

## **Urban Planning as a Tool for Climate Change Adaptation and Mitigation in the 21st Century National Development: A Review**

**\*Onuoha, D. C.; David, D.; Odo, C. C. & \*\*Ulasi, J. O. J.**

\*Environmental Management Department, Nnamdi Azikiwe University,  
P.M.B. 5025 Awka, Nigeria.

\*\*National Population Commission, Awka, Anambra State Directorate.

Email: dc.onuoha@unizik.edu.ng OR chidave2k3@yahoo.com Phone: +2348037603720

DOI: [10.56201/rjpst.v7.no2.2024.pg70.88](https://doi.org/10.56201/rjpst.v7.no2.2024.pg70.88)

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### **Abstract**

*Considering the obvious effects of land use on climate change and variability, this paper sought to review the applicability of urban planning as a tool for climate change adaptation and mitigation in the 21st century national development. The causes of climate change were identified to include: industrialization and manufacturing of goods, farming activities and food production, consumerism / too much consumption of products, transportation and vehicular movements, oil drilling and gas flaring, power plants / generating power and powering buildings, increased waste generation and management, deforestation, oil and gas usage and overfishing, among others. The main effects of Climate Change include but are not limited to: global warming, greenhouse gas effects, flooding, acid rain typhoons, rising sea levels, rising sea temperatures resulting in depletion of marine organisms, earthquakes, wind storms, land and mud slides, desertification, tsunamis, erosion, volcanic activities, hurricanes, pollution, deforestation among several others. It was also found from literature that climate change adaptation can come in the form of defense and fortification, accommodation, retreat, and clean-up; all of which can be achieved through proper urban planning. It was also found that a well-designed urban planning policy can mitigate greenhouse gas emissions and adapt to anticipated climate change impacts, although there has been limited analysis of the extent to which urban planning policy documents addresses climate change adaptation and or mitigation. There is a need to rapidly reduce greenhouse gas emissions in order to condense warming to 1.5°C above pre-industrial levels by 2100, and to be well adapted to this change in line with the Paris Agreement, we must act now. Since we are still building our cities, we need to be agile to use this moment as an opportunity and plan well to adapt to and mitigate climate change. A regional analysis and assessments that provide the basis for understanding where, how, and why certain regions are affected by climate change is called for. The paper thus recommends that there is need for a platform where discussion and decision making process on the potential aspects of climate change Adaptation and Mitigation issues can become part of National and Local spatial planning policies; need for an integrated, comprehensive, cross-sectoral, coordinating, spatially oriented planning on different scales (from national to local); which is focused on achieving an efficiently and balanced sustainable territorial*

*development; enlistment of multidisciplinary professionals in our planning and designing of modern cities is very important and urban planning policies must do more to include and integrate climate change adaptation and mitigation actions; finally funds allocated to Climate Change mitigation and adaptation projects/programmes should be utilized for that.*

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## **1.0 Background to Paper:**

Climate change is a global problem of weather variations characterized by extreme conditions measured over several decades. That climate change is the biggest threat facing humanity today is no longer in doubt. According to the United Nations Intergovernmental Panel on Climate Change, the world must cut its carbon dioxide emissions to net zero by 2050 in order to prevent global warming of 1.5°C, or likely more, above pre-industrial levels.

The sixth assessment report of the Intergovernmental Panel on Climate Change (IPCC), released earlier this year, pointed out that over half the world's population living in cities presents both a risk and an opportunity. Growing urbanization and climate change create complex risks, especially for those cities that already experience poorly planned urban growth, high levels of poverty and unemployment and a lack of basic services, Debra Roberts, co-chair of the IPCC Working Group II, had said. She added "cities also provide opportunities for climate action", using renewable energy, green buildings and sustainable transport systems.

Urban planning and design are among the most effective tools in dealing with climate change, because they address both mitigation and adaptation. Mitigation is global in scale, it involves the reduction of carbon emissions that are linked to rising global temperatures. As most of the energy is used in urban areas, energy efficient urban planning and design can contribute to the decrease of greenhouse gas emissions and, thus, lessen the threat of global climate change. In cities, efficient energy consumption, multi-modal transportation, hydroelectrically powered transportation, land use planning, building direction, height-spacing densification of structures, multiple centers, mass transportation, and non-motorized transportation are found as the main mitigation measures. Urban Planning Tools for Climate Change Mitigation (Policy Focus Report) Book by Duncan Cavens, Nicole Miller, and Patrick Condon (2022)

## **1.1 Causes of Climate Change**

Global warming is the extra heat within the earth's atmosphere which has caused the rise in global temperature. Global warming leads and continues to cause climate change. Climate change can cause rising sea levels, destruction of communities, as well as extreme weather conditions. Here are 10 causes of global warming that are contributing to the climate crisis.

### **1.1.1 Industrialization and Manufacturing of goods.**

Industrialisation is harmful in a variety of ways. The waste this industry produces all ends up in landfills, or in our surrounding environment. The chemicals and materials used within industrialisation can not only pollute the atmosphere but also the soil underneath it.

### **1.1.2 Farming Activities and Food Production**

Farming takes up a lot of green space meaning local environments can be destroyed to create space for farming. These animals produce a lot of greenhouse gases for example methane, as well as this they also produce an extreme amount of waste. Factory farming is responsible for even more climate issues because of the extra pollution it produces and the more animals it can hold.

### **1.1.3 Consumerism / Too Much Consumption of Products**

Due to the innovations in technology and manufacturing customers are able to purchase any product at any time. This means we are producing more and more products every year, and over producing them. Most items we purchase aren't very sustainable, and because of the reduced lifetime of electronics and clothing items, we are creating more waste than ever.

### **1.1.4 Transport and Vehicles**

The large amount of transportation is done through cars, planes, boats and trains, almost all of which rely on fossil fuels to run. Burning fossil fuels releases carbon and other types of pollutants into the atmosphere. This makes transportation partly responsible for the greenhouse gases. The transport sector contributes significantly to the emission of global greenhouse gases (GHGs) resulting in a rise in global temperature and climate change. A troubling aspect of emissions from the transport sector is that they are increasing rapidly. With the ongoing rapid increase in population, expansion of middle class in developing countries, and availability of cheaper vehicles such as Tata Nano in India, the desire to own private vehicles is within reach now than ever for millions of people in the developing world. This could have a huge implication on ongoing effort towards containment of GHG emissions.

We look at the role of urban design forms e settlement density e housing and employment activities and the effects they could have in reducing travel demands, motor vehicle dependency and GHG emissions. Although urban planning has a limited effect on the reduction of GHG emissions, in the short term, due to the time needed to build up the necessary infrastructures, in the long term, it can be very effective through the shift from private vehicle dependency to public and other alternative environmentally friendly modes of transports (such as walking and cycling). A mixture of high residential and employment density could influence shorter commuter journeys and a reduction in private vehicle use if it is supported by an efficient public transport system and appropriate fiscal and regulatory instruments. Among the set of available instruments to reduce

GHGs from the transport sector, urban planning, may be equally important, if not more to contain emissions from the transport sector. Also the introduction of electric vehicles can help.

### **1.1.5 Oil Drilling and Gas Flaring**

Oil drilling is responsible for 30% of the methane population and around 8% carbon dioxide pollution. Oil drilling is used to collect petroleum oil hydrocarbons in this process other gases are released into the atmosphere, which contribute to climate change, it is also toxic to the wildlife and environment it surrounds.

### **1.1.6 Power Plants / Generating power and Powering buildings**

Generating electricity and heat by burning fossil fuels causes a large chunk of global emissions. Power plants burn fossil fuels to operate, due to this they produce a variety of different pollutants. The pollution they produce not only ends up in the atmosphere but also in the water ways, this largely contributes to global warming. Burning coal which is used in power plants is responsible for around 46% of total carbon emissions.

### **1.1.7 Waste Generation and Management**

Humans create more waste now than ever before, because of the amount of packaging used and the short life cycle of products. A lot of items, waste and packaging isn't recyclable, which means it ends up in landfills. When the waste in landfills begins to decompose/break down it releases harmful gases into the atmosphere which contribute to global warming.

### **1.1.8 Deforestation**

Deforestation is the clearance of woodland and forest, this is either done for the wood or to create space for farms or ranches. Trees and forests turn carbon dioxide into oxygen, so when they are cleared like the stored carbon is then released into the environment. Deforestation can also occur naturally which has a greater effect.

### **1.1.9 Oil and Gas Usage**

Oil and Gas is used all the time in almost every industry. It is used the most in vehicles, buildings, production and to produce electricity. When we burn coal, oil and gases it largely adds to the climate problem. The use of fossil fuels is also a threat to wildlife and the surrounding environments, because of the toxicity it kills off plant life and leaves areas uninhabitable.

### 1.1.10 Overfishing

Fish is one of humans main sources of protein and a lot of the world now rely on this industry. Due to the amount of people buying and consuming fish, there is now a reduced amount of marine life. Overfishing has also caused a lack of diversity within the ocean.

## 1.2 Effects of Climate Change

From literature, the main effects of Climate Change include but are not limited to: global warming, greenhouse gas effects, flooding, acid rain typhoons, rising sea levels, rising sea temperatures resulting in depletion of marine organisms, earthquakes, wind storms, land and mud slides, desertification, tsunamis, erosion, volcanic activities, hurricanes, pollution, deforestation among several others. According to Adepoju (2017), the impacts of climate change in Nigeria include rising temperature, more intense and frequent weather events and flooding due to sea level rise. The consequences are increased water and food shortages, higher exposure to heat stress and ultraviolet radiation. Borokinni (2017) provided evidence that climate change events affect all aspects of human life, especially the social and environmental determinants of health, clean air, safe drinking water and food security. Nwoke *et al* (2009) linked climate change to higher temperatures, which enhance production of various secondary pollutants and, thereafter, increase in the frequency of allergic and cardio-respiratory disorders and deaths caused by these air pollutants. Furthermore, cases of mental health and population mobility are a result of environmental disasters such as flooding, rising sea levels and shortages of water (Hathaway &Maibach, 2018). Horton and McMichael (2008) have identified emotional stresses and mental health problems in response to perception and fear of climate change to constitute health challenge to affected communities. This was supported by Ilevbare (2019), who posited that health risks associated with climate change in Nigeria cannot be overemphasized. All populations are affected by climate change, particularly the vulnerable like the children and the elderly people. The impacts of climate change are also expected to increase with time, which mean that some existing health challenges will increase.

The long-term changes in the average weather patterns which have come to define the earth's climates locally, regionally and globally with a broad range of observed effects is here with us. These uncertain effects of a changing climate on the global scale cannot be over emphasized, with the developing countries like Nigeria bearing more of the brunt of an overheated planet caused mainly by anthropogenic activities due to the release of greenhouse gases like Carbon IV Oxide (CO<sub>2</sub>), Methane (CH<sub>4</sub>), Nitrous Oxide (N<sub>2</sub>O) and Chloro-Fluoro-Carbons (CFCs) among others, which end up depleting the ozone layer.

One major event revolving around climate change in Nigeria is the drying up of Lake Chad. The southern part of Lake Chad is the part of the section of the lake that lies inside Nigerian territory. Some years back, Lake Chad covered an estimated area of over 40,000 km, while presently it now covers only about 1300 km<sup>2</sup> (During, 2017). The implication of this occurrence is that the land is laid to wastages by rising temperature which leads to the southwards expansion of the Sahara

desert. Hence, farmlands and surrounding villages have become barren due to the overpowering nature of advancing desertification, whose ripple effects have led to the massive migration of people in search of more fertile land.

## **2.0 Climate Change Mitigation and Adaptation**

Urban planning and design are among the most effective tools in dealing with climate change, because they address both mitigation and adaptation. Mitigation is global in scale, it involves the reduction of carbon emissions that are linked to rising global temperatures. Communities can lower emissions in many ways, including using the principles of New Urbanism to reduce the need for motor vehicle travel.

Adaptation is local. The forms and combinations of adaptation are as varied as local communities themselves. The impacts of adapting manifest relatively quickly. With adaptation, communities can take control of their own destinies to a degree.

The Adaptation Policy Framework is built around four major principles that provide a basis from which integrated actions to adapt to climate change can be developed:

- Adaptation to short-term climate variability and extreme events serves as a starting point for reducing vulnerability to longer-term climate change;
- Adaptation occurs at different levels in society, including the local level;
- Adaptation policy and measures should be assessed in a development context; and
- The adaptation strategy and the stakeholder process by which it is implemented are equally important.

The APF can be used by countries to both evaluate and complement existing planning processes to address climate change adaptation.

As an assessment, planning and implementation framework, it lays out an approach to climate change adaptation that supports sustainable development, rather than the other way around. The APF is about practice rather than theory; it starts with the information that developing countries already possess concerning vulnerable systems such as agriculture, water resources, public health, and disaster management, and aims to exploit existing synergies and intersecting themes in order to enable better informed policy-making.

Note in the context of the above discussion while mitigation is more of preventive, adaptation is more of management and control.

## **2.1 Climate Change Adaptation Through Urban Planning**

spatial plans directly control the physical development of the city by giving permission for various infrastructures like transportation, industries, housing and resource allocations for social and

public amenities. It also provides guidance for land-use change that affects ecological aspects in the form of land fragmentation, ecosystem, biodiversity and other natural resources. Thus local-level spatial plans are the basic policy framework that shapes social, economic and physical development of cities and at the same time interaction of these aspects become the main drivers of climate change issues at various scales (Wilson and Piper, 2010). Hence spatial planning has a bigger role to play at the local level to climate change issues as it effects of policy measures on spatial development and it possibly has the potential to act as an effective instrument for climate change adaptation response at local level (Wilson, 2006, Wilson and Piper, 2010).

Spatial plans directly control the physical development of the city by giving permission for various infrastructures like transportation, industries, housing and resource allocations for social and public amenities. It also provides guidance for land-use change that affects ecological aspects in the form of land fragmentation, ecosystem, biodiversity and other natural resources. Thus local-level spatial plans are the basic policy framework that shapes social, economic and physical development of cities and at the same time interaction of these aspects become the main drivers of climate change issues at various scales (Kumar and Geneletti, 2015). Hence spatial planning has a bigger role to play at the local level to climate change issues as it effects of policy measures on spatial development and it possibly has the potential to act as an effective instrument for climate change adaptation response at local level and its mitigation.

CNU co-founder Plater-Zyberk describes four phases of community adaptation in a recent *On the Park Bench* webinar: fortify and defend; accommodate; retreat; and clean-up.

**Fortify and defend:** The Netherlands has been living with the threat of coastal floods for centuries. Large, heavily populated areas, including Amsterdam, are below sea level. The Dutch have long built dikes and, in the last century, more comprehensive civil engineering works, to protect against the sea. Note that in fortification and defense, Cameroun built the Lagdo Dam and reached an agreement for their neighboring country Nigeria to build another defensive dam. If the Nigerians have completed the Dansin Hausa Dam in the Dansin village of Fudore LGA, Adamawa State which has been under construction for about 40years now (since 1982), the flood disasters of 2012 and 2022 would have been averted.

Compact urban places are more practical to fortify against rising seas, because levees and seawalls can be built that are hard to economically justify for low-density regions. The urban design firm Dover Kohl worked with Jean Lafitte, a very low-lying town south of New Orleans, Louisiana, to plan for the densification of a one-square-mile “heart of town” that was afterwards protected by a new levee. The municipality had been unsuccessful in procuring funds to build a much larger levee around the entire town, but the “heart of town” concept enabled action to be taken (It also won a 2014 CNU Charter Award).

Miami Beach, another example, has been raising streets that are prone to “sunny day flooding.” Although this measure is likely to only buy the city four or five decades of protection, officials and citizens may use that window of time to pursue other adaptation strategies, such as raising buildings and seawalls.

**Accommodate:** Cities may accommodate some impacts of climate change through a number of urban design measures. One of the simplest is just to plant trees, which reduce episodes of extreme heat. The cooling impact of a single healthy tree through evaporation and shade “is equivalent to ten room-size air conditioners operating 24 hours a day,” according to the US Department of Agriculture. Similarly, light colored roofs and asphalt reduce the impacts of summer heat waves in cities, explains Doug Kelbaugh in *The Urban Fix*.

Designing for small groups of households with social connections, like “pocket neighborhoods,” may also build resilience to climate change. In *Heat Wave: A Social Autopsy of Disaster in Chicago*, Eric Klinenberg showed how a neighborhood with stronger social ties reduced mortality during an extreme heat event in 1995. The rate of death in the Englewood neighborhood was eleven times that of nearby Auburn-Gresham.

Buildings, streets, and public spaces may be designed to accommodate flooding with less damage. Venice, Italy, has been using that strategy for a long time. In the most flood-prone areas, the first floor of buildings may be built to periodically “take a bath.”

**Retreat:** Throughout history, people have always moved away from danger, Plater-Zyberk notes. They will do so in response to the storms, fires, floods, and heat of climate change. The migration may happen quickly, such as around the time of a hurricane, or over decades. Matt Lambert of DPZ Co-Design describes three categories of climate change migrants: The able and aware, the affluent and ignorant, and the refugee. The first category will see what is coming and sell before housing values drop; the second will move when they are forced to for economic reasons, but have the means and choices to land on their feet; and the third will respond to catastrophe with little or no choice.

The migration process will affect growth and demographics across the US for generations, and urban designers can shape that process. People will move from front-line cities that are most impacted by climate change to “receiver cities” that are safer. Receiver cities may include historic cities or new towns, and may be relatively close to the front-line cities (at higher elevations or otherwise advantageous locations), or in another part of the US (like Rust Belt cities of the Northeast).

This migration has already begun. In his recent book, *The Climate Planner*, author Jason King offers a number of examples. King is a principal with Dover Kohl, and the urban design firm created a plan and a form-based code for Hammond, Louisiana, in the years following Hurricane Katrina. Hammond, which is 45 miles northwest of New Orleans, grew rapidly for several years due to migration from New Orleans. Dover Kohl’s plan addressed how Hammond could grow sustainably by repopulating the downtown, adding “missing middle” housing to neighborhoods, and transforming suburban commercial areas to mixed-use. The plan has changed the form of growth in Hammond, a town that is better prepared for a future role as a receiver city.

Town and nature in Newfield, Martin County, Florida. Some green-field growth will take place, and that also requires more sustainable planning. The 3,400-acre Newfield, in Martin County,



Florida, is being developed by Knight Kiplinger, head of the Kiplinger Media company. Ten miles from Florida's vulnerable southeast coast, Newfield averages 26 feet above sea level, which means that residents will not have to evacuate except during the worst storms. Newfield is designed on the model of the 15-minute city, with daily and weekly needs, including employment, within a 15-minute walk or bicycle ride.

"Climate migration presents an opportunity to change patterns of development and correct issues of social isolation, increased disease, and re-balance economic systems to benefit a society more broadly," notes Lambert in an essay. "To extract social benefit from this environmental tragedy, we must return to responsible regional planning before major migration begins. Should we take the normal route and wait, current patterns will continue, perpetuating growing metropolis and mega-regions."

**Clean-up:** The final stage, clean-up, is mostly a technical, rather than urban design, issue and it is very necessary.

### Scale of development

The three scales of New Urbanism—block, street, building; neighborhood, district, corridor; town, city, and region—are factors in addressing climate change.

**Block, street, and building:** Some ways that building and street design can respond to climate change, e.g., raising foundations or designing to accommodate flooding. On the block scale, pocket neighborhoods may use social connection as a form of resilience.

**Neighborhood:** Programs that address climate change in every neighborhood of a city may mean that disinvested neighborhoods get special attention. Philadelphia, for example, has a goal of 30 percent tree canopy in every neighborhood. Neighborhoods that have been long disinvested tend to have lower tree canopy levels. Urban planner Donald Shoup proposes a practical means to enhance tree canopy over time. "Cities can require property owners to plant any missing street tree in front of their property when they sell the property. Because the rate of property sales is uniform throughout most cities, this policy would lead to a uniform rate of tree planting in all neighborhoods and thus improve equity in the tree canopy." Such a policy could be combined with a program to help elderly and lower-income property sellers.

The work of Klinenberg shows that social connections are important on the neighborhood scale. New urbanists have long focused on designing for the infrastructure of neighborhood cohesion. That may be critical for long-term resilience.

**Region.** Both the metropolitan region and national regions will be important in climate change planning. A section of *The Climate Planner* summarizes potential impacts by US regions, which have unique and specific vulnerabilities. The Southwest and Great Plains are prone to drought and water supply vulnerability. The Pacific region, particularly California, is prone to wildfires. Coastal areas along the east and Gulf Coast, are subject to hurricanes. Many regions could experience increased inland flooding during storms.

There are finer-grained implications in all of the regions. As King's book points out, every region will have more or less safe areas. Regional planning in this era begins with identifying better and worse locations. The wildfire risk in the West is concentrated in the wildland-urban interface. The greatest risk in Eastern coastal areas is below 10 feet in elevation and within a few miles of the coast. Away from the coast, the flooding risk is concentrated in 100-year flood zones.

### **Urban-to-rural Transect and conclusion**

The Transect has implications for both mitigation and adaptation. More urban Transect zones save energy per person because residents tend to drive less and share walls that reduce energy consumption.

Downtowns also tend to be less susceptible to some kinds of disasters associated with climate, such as wildfires. Their density means that they can be fortified against storms and flooding. But environmental regulations need to be tailored to these locations. There is little room in high density areas to provide a lot of space for individual trees, and yet trees still grow. In higher Transect zones, cities could trust in the tenacity of trees, and accept that they will create some problems in exchange for their tremendous benefits and resilience that they offer.

Climate change is one of the greatest issues facing humanity. Urban designers cannot solve climate change, but they can help communities to better respond to it, Plater-Zyberk explains. As King notes in his book, subtitled "Overcoming Pushback Against Local Mitigation and Adaptation Plans," urban designers must navigate tricky political waters while influencing those responses. As long-time reformers of the built environment, New Urbanists are accustomed to that challenge.

## **2.2 Climate Change Mitigation Through Urban Planning**

Condon, Cavens and Miller (2009) in their review on urban planning tools for climate change mitigation, stipulated that land use patterns and urban form can strongly impact an urban community's contribution to global climate change through the production of greenhouse gas emissions (GHG). Key contributors to a city's climate footprint include the physical arrangement of streets and public transportation infrastructure, building types, and land uses that influence both vehicle use and energy consumption in buildings. City and regional officials now facing new greenhouse gas emissions reduction requirements are increasingly turning to urban design as a key component of climate change mitigation. But implementing an urban planning strategy that includes effective climate change mitigation techniques requires decision support tools that illustrate the GHG implications of land use and transportation options. While a wide spectrum of environmental urban planning tools currently exists, few have the capacity to work simultaneously at both the regional and local scale, or to capture both building performance and transportation demand analysis.

**Urban planning:** Urban planning seeks to manage the use and development of land in a way that considers, confronts and resolves the conflicts between demand for growth, social equity and the environment (Campbell, 1996). There are numerous tools available to urban planners to articulate

and affect the desired outcomes for cities, and these can be expressed at multiple scales. According to Hopkins (2001), Hurlimann *et al.* (2018), Hou *et al.* (2018) and Caparros-Midwood *et al.* (2019); a plan identifies a decision that should be made in light of other concurrent or future decisions. Spatial planning plays an increasingly significant role in climate change mitigation by providing energy efficient settlements and promoting the utilization of renewable energy resources. However, the effect of urban spatial planning on spatial pattern of carbon dioxide emissions in cities is rarely discussed. The relationships between the changes in urban zoning plans and carbon dioxide emissions of major economic sectors has yet to be investigated on a scale smaller than an entire city (Wang *et al.*, 2018).

**Behavior:** New Urbanism's contribution to mitigation largely involves the influence of behavior. Urban design in the form of walkable communities allows for significant reduction in carbon emissions from transportation. The transportation sector may make up as much as 40 percent of mitigation at the community level, according to Elizabeth Plater-Zyberk of DPZ CoDesign. Urban design can also impact housing choice, enabling people to choose smaller and/or attached housing types in exchange for neighborhood amenities. Smaller, attached housing uses less energy. Urban design strategies may also reduce the need for air conditioning, a significant source of carbon emissions.

**Technology:** Urban design indirectly impacts technology. Specific street design techniques enable greater use of small electric vehicles. As *The New York Times* columnist Farhad Manjoo explains, converting to clean car technology without also reforming the built environment does little good for the environment. Absent better community design, drivers tend to convert environmental gains to the purchase of bigger cars while driving more miles.

**Other mitigation:** Urban trees exemplify a carbon sink, and planting more of them is a mitigation strategy that can be promoted by urban design.

However, limited mitigation measures by government and private organisations noted include localized embankment of shoreline, beach nourishment, re-forestation, channelization, etc. were more of reactive than proactive which pose serious challenges to management of climate change impact on the coastal zone. Holistic attitudinal change by individuals towards environmental protection, promulgation and implementation of eco-friendly policies by government and private institutions, environmental education as a teaching subject from primary schools, capacity development and poverty eradication, etc.

### **3.0 Case Examples of Some Developed Nations and Their Climate Change Adaptation and Mitigation Policies and Attempts**

As was highlighted earlier, cities and urban areas are vulnerable to the effects of climate change. Because of their population and infrastructure density, cities contribute significantly to global GHG emissions, but they are also uniquely positioned to address climate change impacts. Urban planning and design can effectively tackle climate change by addressing climate adaptation and mitigation. Recent scholars and researchers have shown that investment in new cities set to boom,

in fact it is no gainsaying that reimagining urban design on new and existing developments can help cities build climate resilience through the adoption of new design principles to accommodate the issues of climate change effects. This has been applied in the plans to build the following future cities: ‘The Line’ In Saudi Arabia, ‘Telosa’ in the United States, and ‘Tengah’ in Singapore.

These new urban designs possess standard features such as multi-layer infrastructure, dynamic urban spaces, green infrastructure, modulation construction design, pedestrianization and 20 minutes neighbourhood, smart mobility, electrification, waste management and recycling, micro-cities, cities-in-a-city, connected assets and infrastructure, digital twins, and many more (Wray, 2021).

For example, Saudi’s ‘The Line,’ proposed by its Crown Prince Mohammed Bin Salman, features a car-free pedestrian city. It also aims to cater to its resident’s needs within a five-minute walk.

The ‘Telosa’ in the US, with a possible location in several states, including Nevada, Texas, and Arizona, design the city for active transport, electric and autonomous vehicles, and an underground network for deliveries and waste management.

Singapore’s ‘Tengah,’ a high-rise public housing community, plans to offer its residents a centralised cooling system, solar energy, and electrification to lower their carbon footprint.

Another article, “How Urban Planners Are Reacting to Climate Change”, from Architectural Digest, shows how urban planners respond to climate change and transform cities from less car-centric to resident-centric. O’Neill (2020) says, “Policy at the national level has moved painfully slow in most countries, but urban areas have the authority to make meaningful changes in land use and zoning, transportation, green space, and energy policy.”

Some examples from cities worldwide and what they are doing to reduce their GHG emissions and reliance on fossil fuels are as below:

- Copenhagen, Denmark is harnessing wind energy to become the first carbon-neutral city by 2025.
- The city of Boston transforms 47 miles of shoreline to increase access to open spaces and protect the city from major floods.
- Bilbao, Spain has opened the Duetso Canal, which allowed the river to flow through and reduced water levels by a full meter.
- In Madison, New York, a retrofit of public green space has nearly doubled its size, adding a new garden and water feature. The expanded green space has significantly benefitted the building tenants, occupants, and the public, who are increasingly becoming aware of climate change impacts.

In Japan, they're planning to build the Toyota Woven City, a future city at the foot of Mt. Fuji. Hydrogen fuel-cell, geothermal and solar energy will power the city. The BIG website describes: "Roads are split up for three purposes, with designated areas for faster motor vehicles; a recreational promenade dedicated to micro-mobility, such as bicycles, scooters and other modes of personal transport; and a linear park for pedestrians, flora, and fauna. Roads weave around three-by-three city blocks that are organized around a courtyard. The result is a safe, outdoor space accessible only to pedestrians, surrounded by buildings that are still easily serviceable." The idea is to take away space for cars and create space for people and nature.

The creation of Uber is another example of reinventing existing infrastructure – where the individual car can be used more efficiently. Transport sharing can reduce the need to build bigger roads and the demand for more cars that follow, resulting in more traffic congestions. Apps like Uber provides data about traffic movement. These traffic trends can be analyzed over time which can help policymakers "alleviate gridlock or assess how congestion pricing might work," says Emily Strand, head of policy for Uber Movement (O'Neill, 2020).

In order to incorporate adaptation activities like structural as well as non-structural measures and adaptation strategies in these planning instruments spatial planning authorities require information about the impacts of climate change on a detailed level. The exchange of information between the responsible actors in charge of resource management as well as planners, climate modelers and impact assessors is critical to this process. However, these communication needs have to date not been sufficiently considered in planning procedures in developing countries like Nigeria, hence progress on adaptation is still at an early stage. The reasons for this may include: (a) the uncertainties inherent to the projection of climate change impacts, (b) the gap between scientific projections and their translation into management action, and (c) the prevailing neglect of the social impacts of climate change in regional and local assessments.

(a) There is still skepticism about the evidence of climate change and several aspects related to climate change are coupled with high uncertainty. This stems from problems in identifying and understanding all crucial processes within the climate system as well as the pre-conditions for climate change in terms of the effects of greenhouse gas concentrations and greenhouse gas scenarios. But it also applies to the validity of climate models, the accuracy of climate simulations, their uncertainty ranges and the estimated direct effects (climate change signals: deviating temperature variation – means, maxima, minima – precipitation sums, frequency and magnitude of extreme events) as consequences of greenhouse gas increases.

This uncertainty becomes even greater when direct impacts (magnitude and frequency of floods, landslides, droughts) as consequences of extreme events and second order impacts (severity of damage to natural environment and ecosystem services, human property and infrastructure, food and timber production, and severity of social disturbances) as consequences of direct impacts are projected. Even though knowledge about climate change impacts is slowly accumulating there is a major deficit in the understanding of the indirect effects of climate change on land use landscapes

or even ecosystem services. Providing this information is still seen as a major challenge, especially for landscape ecology.

(b) There is a mismatch between the way knowledge is produced by the scientific community and the need for information for decision makers. This results in a persistent gap between an understanding of impacts and the development of adaptation strategies and measures. Scientific impact analysis and planning are pursuing quite different goals. Whilst the scientific approach adopts a reductionist approach to find evidence by condensing the essence of a cause-and-effect-chain, the planning approach is focused on generating integrated solutions that cover all issues addressed by spatial development. Hence, a new form of communication between science and decision-making that bridges the gap between the producers and consumers of knowledge is required.

(c) Regional and local impact studies frequently focus only on environmental data; impact assessments in resource management and conservation in particular largely neglect social factors. However, it is widely accepted that the integration of social impacts is a precondition for effective adaptation activities. So far most vulnerability/adaptation assessment studies can be characterized as sector-oriented assessments. Several studies are focused on only a limited group of sectors, while comprehensive indicator-based assessments distinguish impacts based on sectors.

In rapidly developing urban-regions, the ability of the local planning authorities to quantify the spatial structure and form of existing urban areas, new developments and the emergent urban-region in terms of GHG emission is vital to any effective local, national and global climate change mitigation effort. While a wide array of tools has been developed for assessing built environment sustainability at various spatial scales, these are predominantly eco-efficiency rating tools that do not model the ‘spatial structure-GHG’ relationship and do not illustrate the GHG implications of urban structure and form, which crucially inform local planning decisions with respect to climate change mitigation. Some models have been developed and adopted in some advanced countries in Asia and Europe in the regards. Some of the spatial-based planning models that took GHG emission into consideration include: Envision Tomorrow, GHG-Proof and the URBEMIS all of which tried to estimate GHG emissions towards assessing their adaptability for application in Malaysian cities. Looking into the models’ characteristics and features; “inner working”, unpacking the variables and their relationships; assumptions and conversion rates used; their data requirement and structure; their limitations and relevance to the Malaysian urban planning context, particularly in terms of data availability; their capabilities were critically evaluated before they were adopted in Malaysia.

Another powerful model in this regards in the Low Carbon Society Blueprint for Iskandar Malaysia 2025, developed in 2012 by a coalition of the Malaysia University of Technology, Iskandar Regional Development Authority, Kyoto University, Okayama University and the National Institute For Environmental Studies. This kind of collaboration of experts is very rare in most developing countries like Nigeria and even when initiated remains unfruitful due to destructive politics and corruption.

Savills, AEA Technology and MVA Consultancy in 2011 also developed a Quantitative Greenhouse Gas Impact Assessment Model, to be used as a Tool For Spatial Planning Policy Development, Designed for Scottish Government and Scottish Environment Protection Agency.

The application of the indicator-based assessment method to explore potential impacts of climate change relevant for spatial planning in Germany pursued the following objectives:

- the identification of major impacts relevant for spatial planning,
- the spatial analysis and assessment of these climate change induced impacts and
- the identification of “hot spots” by overlaying the spatial pattern of climate change induced impacts and exploring cumulative effects.

#### **4.0 Reference to the Nigeria Situation and the Major Challenges**

The Government of Nigeria acknowledges the importance of developing a national response to climate change, and is taking steps to build a governance structure to manage the issue as this is very vital. a lot of policy documents have been prepared and adopted to tackle the issue of climate change in Nigeria. Some of them include: The development of a National Climate Change Policy for Nigeria, and of a Nationally Appropriate Mitigation Action (NAMA) programme document. Already developed fully in recent time is the NASPA-CCN (National Adaptation Strategy and Plan of Action on Climate Change for Nigeria) Vision, Goals and Objectives bothering on measures for adapting to and mitigating the impacts of Climate Change in Nigeria (Blueprint for Climate Change in Nigeria and Anambra State in Particular Developed by a Coalition of Centre for Sustainable Development And Centre For Water Resources and Climate Change Nnamdi Azikiwe University, Awka).

The Nigerian coastal zone especially the Niger Delta region is quintessential as it is the richest in petroleum and fishery resources in the Sub-Saharan Africa. However, the integrity and sustainability of coastal zone are threatened by climate change coupled with anthropogenic pressure. A projected possible impact of climate change on the coastal cities of Lagos and Port Harcourt using the Model for the Assessment of Greenhouse Gas Induced Climate Change (MAGICC-SCENGEN) and geographical information system (GIS) interpolation techniques confirms that sea level rise may occur with a consequence of submerging all coastal cities of the Niger Delta area and a larger part of Lagos but these information and warnings are under-utilized and lives and properties are wasted thereafter due to misplacement of priority and corruption.

Most recently is the climate change bill signed into law, which seeks to adopt nature-based solutions and strengthen REDD+ projects will ensure the concretization and effective implementation of government policies and programmes geared toward naturally addressing climate change.

## 5.0 Conclusion and Recommendation

### Recommendations

Critically considering the points raised and discussed above, the following recommendations were made:

1. There is need for advanced research to develop more effective models which will serve as eco-efficiency rating tools and also model the ‘spatial structure-GHG’ relationship with the various environments; like the ones adopted in some advanced countries in Asia and Europe. Example of spatial-based planning models that took GHG emission into consideration include: Envision Tomorrow, GHGProof and the URBEMIS all of which tried to estimate GHG emissions towards assessing their adaptability for application in Malaysian cities.
2. There is need for a new form of communication between science and decision-making that bridges the gap between the producers and consumers of knowledge.
3. Funds allocated to Climate Change mitigation and adaptation projects/programmes should be utilized for that.
4. The enlistment of multidisciplinary professionals in our planning and designing of modern cities is very important.
5. Urban planning policies must do more to include and integrate climate change adaptation and mitigation actions. Climate change is the result of human impact on the natural systems. And the only way to mitigate it is to acknowledge the importance of nature in cities to buffer against extreme events.” “A complete focus on infrastructure without making any space for natural buffers results in extreme flooding.”
6. There is need for an integrated, comprehensive, cross-sectoral, coordinating, spatially oriented planning on different scales (from national to local); which is focused on achieving an efficiently and balanced sustainable territorial development. Addressing climate change involves creative thinking and talking about how buildings and cities could evolve to become more resilient, sustainable and improve the lifestyle and well-being of residents. Achieving these outcomes requires a coordinated effort across multiple fields and sectors; science and technology, engineering, government, and private sectors. Planners and Designers need to be responsive to policymakers’ priorities and actively advocate for policies that will enable the changes we need – building climate-resilient cities, creating environments where we can thrive, and securing a future that can sustain us.
7. To satisfy the need for efficiency of information in spatial planning, an integrated and comprehensive assessment is required. A regional analysis and assessments that provide the basis for understanding where, how, and why certain regions are affected by climate change is called for.



8. Finally there is need for a platform where discussion and decision making process on the potential aspects of climate change Adaptation and Mitigation issues can become part of National and Local spatial planning policies. There are several examples that demonstrate the remarkable role that individuals can have in leveraging significant emissions reductions through advocacy and campaigning. It is evident that local government, households, and individuals are under-recognized, yet highly significant sites of climate change mitigation and adaptation.

## Conclusion

From the foregoing, a well-designed urban planning policy can mitigate greenhouse gas emissions and adapt to anticipated climate change impacts. Although, there has been limited analysis of the extent to which urban planning policy documents addresses climate change adaptation and or mitigation. There is a need to rapidly reduce greenhouse gas emissions in order to condense warming to 1.5°C above pre-industrial levels by 2100, and to be well adapted to this change (in line with the Paris Agreement), we must act now. Since we are still building our cities, we need to be agile to use this moment as an opportunity. To achieve this, our minds must work together. The UN Secretary General António Guterres recently said, “Half of humanity is in the danger zone, from floods, droughts, extreme storms and wildfires among others; Yet we continue to feed our fossil fuel addiction. We have a choice. Collective action or collective suicide. It is in our hands.”

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