



Environmental Impact of Urbanization in Nigeria

Odafivwotu Ohwo^{1*} and Abel Abotutu²

¹Department of Geography and Environmental Management, Niger Delta University,
Wilberforce Island, Bayelsa State, Nigeria.

²Department of Geography and Regional Planning, Delta State University, Abraka, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author OO, designed the study and wrote the first draft of the manuscript. Author AA, managed the literature search. Both authors read and approved the final manuscript.

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ABSTRACT

This review revealed that there are several evidences of environmental impact of urbanization in Nigeria. The linkages between urbanization process and the environment are profound that the major components of the environment-air, water and land are adversely affected by the daily anthropogenic activities of urban residence and in the process of exploiting the natural resource base. The goal of ensuring environmental sustainability is greatly threatened by urbanization, which has created several serious environmental problems, such as pollution, deforestation and wetland destruction, erosion and flooding, urban sprawl, slum and squatter settlements, heat island and aesthetic degradation that have had negative impacts on man and other living organisms in the environment. If the threats posed by urbanization in Nigeria are not adequately managed, the capacity of the environment to continuously support life may be jeopardized with dire consequences on human life.

Keywords: Environmental impact; Nigeria; pollution; Urbanization.

*Corresponding author: E-mail: drowodafe@gmail.com;

1. INTRODUCTION

Man continues sustenance on earth and the quality of his living is heavily dependent on the environment. The major components of the environment-air, water and land are supporting pillars of man, which he depends on directly or indirectly for his survival and well being. Unfortunately, man seems to be at war with his environment, which is evident in his over exploitation and inadequate management of the basic components of the environment. This unsustainable exploitation of the natural environment has posed serious challenges and great threat to Nigeria's natural resource base. One of the major threats to the Nigeria environment is urbanization. Mabogunje [1] stated that urbanization is a process of human agglomeration in multi-functional settlement of relatively substantial size. Urbanization process is one of the most powerful and visible anthropogenic forces on earth [2]. This process, as explained by [3], has been responsible for transforming towns, cities and metropolitan areas, while at the same time depopulating the rural setting through a process of direct rural-urban migration.

Studies have shown that rapid urbanization has greatly accelerated economic and social development and global cities are engines of economic growth and centres of innovation for the global economy and the hinterlands of their respective nations [4]. Hence, the world continues to experience high rates of urbanization, especially in developing countries like Nigeria, which has an estimated 5.3 per cent annual growth rate. The United Nations [5] noted that 30 per cent of the global population lived in urban areas in 1957; while the figure reached 50 per cent in 2008, and an estimated 70 per cent is projected for the year 2050. It stated further that in the foreseeable future, virtually all of the world's population growth will be absorbed by the urban areas of the less developed regions, whose population is projected to increase from 2.4 billion in 2007 to 5.3 billion in 2050. Today there are over 400 cities in the world with populations of over 1 million people [6]. In Nigeria, the Human Development Report (2004) cited in [7] observed that of the 2002 estimated population of 120.9 million people, 45.9 per cent of the population resides in urban centers. According to [8], residents of urban centers in Nigeria in 1950 were less than 15 per cent of the population; while it rose to 23.4 per cent and 43.3 per cent in 1975 and 2000 respectively; with an

annual urban population growth rate of 4.8 per cent. He also noted that Nigeria has 359 urban settlements of at least 20, 000 people according to the 1991 National Population Census.

The high influx of people into the urban centres from the rural areas to take advantage of the perceived opportunities offered by these urban centres, without adequate planning and effective management strategies to accommodate this influx by the government, results to serious pressure on both the socio-economic supporting infrastructure and the environment. For instance, urbanization has been identified as the cause of numerous environmental problems, which include and not limited to air, water, land and noise pollution, deforestation, local climate alteration, and traffic congestions, which ranges from local to the global scale [9-13].

In Nigeria, [9] cited in [14] identified several types of environmental problems classified as ecological, poaching and habitat loss, increasing desertification and soil erosion. These are further subdivided into pollution, deforestation, global warming, slum development, etc. Nigeria's coastal regions are currently experiencing widespread contamination from petroleum exploration (gas flaring, oil spillage) while the general poor living conditions in urban areas in the country constitutes an affront to human dignity [14]. These environmental problems continue to increase as the urban growth rate continues to rise.

The National Population Commission [15] observed that most urban areas in Nigeria have grown beyond their environmental carrying capacities and existing infrastructure. For instance, data from the National Population Census (2006) revealed that most of the urban areas in Nigeria with small land mass have already exhausted or have extremely limited capacities to accommodate further increase in population [16]. With a population figure of more than 140 million and land mass of about 924,000 Km², current estimates indicated that 10 per cent of the land area accommodated 28 per cent of the country's total population [17]. The implication of this is that there is disequilibrium between the population and the environment, and this has adversely affected the carrying capacity of the urban areas in the country; hence the increasing poor quality of the living conditions and the low livability index of urban areas in Nigeria [14].

The goal of ensuring environmental sustainability is greatly threatened by urbanization, which has created several serious environmental problems that have had negative impacts on man and other living organisms in the environment. If the threats posed by urbanization in Nigeria are not adequately managed, the capacity of the environment to continuously support life may be jeopardized with dire consequences on human life.

In spite of the importance of the environment for human sustainability, not much study has been carried out in Nigeria to investigate the fundamental linkages between the environment and urbanization. Past studies on impact of urbanization are broad based, focusing on socio-economic and environmental issues [14;18], which have created gaps in the in-depth analysis of environmental and urbanization linkages. However, without an adequate understanding of the intricate linkages between the environment and urbanization process, it would be difficult to propose effective and efficient strategies to resolving or ameliorating the plurality of the impacts of urbanization on the environment. Hence, this study was aimed to fill the gap in the understanding of the environment and urbanization linkages through a comprehensive review. It is hoped that this understanding will prove valuable to Nigerian policy makers, urban developers and environmentalists in the sustainable management of the environment and urbanization linkages to the benefit of man and other living organisms. This review is presented under the following subheadings: introduction, pollution, deforestation and wetland destruction, erosion and flooding, urban sprawl, slum and squatter settlement, heat island, aesthetic degradation, conclusion and recommendations.

2. POLLUTION

Human activities generate tremendous amount of waste materials, which increases as production and consumption activities increases, especially in urban areas as population agglomerates. The waste generated may find their way into the major components of the environment (air, water and land) bringing about environmental pollution. Environmental pollution is an undesirable change in the physical, chemical or biological characteristics of air, water or land that will be or may be harmful to human and other life, industrial process, living conditions and cultural assets or cause wastages of our raw material resources [19].

2.1 Water Pollution

In most Nigerian urban areas, waste management is a big challenge, which has brought about severe pollution of the major environmental components, with dire consequences on the inhabitants. For instance, [20] reported that rain water in Warri metropolis contain a high level of acidity due to the high emission of particulate matters and gases into the urban atmospheric environment. He stated further that the resultant acid rain pollutes both surface and groundwater sources with negative effects on the health of the inhabitants. Similarly, [21] reveals that some of the selected quality parameters of hand-dug wells in Warri-Effurun metropolis have concentrations, which are not within the World Health Organization (WHO) thresholds. For instance, pH concentrations in all the sampled well water are not within the 6.5-8.5 WHO thresholds for drinking water, as all the values are below the minimum 6.5 WHO range. This shows that well water supply in the metropolis is acidic, (which agrees with [20]). Also, the report revealed that all well water samples contain total coliform counts, as against the WHO zero thresholds. This indicates that there might be the presence of disease causing pathogenic bacteria, which may pose a threat to human health if such water is consumed without treatment [21].

This scenario in Warri metropolis is not different from what is obtainable in other urban areas in Nigeria. For instance, a study by [22] reveals that some of the selected quality parameters of borehole water in Yenagoa metropolis, have concentrations above the WHO thresholds for potable water. They reported that turbidity values in all the sampled water were above the WHO 5 NTU thresholds; while 46.67% samples have pH values below the WHO minimum value of 6.5, indicating acidity.

Studies have identified several human activities that cause water pollution. These activities pollute both surface and groundwater resources in Nigerian urban centres. One of the major sources of water pollution in the urban areas of the Niger Delta is oil spills, which has brought about massive pollution of the water resources in this area, killing aquatic lives and rendering the affected water sources unsafe for human consumption. In addition, buried chemical waste and poorly maintained dumpsites, which are common features in most Nigerian cities can pollute both surface and groundwater sources. The poor sewage treatment and solid waste

disposal in most cities in Nigeria, is another veritable source of water resources pollution (Plate 1). Unrestricted use of pesticides, insecticides, herbicides and indiscriminate dumping of refuse, excreta and animal dung as well as spillages from refineries, large scale bush burning are identified as some of the leading factors of environmental pollution in Nigeria [23,24]. Furthermore, soil erosion, siltation, salinization, irrigation, saltwater incursion and pollution from urban and municipal sources each pose grave threats to Nigeria's freshwater resources. In times of drought, and/or with areas confronted with desertification these threats are even more exacerbated. In the dry land areas of the north, human habitation relies heavily on groundwater resources that are recharged from freshwater percolation and runoff during the rainy season. Anything that upsets this balance threatens the livelihoods and economy of the people who live there [25].

A major source of water pollution in Nigeria urban areas is fertilizer used in agriculture. Urban agricultural practices make extensive use of fertilizers, which usually contain large amounts of nitrogen and phosphorus. When it rains the fertilizer is washed into streams, rivers and creeks, which pollutes and facilitates the process of eutrophication that degrade the quality of the surface water, which makes it unfit for human consumption.

2.2 Air Pollution

In Nigeria, ambient air pollution emanates from three major sources-energy generation, industry and transportation-all of which increase with population and economic growth. Rapid urbanization is a major contributing factor to all

the three major sources. Degraded air quality in key urban centers, such as Lagos, Port Harcourt, Kano amongst others, is as a result of the heavy dependence on oil-dominated transportation. Motor vehicles produce more air pollution than any other single human activity [26]. Transportation requires huge amounts of energy. Globally, 20% of all energy produced is used for transportation. Of this, between 60 and 70% goes toward transporting people, and the rest toward moving freight [27]. In addition, power plants, factories, and other stationary sources including the thousands of privately owned petrol and diesel generators used for power failure backups degrade the air quality of major urban centres in Nigeria.

The situation is compounded by poor urban transportation planning as manifested by congestion in both large and small cities of Nigeria. Clogged city streets exact a major toll on economic productivity and exacerbate air pollution. In highly congested city centers, traffic can be responsible for as much as 90 to 95% of the ambient carbon monoxide levels, 80 to 90% of the nitrogen oxides and hydrocarbons and a large portion of the particulates, all posing a significant threat to human health and natural resources [26]. Nigeria's current use of leaded gasoline contributes to the high levels of lead in the ambient air. Producing the energy required to run modern urban systems often involves burning fossil fuels, which releases such greenhouse gases as carbon monoxide, carbon dioxide, and nitrogen oxides. These emissions lead to global warming, which can cause destruction of the ozone layer, climate change, rising sea levels, changes in vegetation, and severe weather events [25].



Plate 1. Indiscriminate disposal of municipal solid waste, court road Gyadi-gyadi, Kano

Source: Adapted from Butu, A. W and Mshelia, S. S [33] (2014)

2.3 Land Pollution

Several studies have identified industrial and agricultural activities, indiscriminate waste disposal and oil spills as major causes of land pollution in Nigeria [28,29]. In urban areas in Nigeria, there are more concentrations of industrial activities and high level of waste generation, coupled with poor disposal and management (Plate 1), which increases the probability of land pollution. For instance, the World Health Organization [30] observed that almost all industrial activities cause some pollution and produce waste. However, relatively few industries (without pollution control and waste treatment facilities) are responsible for the bulk of the pollution. Adebisi and Fayemiwo [29] identified three kinds of industrial pollution, which affect the land. They include construction debris, petrochemicals from transport and fuel and heavy metals and chemicals. Industrial wastes and emissions contain toxic and hazardous substances, most of which are detrimental to human health [31,32].

In most urban centres in Nigeria there are heaps of municipal solid wastes unattended to (Plate 1); and many of the objects that are thrown away contain toxic substances, which leach into soil and water affecting the health of plants, animals and humans. Electronic waste contains mercury, lead, arsenic cadmium, chromium and other metals that have environmental health implications. Construction waste may contain asbestos, fossil fuel derivatives, and other toxic substances. Measures to control these substances are hampered by the fact that they are dispersed within less toxic trash in millions of tons, making their removal very problematic [33]. As a result, some of these toxic wastes linger in the soil surface for a long time and makes it unsuitable for human use.

3. DEFORESTATION AND WETLAND DESTRUCTION

The threats to biodiversity, tropical forests and the rest of the many ecosystems and natural habitats in Nigeria are overwhelming and escalating. A key feature of Nigeria's ecology is its large and burgeoning human population and the increasing pressure this population growth is putting upon the natural environment. Urban areas are congested and growing, without adequate environmental safeguards [25].

Most land areas in Nigeria have been converted to agricultural or pastoral uses and agricultural encroachment threatens the natural areas that remain. In addition, the escalating practices of overfishing, uncontrolled logging, and many other unsustainable uses of the natural resources pose serious threats to the survival of significant component of Nigeria's biodiversity [25]. Echoing the same view point, [34] stated that agricultural development, urban growth, industrial expansion and pressure from an increasing population have reduced the extent, diversity and stability of the Nigerian forest. Unfortunately, the capacity to integrate environmental concerns into economic development planning and activities is extremely weak in Nigeria.

Mba [9] cited in [14] identified deforestation resulting from road projects, subsistence activities, lumbering, mining and dam construction as constituting the greatest threat to environmental sustainability in Nigeria. In the loss of biodiversity, for instance, [14] reported that the World Fact Book (2005) identified Nigeria as one of the countries with the highest rates of forest loss (3.3 per cent) in the world. Since 1990, the country has lost some 6.1 million hectares or 35.7 per cent of its forest covers. The record also indicated that Nigeria's most biologically diverse ecosystems are fast depleted at an unbelievable rate. For an example, between 1990 and 2005, the country lost a staggering 79 percent of these forests and since 2000 Nigeria has consistently been losing an average of 11 percent of its primary forests per year. These constitute serious challenge to environmental sustainability. The various species of plants and animals that are required to establish and sustain the various food webs and chains as well as natural cycles are systematically being depleted and thus resulting in ecological imbalance and threatening the survival of man in the environment [14]. Ajibola [35] noted that urbanization is a major cause of loss of coastal wetlands. Urbanization impacts wetlands in numerous direct and indirect ways. For example, construction reportedly impacts wetlands by causing direct habitat loss, suspended solids additions, hydrologic changes and altered water quality. Indirect impacts include changes in hydrology and sedimentations which substantially alter wetlands. It also exerts significant influences on the structure and function of coastal wetlands, mainly through modifying the hydrological and sedimentation regimes, and the dynamics of nutrients and chemical pollutants. The loss and degradation of

wetlands has resulted in increased risks from coastal storms and tidal surges, leading to unintended consequences for both human and natural systems [35]. The hydrological changes caused by urbanization process have the potentials of exerting severe stress on a wetland's sustainability.

4. EROSION AND FLOODING

Flooding and erosion are common environmental challenges in southern Nigeria. Flooding had forced millions of people to leave their homes, destroying lives and properties, polluting water resources and increasing disease outbreaks. These environmental challenges are attributable to urbanization process. Environmental conditions in cities have gradually deteriorated due to the rapid growth of the cities and the attendance inability of social services and infrastructures to keep pace with the rate of growth. Inadequate storm drains, dumping of refuse in drainage lines and construction of houses close to and even on the natural water channels have been shown to be responsible in that order for the increasing cases of flood in the urban centres [36]. Also, the concrete nature of urban land surface accentuates runoffs, which is a veritable aid to erosion and subsequent flooding.

Furthermore, when forest is cleared, the soil is exposed to erosion devastation, floods occur, and rivers and lakes, are filled up with silt. The water becomes dirty and impure for mankind. The removal of tree canopy (particularly the leaves) has effect on the rainfall of that area, as there is less leaf surface area for the transpiration of water, which in turn affects the relative humidity of the atmosphere [34].

5. URBAN SPRAWL, SLUM AND SQUATTER SETTLEMENTS

Sprawl is the spreading out of a city and its suburbs over more and more rural land at the periphery of an urban area. This involves the conversion of open space (rural land) into built-up, developed land over time (<http://www.sprawlcity.org/defining.html>).

Increasing urban population necessitates the provision of more roads to accommodate an ever growing number of vehicles, thereby creating sprawling metropolises. This situation is very common in Nigerian urban centres, due to lack of effective planning. This claim is supported by [33]

in their study of Kano State, where they observed that urbanization affects land use and when not properly controlled causes emergence of illegal structures and neighbourhoods, which is the characteristics of some quarters within Kano metropolis. This has affected the city master plan, thereby affecting social services such as waste collection, and eventually leading to indiscriminate dumping of waste in illegal areas

Sprawl has directly contributed to the degradation and decline of natural habitats such as wetlands, woodlands and associated wildlife. It also reduces farmland and open spaces. Sprawl is used as an aesthetic judgment about a general urban development pattern. Generally, sprawl is widely known as ugly development with tendency to discontinuity and haphazard layout [37].

Urbanization in Nigeria is characterized by city slums with serious environmental and social consequences. According to [36] millions of Nigerians live in sub-standard and sub-human environment, plagued by slum, squalor and grossly inadequate social amenities. The result is manifested in growing overcrowding in homes and increasing pressure on infrastructural facilities and rapid deteriorating environment. The problems of slum formations and urban degeneration in Nigeria are common occurrence in major cities-particularly, in Lagos and Ibadan which are probably among the largest cities in the country [38]. Over the past decades, these problems have constituted major challenges to sustainable urban development [39]. Similarly, [8] stated that today's Nigerian city is typified by substandard and inadequate housing, slums and lack of infrastructure. This situation has given rise to poverty, broken families, poor educational system, malnutrition, along with parallel economics linked to gangs, prostitution, drugs and high crime rates, which are indication of the degraded social conditions in such unplanned developments. It is in such environments that the urban poor rotates back and forth between these slums and the rural areas, where they poach/mine the rural natural resources in a subsistence mode, thinking only of today and not the long-term consequences of their actions.

The environmental problems in urban centres outweigh the experience in the countryside, as the environmental problems are seen as the results of human activities which are higher in the urban centres [18]. Slums developments in urban centres deplete the physical environment,

increases crimes and violence. In the same vein, [40] noted that the proliferation of these slums, which he refers to as shantytowns results in the unwieldy expansion of the urban centers which poses a major planning problem as provision and management of roads, drainage and sewage systems among other infrastructure, proves very difficult. Furthermore, shantytowns, a consequent of urbanization, cause increases in the incidence of urban poverty, diseases and epidemics, environmental pollution, urban conflicts and crimes.

6. HEAT ISLAND

Urbanization leads to alterations of the local climate, and in particular creates a significant urban heat island (UHI) effect [41,10]. Urban development, including land use changes, dense building developments, heat emissions, human activities, etc., have a great impact upon the local climate of a city. Urban areas are often jungles of asphalt, concrete, brick and other dark materials for the construction of roads and buildings. All of these man-made materials have a low reflectivity, and function to absorb incident solar radiation [42]. This effect causes the city to become 2°F to 10°F (1 to 6°C) warmer than surrounding landscapes, which reduce soil moisture and intensification of carbon dioxide emissions [43]. In addition, it may lead to thermal physiological discomfort of people living in the affected areas.

7. AESTHETIC DEGRADATION

Aesthetic degradation or visual pollution occurs, when the outer ambient atmosphere contains

materials in concentrations which are harmful to man and affect the aesthetic value of his environment. There are several sources of aesthetic degradation in Nigeria, which include urban sprawl, indiscriminate waste disposal, billboards amongst others. Although signs and billboards are works of graphics which have contributed immensely to the development of Nigerian cities [44], however, it has contributed to visual pollution in Nigerian cities. There are several instances where billboards are pulled down and destroyed by wind, torn or have peelings and are not replaced for years; which constitute visual environmental pollution (Plate 2). According to [45] such billboards project visual disorder and visual clutter perpetuating visual pollution, visual chaos and visual obstruction which tend to diminish aesthetic sensibility and visual literacy in Nigerian cities. He stated further that environmental pollution of billboards is assuming global magnitude, and its frontiers are no more confined to any particular part of our planet.

Indiscriminate wastes disposal, which are common occurrence in most Nigerian urban centres harbours pests and rodents and produce foul odour that degrades the aesthetic quality of the environment [46]. In addition, the indiscriminate erections of communication masks and other unsightly structures degrade the aesthetics of the urban environment.



Plate 2. Urban aesthetic degradation: A billboard constituting visual pollution, Akure, Nigeria.

Source: Adapted from E. B. Oladumiye, [45] (2013)

8. CONCLUSION AND RECOMMENDATIONS

This review highlighted the linkage between urbanization and the environment and revealed that the linkage is profound. Hence, there is the need for a proper understanding of this linkage in order to effectively and efficiently develop programmes and strategies that will enhance the drive towards sustainable environmental management. In Nigeria, urbanization process has created severe negative environmental impacts, such as pollution, deforestation and wetland destruction, erosion and flooding, urban sprawl, slum and squatter settlement, heat island and aesthetic degradation, which have had dire consequences on both human and other living organisms. In order to be on the desirable path to sustainable environmental management, urbanization process should be controlled and managed effectively, without exceeding the carrying capacity of the environment. This can be achieved by fashioning rural development strategies, which could reduce rural-urban migration. In addition, other anthropogenic activities, which have negative impact on the environment, should be effectively and efficiently managed.

Air, water and land pollution is most widespread and potent in the Niger Delta region of Nigeria. This is due to unbridled exploitation of oil resources by multinational oil companies and activities of oil bunkerers. Quantitatively, there is dearth of data on pollution in Nigeria, and indeed the Niger Delta region. The environment of the Niger Delta region has been abused and degraded by oil exploration and other human activities which include forest resource extraction and demographic change. The ecosystem of the region faces imminent extinction if current policies and behavioural patterns are not immediately evolved to curb the menace.

There are two broad long term strategies necessary for the mitigation of the negative impact of pollution in the Niger Delta cities in particular and other Nigerian cities in general. These strategies include:

(i) Stemming the tide of rural-urban migration via rural development programmes with three main elements as follows:

- accelerated output growth through technological, institutional, and price incentive changes designed to raise the productivity of small farmers;

- rising domestic demand for agricultural output derived from an employment-oriented urban development strategies; and
- diversified, non-agricultural labour-intensive rural development activities that directly and indirectly support and are supported by the farming community.

(ii) There is a dire need to control the activities of man in the Niger Delta region to curtail the unbridled degradation of the environment. This objective can be achieved by strengthening the enforcement mechanism of the Ministry of Environment to implement the provisions of the existing Environmental Impact Assessment (EIA) Degree 86 of 1992 to the letters. With this done, it becomes mandatory for developers to submit an (EIA) report to the relevant ministry and applications for development granted only if operators whose activities pollute the environment are made to bear the cost of their negative externalities. For instance, the oil companies will be legally bound and under obligation to clean-up oil spills land and regenerate same through a long-term programme of phyto-remediation. In the same vein, polluted water can be purified through a long-term programme of water treatment/chlorination project. Urban heat occasioned by human activities such as deforestation and construction can be mitigated via a long-term programme of "greening"-afforestation in rural areas and tree planting in cities.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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