State, Causes, Prevention & Remedies* Text of a Paper delivered on the occasion of the Celebration of World Earth Day by Anambra State Government at Dora Akunyili Women Development Centre on 20th April, 2023.
- National Bureau of Statistics (2008). *Annual Abstract of Statistics*, Federal Republic of Nigeria.
- National Population Commission (2006). *2006 Population and Housing Census of the Federal Republic of Nigeria Priority Tables*, vol. I.
- Nicholas Steen, (2006). "The Stern Review of the Economics of Climate Change: A Comment," November 2, 2006. Available at <http://www.fnu.zmaw.de/fileadmin/fnu-files/reports/sternreview.pdf> <http://www.sternreview.org.uk/> Accessed August 20, 2023.
- Odjugo, P.A.O (2011). Climate Change Evidence, Impacts and Adaptation Strategies in Nigeria, in Ayobami T. Salami & Oluwagbenga O.I. Orimoogunje (eds) *Environmental Research and Challenges of Sustainable Development in Nigeria*, Ile-Ife: Obafemi Awolowo University Press, pp. 142-164.
- Odjugo, P.A.O. (2009). Quantifying the Cost of Climate Change Impact in Nigeria: Emphasis on Wind and Rainstorms, *Journal of Human Ecology*, 28(2), 93-101.
- Odjugo, P.A.O. (2010). General Overview of Climate Change Impacts in Nigeria, *Journal of Human Ecology*, 290, pp. 47-55.
- Ofomata, G.E.K (Ed) (1975). *Nigeria in Maps: Eastern States*. Ethiope Publishing Company.
- Ogunyemi, D. (2017, September 25). *What's driving multiple outbreaks of cholera in Nigeria?* Retrieved from The Conversation: <https://theconversation.com/whats-driving-multiple-outbreaks-of-cholera-in-nigeria-84227>
- Omuogun; Egbonyi, Etuki; & Onnoghen, Usong Nkonu (2016). From Environmental Awareness to Environmental Responsibility: Toward a Stewardship Curriculum, *Journal of Educational Issues*, vol. 2, 2.
- Onafeso, O.D. & F.O. Akintola (2012). Flood Early Warning Systems in Nigeria in Matt F.A. Ivbijaro & Festus AKintola (eds) *Sustainable Environmental Management in Nigeria*, Ibadan: Book Builders, pp. 209-224.
- Osuji, G.E. (1983). *Soil Erosion: Global National Comparisons*. Paper Presented at the National Conference on Development and the Environment. NISER, Ibadan, Nigeria.

- Pawan Thapa, (2021). The Relationship between Land Use and Climate Change: A Case Study of Nepal. *Global Warming and Climate Change*, DOI: <http://dx.doi.org/10.5772/intechopen.98282>.
- Rudel, T.L. (2009). How do people transform landscapes? A Sociological perspective on suburban sprawl and tropical deforestation, *American Journal of Sociology*, vol. 115, no. 1, pp. 129 – 154.
- Schmidt, Gavin & Wolfe, Joshua (2008). *Climate Change: Picturing the Science*, London: W.W. Norton & Company.
- Schmidt, L., Falk, T., Siegmund-Schultze, M., & Spangenberg, J.H. (2020). The Objectives of Stakeholder Involvement in Transdisciplinary Research. A Conceptual Framework for a Reflective and Reflexive Practise, *Ecol. Econ*, vol. 176 p. 106751.
- Seldon, N., Chausson, A., Barry, P., Girardin, C.A, Smith, A., & Turner, B. (2020). Understanding the Value and Limits of Nature-based solutions to climate change and other global challenges, *Philos. Trans. R. Soc. B*, vol. 375, no. 1794, p. 20190120.
- Thapa, P. & Dhulikel, N. (2019). Observed and perceived climate change analysis in the Terai Region, Nepal, *GSSJ*, vol. 7, no. 12, pp. 35-43.
- UN-HABITAT. (2009). *Structure Plan for Awka and Satellite Towns*. Retrieved from [unhabitat.org: https://unhabitat.org/structure-plan-for-awka-and-satellite-towns](https://unhabitat.org/structure-plan-for-awka-and-satellite-towns)
- United Nations. (1992). *United Nations Framework Convention on Climate Change*. Retrieved from [unfccc.int: https://unfccc.int/resource/docs/convkp/conveng.pdf](https://unfccc.int/resource/docs/convkp/conveng.pdf)
- United Nations Human Settlements Programme. (2002, March). *The Global Campaign on Urban Governance*. Retrieved from [unhabitat.org: https://unhabitat.org/sites/default/files/download-manager-files/Global%20Campaign%20on%20Urban%20Governance.pdf](https://unhabitat.org/sites/default/files/download-manager-files/Global%20Campaign%20on%20Urban%20Governance.pdf)
- Urey, M., Colak, K., & Okur, M. (2009). *Regional differences in environmental education of Primary education in terms of teacher conception*, *Procedia Social and Behavioural Sciences*, 1, pp.795-799. <http://dx.doi.org/10.1016/j.sbspro.2009.01.142>. Accessed August 20, 2023.
- USAID. (2019, February). *Climate risk profile: Nigeria*. Retrieved from [climatelinks.org: https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID-ATLAS-Nigeria-Climate-Risk-Profile.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID-ATLAS-Nigeria-Climate-Risk-Profile.pdf)
- USAID. (2019, February). *Shifting Burdens: Malaria Risks in a Hotter Africa*. Retrieved from [climatelinks.org: https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID_ATLAS_Shifting%20Burdens.pdf](https://www.climatelinks.org/sites/default/files/asset/document/2019_USAID_ATLAS_Shifting%20Burdens.pdf)
- World Health Organisation. (2016, December 20). *Climate and Health Country Profile – 2015: Nigeria*. Retrieved from World Health Organisation: https://iris.who.int/bitstream/handle/10665/208865/WHO_FWC_PHE_EPE_15.11_eng.pdf?sequence=1