

COPING WITH CLIMATE CHANGE: THE IMPERATIVE FOR HOME-BASED GREEN AREA IN PHYSICAL DEVELOPMENT PLANS IN NIGERIA

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Abstract

Human population is increasingly urban and IPCC reports increasing emissions by urban-based sectors. This is the premise for focusing on home – based green area as essential in coping with climate change. It is premised on the need for an innovative planning strategy to cope with desertification and general climate change challenges. Data for this study were derived from two sources; primary and secondary. Primary data instruments were the questionnaire and field observation. Field observation was complimented with physical measurement. Observation was with the aid of a checklist. Finding shows that very insignificant number of households observes green cover within the residential/home area, and building plan approval is silent on green cover. In addition, about 70 – 80 percent of the sampled residential plot sizes were developed contrary to the planning standards in the state. Based on the findings, recommendations that will enhance the incorporation of green cover in homes were put forward. These include the inclusion of tree planting as part of building permit approval by the town planning authority.

Key Words: Green home, Climate Change, Household and Land use

INTRODUCTION

The United Nations Framework Convention on Climate Change (UNFCCC 2013), defines climate change as: change of climate which is 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'. And according to the Intergovernmental Panel on Climate Change (IPCC) report, human population is increasingly urban

and there is increasing emissions by urban-based sectors. Unfortunately and increasingly too, urban master plans in Nigeria though contain provisions for green areas, they are hardly implemented due to a myriad of reasons. Yet, urban areas are heavily impacted by climate change, where adaptation efforts must focus. In Africa, vulnerability to climate change is exacerbated by low adaptive capacity and poverty among others.

Africa's per capita energy consumption is among the least in the world, her biomass energy use is however among the highest in the world. According to the African Water Development Report (2006), about 75% of wood harvested in sub-Saharan Africa is used for household cooking and the region accounts for 86% of biomass energy use in the continent. Similarly, 65% of biomass use comes from firewood and 3% from charcoal. Wood and charcoal use are detrimental environmentally and health wise. Women and children suffer disproportionately from the negative effects of smoke associated with biomass fuel, (Energy in Africa, 1999). The United Nations (2007) in Osman- Elesha (2009), observed that over 80% of Sub-Sahara Africa's population depends on traditional biomass for cooking. The increased dependence on firewood has tended to aggravated forest depletion with climate change becoming an additional stress. Accelerated forest depletion can alter the micro-climatic scenario of an area. Similarly, uncontrolled animal grazing and the increasing rate of building construction also put pressure on forest resources. According to the FGN (2008), the proportion of land covered by forests has been reducing by 0.28 percent on the average in Nigeria. The baseline estimate, using the forest depletion rate for 2015, is that the proportion of land covered by forest will be 10.31 percent. The proportion of land area covered by forest also fell from 14.6 percent in 2000 to 12.6 percent in 2007. On the Millennium Development Goals (MDGs) Climate change alone is capable of negatively impacting on other sectors such that the backward and forward linkages coupled with sector specific constraints like drought – induced power shortages would transmit climate change shock to non-agricultural sectors (MDG 2009). In Sudano-sahelian region of Nigeria, statistical values showed that rainfall

has consistently decreased in this region for decades (Olatunde and Alaci 2012), signifying a changing climate.

Climate change is perhaps one of the worst environmental pains and conceivably the most intractable environmental challenge of our time emanating mainly from anthropogenic activities. The built environment constitutes a key manifestation of the anthropogenic footprint. Ironically, a Town Planner is saddle with task of providing an aesthetically pleasing and functional environment. The functional environment includes the home environment. As Agbola (1985) contended, Urban and Regional Planning aimed at providing a more satisfying environment, where residents can reside, work, and pursue other ambitions enhancing human dignity and leading to the attainment of a richer and more satisfied life. It is in line with this aim that development control applies various instrument of control in urban development. Existing instruments including Zoning, building line regulation, density control, building height regulation and type of material for construction do not address climate change and or desertification impact at household level in a typically built environment. Yet the urban areas with its high population density are areas of vulnerability with high impact.

As Satterthwaite (2008) observed, urban heat islands and higher temperatures occur in urban areas than in rural areas due to diurnal cycles of solar energy input and heat generation from built/paved physical structures. These increase the frequency and severity of heat-stress events in cities and can affect the economic, health, labour productivity and leisure activities of the urban population. It has been estimated that existing buildings are responsible for more than 40% of the world's total primary energy consumption and 24% of global carbon dioxide emissions (Wikipedia 2012). This has led to calls for energy efficient or

eco friendly buildings often described as GREEN HOMES. Usually green home as a type of house designed to be *environmentally friendly* and *sustainable*, has a deficient placement for a planner. The definition and scope of green homes has tended to overtly consign the business of Green home provision to architects and builders alone. This is the background setting, upon which this paper X-rays residential-based green area provision as a town planning tool in climate change coping strategy.

Although several studies and reports have exonerated Africa as a culprit in Green House Gas (GHG) emission (GHG are believed to be responsible for climate change), nowhere is more vulnerable and impact likely to be more severe than Africa. This is because more often than not in Africa, Climatic issues do not reflect in investment decision-making and development policy (UNDP 2006, Ogboi 2012). Yet, climatic variability, risk and change are a continuous process that adaptation and mitigation needs to be a continuum. According to the 8th Meeting of the Africa Partnership Forum (APF), over time climate change may modify general climatic conditions resulting in more frequent occurrences of climate extremes. Satterthwaite (2008) reported that, most cities in Africa, Asia and Latin America and the Caribbean will experience more heat waves in the coming years. Similarly, associated problems like air pollution will increase as concentrations of air pollutants change in response to climate change because a portion of their formation depends, in part, on temperature and humidity. Consequently, climate change and its associated impacts on biophysical systems (desertification) require also the integration of a forward-looking perspective into decision-making processes to ensure that changes in climate risks are recognized and addressed where necessary and possible (APF 2007).

This study adopts a case study approach using Lokoja, the Kogi state capital as focus for data collection. Lokoja is an emerging urban centre where observable intense anthropogenic activities are evident. Land use cover change in Lokoja is on the increase. Evidence from the 2005 NigeriaSat-1 image classification shows that the Built-up area expanded by 1.14 sq.km (1.87%) and cultivated area by 0.93 sq km (1.72%), while Natural Vegetation land use shrunk by 2.23 sq km (3.45%) see Alaci and Amujabi (2009). This was found to be consistent with other studies like Alabi and Ufuah (2007), who examined the rate of farmland conversion to built area and Abraham (2012) on Lokoja industrial belt and land use activities.

According to Oluseyi (2007) urban heat island in Lokoja town is significant, with average Land surface temperature values, maximum urban/suburban temperature difference reaching 10.9°C., suggesting that vegetation is the principal determinant controlling the spatial distribution of land surface heat flux. Unfortunately, increasing anthropogenic activities have tended to reduce the total vegetation cover over time. The rate of land cover change and the fact of declining vegetation cover in Lokoja have been well documented; see Alabi and Ufuah (2007); Alaci and Amujabi (2009); Alaci, Amujabi, Baba and Ogbaje (2011) and Abraham (2012). Observation has shown increasing tendency towards increased paved surfaces. Similarly Ifatimehin; Ishaya, and Fanan (2010) observed that significant variation in the micro climate of Lokoja town dates back to 1987. The morphology and thermal conductivities of the various buildings is said to account for this variation in temperature. Generally Lokoja has warm weather. Average monthly temperature for Lokoja is contained on table 1.

Table 1: Average Monthly temperature and precipitation for Lokoja

Months	Temperature			Precipitation
	Normal	Warmest	Coldest	Normal
January	-	33.5°C	20.3°C	1
February	-	34.9°C	22.8°C	1
March	-	34.7°C	23.9°C	3
April	-	33.6°C	23.9°C	6
May	-	32.0°C	23.1°C	12
June	-	30.5°C	22.6°C	13
July	-	29.5°C	22.3°C	15
August	-	29.6°C	22.3°C	15
September	-	30.2°C	22.1°C	17
October	-	31.2°C	22.3°C	12
November	-	32.6°C	21.6°C	1
December	-	32.9°C	20.0°C	0

Source: Weather statistics for Lokoja, Kogi (Nigeria) www.yr.no/place/Nigeria/Kogi/Lokoja/statistics.html
 Accessed on 10/4/2012.

The temperature values are abnormally warmer than expected (Nmet 2011). One of the direct and primary effects of climate change is in the areas of flood occurrence, increased drought and intensification of desertification among others. Absence of plant due to the many facets of anthropogenic influence, translates to a reduction in the oxygen supplied into that environment and an increasing inability to scoop up carbon dioxide emission. Loss of vegetal cover, more paved surfaces, use of corrugated iron sheet together with increase in built up area among others which are evident in Lokoja result in higher surface run off with its attendant environmental challenges. Annual flooding in both riparian and non riparian areas of the city is a common phenomenon particularly in the month of September, with the flood event of 2012 going down in history as the most severe.

The aftermath of anthropogenic activities resulting to burning of "fossil fuels" such as coal, oil and gas has impact on the

human environment and on the climate. These fuels contain carbon. Burning them makes carbon dioxide gas. In addition, deforestation and de-vegetation remains an important potential factor in climate change and desertification. In fact, even if efforts to reduce greenhouses gas (GHG) emissions are successful; it is no longer possible to avoid some degree of global warming and climate change, therefore studies are needed to produce adaptation strategy, especially at household level. And as Dodman, Brown, Francis, Hardoy, Johnson and Satterwaite (2013) summed up; additional and indeed improved knowledge is required to reduce the consequences of risk associated with climate change especially in low and middle – income countries, this include Nigeria. Previous studies on climate change have not focused on the place of Town planning operations and adaptation at the household level. This study is a departure from the traditional issues

of conceptualization, Olatunde and Alaci (2012), (2010); Ogboi (2012) even when mitigations and adaptation are focused, Edorado, Sabrina and Melandri (2011); Eke (2011) and Anselm, Eneh and Stephen (2011) and impact studies Ademola (2011) and Adefila (2011) it does not cascade to the household level and town planning operations.

Objectives

The specific objectives of the study are to:

- ❖ Assess climate change awareness level among households in the study area.
- ❖ Identify climate change coping strategies inherent in the land use.
- ❖ Highlight the place of Green Cover as a Climate Change coping strategy.
- ❖ Make proposal for integrating Green areas/spaces in Residential Development Plans

Methodology

Data for this study were derived from two sources; primary and secondary. Government documents such as reports and manuals as well as other relevant literature constitute the secondary sources of data. The reports and manuals were sourced from relevant government Department while libraries and the internet makes up the sources of other literature materials used.

Primary data instruments were the use of questionnaire and field observation involving physical measurement. The questionnaire sought to know from respondent if they are aware of climate change. Observation using a checklist sought for the presence of such features like vegetation especially trees and flowers and whether it was deliberate landscaping exercise, a heat control measure or incidental green areas within in the compound. In the summary table neighbourhoods are classified as yes or nil in grass/flower cover

depending on the predominance. For example, significant presence will attract yes, while insignificant presence or no presence is rated as nil. The total built up area was measured in meters with a measuring tape. The values were then converted to percentages to make it easy to compare. The presence or absence of green cover/tree was also noted. Sub-constructions such as houses for domestic birds, animals or pets were considered as part of the built up area. The aspect of measurement was usually carried out after the questionnaire session and where a respondent is oppose to it as was observed in few places, a quick estimate was made. Such incidence were however minimal and will not impact on the result of the study.

Sampling method used is multi – stage sampling technique. In this approach the town of Lokoja forms the basic primary sampling unit. The neighborhoods form the next stage. There are fifteen neighbourhoods in Lokoja out of which eight were purposively sampled. This is because a mix of the three income classes was observed in most of the neighbourhoods going by the nature/standard of housing. However, care was taken to have a good mix of government and privately provided residential apartment. Therefore all government/public housing estates accounted for all the samples taken in neighbourhoods having government residential estate. This was done with the backdrop of government been the prime planner. In government housing estate where houses are of semi-detached design, household plot size was determined by dividing building-plot size by the number of households accommodated. Neighbourhoods with government estate that were used for the survey are Adankolo, Gaduma and Lokongoma. The sampled neighbourhoods in all are Adankolo, Lokongoma, Newlayout, Ganaja, Gaduma, Filele, Karaworo and Kabawa. In each

neighborhood a sample of 20 compound/homes was selected purposively, due to their largely homogenous nature. The choice of individual respondent relied on the use of random numbers. However; a limit of only first digit was adopted so that the random number arrived, was used as the sampling interval. Thus a sampling interval of 5 compounds was adopted. In all one hundred and sixty compounds (160) respondents involving eight (8) neighbourhood was used in the questionnaire administration. Presentation relied on instruments such as tables and averages, because they present actual facts devoid of ambiguity. Analysis was largely qualitative inferences derived from the data.

Result and Discussion

Awareness of Climate Change

Data on household awareness were derived in two ways. These were the simple interactive method and the more detailed compound survey. Generally, awareness of household on climate change issues appears to be high, about sixty eight percent (68%) of household claimed that they are aware of climate change issues. The sources of information listed were mostly formal sources like radio, television and newspaper this accounted for fifty one percent (51%), informal sources like friends and colleagues accounted for twenty nine (29%) percent while from studies it was found to be only twenty percent (20%). The high level of awareness however does not transcend beyond mere head knowledge information. This because further probing into climate change –based environmental issues such as Green House Gases (GHG) emission, as well as

the role of green cover in climate – change adaptation, a clear ignorance was observed. This is worrisome given that over eighty percent 80% of the sampled respondent had formal education above primary school. Only about nineteen percent (19%) agreed to having knowledge on issues of Green House Gas emission as well as the fact that green cover can plays some vital role in the inter change between oxygen and carbon dioxide. The implication of the preceding revolves around some queries on individual household activities at that level. The queries include, whether household activities will likely induce climate – change? Do household take action(s) to aid/help in climate - change adaptation? Are households in a state of hopelessness or helplessness? The next section addresses the state of adaptation as provided by planning regulations.

Compound/Home based land use pattern

The land use pattern of households was assessed with particular reference to green covers. The green cover were taking to represent coping strategies, even though the presence of green cover as discussed here are largely unconscious efforts of the sampled population. For a vast majority, it has nothing to do with climate change; we have already noted that most of the respondents have limited information on the casual agents of climate change and the relationship between climate change and anthropogenic activities. The summary of the land use pattern in homes/compound is presented on table 2

Tables 2: Average Land use within Compounds/Homes in the sampled Neighbourhood

Neighbourhood	Plot size (meters)	% built up	Grasses/flowers	No of trees
Adankolo	15 by 15	80%	Nil	Nil
Lokongoma	15 by 30	75%	Yes	3
New layout,	15 by 25	85%	Nil	1
Ganaja,	15 by 20	85%	Nil	1
Gaduma,	30 by 40	65%	Yes	5
Felele	15 by 15	80%	Nil	Nil
Karaworo	12 by 15	88%	Nil	Nil
Kabawa	12 by 15	89%	Nil	Nil

Source: Field survey, 2012.

The Physical development of individual compounds and homes across the sampled neighborhoods appears to be total. Observable variations were only in intensity, which was also reflected in the presence or absence of green cover either in the form of trees and or flowers or grasses. Adankolo, Lokongoma and Gaduma with heavy presence of government housing estate show lower percentage of physical development. This was also found to be consistent with the average plot sizes which are higher. Although, new-layout is a government designed layout, its age being in existence before the state creation may have accounted for the observed dense development. The older parts of the city Karaworo and Kabawa had the least plot

sizes and the highest percentage of physical development; these are areas with native land allocation procedures. All the respondents at Karaworo and Kabawa had obtained their present plots through some form of transfer. This varies significantly from the case in Lokongoma and Gaduma where lands were obtained through official government allocation. This is not unexpected as samples were all government estates. In Ganaja, a mix of both the native and government allocation procedure was observed. In some places paved surfaces were observed. This was so in homes and or compounds that appears to be medium to high income groups. Plate 1 is an example of a paved compound.



Plate 1: Example of paved surfaces in sampled Residential units'

Source: Field Survey, 2012



Surfaces such as shown on plate one will reduce infiltration and so reduce underground recharge. This will increase surface run off and possibility of flooding. On the other hand counter radiation will be enhanced and thus increase the surface temperature thus contributing to global warming and the incidence of urban heat island.

Generally, there appears to be a close relationship between plot sizes and use intensification and pattern. The bigger the plots size the lower percentage developed and the higher is the presence of green cover. In all the sampled areas, development appears to have progressed beyond the official permit, even in government provided housing estate. Table3 shows the ratio of plots permitted for development according to the laws of Kogi state.

Table 3: Building Plot Development Percentage

Building Plot Ratio	Density Area
33 ¹ / ₂ %	Low Density Residential Area
50 ¹ / ₂ %	Medium Density Residential Area
60%	High Density Residential Area
75%	Office, Commercial and Industrial Areas

Source: Annual volumes of Laws of Kogi Sate of Nigeria 1991 Volume 2

Although the law clearly stipulates a maximum of 60% plot development for high density residential area, this is completely at variance with the practice. Evidence from Table 2 as already noted is a confirmation. This is an indication that development control and planning laws in the state are not being enforced. There was utter disregard to setbacks in most of the places; approved set-backs to be maintained for buildings are 1.8meters on one side and

3meters on the other side for a drive-in from above the other locations. Low presence of green areas/covers was recorded in all the samples. As expected the severity was higher in the smaller plots, the entire finding was considered a paradox in view of the generally high incidence of temperature in Lokoja. The paradox high temperature occurrence in Lokoja and the adaptive role of vegetation was assessed with a quick review of planning approval requirements in the state.

The requirement for building plan approval includes: - Health and Safety requirement; adequate setback from key public facilities/amenities and aesthetics and provision of standard amenity. Other requirements include adherence to the planning regulations relating to land use, setbacks, density, building height requirement, etc. Although an array of environmental, safety and convenience prerequisite are contained in the plan approval requirement, the provision of green cover/area was conspicuously absent. This is considered to be a missing link in the approval process and a possible tool for town planners and town planning in the struggle to adapt to climate change phenomena like desertification. It is on the strength of this that an integration of green provision in the plan approval requirement is proposed. This is in addition to a general need for increased green infrastructure across the city.

The Green Cover option in the Climate Change Coping Strategy

Generally green spaces moderate local micro climate. This is because the plants export oxygen into the environment. The foliage of the plants also helps to reduce the actual and potential impact of radiation. According to communities (2007), It has been argued that one possible solution to the effect of secondary

heat otherwise known as Urban Heat Island (UHI) effect is in growing plants on rooftops and creating sky-rise gardens. A study in Singapore found that growing plants on roof tops reduce roof ambient temperature by 4°C and that heat transfer into the rooms below is lower. A similar study in Tokyo shows that a reduction in temperature by 0.8°C as a result of rooftop gardens is capable of saving electric-bill equivalent to approximately S\$1.6 million per day (Wong, 2011).

The benefits of green areas are therefore monumental. Healthy, properly maintained green space provides significant benefits to the environment in terms of water and air quality. One of the most significant functions of green space is to stabilize and protect the soil against water and wind erosion. This is particularly important in preventing nutrient run-off. Healthy, dense green space is three times more effective than weedy, unhealthy green space in preventing nitrogen run-off (John 2011). A rich or fertile soil is also a necessary condition for healthy plant growth.

Economically, Green spaces around homes can reduce air conditioning costs. For example, an addition of 10% green space in high density urban areas will allow cities to maintain current summer temperature levels (and thus current summer utility costs) for the next 70 years (up to 2080). Similarly A 50 by 50 foot green space releases enough oxygen for a family of four on a daily basis, an average 18-hole golf course release enough oxygen for 4000 to 7000 people and green space along the U.S. interstate highway system releases enough oxygen for 22 million people (John 2011). The introduction of more green areas into the built environment is a major strategy for mitigating climate change and desertification. The level of impact however depends on the size, quality and shape of a space, vegetation type and proportion of coverage. Green spaces are

therefore in a position to relieve the effects of raised temperature as climate change increases. This will for example become center for cool air.

Proposal for Green buildings and Green Homes

A number of strategies are available for increasing green in homes and compounds in our towns and cities. Some of such strategies are discussed below.

Mandatory creation of green spaces in new development: this approach ensures that green spaces are included in the planning and design of new residential areas. A well – designed park or green space can be the making of a new development.

(and 23% of their ecological) food print. We can reduce this effect by utilizing green spaces in our compounds and homes to grow our own fruits and vegetables. This strategy which is part of the concept known as urban agriculture ensures dual benefits to the household in the form of food supply and ecological benefits.

Plant a Tree Strategy; Trees should be treated as indispensable components of any new building. Trees, provides key environmental services such as improving air quality and reducing the urban heat Island effect. In this particular way, it will be possible to establish a positive correlation in number of buildings with number of trees in urban centres.



Plate 2: A model of a green home

Developing Green Roots; Green roots and building facades can be built on new buildings and retrofitted on existing ones especially in urban areas where there are few other opportunities for adding green infrastructure.

Growing Food in compounds and homes; Food production, processing and transportation is responsible for 8% of the average person's carbon

Conclusion

This study attempt to show that town planning operations can play a role in climate change adaptation at household level. Findings show that in many homes awareness on climate change is low and home-based land use patterns are not pro- climate change adaptation. While building plan permit neglect the inclusion of trees and green areas as

permit pre-requisites, building plot ratio were never adhered to. The broad conclusion is that tree planting should be made one of the pre-requisite in the granting of building permit.

This would be able to match to some extent the rise in building with a corresponding rise in tree population. And in this way, we can help to reduce the incidence of increase carbon dioxide, while enhancing oxygen availability. A case of using brown agenda, approach in a green environmental issue.

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