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Innovative Spatial Planning in Mitigating Climate Change-Related Vulnerability in Nigerian Urban Centres

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1 ABSTRACT

In recent time, climate change has risen to join multitude of phenomena that pose challenges to world community. Analysts have agreed that climate change is happening and that it will continue to occur for some foreseeable future. The challenge of climate change and its reality are similar to the challenge of cities and their reality in human settlements. In Nigeria, climate change is clearly showing its face, the impacts are becoming glaring while cities are also becoming more and more vulnerable to the impact of climate change. This paper explores the reality of climate change in Nigeria, underscores its driving forces and examines the vulnerability of Nigerian urban centres to its impacts. The paper believes that although cities have inert capacity to address the problem of climate change, but that this advantage must be supported by innovative spatial planning that is anchored on eco-city approach and that is sustained by good urban governance.

2 INTRODUCTION

The concept of climate change is not new. On theoretical ground, it is possible. But the current experiences are beyond mere speculations. It has become a reality supported by scientific evidences. The scientific evidence of climate change led to the establishment of Intergovernmental panel on Climate Change (IPCC) by the United Nations Environment Programme and the World Meteorological Organization (Red Cross, 2003). As a follow-up to this, in 1992, the United Nations Framework Convention for Climate Change (UNFCCC) was established. As scientific evidence for climate change grew stronger during the 1990s, parties to the UNFCCC signed the Kyoto Protocol in 1997 (Red Cross, 2007). Climate change is part of 'mosaic of challenges ' (Rockstrom, et al, 2009) or part of 'a multitude of threatening phenomena' (West, 2009) facing humanity. According to the UN-habitat (2008), 'climate change brings new challenges, which impact on the natural and built environments and aggravate existing environmental, social and economic problems'. This challenge is defining (UN-Habitat) and forms part of triple challenge of modern man (Hazlewood and Mock, 2010). The other challenges are ecosystem decline and poverty. These three mutually relate to effect myriad of problems that face world community today.

Climate change upsets the very foundation of modern society (UN Millennium Ecosystem Assessment, 2005) and is recognized as one of the greatest threats to life and well-being (Rockstrom, et al, 2009). The challenge of climate change is compounded by the fact that human beings and human settlements are intricately and sometimes fatally connected to climate. The challenge thrown by climate change also means that it concerns the totality of world community and has attained political dimension. To this end, it is part of the priorities of the UN System and indeed of world leaders. This is seen in the World Climate Change Conference of 7-18th December, 2009 held in Copenhagen, Denmark. The Conference included the 15th Conference of Parties(COP 15) to the United Nations Convention on Climate Change and the 5th Meeting of the Parties (MOP 5) to the Kyoto Protocol. The Climate Change Conference led to Copenhagen Accord drafted by the United States of America, China, India and Brazil. Although the Accord was noted but not adopted; it recognized climate change as one of the challenges of present day and that actions should be taken to keep temperature increase below 2 degree centigrade. Although the Accord is not legally binding but by January 4, 2010, 138 nations have signed the Accord (Wikipedia; www.wikipedia.com;).

At another level of analysis, it is also appropriate to see urbanization as another challenge. The two are also similar. Both are realities of modern world; they have become inevitable constituting challenges, thereby and both are seen as facts of the future. The two have become globalised and constitute rights. As favourable climate sensitive to meeting environmental and developmental needs of man contributes to the fate of man, so are the future of humanity and the long term sustainability of the planet linked to the fate of the cities (West, 2009).

It is against the backdrop of these similarities and the key to future success of man that spatial planning become relevant in shaping the future and in making the cities more relevant and capable in facing the

challenge of climate change. The objectives of this paper are to explore the concept of climate change, to establish the climate change as a reality; to examine the vulnerability of Nigerian urban centers to climate change and to explore spatial planning measures to mitigate impacts of climate change.

3 CLIMATE CHANGE: CONCEPT AND REALITIES

Climate is defined as 'the overall long-term characteristics of the weather experienced at a place… it is thought of as a long term summary of weather conditions, taking account of the average conditions as well as the variability of these conditions' (International Strategy for Disaster Reduction, ISDR, 2008). A regional climate is part of its resource base. It has tremendous utility to man. It is also linked to other resources and affects the evaluation of such resources. According to Desai (2007), 'environmental resources like biodiversity or the delicately balanced chemistry of the atmosphere are resources which are critical to the maintenance of life on earth'. The atmosphere, perfectly reflects the climate and together with the ocean and the Earth surface constitute 'the global climate system'. (ISDR, 2008) At a very liberal level, a change in climate will set in when these known average conditions do not hold again. The International Strategy for Reduction of Disaster (ISDR) sees climate change as 'a change in the state of the climate that can be identified by changes in the mean and or the variability of its properties, and persists for an extended period, typically decades or longer'. According to IPCC (2001) Climate change is a statistically significant and persistent (decades or longer) variation in the mean state or variability of climate' (in Butler and gates, 2010). According to Akpodiogaga and Odjugo (2010), climate change usually takes over a long period of time of at least 150 years with clear and permanent impacts on the ecosystem. According to the UN Framework Convention on Climate Change (in ISDR, 2008), climate change is one that can be attributed 'directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods' . On this premises, scientists have made a distinction between climate variability and climate change. Climate variability is a change in climate effected by natural factors as opposed to climate change which is associated with the impact of human activities. Natural processes effecting climate variability are defined as astronomical factors (changes in the eccentricity of the earth's orbit, changes in the obliquity of the plane of ecliptic and changes in orbital procession) and extra-terrestrial factors (solar radiation quantity and quality), (Akpodiogaga and Odjugo, 2010).

There is also a subjective dimension to defining climate change; a definition that lies with the people using their experiences and perception. This becomes relevant in communicating climate change and in getting support for community adaptation process. As pointed out by Rahmstort, Morgan, Levermann and Sach (2009), 'whether this warming constitutes dangerous change cannot, of course, be determined by scientists alone, as such an assessment depends on societal judgments about what is dangerous'. Hence, it is safe to say that climate change is a significant deviation over a long period of climate conditions that people know or experience as normal. So, a sustained climatic anomaly over a long period of time will constitute climate change.

From the distinction between climate variability and climate change, it is clear that climate change is traceable to anthropogenic factors. Man is at the centre of climate change through activities that add to the amount of greenhouse gases in the atmosphere (Akpodiogaga and Odjugo, 2010). The interaction between the human activities and the resulting increase in global temperature can be seen in Table 1. The table shows increase in greenhouse gases of carbon dioxide, nitrogen and methane and reduction in the forest resources of the earth surface. These are the contributory factors to global warming. The warmth is reflected in increase in temperature over the years. The table shows that all the greenhouse gases increase substantially between the base year, 1750 and 2000. Atmospheric concentration of carbon dioxide increased from 56ppm in 1750 to 280ppm in 1850 and 300ppm by 1950. Although methane concentration stabilized around 875 from 1750 to 1850, it rose to 900 at the end of 1900 and to 1200 in 1950. Similarly, percentage loss in forest and woodland increased from one in 1750 to three percent in 1900 and eight percent in 1950. For all these changes that reflect growth in human activities throughout the world, the increase became substantial between 1950 and 2000. Between this period, carbon dioxide concentration increased by 60ppm, that of nitrogen increased by 22ppbv while that of methane increased by 500ppbv. In the same manner, loss in forest and woodland increase to 30 percent in 2000 while amount of cultivated land increased to 35 percent from 25 percent.

	changes over years					
ecosystem services	1750	1800	1850	1900	1950	2000
carbon dioxide concentration (ppm)	56	110	280	282	300	360
nitrogen concentration (ppbv)	272	272	274	278	282	305
methane concentration (ppbv)	875	875	880	900	1200	1700
percentage loss of total column ozone	0	0	0	0	0	60
temperature anomaly oC	-0.8	-0.8	-0.7	-0.7	0.25	0.75
decadal flood frequency	0	0	0	0.005	0.01	0.025
percentage loss of total column ozone	0	0	0	0	15	70
percentage fisheries fully exploited	0	0	0	0	2	27
nitrogen flux)	0	0	0.1	1	2	8.3
percentage loss in tropical forest and woodland	1	1	2	3	8	30
amount of cultivated land as % of total land area	12	12	13	15	25	35
species extinction in thousands	0	0	0	0	5	20

Table 1: Changes in Earth's Ecosystem Services. Source: Derived from graphs provided on these elements by Rostrom, et al, 2009.

The impact can be seen in percentage loss in total ozone column in the atmosphere and the subsequent temperature increase. While there was no loss in ozone until 2000; but the change from 0 in 1950 to 60 in 2000 is remarkable. Temperature change was on the negative side meaning a relatively colder world until 1950 when there was an increase of 0.25 degree centigrade in global temperature. This increased to 0.75 degree centigrade in 2000. It is clear therefore that the stage is set for climate change. it is important to know whether the increase in temperature can be linked to these variables. The answer seems to be yes, since there is a wonderful 100 percent correlation between temperature anomaly and the predictor variables of methane concentration, carbon dioxide concentration, percentage loss of total ozone column, hydrogen concentration and amount of cultivated land. it is clear that the world temperature is rising and that it is due to emission of greenhouse gases and reduction of the earth's sinks.

At this point, it is important to examine evidences of climate change in Nigeria. Reports from current literature point to climate change in Nigeria. Spurgeon, Wasilawski, Ikpi and Foster[2009]reported 0.05□C change in temperature per decade throughout the 20th century in Africa. Warming was said to be more significant between June to November every year. Similarly, reduction in rainfall occurred in semi arid West Africa. In the Sahel Nigeria, there was 25% reduction in rain fall on the average in the last 30 years.

These trends have been supported by other studies that use long term climatic data. Akpodiogaga and Odjugo [2010],Fasina and Omojola (2005),Olaniran, (1991) have shown trends in climate change in Nigeria. Fasina [2005] showed evidences of climate change in the Guinea Savanna and Sahel zone of Nigeria by using rain fall data for stations within the zone from 1940-2000.For most stations, deviation of rainfall from the grand mean is negative. For examples, Birnin Kebbi, Gusau, Kano, Maiduguri, Sokoto, Yola, Nguru, Potrskun and Katsina, with Nguru, Maiduguri and Katsina worst affected. Other stations experience positive deviations. For the six decades covered by the study, there were 3 decades of when decadal mean was below the grand mean for the sixty years [1941-1950,1971-1980 and1981-1990] and there were 3 decades when the decadal mean was above the grand mean [1951-1960,1961-1970 and1991-2000].

The study by Odjugo [2010] showed a gradual temperature increase between 1901 and 1940s.This dropped slightly between late 1940s and early 1950s and took a sharp rise till late 1960s.The sharp rise in temperature became evident between early 1970s and 2005. "This sharp rise within this period is in agreement with the global trend"[Odjugo 2010]. Tables 2 and 3 provide further indications of climate change in Nigeria.

period	average temperature	periodic change	deviation from grand mean
1901-1935	26.0 °C		-0.7 °C
1936-1970	26.5 °C	0.5 °C	-0.2 °C
1971-2005	27.8 °C	1.3 °C	1.1 °C
Grand mean	26.7 °C		

Table 2: Trends in Air Temperature, 1901-2005.Source: After Odjugo,2010

town	1901-1935	1936-1970	1971-2005	1901+2005
Port Harcourt	25.5 °C	25.8 °C	26.7 °C	1.2 °C
Nguru	28.2 °C	29.1 °C	30.2 °C	2.0 °C

Table 3: Trends in Air Temperature for Port Harcourt and Nguru, 1901-2005. Source: After Odjugo,2010

Periodic mean temperature and temperature changes for Nigeria are shown in Table 2.The table shows that air temperature in Nigeria rose from 26.0 °C between 1901-1935 to 26.5 °C between 1930-1970 and 27.8 °C between 1971-2005.Hence, there occurred temperature change of 0.5 °C between 1901-1935 period and 1930-1970 period and a change of 1.3 °C between 1936 and 1970 period and 1971-2005 period. Between 1901 and 2005 the mean temperature was 26.7 °C. So, the first two periods witnessed mean temperature below the grand mean while the last period, 1971-2005 witnessed 1.1 °C rise above the grand mean. Table 3 provides temperature changes with regard to two Nigerian cities, Port Harcourt and Nguru, between 1901-2005.The two cities witnessed rise in temperature within this period. While Port Harcourt (a coastal city) witnessed an increase of 1.2 °C within the period, Nguru (A Sahel city) witnessed an increase of 2.0 °C. That is, 4.7 percent increase for Port Harcourt and 7.1 percent increase for Nguru.

With respect to rainfall, Akpodiogaga and Odjugo submit that between 1901 and 2005 rainfall trend in Nigeria shows a general decline. Within the period rainfall amount dropped by 81mm . The marked decline in raninfall since early 1970s continued into 2000s. The period of drastic rainfall decline corresponds with the period of sharp temperature rise. Although there is a general decrease in rainfall in Nigeria, the coastal areas of the country are found to experience slightly increasing rainfall in recent times. Odjugo (2005, 2007) has also shown that the number of rain days dropped by 53% in the north-eastern Nigeria and 14% in the Niger-Delta Coastal areas. These studies also showed that while the areas experiencing double rainfall maximal is shifting southward, the short dry season (August Break) is being experienced more in July as against its normal occurrence in the month of August prior to the 1970s.

The IPCC in its Fourth Assessment Report shows sea level rise of between 1.3 to 2.3mm per year between 1961 to 2003. The Report also adds that Nigeria's coastline has been affected by this rise. Nwilo (1995 in Nwilo, 1997) used 19 years of hourly values of sea level data for Bonny, to show that the rate of sea level rise along the Nigerian coast is 1 mm per annum. However, this value did not take into account subsidence.

3.1 Future Trends in Climate Change in Nigeria

Drawing conclusion from the temperature data between 1901 and 2005, Odjugo (20100 remarks that if the observed rate continues, Nigeria will fall within low to medium scenario of global warming of less than 2.5 °C and that if the observed rate for 1971-2005 continues, Nigeria will fall into the high scenario of 2.5 °C to 4.5 °C. Table 4 shows the projected changeS in temperature and rainfall in Nigeria, using different scenario, between 2010 and 2050. The Table shows that temperature change was expected to be 0.7 °C by best estimate by the end of 2010; 0.8 °C at the end of 2020 and 1.8 °C at the end of 2050. In general, temperature change is expected to vary between 1.0 °C (at low scenario) and 3.2 °C at high scenario estimate at the end of 2050. Similarly, rainfall is also expected to increase over the next 40 years in Nigeria. By the end of 2020, rainfall increase will range between 4mm to 9 mm per annum; and between 8mm and 19mm per annum at the end of 2050. However, Spurgeon, Wasilawski, Ikpi and Foster (2009) remarks that while average precipitation is expected to increase in Nigeria, the different zones will experience different rainfall pattern. As some areas become increasingly desertified, others will likely suffer increased precipitation. Over the next 40 years, sea level is also expected to rise in Nigeria (Table 5). Under low estimate scenario, sea level will rise by 0.2 m by the end of 2020 and 0.5 m by the end of 2050. However, high scenario estimate indicates expected rise of 1.0 m at the end of 2020 and 2.0m.

Scenario	2010	2020	2050
Low	0.1	0.2	0.5
Best Estimate	0.15	0.4	0.9
High	0.3	1.0	2.0

Table 5: Projected Increase in Sea Level in Nigeria (Change in meters). Source: Spurgeon, Wasilawski, Ikpi and Foster, 2009

Nigeria is not an industrialized country but it also has its own of contribution to global warming through emission of green house gases. These come largely from high car ownership, in particular within the last eleven years when substantial increase in salaries had led to high level of car purchase by many households. In Calabar, Cross River State, Abam and Unachukwu established transport-related pollution in the city.

Onuma (2010) reports that Nigeria's energy sector contributes 54.9 percent of emissions, out of which gas flaring accounts for 31.4 percent. Already, Nigerian urban centers have been feeling the impacts of climate change with incessant annual flooding that affect large areas and large number of people. For example, in 2010, flood in Northern Nigeria affected 2 million people in Jigawa State and another 40 000 people were displaced in Sokoto State where Usmanu Dan Fodio University was forced to close down for weeks as a result of bridge collapse associated with the flood. Similar floods were reported in Lagos where 689 people were to be relocated in Ajegunle as a result of flood. Figure 1 shows the possible impact of climate change across the ecological zones of the country. Each of these impacts will also have varying effects on cities and their inhabitants. The Figure shows that in the Sahel North of the country, climate change will lead to expansion of Sahara and Sahel southwards while in the central zone, climate change will lead to influx of refugees from both the far North and the South and possible reverse flow from urban slums.

Fig. 1: Possible Climate Change Impact across Ecological Zones of Nigeria. Source: Spurgeon, et al, 2009.

4 VULNERABILITY OF NIGERIAN URBAN CENTRES TO CLIMATE CHANGE

Tanner, Mitchel, Polack and Guenther (2009) assert that 'rapidly expanding urban settlements in the developing world are and will continue to face severe climatic risks in light of climate change'. Vulnerability is defined as 'the characteristics of a person or group of person in terms of their capacity to anticipate, cope with, resists and recover from the impact of a natural or man-made hazards' (red Cross and Red Crescent, 2007). It is seen as 'a human condition or process resulting from physical, social, economic and environmental factors, which determine the likelihood and scale of damage from the impact of a given hazard" (UNDP, 2004). Some definitions have also attached weight. For example, UNDRO (1991) defines vulnerability as 'the degree of loss to a given element at risk or set of elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from 0 (no damage) to 1 (total damage)" . In particular, it is ' a product of exposure of people to such changes (which is influenced by the limits they face in being able to reduce their exposure) and limited or no capability to cope (the immediate responses) and adapt (longer-term responses)' (Satterwaitte, et al, 2008).

It has been argued that cities are major contributors to the conditions leading to climate change; contributing almost 80 percent of carbon dioxide emission into the atmosphere (WWF, 2009). Second is the fact that cities represent a paradox in the equation of the good and the bad. They reflect the best of what humanity desires and the worst of what it abhors. Cities represent a paradox; a mix of two opposing and sometimes contradicting forces. West, a scientist who recently turned attention to cities captured this well in his contribution to a major work on sustainability; Global Sustainability, A Nobel Cause. As every good thing increases with the size of the city, so does every bad thing. While increase in good things as city size increases follows a system of super linear scaling, the bad thing increases with city size in a system of super linear behavior (see Box 1).

BOX 1: CITY AS A PARADOX

His views on the good side and the bad side of cities are reproduced in Box 1. Cities have traditionally been, and continue to be, the sources of creativity, innovation and wealth production. They are hubs of social activity, the magnets that attract creative individuals, vacuum cleaners that suck up innovation, and stimulants for ideas, growth and wealth production. Analyses of data confirm this (Bettencourt et al., 2007); regardless of which indicator one looks at, the larger the city the more innovative 'social capital' is produced. For example, if a city doubles in size, then, on average, wages, wealth, the number of patents and number of educational and research institutions all increase by approximately 15 % on a per-capita basis. We refer to this systematic phenomenon as 'superlinear scaling'; the larger the city, the more the average individual resident owns, produces and consumes, whether it be goods, resources or ideas. As urban creatures we all participate in the multiple networks of intense human interaction manifested in the metropolitan buzz of productivity, speed, and ingenuity. This is the good news about ities and why they have been so attractive and seductive.

Similar analyses of data representing the negative side of urban life manifest an analogous 'superlinear' behaviour. By approximately the same degree as for the positive indicators, negative indicators of human social behaviour also systematically increase with city size: doubling the size of a city not only increases wages, wealth and innovation by approximately 15 % but also increases the amount of crime, pollution and disease to the same degree (on a per capita basis). Apparently, the good, the bad and the ugly seem to come hand in glove as an integrated, almost predictable, package. A person may move to a bigger city drawn by more innovation, a greater sense of 'action' and better wages, but they can also expect to confront an equivalent increase in garbage, theft, stomach flu, and AIDS.

Source: West, 2009.

In a similar sense, urban centres in relation to climate change are likely to exhibit what Satterwait et al (2008) call 'concatenated hazards' where as primary hazard leads to secondary hazards as well as natech events where natural hazards trigger off technological hazards including pollution and where all these events compound one another.

The vulnerability of the urban centres in Nigeria arise first from the rising urban population that subject increasing number of people to vagaries of climate change occurring within a small land area with large population. Morenikeji and Sanusi (2010) reports on changing urbanisation in Nigeria. According to them existing records show that in 1931, 7.2 percent of Nigerians lived in urban centres, 10.6 percent in 1952 and 15 percent in 1952. Three years after independence, urbanization level rose to 19.1 percent. By 1980, urbanization level stood at 27.1 percent while in 1990, it was 35.1. By 2000, urbanization level rose to 43.5 percent. It is also expected that it would stand at 50 percent by the end of 2010 . The number of urban centres with 20 000 or more increased from 27 in 1931 to 58 in 1952. By the end of 1960, such centres rose to 180. In 1991, there were 359 urban centres with 20 000 and above people and 450 in 2000. Records also show that by 2002, there were at least 73 urban centres with 100 000 people and above. Out these, six have more than one million, four have between 750 000 and 970 000 while eight have between 500 000 and 750 000. Lagos has attained megacity status. Reports from Morenikeji and Sanusi (2010) also show that by 2008, the population of Lagos increased from 665 000 in 1963 to 5.1 million in 1991 and to 18.5 million in 2008. Similarly, Ibadan, Port Harcourt and Kano are also on their ways to being mega cities. Urbanization increases concentration of people, resources and infrastructure on relatively small space. These increase their vulnerability to effects of climate change.

The incidence of high urban population is marched with increasing poverty. Poverty by itself presents a unique form of vulnerability and when the poor stand face to face with climate change, vulnerability becomes compounded. Evidences of increasing in Nigerian urban centres abound and many analysts have directed attention to this. Records from National Bureau of Statistics (NBS, 2005) show that urban poverty in Nigeria stood at 17. 2 percent in 1980, 37. 5 percent in 1990 and 43. 2 in 2004. Reports also indicate that the poverty situation in Nigerian urban centres has not dropped below the 2004 level. The poor are vulnerable to climate change in many ways. First. The poor depend on natural resources for their livelihood. Such resources are largely influenced by climate. Hence a climate change that ravage their means of livelihood suppresses the poor more and drives them more into poverty. Second, the poor are forced them to adjust in

terms of space need for their livelihood and for accommodation. They are forced to reside on ecologically unstable land that is naturally vulnerable to climate change. Ecologically unstable lands consist of land which by their characteristics can be subject to disaster and which when occupied may threaten human life and environmental quality. They are seen as lands which are prone to mass failure under natural conditions and where human activities are likely to increase landslide distribution in time and space (Reld, Ziemer, Smith,. and Close, 1994). They include flood plains, hill tops and slopes. As a result of their nature, such lands remain marginal. Living in ecologically unstable land raises another vulnerability; vulnerability to forced evictions. Between 1999 and 2010, many residents of Abuja, Port Harcourt and Lagos were forcefully evicted on account of residing on flood plains. The Abuja metropolitan management Council (AMAC) in a report on forced evictions in Abuja between 2001 and 2007 writes that

a number of disasters were experienced in some parts of the territory. Flooding occurred in Jiwa, Gwagwa and Kubwa. These occurrences were traceable to illegal developments in some ecologically sensitive areas such as flood plains. Further to this, the physical organization of these settlements was haphazard to the extent that rescue operations could be difficult to provide in times of natural disasters. Thus, in order to prevent future occurrence of such incidences, structures that fell within flood plains were removed in these areas. A total number of 12,015 structures in this category were removed (AMAC, 2009).

The poor in Nigerian urban centres face higher risk from climate-related disaster as a result of absence of insurance cover for their assets. As summed up by Reid, et al (2008), 'poor people rarely have insurance to cover loss of property due to storms or cyclones. They cannot pay for the healthcare required when climate induced outbreak of diseases occur'. The poor capability is limited and so their vulnerability to climate change is compounded by limited alternatives to choose livelihood, to cope with climate change hazards and to adjust to the aftermath of disasters. Indeed, 'climate change could push many beyond their ability to cope or even survive; (Reid, et al, 2009). There is also the danger of maladaptation in attempts to adapt to climate change conditions. Maladaptation is defined as 'actions that increase vulnerability to climate change' (Burten, 1998 in Reid, et al, 2009).

The housing form and pattern in Nigeria also increase city's vulnerability to climate change. Houses are generally of low quality. Houses are built on account of self-adjustment to the current income level irrespective of the social class. Poor houses come not only from the poor but also from the not-so-poor middle income people who depend solely on trade-off among many contending needs to build houses for themselves. These houses can variously be classified as poor housing (where poor people provide clearly poor quality housing), adaptive housing where the not so poor also self-provide housing to escape debilitating effect of housing markets) and sub-class housing where the middle income people also self-provide housing for themselves which though are of higher quality than the other two categories but are inherently vulnerable to hazards. The result is compromised housing quality that cannot withstand climate change related disasters. Spatial planning is inadequate in Nigerian urban centres. Two elements of inadequate planning may be identified. First is the fact that most neighborhoods emerge organically and have no layout. In particular, many peri-urban settlements that are legitimate parts of cities have no layout. The second dimension relates to layouts without follow-up action to provide roads, treed open spaces and utilities that can provide natural mechanism for coping with disasters. Today, Abuja may stand as the best planned city in the country, but it is sad to note that the planning is confined to the Federal Capital City. Outside the city, there is no difference in planning between the Federal capital territory and the states in the country. Figure 2 is a clear example of what most low income neighbourhoods look like in Nigeria. This Google earth image of Kpakungu, a neighbourhood in Minna, Niger State demonstrates the physical appearance of most urban neighbourhoods in Nigeria. Major climate change vulnerability features of the neighbourhood are high density, grossly small green areas, absence of drainage along the access roads, narrow and untarred roads and inaccessibility of many residential buildings. These features are complemented with poor waste disposal system that turn roads and right of ways into refuse dumps.

Fig. 2: Google Image of Kpakungu, Minna.

Poor planning denies the urban centres of the mechanisms to sufficiently absorb shocks from disasters. It is a fact that Nigerian cities are visibly vulnerable to all climate change conditions of tropical type (flood, windstorm, extreme harmattan and heat). The cities face different climate change effects in varying forms. But it is safe to say that coastal cities and towns are vulnerable to the impact of increasing sea level through coastal flood and erosion. Analysts assert that cities within the range of 60 km to the coast face the risk of climate change driven flood. Already, flashes of this have been happening in Lagos. Indeed, a German scientist, Stefan Cramer was reported to have said that "in 50 years with a one-meter sea level rise, two million or three million people would be homeless. By the end of the century we would have two meters and by that stage Lagos is gone as we know it," (Okpi, 2010). On the other hand, the far north cities face the danger of extreme aridity and its attendant problem of drought and heat. The health impacts will be reflected in meningitis, cholera and even malaria. The danger of aridity also spells the danger of hunger arising from reduced food output. The nation and the cities in particular depend on grains and cereals from the northern part of the country. Climate change effects that reduce food crop output will aggravate the already observed food security problem (Morenikeji and Sanusi, 2010) in the country, in general and in the urban centres, in particular. The mass migration from the arid-ridden and even flood ridden rural areas will stress the urban population even further. Same will apply to water supply shortage arising from pollution from flood and scarcity from aridity and drought. In either case, water stress looms high in the urban centers.

While all these conditions increase vulnerability, the truth also remains that bad governance reflected in low urban capacity and responsiveness aggravate vulnerability. Satterwaite et al (2008) observe antagonistic relationship between urban governments and the low income groups. First, the urban poor are not seen as critical part of city economy and urban development and secondly, official urban policies increase people's vulnerability to environmental hazards and climate shocks rather than reducing them.

5 SPATIAL PLANNING IN ADDRESSING CLIMATE CHANGE

With climate change, cities can be said to be under a siege, but it can also be added that that they possess the inert capacity to remove the siege. Indeed, cities 'provide many opportunities to lighten the human load on earth's ecosystem' (Hassan, Scholes . and Ash, , 2005). In overcoming the siege of climate change, physical planning has to align with the basic principles of overcoming disasters and its effects on the urban physical landscape and on the people. In this case, spatial planning efforts can be seen as all proposals and actions that can help to prevent the occurrence/intensification of climate change -related conditions, to contain the impacts of climate change and to manage the impact of the change in space. The concept of space will of necessity include the people and their activities, in particular livelihood activities. It should be noted that addressing climate change primarily rests with mitigation and adaptation. Mitigation is reduction in greenhouse gas emission (ISDR, 2008).

According to IPCC, mitigation is 'an anthropogenic intervention to reduce the anthropogenic forcing of the climate system. It includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks'. On the other hand, IPCC also sees adaptation as 'the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities' (in ISDR, 2008). In either mitigation or adaptation, spatial planning has a clear role to play. Largely, the role of spatial planning is to create an eco-city; a city which is meshed in nature and works with nature. It is a city which destroys less of the natural features; and which strives to create as much green as possible. The greens will achieve non-technology-based mitigation and help largely to achieve adaptation. How will spatial planning drive home the eco-city? The base of this drive is that spatial planning must be innovative by making creativity a permanent feature.. To reduce the compromising effects of climate change on sustainability, planning must hold, it must be improved and it must be sustained. Innovative spatial dependent on creativity is characterized by originality, capability to develop new projects, procedures or approaches, unconvential ideas , visionary power, phantasy, willingness and readyness to experiment and to take risks, mental, cognitive flexibility, multi-dimensional thinking (Kunzmann, 2006).

First is that physical planning must involve climate change disaster risk assessment where the city system is assessed based on the probability of its vulnerability to the risk of climate change hazards. This will help in producing climate change induced disaster vulnerability mapping . While this is similar to the traditional land suitability mapping, this has the added advantage of helping to prepare cities for absorbing shocks from climate change-induced disasters. From here, it becomes clear to isolate urban lands that are seriously vulnerable and to plan for their protection. Naturally, ecologically sensitive areas will need special attention for preservation. This is not unknown but the new planning that takes climate change into account will focus more attention on these areas and clearly mark them out for preservation and exclusion from any serious physical development. Such areas will be good for livelihood development such as farming and livestock production and will be the bases for green urban economy. While flood plains will suit urban horticulture, mountain areas will be useful for controlled livestock production. There is thus a dual role of preservation and capacity building for livelihood development. Second is the issue of city-wide tree planting. The green economy will also be enhanced by linking jobs with neighbourhoods. Planned economic areas within neighourhoods will reduce traffic on urban roads, reduce illegal trading that contribute to poor waste management and associated impact on urban drainage.

All parts of the city deserves tree planting and so, spatial planning must make sure that this is realized. There are two issues involved here. First is the public provision of trees and second is tree development by the urban dwellers. The two have to hold and complement each other. In doing this, planners have to borrow and apply the concept of street fruit trees where streets are lined not only with ordinary trees but also with fruit trees that will serve ecological and dietary purposes. The idea of living or green roofs has also been recommended as part of urban physical landscape. The living roof can cool the roof surface of a building through evaporation from soil media and transpiration from plants, reducing air temperatures above the roof which then mix with adjacent air to cool the entire surrounding area (Davis, S., Martien, P. and Sampson, N.,1992). It can also reduce building energy demand by decreasing the amount of solar energy that is conducted into a building and improve the quality of storm water runoff (Corburn, 2008). Neighbourhood forest is also another idea that city planning conscious of climate change should also imbibe. As much forest cover as can be conveniently accommodated and as desired within neighbourhoods should be provided. In this case, spatial planning has to explore its concept of neighbourhood to the fullest in achieving community support and turning urban planning inside and making it part of the daily urban living. Trees should extend from homes to the streets. In this case, it becomes imperative to explore the possibility of making tree planting a requirement for plan approval and a condition for other urban supplementary activities. Within and around neighbourhoods, community planning and actions that will increase resilience can be built.

Furthermore, Nigerian cities can longer plan in principle. They have to move to practice. Hence, development without layout should stop. Development approval for any developments must be for plots from approved layouts. Spatial planning should thus take a legitimate look at land ownership and allow private land owners and communities to prepare layout and get same approved by town planning institutions. To fall into eco-city concept, all layouts must show sufficient provision for greens and preservation of ecologically sensitive areas. There is the danger of failed cities arising from being excessively vulnerable to climate change disasters. All the ideas embedded in eco-city approach may likely fail and drive cities to failing if

development control anchored on good urban governance is lacking. The failure of development control in Nigerian cities must be contained by making the exercise practical, participatory, responsive and accountable. Development control institutions deserve capacity building and the exercise should be opened up to private sector participation, to new technology that can sufficiently de-personalize development control and make it transparent and effective.

It is known that environmental impact assessment is a requirement for approval of certain developments in Nigeria. The EIA is pro eco-city and anti-climate change effects. In otherwords, it is supposed to prevent some of the conditions favourable to climate change. The current approach to the implementation of EIA Act has little link to maintaining ecological sustainability. If the EIA reports have to fulfill the spirit and letters of the Act setting it up, the current attitude has to change. There must be a clear green provision in mitigation measures recommended in EIA reports.

At this point, it is important to see how one of the ecosystem-friendly cities of the world is addressing the challenge of climate change through physical planning measures. Box 2 shows the various measures being adopted by Vancouver to address climate change. Vancouver has maintained the status of the world's most livable city since 2007, according to Economist Intelligence Unit survey. It qualifies as a model for developing eco-friendly city.

BOX 2: VANCOUVER, BUILDING A CITY WITH NATURE IN MIND

Green and growing spaces are both functional and artistic parts of Vancouver's urban design, contributing an enviable network of parks, greenways, community gardens and living rooftops. They contribute to the City's "Living First" strategy. Innovative projects like Green Streets, community gardens and living rooftops have achieved wide-spread pularity in Vancouver, expanding the realm of nature in the city. Through the Green Streets program, neighbourhood residents become volunteer street gardeners, tending gardens planted in traffic circles and corner bulges. The program started in 1994 as part of a successful traffic calming plan and continues to grow along with Vancouver's network of greenways and bikeways. These colourful gardens personalize each neighbourhood, and connect residents through shared pride and the simple experience of meeting and chatting with neighbours while gardening. Volunteers receive benefits including free compost, access to Green Streets Master Gardener Mentoring, and a coveted invitation to the annual Green Streets Garden Party.

URBAN GREEN THUMBS

Apartment dwellers interested in gardening beyond their balconies can join Vancouver's growing community of gardeners. Community gardens across the city bring residents together to nurture both floral and edible harvests. On March 4, 2009, Vancouver Mayor Gregor Robertson announced that a community garden would be built on the lawn at City Hall, and its produce donated to food providers in Vancouver's Downtown Eastside. This symbolized a commitment, now carried out successfully, to establish 2,010 new shared garden plots in neighbourhoods around the city, as a legacy of the 2010 Winter Games. Today, there are over 2,900 gardens across the city.

GARDENS IN THE SKY: RECLAIMING ROOFTOPS

Living rooftops give buildings the appearance of having sprouted up naturally from the earth. Covered with soil and plants, they are transforming the urban roofscape – replacing lifeless surfaces with growing meadows and parks. The Coal Harbour Community Centre, for instance, is concealed beneath a waterfront park, yet is a bright sunny space with wonderful harbour views. Vancouver is home to the largest living rooftop in Canada, covering all six acres of the Vancouver Convention Centre's west building. Nurturing more than 400,000 indigenous plants and grasses, the rooftop is a natural habitat for birds, butterflies, insects and small mammals. It also supports four beehives housing 60,000 bees whose honey is used by the Centre's kitchen. Beyond the re-creation of natural habitat, there are many practical reasons to build living rooftops. The soil and vegetation absorb rainfall, filtering and retaining a portion of it to drain more gradually, helping to reduce sewer overflows and returning cleaner water to the surrounding watershed.

Vancouver has established a forward-thinking Transportation Plan for the city. The City has designed for a variety of road users by supporting transit, creating greenways and incorporating bicycle lanes. The result is a 44% increase in walking, a 180% increase in bike trips and a 10% reduction in vehicle trips since 1997. Transit ridership has increased by 50% in the last decade. In addition, Vancouver is working on the

EcoDensity initiative. Building on the work of the CityPlan process that promotes the development of complete, mixed use urban communities in all the City's neighbourhoods; EcoDensity is a way to plan our growing city while reducing our ecological footprint. It is the City's vision for how Vancouver will grow in a way that is green, as well as livable and affordable.

Vancouver is proof that cities can be vibrant, growing and prosperous while also taking meaningful action on climate change. Greenhouse gas (GHG) emissions have already been reduced to 1990 levels and Vancouver is on track to meeting the Kyoto target (6% below 1990 levels by 2012). At the same time population has grown by 27% and jobs by 18%.

Source: http://vancouver.ca/ sustainability/building.htm

Vancouver, was at the beginning of 2010 judged as one of the ten most livable cities in the world. Vancouver is addressing climate change through initiatives that include the creation of sustainable community energy system, forward-thinking transportation plan and EcoDensity initiative. As shown in the Box, urban green thumbs and gardens in the sky are also part of the ways of adapting the eco-city approach. These initiatives are commendable and should be undertaken in Nigeria to mitigate the effects of climate change.

6 CONCLUSION

It has been demonstrated that climate change is real and that it is here to stay. The phenomenon of climate change throws a challenge which when considered with the challenge of urbanization becomes substantially burdensome. In spite of this, the challenges are surmountable and in doing this spatial planning is a dependable ally. Spatial planning can help Nigeria to create eco-friendly human settlements that will contain the effects of climate change. It will also help to provide spatial solution to reducing greenhouse gases in the atmosphere.

Spatial planning will be more effective in mitigating and adapting to climate change if a more strategic. Value-based approach is taking to urban planning. The UN-Habitat (2010) sees strategic, value-based urban planning as ‘a systematic, participatory and transparent decision making process that determines priorities, makes wise choices and allocates scarce resources (time, money, skills) to achieve agreed-upon objectives that are developed using local community values’. The crux of this approach is that urban planning must see climate change as part its subject areas. In particular, urban planning must gauge, prioritize and plan for real, emerging and potential climate change impacts at the local level; support the “mainstreaming” of climate change planning at the local level into spatial, physical, sectoral and comprehensive development plans; promote an inclusive, participatory climate change planning process that integrates strategic planning, local area participation and good decision making; and support capacity building for urban planners and allied professionals (UN-Habitat, 2010). Spatial planning approach should be supported by ancillary planning activities that cover local economic planning and environmental management (solid waste management, wastewater management, pollution control), community health improvement and public education on climate change and urban planning.

It is also hoped that good governance will be allowed to take root in urban planning and development in Nigeria. Good governance-based urban planning is related to the principles of Vancouver Declaration, 2006 on New Urban Planning. The Declaration called for a new, proactive approach that focuses on sustainability and making the connections between people, economic opportunity and the environment (UN-Habitat, 2010). The principles underlining the Declaration are relevant to climate change and underscore the fact that good urban planning supports and creates a foundation for climate planning. . These principles are

- ‘Sustainability: A practical focus on integrating social, economic and environmental considerations in human settlements development that considers the impact of today’s developments on future generations
- Integrated: An integrated approach that combines and coordinates economic planning, physical planning, and environmental planning to deliver efficiency and effectiveness by adding value through policies that support, rather than undercut, each other.
- Integrated with Budgets: A recognition that successful plans effectively link to private and public budgetary processes. Neither plans by themselves, nor unregulated market processes, can deliver more sustainable settlements.

- Planning with Partners: Plan with all sectors of the community with a stake in the place, including governments, private sector organisations, voluntary agencies and civil society. New Urban Planning fosters voluntary collaboration amongst all these actors.
- Subsidiarity: While national governments have important roles in setting national urban development policies and programs, subsidiarity recognizes the need for decentralization, with local governments playing a leading role, and empowerment of community-based organisations on matters that can be determined at neighbourhood level.
- Market Responsive: New Urban Planning understands market demand, particularly in land and property markets, and is aware of the dynamics and potential of the informal sectors. It is responsive, but not reactive.
- Access to Land: A supply of land in safe and accessible locations to meet the needs of all sectors of society is fundamental to achieving efficient and equitable settlements. Traditional town planning too often under-estimated needs, particularly of the poor. Equitable systems of land ownership and land management need to underpin successful urban planning.
- Appropriate Tools: Urban development regulation and control should be strategic, affordable, effective, and sensitive to the needs of the poor while conserving essential ecological resources. New Urban Planning recognizes that rigid urban containment is not a feasible, equitable or affordable policy in conditions of rapid urbanization.
- Pro-poor and Inclusive: Successful planning is inclusive, pro-poor, recognizes diversity and promotes equality. Plans can and should be driven by the objectives and priorities as expressed by all groups in the city.
- Cultural Variation: New Urban Planning allows for a variety of outcomes according to cultural priorities and preferences' (UN-Habitat, 2010).

In general, the new urban planning should not only be eco-friendly, it must also plan for climate.

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