THE ENVIRONMENTAL EFFECT OF MASS HOUSING DEVELOPMENT IN ABUJA, NIGERIA

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ABSTRACT

This paper is aimed at assessing the effects of mass housing development in Lokogoma district of Abuja Phase II. This study was an inquisition into how mass housing development affects the environment as well as alters the design of the original master plan. The study examines the extent and magnitude on the social, economic and environmental aspect of the communities within the Phase II of the city. The scope of the study covers other areas of mass housing development within the Lokogoma district of the Abuja Phase III and emphasis is placed more on the private estate developers. Data on air quality, water quality, soil quality, vegetation and relief and landform were collected and assessed. A control point of 2km from the study location was picked to aid in the examination of the variation in the natural order. Air quality measurement was conducted using Gassman portable Digital Gas Monitors. Noise pollution test was carried out using a sound level meter. Physical and chemical contaminants in water were measured through water quality test. Other tests were also carried out to examine pollution from soil and vegetation. Impact assessment management matrix analysis was conducted to determine the environmental impacts through the construction of mass housing development. The results of the study revealed that air pollution and deforestation are two environmental problems affecting the study area and are having significant effect on the public health of the residents and causing flooding as well as soil erosion in the study area respectively. Thus, there is the need for urgent intervention from the authorities concerned in order to avoid or control the spread of these problems.

KEYWORDS: Environmental pollution, mass housing development, urban development, Abuja-Nigeria.

INTRODUCTION

Mass housing is literally defined as large number of buildings or other shelters in which people live, a place to live, dwelling and to a Nation, is a critical component in social and economic fabric. Housing represents one of the most basic human needs. As a unit of the environment, it has a profound influence on the health efficiency, social behavior, satisfaction and general welfare of the community (Onibokun, 1998).

To most groups, housing means shelter to people but to others it means more as it serves as one of the best indicators of a person's standard of living and his or her place in the society (Osman, 2002). It is a priority for the attainment of living standard and it is important to both rural and urban areas. These attributes make demand for housing to know no bound as population growth and urbanization increases rapidly and the gap between housing need and supply became wider. Therefore, mass housing is the effort to bridge the gap between housing need and housing deficits (Osman, 2002). Housing provides a link between the physical development of a city and its social and economic outcomes.

Mass housing generally is a term most people use to describe a cluster of high rise low cost residential buildings. Mass housing is the construction or springing up of a relatively high number of residential buildings in an area in relatively short period of time due to high demand and it became an essential development in most developing countries because of the volume of people migrating to urban areas (Ozkan, 1988).
Mass housing is a solution which Nigeria and most other developing countries take up as a solution to their housing problems, but in most of these mass housing environments, neither the demand of the households nor the need of space or environmental factors are usually considered during the construction process. This coupled with other factors will not only affect the mass housing environments but also affects the housing of the country as a whole in one way or the other.
As a new Federal Capital Territory (FCT) of Nigeria, Abuja is a city where urbanization and development in terms of commercial, residential, industrial, social and political growth has been in progress and still taking place. Today, it is a city of huge complexes which houses government offices. The population of Abuja has increased tremendously and still on the increase due to urbanization. As a result of that, there is a huge gap between the production of housing and its demand.
Abuja is a beautiful city but too costly for most of government workers and as such like so many other cities in developing worlds, it is surrounded by vast neighborhoods of satellites towns, slums, informal settlements and different mass housing schemes.
The provision of this mass housing in Abuja by the government is a concept to providing shelter for people, but in most cases, these developments come with negative physical, socio-cultural, environmental and economic effects on the city.
Mass housing in Abuja is rapidly increasing which covers hectares of land within the Phase III of the City. Prior to mass housing development in the FCT, the environment was in its natural state, with a well-balanced ecosystem. The dynamics of the natural environment to housing environment due to some series of proposed mass housing actions has been a point of contention to environmentalist.

BACKGROUND STATEMENT OF THE PROBLEM

Mass housing has a global effect on the environment such as energy consumption in the form of over exploitation of the natural resources for raw material used for the building constructions like wood, mineral resources such as gypsum, chipping, sand, stone among others. The frequent use of those resources leads to their over exploitation thereby affecting the environment which implies energy use leading to global warming causing climate change.
In the same vein, mass housing development has resulted to greenhouse gas emission due to the use of power generating equipment at site like bulldozers, pay loaders and other heavy vehicles at site (Brebbia et al., 2002). Hardoy et al. (1990) also identify mass housing as a major source of noise around new towns in United Kingdom. Noise as a result of such activities disturbs people at home and in their offices. Such noise is responsible for the extinction of animal species especially birds as observed in Southern Wales.
Mass housing construction has a major impact on the environment in its consumption of energy, both directly and embodied in the materials that it uses. The large bulk of materials used consume a great deal of energy for transport. Construction equipment generates a lot of carbon dioxide which contributes to global warning from the greenhouse effect (GHG)
Vegetation is among the clearest indicator of life in our environment. It is also a key pillar in the environmental dynamics especially the weather. Vegetation takes different forms and shapes and varies from one type of environment to the other. Mass housing development affect vegetation especially through clearance of sites in the bush or forest using heavy equipment leading to deforestation; destroying fauna and flora species of the area as well as

exposing the topmost soil to erosion thereby constituting health hazards to the neighboring communities.

Housing construction activities such as those proposed will result in areas of soil and ground being exposed in workings and in stock piles. Open areas of soil and gravel can result in the creation of airborne dust which has the potential to move offsite and affect other people and activities in the immediate area. Dust has the potentials to create nuisance effect as well as health effects. However, the dust can result to changes in weather due to the diffusion of construction particles from mass housing site.

Soil is the mainstay of the environment whether in its loose soft form or in the form of rock. However, mass housing construction distracts the soil profile thereby shaking the environmental mechanisms that the same support. Blasting of rocks, mining building materials, mass excavation of topsoil, soil compaction, and importation of alien soil for construction purposes among others have resulted to change of soil structure and profile leading to erosion and eventually affect agricultural activities.

Lokogoma district in the FCT has been dedicated and allocated to private and public housing developers. This implies that the district as a whole experienced rapid and sudden environmental changes due to mass housing construction. The district was created in 2004 and its development began in early 2005. During the period, some level of housing development was noticed in the form of site clearance, rock blasting and the construction of N8 road which is the main access to the district.

These activities however, resulted to serious environmental damages and changes to the ecosystem. It was observed that, indigenous and economic trees like Guava, Cashew, Mango, Malina among others were destroyed as an effort to mobilize and take possession to mass housing sites in 2006. In the same vein, Rock outcrop that beautifies and protects the soil were blasted as an attempt to pave way for access roads to the other parts of the district. In 2006, the popular Dutsen Gwari was destroyed by Arab Contractors (Construction Company) in other to create road linkages to mass housing sites in Lokogoma leading to changes to soil structure and natural beauty of the environment.

In 2007, the pattern of housing development in the district changed, as numerous housing developers mobilize to their sites for housing construction activities. Soil has been destroyed using bulldozers in an attempt to clear and level the ground, digging of foundation for houses which leads to change in the soil structure and paves way for soil erosion within the surroundings.

However, there are instances of channeling a natural drainage (i.e. streams) to other direction outside allocated plots, as an effort to create more land for housing development. Stone peaching of natural valleys within housing site is common in the district thereby altering the natural state of the environment as well as polluting the water from the streams. Recently, thick dust and other particles in the atmosphere were observed throughout the month of September in the district particularly around EFAB estate and could be evident from the roofs of already existing building around the district (Ibrahim, 2010).

In addition, with the destruction of vegetation and arable land as a result of erosion and the generation of construction waste and particles into the atmosphere are some of the major problems observed. This implies that the district is liable to loss of bio diversity in general and there is the possibility of spreading across other new mass housing sites within the FCT if not properly addressed. Therefore, this is what prompts the study as an attempt to establish the extent of the impact of the mass housing construction activities on the environment with the view to recommend appropriate mitigatory measures for sustainable development of the areas.

CONCEPTUAL FRAMEWORK OF THE STUDY

This study centers on the effect of housing construction on the environment and five elements are utilized as shown in figure 1.

1. **Air**

Mass housing construction techniques especially in developing countries may lead to the contamination of air as a result of dust generated from site clearance, exhaust from heavy construction equipment, and noise pollution which may have effect on ozone layer, visibility effects and extinction of animal species (especially Birds).

2. **Vegetation**

Site clearance is a major step in any construction process. It involves using heavy equipment to uproot trees, shrubs, grasses and other plant species in an attempt to construct roads, drainages and buildings. This act will however lead to the extinction of plant species especially economic trees and soil erosion leading to deforestation and climate change as a whole. This research will look at the possible effects of the mass housing construction process in relation to loss of vegetation cover.

3. **Water**

The major water sources within the study area, (such as streams, river and its tributaries) will be studied and analyzed with a view of the mass housing construction processes. Scientific approach particularly water quality analysis will be adopted to determine whether there is water contamination by construction activities. The research will also look at possibilities of flooding as a result of creating artificial embankment instead of the natural drainages within the study area and the possible effect to the surrounding and human health.

4. **Soil**

Mass housing construction and its methodologies may have negative effects to the soil quality and soil profile as a whole. This study will also explore scientific method of assessing the soil (especially the soil's chemical composition and the fertility) in view of mass housing construction. Soil erosion due to the use of heavy equipment on site is a possible challenge which will affect the agricultural production around the study area.

5. **Relief and Landform**

The site's natural recreational potentials as well as its natural endowment has been exhausted and converted to huge building of various forms covering hectares of land. The effects on relief and landforms manifest in the form of rock blasting, sand filling of valleys, hill excavation among others.

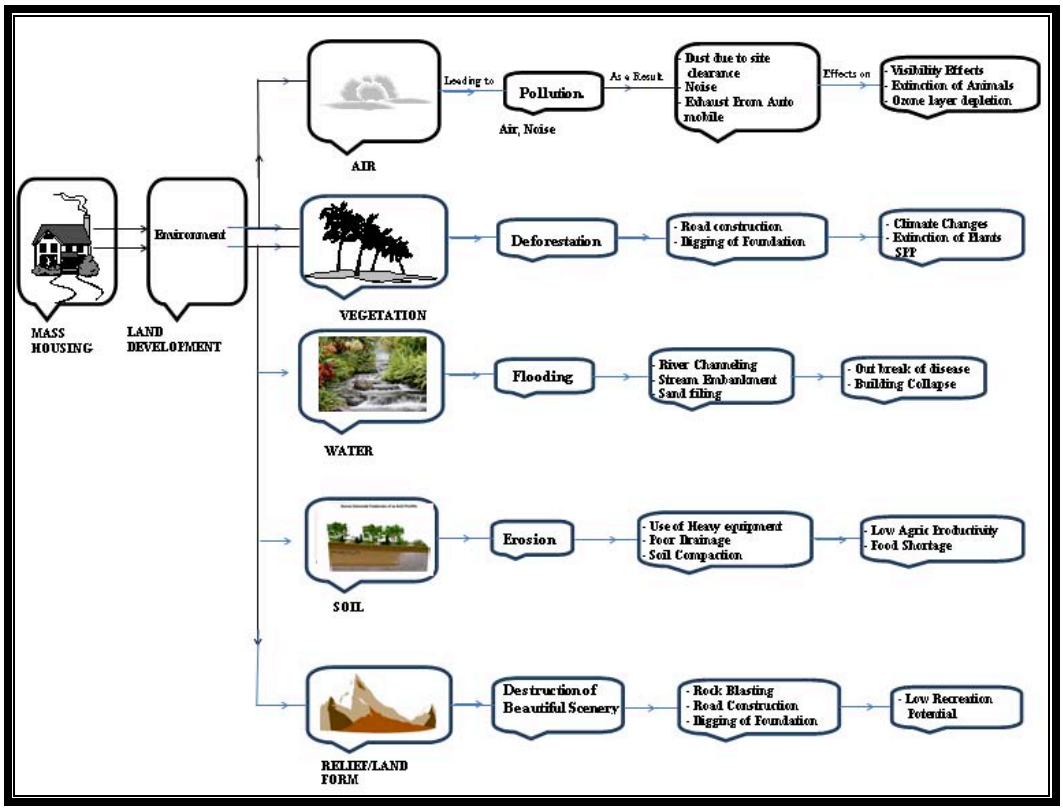

Figure 1: Conceptual frameworks

Housing and Housing Environments

Housing is by far the most common form of building in the world and has, in many ways received considerable attention from decision-makers, architects, planners and environmentalist (Priemus, 2001). It is a form of development which has been in existence since in the Stone Age. This is because it provides the shelter and protection human beings need from harsh climatic conditions and crime. It is in many respects the most central environmental setting encountered by individuals during their daily routine, taking into consideration its psychological and social significance, which makes it one of the most vital development issues of our time.

Housing environments may provide a haven of security and comfortable, supportive milieu from which individuals organize their daily plans and activities. (Oktay, 2001) Housing, as human habitat, is a dominant factor in the recognition of a society's success among nations. The availability of decent shelter for each family defines the level of development that the nation has reached.

The social and economic wealth can only co-exist with good housing. (Ural, 2002) It represents the physical manifestation of investment in a community, and directly relates to a primary concern of municipalities, that of land use and development, and provides a link between physical development and social and economic outcomes. Housing therefore, appears to be a reasonable and potentially powerful medium for monitoring the social, physical, environmental and economic characteristics of community (Vehbi, 2009).

As economies grow, urbanization accelerates and demography explodes, pose some of the greatest practical and ethical problems that developing countries face. In the seamless web we call national development; housing is only one factor influencing the quality of human life. But how vital is it to human safety, still more fundamentally, the state of a person's home touches deep chords in the human spirit (Khan, 1988).

Land in rural areas cannot provide the poor with a job, so migration in most cases is like a plea for employment, a courageous expression of the willingness to work, more than the poor soil or the unjust society of their home area. When these poor, jobless migrants land up in cities, they find neither jobs nor affordable housing and having no other alternative tend to become part of the sprawling, ever-expanding squatters‟ slums. In some of the countries, half-hearted attempts have no doubt been made to solve the problem by launching low-cost housing programs for the urban poor but these policies miserably fail mainly because the government response to meet the shelter needs of the urban poor is not compatible with their sociology and economics (Siddiqui, 1988).

The changing scenario of habitat all over the world is creating chaotic urban areas. These are characterized by rapid migration to the cities and chaotic developments of slums, unplanned habitable spaces. (Sanyal, 2002)

Housing is not only concerned with the design of a specific number of house units, but rather, the design of a whole environment that provides accommodation, jobs, education, health, services, etc. all this is to be achieved within a context that is accessible, safe, beautiful and sustainable (Serageldin, 1998)

Communities that have control over their environment are more inclined to intervene in issues such as crime that may be to their social and economic detriment. The benefit of territoriality and ownership stretches wider than encouraging the defending of private space. It also encourages improvements to and better maintenance of the built environment, resulting in a better quality environment. (Plessis, 1999)

In his essay: “Towards a Sustainable Housing Development” Dilip da Cunha - states that: “Housing, because of its ability, as a total entity, to satisfy all the levels of need - spiritual, cultural, economic and physical is in a unique position to be the leading sector, showing the way towards more holistic policies and sustainable development”. (Vehbi, Hoskara, Hoskara, 2009).

Dimensions of Sustainability

Sustainable development is now commonly classified as having three main components: Economic Sustainability, Environmental sustainability and Social sustainability (equity) thus giving the so called three Es: Economics; Environment and Equity) (Pitts, 2004) (Figure 2). Therefore, there are three dimensions of sustainable development: 1) the Social Dimension, which covers cultural identity, empowerment, accessibility, stability and equity; 2) the Economic Dimension, which includes growth, development, productivity and tickle-down; and 3) the Environmental Dimension including ecosystem integrity, carrying capacity and bio-diversity. The linkages between these different dimensions of sustainability should be fully taken into account, and they should not be isolated from one another (Khan, 1995; Goodland and Daly, 1996; Mitlin and Satterthwaite, 1996, Hart, 1999; Williams, et al, 2000; Chiu, 2003) in (Hoskara el al., 2009).

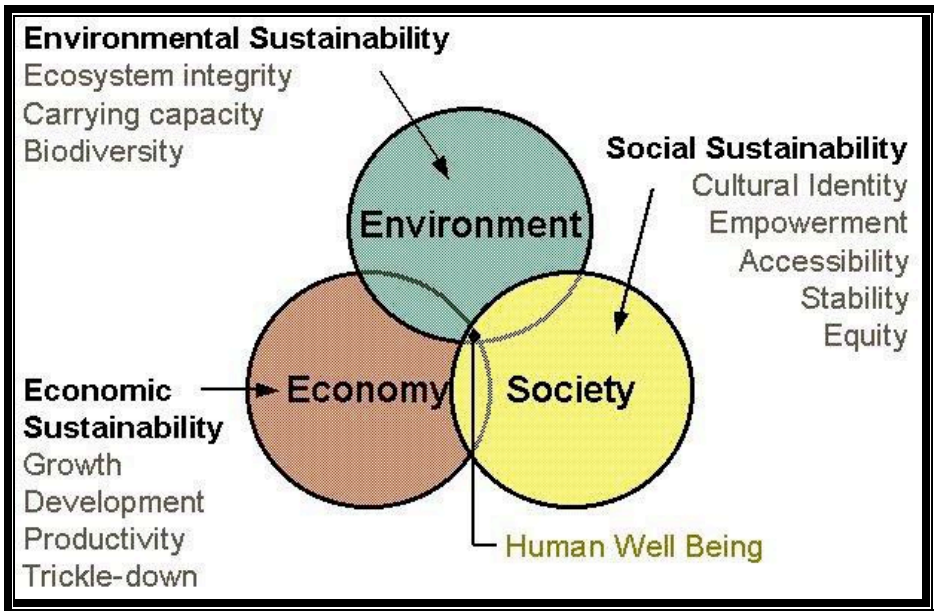

Figure 2: Relationship between the three dimensions of sustainability
Source: Tursoy (2009)

Mass Housing and Sustainability

Sustainability is a concept which brings together a housing environment which solves most of the problems faced by mass housing developments. Among the solutions provided or put forward to solve these problems faced by mass housing developments, Ebenezer Howard's Garden City, and his Social City, which included clusters of his Garden city is an example which best brings together a development which provides a sustainable solution to these developments.

Cities provided an urban environment which had characteristics as described by Ebenezer Howard in his diagram of the three magnets (Figure 3). It consists of an environment closing out of nature, social opportunity, isolation of crowds, places of amusement, distance from work, high money wages, high rents and prices, changes of employment, excessive hours, army of unemployed, fogs and droughts, costly drainage, foul air, murky sky well lit streets, slums and gin palaces.

The city had economic and social opportunity, but overcrowded housing and an appalling physical environment. The countryside offered open fields and fresh air, but there all-too-few jobs and very little social life; and, paradoxically, if anything housing conditions for the average worker were just as bad. Ebenezer Howard's diagram of the three magnets consisted of the Town, Country, and the Town-Country, with the people at the center.

The Town segment showed its characteristics of an environment closing out of nature, social opportunity, isolation of crowds, places of amusement, distance from work, high money wages, high rents and prices, changes of employment, excessive hours, army of unemployed, fogs and droughts, costly drainage, foul air, murky sky well lit streets, slums and gin palaces.

The Country segment showed its characteristics of lack of society, beauty of nature, hands out of work, land lying idle, trespassers beware, wood, meadow, forest, long-hours-low wages, fresh air low rents, lack of drainage, abundance of water, lack of amusement, bright sunshine, no public spirit, need for reform and deserted villages.

In the third segment, his idea was to discover an environment which possesses the power to redistribute the population in a spontaneous and healthy manner. Its characteristics was a combination of some aspects of both the town and country which included beauty of nature, social opportunity, fields and parks of easy access, low rents, high wages, low rates, plenty to

do, low prices, no sweating, field for enterprise, flow of capital, pure air and water, good drainage, bright homes and gardens, no smoke, no slums, freedom and co-operation.

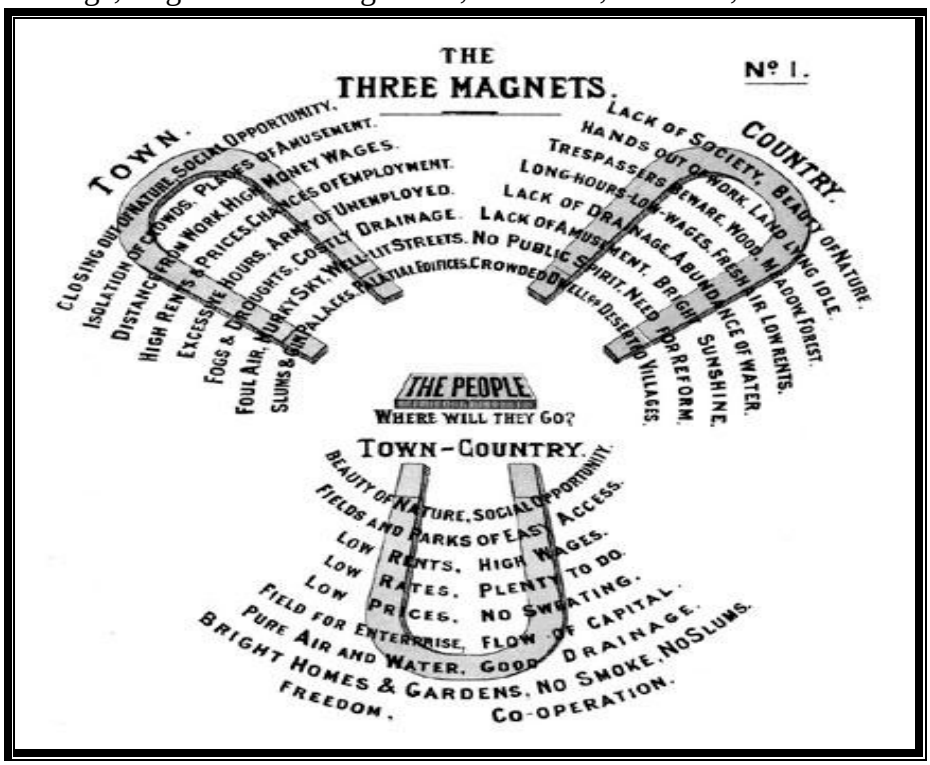

Figure 3: Ebenezer Howard's Three Magnets
Source: Oktay (2001)

To achieve this, Howard argued, was to create a very new town in the middle of the countryside, outside the sphere of the big city, where land could be bought at depressed agricultural land values. (Hall and Ward, 1998)

He came up with the idea of the Garden City (figure 4). The basic notion was a mix-use, medium density, fixed-size development, jobs, schools, shops, parks, countryside all within walking distance.

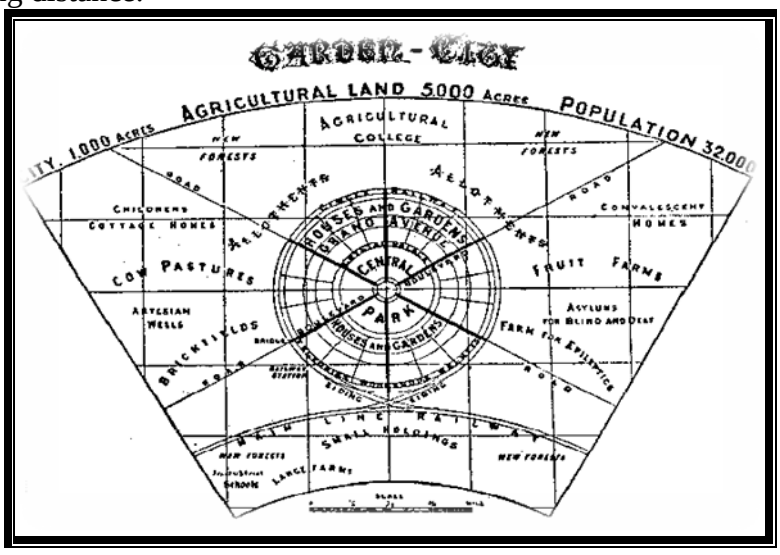

Figure 4 Ebenezer Howard's Garden City
Source: Oktay (2001)

The garden city concept seems to be a fruitful starting point when looking for areas that combine sustainability and high quality, at a low cost, highlighting the significance of an urban density (Oktay, 2001). The Social City (figure 5), which included clusters of garden cities, each "sustainable" by the standards of the 1990s, linked by a rapid transit system was to be the realization of Howard's third magnet.

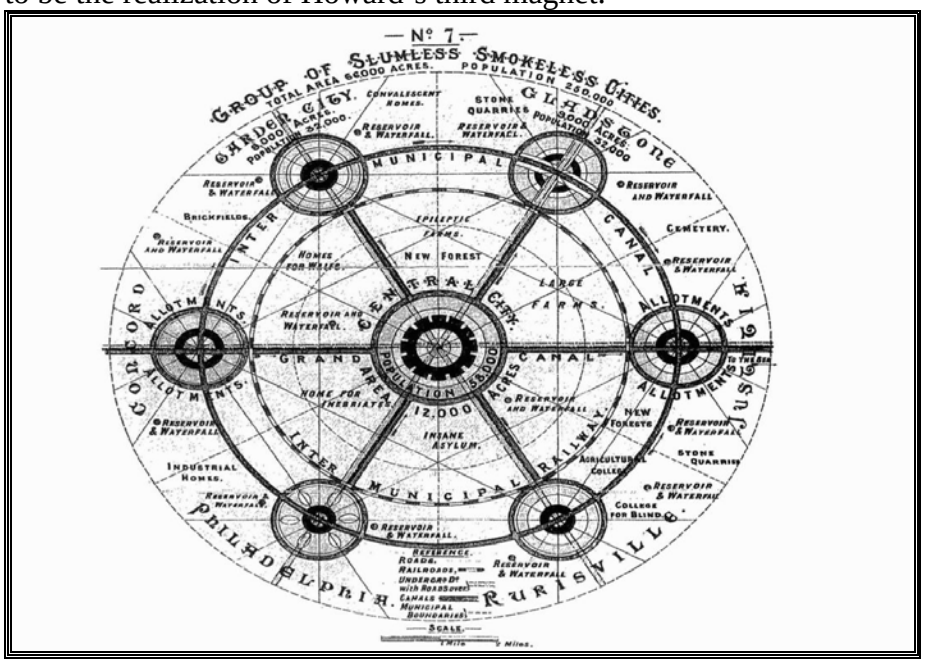

Figure 5: Ebenezer Howard's Social City showing clusters of garden cities, each sustainable
Source: Oktay (2001)

Today, we need one sector to show the way towards sustainable development. Housing, because of its ability as a total entity to satisfy all the level of need, is in a unique position to set this example, of a more holistic policy which proactively considers the broader issue of the global environment together with local tradition.

Environmental Degradation and Mass Housing

Massoudi et al., (1978) defines environmental degradation as a process through which the natural environment is compromised in some way, reducing biological diversity and the general health of the environment. This process can be entirely natural in origin, or it can be accelerated or caused by human activities.

Several international organizations recognize environmental degradation as one of the major threats facing the planet, since humans have only been given one Earth to work with, and if the environment becomes irreparably compromised, it could mean the end of human existence (Gonduan, 2002).

There are a number of ways in which environmental degradation can work. In a classic case, resources simply become depleted. Air, water, and soil are all resources which are vulnerable to depletion through overuse, as are natural resources like minerals and oil deposits. Habitat pressures which force animals into a small area can also contribute to resource depletion, as the animals consume a high volume of material in a small area.

Pollution is another cause of environmental degradation. When the environment becomes polluted, it means that toxic substances have rendered it unhealthy. Pollution can come from a variety of sources, including vehicle emissions, agricultural runoff, accidental chemical release from factories, and poorly-managed harvesting of natural resources. In some cases, pollution may be reversible with costly environmental remediation measures, and in other

instances, it may take decades or even centuries for the environment to cope with the pollution (Edwards et al, 2000).

Simple damage is also a common issue. Clear cutting, unsustainable development, and erosion are all forms of environmental damage. If the damage is extensive, the environment may not be able to reach a state of balance on its own, and the problem could become compounded. Erosion as a result of bad agricultural practices, for example, can strip the earth of its valuable topsoil, leaving coarse, useless soils behind. This infamously occurred in North America during the Dust Bowl of the 1930s, in which drought, poor farming practices, and severe weather led to a widespread stripping of fertile topsoil from farmlands (Green et al., 1999).

A number of social and legal issues are involved in environmental degradation, ranging from the need to provide living space for humans to questions about who is responsible for environmental cleanup. For example, if a company acquires a company which released toxic chemicals into the environment in an era when this practice was commonplace, it may argue that it has no legal obligation to clean up the chemicals, although it may be obliged to do so under ethical principles (Kutlusan, 2001).

The construction and use of modern buildings causes substantial environmental damage, creating about 50% of greenhouse gas emissions and considerable ecosystem degradation. In the United States, buildings account for 39 percent of total energy use, 12 percent of the total water consumption, 68 percent of total electricity consumption, and 38 percent of the carbon dioxide emissions (UNDP Washington Newsletter, 2011).

According to UNDP Washington Newsletter in 2011, the environmental damage from buildings arises across the whole life-cycle of buildings, which have a very wide range of environmental impacts and demands. The environmental damage can also be summarized as follows.

- Ecosystem and biodiversity loss and impacts from the global consumption of natural resources for building through the depletion of vital ecosystem services. Essentially a reduction in the environment's capacity to maintain our current lifestyle or to improve the lifestyle of the less disadvantaged
- Climate Change and impact of pollutant - from the greenhouse gas emissions and other pollutants associated with buildings

The overuse of modern design rather than sensible use of traditional architecture risks vulnerability to location and weather specific events such as flood and earthquake. For example ‘modern’ houses may become very hot in sunny climates and so create a need for air conditioning, whilst the more traditional buildings which have evolved over centuries are far more comfortable and need no cooling, so less energy.

The health of people and communities and the quality of the environment are closely linked. By building in a self-sustaining manner, the quality of the environment can be improved immeasurably with an increase in both the well-being of human kind and bio-diversity.

The reduced use of locally available resources increases environmental impact through material transportation.

MATERIALS AND METHOD

The Study Area

Abuja, the site of the new Federal capital of Nigeria is located on the Gwagwa plain to the north-east of the FCT. Lokogoma curves under the influence of two prevailing winds – the maritime South-westerlies which are moisture laden from the ocean and prevail from April to October and the dry north easterlies which are dust laden from Sahara Desert. The duration of sunshine varies from season to season with longer hours recorded during the dry season. The largest sunshine hours are witnessed between November to February reaching 8.5 hours. The

lowest value of sunshine was recorded as low as 4hours. The Annual rainfall is strongly associated with the prevailing winds and vary season to season i.e. from April to October. Annual rainfall is as high as 1632mm.

The terrain of Lokogoma is generally undulating land with significant internal height differences. The land rises gently from major river valley (Rivers Dakwo, Jina and Wumba) that run from South-East to North-West below 440m, to the east and S.E to heights of 480m. The highest points are two prominent hills of rock outcrops located in the Southeast. Vegetation is within the Guinea savannah vegetation. The guinea savannah has been affected by human activities in the form of cultivation and grazing. The districts have the features of park savannah with stunted tree cover, man-made vegetation and riparian vegetation. The capital city is essentially cresentic in shape, has an area of 75,658 hectares approximately. It is bounded by latitude 9°10'N in the North, latitude 8°5N in the South, longitude 7°32'E in the east and longitude 7°16'E in the west (Figure 6).

Lokogoma District is part of residential sector which is at the southern most part of Abuja phase III area (Figure 7 and 8). The total area of the district is 741 hectares which is about 5% of the Abuja phase II. The district is generally bell-shaped. It is bounded in the north by Ring road 2, in the south by another road (S30) in the east by road (S12) and in the west by the southern park way. It shares common boundaries with four other district: Gaduwa (in the north) Kabusa (in the south), Wumba (in the east), Dakwo (in the west) and Saraji.

Lokogoma has a macro climatic variation i.e. the dry season last from November to March and wet season from April to October. High temperature was recorded between 32°c to 34°c. Temperature as high as 37°c is recorded in the month of June. Relative humidity values are high during the rainy season reaching 80%-95% between May and October as low as 32% in the dry season and hamattan months of January and February.

Figure 6: Map of Nigeria Showing the study area

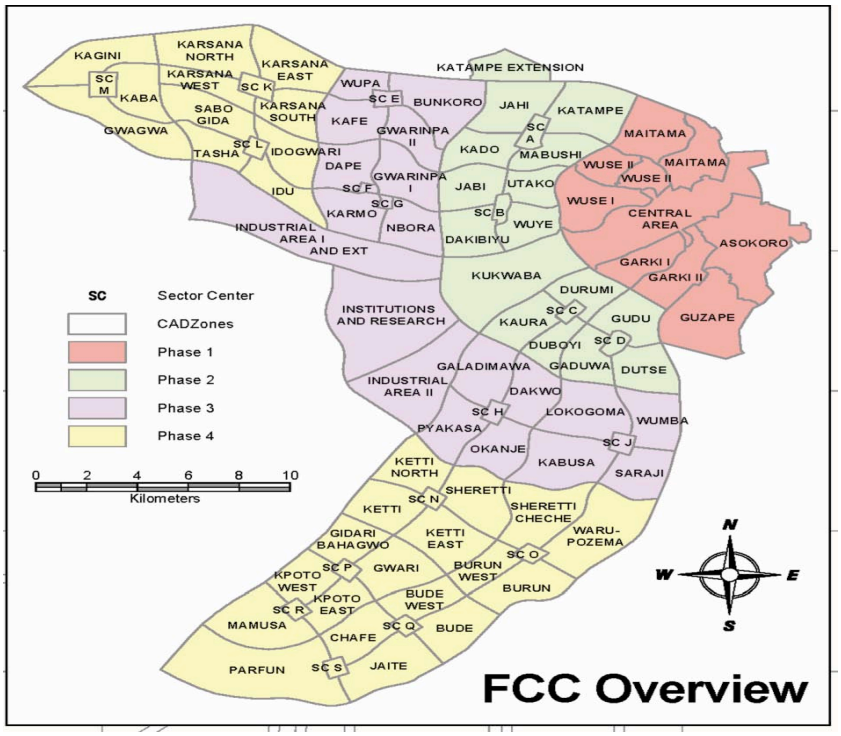

Figure 7: Map of Abuja showing the Planned Districts (Source: Abuja Master Plan)

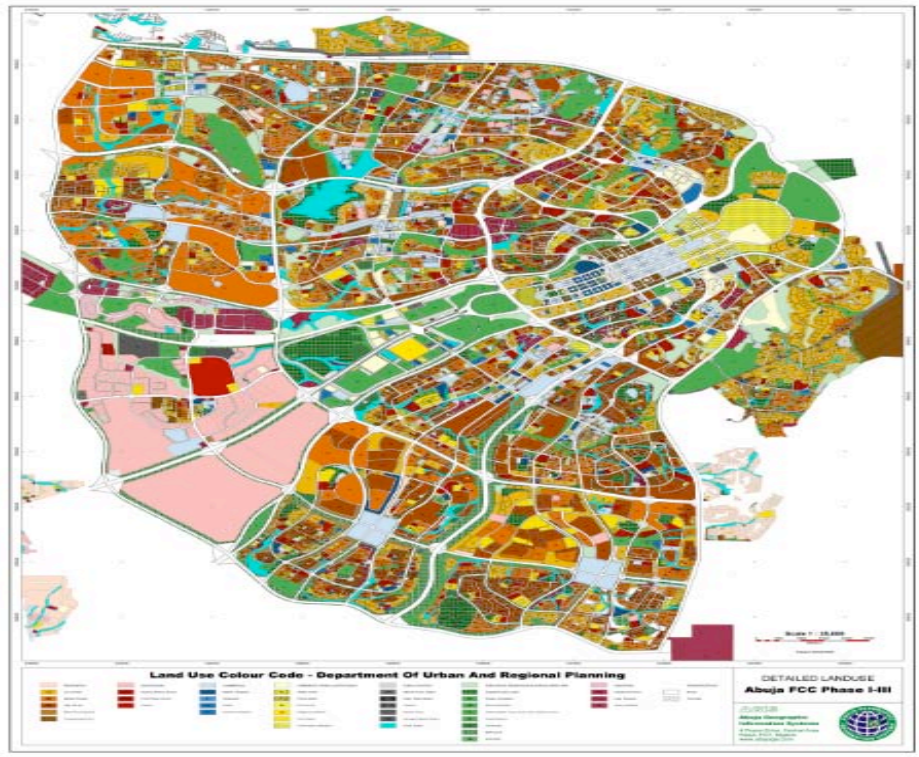

Figure 8: Land use Map of Federal Capital City (FCC)
Source: Department of Urban & Regional Planning, FCDA)

Research methodology

The Control Point

Lokogoma district was designed for mass housing development in the Abuja Master Plan. However, the review of the master plan over the years changed the pattern of mass housing development to other districts in the phase III of the Federal Capita City. Lokogoma district have 35 mass housing plots allocated to different private developers. According to FCT Mass Housing unit, 25 plots (60% of the total district) were developed and others were under construction. For the purpose of this research, 5 out of the 35 plots were selected to represent the entire district using two sampling techniques;

1. Purposive Sampling; the five locations were selected because of the following;
- There are ongoing construction works within estate where people live.
- Data is available in the locations selected.
2. Stratified Sampling; 5 clusters out of the 25 plots (developed) were selected using the stratified sampling to represent the entire district. The 25 plot were grouped into 5 strata and in each strata, one plot was selected randomly.
- SARAHA Estate Latitude 8.96142N, Longitude 7.45237E
- EFAB Estate Latitude 8.9603N, Longitude 7.45021E
- I-PENT Estate Latitude 8.96535N, Longitude 7.45088E
- NNPC Estate Latitude 8.93694N, Longitude 7.4916E
- GODAB Estate Latitude 8.94462N, Longitude 7.44508E

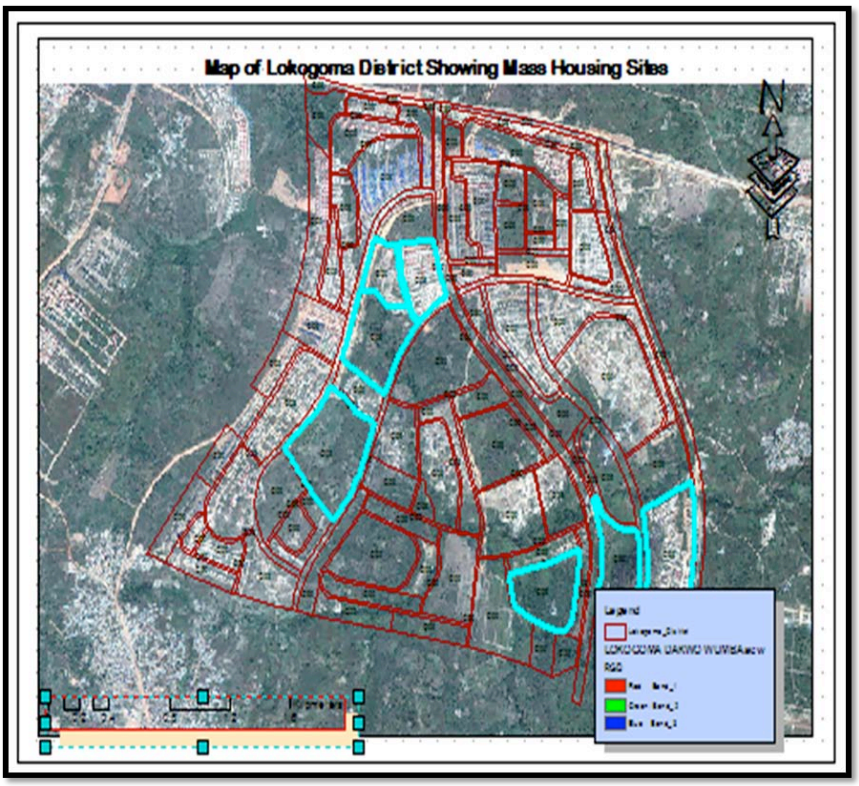

Figure 9: The study site were air quality test was carried out

The control point is a site with all the natural element in place without any propose mass housing action. The site is located about 2 km away from the study area.

Data collection methods

- Laboratory analysis of surface water from the stream within one of the locations using the **Coli form test**.
- Air quality testing in all of the five location using the **Gasman digital Monitor**
- Noise testing at the five location at various times using the **Sound Level Meter (Model Cs 15C)**
- Analysis of soil samples from the different locations using **ELICO pH electrode**,(for soil pH),**titrimetric determination** (for soil organic matter) and **physical measurement method** (for water holding capacity)
- Vegetation Analysis using the **Transect Quadrant Method (TQM)**

The following data will be collected;

Geo Physical Data These will include the following data;

- Vegetation cover, its type and coverage for a period of ten years.
- Data on drainage pattern and system.
- Data on relief and landforms
- Data on annual relative humidity, precipitation and temperature for a period of ten years.

The following checklists were adopted as the components to be examined:

a. Land
b. Vegetation
c. Water
d. Air
e. Aesthetic
f. Spatial

Impact Assessment Analysis

According to the European Commission Impact Assessment Guidelines (2005), impact assessment management matrix aims at providing a careful and comprehensive analysis of likely social, economic and environmental impact. Therefore, the impact significance was determined using the criteria in table 1.

Table 1: Impact Assessment Management Matrix

		LIKELIHOOD RATING		
		A	B	C
CONSEQUENCE RATING	1	1A	1B	1C
	2	2A	2B	2C
	3	3A	3B	3C
	4	4A	4B	4C
	5	5A	5B	5C
	6	6	6	6
KEY				
Consequences		Likelihood	Acceptability	
1-Negligible	4-Significant	A-Low	Negligible with minor mitigation	
2- Minor	5- Catastrophic	B- Medium	Minimize impacts	
3- Moderate	6-Beneficial	C- High	Unacceptable	

Source: European Commission Impact Assessment Guidelines (2005)

RESULTS AND DISCUSSION

The environmental effects of mass housing in this study concentrated on five basic components;

- Air: Effects on the surrounding air and ozone layer depletion
- Water: Contamination of water sources such as stream, well and underground water
- Soil: soil degradation in terms of erosion as a result of pressures on land.
- Vegetation: deforestation as a result of housing development
- Relief and Landforms: destruction of beautiful sceneries such as rocks, and hills.

Mass Housing Development Process in Lokogoma

Mass housing development process in Lokogoma and FCT as a whole involves some activities categorized into the following:

Design Process: This stage involves the design of the land such as architectural drawings, mechanical and electrical drawings and infrastructural designs. After vetting of the drawings by the Development control department, FCT, approvals will be given for development.

Site Clearance: This forms the first construction activities in mass housing construction process. It involves clearing of the wanted vegetation cover that may hinder the construction process, cutting and filling of wanted valleys and depression, extraction of the soil and blasting of unwanted rock outcrop.

Site Fencing: This involves demarcation of the plot where mass housing construction will take place. It involves the delivery of materials for fencing such as blocks, cement, chippings and sand. The delivery of these materials involves the use of Trucks, Lorries and Vans.

Infrastructural Development: It involves the construction of relevant infrastructure within the mass housing site such as construction of roads, drainages, walkways, waste sewers and bitumen surface.

These activities have been the normal practice in mass construction in the FCT. However, the use of construction equipments has some negative impact to the immediate environment especially impact on air, vegetation, soil, water and landforms. Therefore there is the need for environmental analysis to determine the effect of mass housing construction on these environmental components.

Analysis of Data

Air

Emissions to the atmosphere from construction sites include particulates (that is dust, motor vehicle emissions and smoke) and odour. Such emissions can have adverse off-site impacts if they are not properly managed or controlled. The ultimate aim of mass housing construction activity is to construct structures for residential purposes on a piece of land suitably zoned for that purpose. However, the construction activities in the study area include the following;

- Clearing of land and related excavation and compaction activities.
- Operation of heavy machinery and related equipment for earthmoving and construction purposes (excavators, bulldozers, cranes, etc.) and the engines associated with such machines.
- Erection of structures using steel, concrete, brick, glass, timber, and other materials.
- Mechanical activities including grinding, hammering, drilling, grit blasting and demolition.

- Metal joining and finishing including welding, brazing, soldering and other techniques.
- Generation of solid wastes and debris, their stockpiling and transfer through chutes and loading onto trucks or into skips.
- Transport of building materials and supplies on to the site, and transport of wastes off site.
- Movement of vehicles along roadways and paths, in and out of the site and within the site, together with any establishment and maintenance of the roadways (e.g. grading).
- Application of surface coatings and finishes using paints and adhesives.

Emissions can occur from any of the activities listed above, but on different sites to varying degrees and with different durations and frequencies. For example, road dust generated from vehicular movements within the site may occur at regular intervals. Other activities may only occur at a certain stage of the construction process, e.g. earth moving, demolition, grit and sand blasting or spray painting.

It was observed that, there is the presence of CO, NO2 and dust around the site especially at the stage of site clearance is the major threat to its inhabitant which is basically as a result of the following construction activities;

- Smoke as a result of engines combustion of fossil fuel from site automobiles, and those generated from the diesel engines operating vehicles and machinery. Diesel-fired engines emit particulate matter (soot) and gaseous emissions such as carbon monoxide, sulfur oxides, nitrogen oxides and organic compounds.
- Surface finishing such as spray, painting, use of resins, adhesives, caulking compounds, sealants and silicone.
- Carborundum odours from grinding, cutting and sanding operations.
- Site clearance using heavy equipment which generates a heap of dust and particulate matter into the atmosphere.

Apart from dust and emissions of the above mentioned toxic components noise pollution is the second threat to residents especially those around I-PENT and EFAB estates. Therefore, strong measures should be put in place by the authorities concern to reduce the impact.

Noise Measurement

Generally, the noise level in the study area was high. Noise level ranges from 70.4 dB (Average) to 89.5 dB (Average). The results of the study shows that the highest level was recorded at I-PENT estate construction site 89.5db followed by 89.0dB (Average) obtained at EFAB estate. I-PENT estate is the newest amongst the five estates, so construction of houses is in progress which generates a lot of noise from construction equipment and sound from incoming and outgoing moving vehicles also contributes to the noise at this location. The high levels obtained at the estate construction site could have been due to noise from all forms of construction vehicles used for the construction work. The lowest value was however obtained at EFAB estate (70.4 dB (A)) which was mainly because sound emanates from car owners within the estate and there is no more construction going on (estate is fully developed).

When these values were compared with the American Conference of Governmental Industrial Hygienists (ACGIH) values, it will be observed that noise pollution pose serious health risks to receptors at I-PENT construction site when compared with statutory value of 80 dB(A). Staff at this work site should be made to wear ear muffs for the 8-hour day while prolonged work hours should be avoided as much as possible.

Water

Water source within the study area is underground water and surface water (particularly stream).The stream serve as water source to villages around Lokogoma and also used for irrigation farming. The stream cut across the boundaries of the study area and terminates in Saraji district. Mass housing developers also uses the stream as water source to minimize the cost of construction.

However, about 40 percent of the stream within the study area has been sand filled and some part stone peached which has not only reduced the volume of water in the stream but also contaminated with pollutants and other chemicals.

There are two sources of liquid wastes associated within the study area:

a. **Liquid Wastes** was generated through uses such as sewer lines from other estates and other toilet waste. Total dissolved solids, water temperature and turbidity will be high. These will have adverse effects on aquatic organisms and cause decrease in photosynthetic processes by slowing down the rate of growth of plankton in the aquatic environment. All liquid wastes are to be channeled into the central sewage system of the city. Sewage water and other chemically contaminated liquid wastes should not be allowed into public drain or any stream course but disposed of through the central sewer lines which shall be provided for the district.

b. **Storm Water** was generated through rainfall and external/outdoor cleaning and sanitation procedures into the surface water. In the rainy season when high levels are expected, an average of about 2500 liters will be generated daily and this wash away hazardous substances from construction sites into the surface water.

Considering the importance of the stream as a water source within Lokogoma and surrounding neighborhood, water quality analysis was conducted around the EFAB estate extension at a geographical location of Latitude 8.9603N, Longitude 7.45021E.

Soil

Undoubtedly, this set of components is the most seriously affected by the proposed project, since land is the platform for all activities and development that will take place on the site. The mass housing project had impacts on land in three ways.

a. **Removal of topsoil:** The construction process will necessitate (at the initial stage) site clearance, leveling and excavation which definitely affect the topsoil. Similarly, during construction and lying of utilities such as drainage, water pipes, and electricity. These operations affect the environment in diverse ways. Site clearance resulted in the removal of both vegetation cover and topsoil, whilst excavation and construction of facilities, utilities lines subverted local ecosystem. The soil structure and some soil micro-organism were altered and destroyed respectively. However, the negative effects these activities led to soil erosion especially, by felling trees and clearing grasses where necessary, while leveling and excavation are carried out within few days.

b. **Ground vibration and noise pollution:** At the pre-construction stage, site clearance, leveling and excavation involved the use of heavy machineries and plant like D8 Bulldozers. This causes some level of ground vibration leading destruction of the soil profile.

c. **Solid Waste Generation:** Apart from the initial physical changes in ground condition through land preparation and construction activities, improper and inefficient disposal of solid waste method often becomes a source of land pollution. Solid waste from this type of development has been found to be construction waste which includes demolition debris, wood, plastics, among others.

GODAB estate is one of the estates that suffer soil pressure due to various efforts of the developers to build the estate within the stipulated time given to them by the FCT administration. However, there are massive construction activities going on in the estate which put some pressures on the soil. A soil sample within the estate was subjected to laboratory analysis to verify the anticipated effect.
Soil analysis was also conducted at the control point (Saraji district) with geographical coordinate of 10'06'15 N 11'14 07 E. The result will serve as basis for comparism with the results obtained at the study area (GODAB estate).

Vegetation
Vegetation was the most affected component of the environment as a result of mass housing construction in Lokogoma, as evident from the plate below. Vegetation assessment was carried out in the control point (Saraji) to establish original vegetation cover in the area. In the same vein, assessment was also conducted in the study area (Lokogoma-Efab Extension) to identify the existing vegetation cover. The study also observed that the control point has a numerous vegetation cover including both grasses, shrubs, economic and indigenous trees. However, the control point has no housing construction at the moment although there is approved government layout which was allocated to developers but there is no work going on presently. The vegetation at the study area (Lokogoma) has similar characteristics especially before mass housing development in 2004.

Relief and Landforms
Lokogoma is one of the districts in the FCT with a very high potential for recreation and tourism. The district has a lot of hills, natural spring, views, vista and other beautiful sceneries. Analysis of responses from the an interview conducted to village chief of Kabusa, Saraji and Kusaki wards (all located around the study area) shows that, there are two rock hills within the study area, which were blasted in 2008 to create access to other mass housing plot. However, many valleys were sand filled during the construction of N8 road in 2007 which alters the natural environment. There following were the summary of the responses;

- Mass housing construction was the reason for shortages of food supply within the ward as a result of takeover of farm land by the government.
- Housing construction in Lokogoma has led to destruction of beautiful sceneries which could serve as recreational potentials.
- Mass housing development has encouraged degradation of land forms especially extraction and blasting of rocks for construction purposes.
- The construction process has resulted to plant and animal extinction especially in the early stages of the construction in 2006 and 2007.
- There was a lot of water runoff and over flow in some of the surrounding villages due to blockages of natural stream especially in the raining seasons.

CONCLUSION

This study centers mainly on the environmental effects of mass housing. The study focused basically on five main environmental components (i.e. Air, water, soil, vegetation and relief and landforms) and how mass housing development affects them. Mass housing development in Lokogoma district in the FCT has resulted to the following environmental problem;

1. Air pollution: The surrounding area has been contaminated with toxic components as a result of operation of heavy machineries and equipment in mass housing sites. Construction activities from site clearance to finishing has resulted to the generation

of particulate matter, fumes and dust thereby affecting visibility and causing health hazards. The use of machineries especially drilling machine have contributed a lot of noise in the surrounding neighborhood thereby creating nuisance to people.

2. Deforestation: This is the major environmental problem of the district over the years as a lot of indigenous tree were cleared in the name of housing and infrastructural development.
3. Soil degradation: The housing development has result some forms of land pressures within Lokogoma district and has led to land pollution (open dumping of solid waste especially construction waste) soil erosion and some risks of desertification and drought especially behind GODAB and IPENT estates.
4. Flooding: The sand filling of natural drainages, stone peaching of stream channels and conversion of green areas for housing development within the study area has paved way of chances of flooding to occur as evident in EFAB estate were some part of the estate was water logged in the raining season last year.

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