

A Study of the Ecological Impact of Construction on the Environment: A Case Study of Bosso and Chanchaga Local Government Areas in Minna, Niger State - Nigeria

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Abstract— Industrialization comes with the need to construct or erect more structures. However before construction takes place, lands are cleared of vegetation and trees. This clearing of land constitutes deforestation. Deforestation has caused an upset in the ecological balance of the environment by depletion of forests, leading to soil erosion, wildlife extinction, aridity and the much dreaded global warming. This paper seeks to establish the rate at which deforestation occurs as a result of the construction of more housing estates in and around Minna. Relevant literatures (map inclusive) were reviewed. Personal interviews were also carried out by the researcher in the course of the study. The major housing estates selected for the survey were randomly picked from the two Local Government Areas in Minna. Deductions were arrived at by comparing the percentage of forestation in undeveloped sites with the percentage of forestation in the completed estates, and it was discovered that 83.3% of the tree population were cut down during the construction activities, leaving a paltry 16.6% of these trees standing. The paper further concluded from its findings the possible reasons for deforestation which includes lack of government policy on deforestation and proper monitoring instruments to check site clearing activities by developers. Various recommendations on reducing deforestation by site clearing activities were given.

Keywords— Construction, deforestation, ecological balance, site clearing, vegetation

INTRODUCTION

A forest is defined as an area of land with a high density of trees and plants. (Oxford Advanced Learners Dictionary, 7th edition, 2006). According to the new encyclopaedia Britannica, (Volume 10, 1990) a forest is a large area of land covered in trees and other plants growing close together. At the United Nations Framework Convention on Climate Change (UNFCCC), a London-based Rainforest Foundation notes that the UN defines a “forest as being an area with as little as 10% actual tree cover, which would therefore include areas that are actually savannah-like ecosystems” (UNFCCC, 2009). Therefore, a forest can be referred to as a vast area of land that is covered with many trees and other plants of different sizes flourishing together.

Forests have been in existence as long as nature itself. The forest maintains the ecological balance of nature by providing various benefits to the environment and performing other important functions to humans. Forests support biodiversity by providing a habitat for wildlife, plants and other organisms.

Moreover, trees and plants manufacture their food through the chemical process called photosynthesis which utilises sunlight and carbon dioxide, to release pure oxygen for human respiration.

Hence, photosynthesis modifies temperature by absorbing sunlight and serves as an air purifier (Butler and Lawrence, 2008). In addition, the canopy of tree cover and grasses serves as a buffer for noise, windbreaks and protects the soil from the direct impact of rainfall by redirection of water that can cause flooding and erosion. This canopy is also able to capture fog, which it distributes into the vegetation and soil. Forest canopy and root systems provide natural filters for the water used from lakes and rivers. Root systems also prevent erosion and leaching from wind and rain by holding the soil together.

Forests increase the ability of the land to store water. The forest floor can hold as much as five times its weight in water and a tree contains water in its roots, trunk, stems, and leaves. Because of all this stored moisture, forests help to maintain an even flow of water in rivers and streams in times of flood or drought (Butler and Lawrence, 2008).

There have been various arguments on the rate of tree cutting that constitutes deforestation which has resulted in various definitions. Some attempt to reduce it to overharvesting or over cutting of trees while others, majorly environmentalists, argue that the clearing of any form of vegetation at any rate, constitutes deforestation (Hibbard, 2001). Deforestation is hereby defined as the indiscriminate cutting of trees to obtain timber (to be used as fuel, building materials or wood pulp for paper production) or clear the land for agriculture, construction or other human activities. “Indiscriminate” implies that, no careful selections or choices are made, and it is carried out haphazardly. (Oxford Advanced Learners Dictionary, 7th edition, 2006).

Few environmental issues have attracted as much attention

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worldwide in recent years as deforestation. A major reason for the high visibility of deforestation as an issue is of course its overall impact on the earth's ecological well-being. (Hibbard, 2001). This is due to the fact that deforestation has been on the increase simultaneously with modernization and industrialization. According to a UN Report on Underlying Causes of Deforestation, factors that allow deforestation to occur on a large scale include lax forest management and defective environmental laws, lack of awareness of the intrinsic value of forests, and the absence of ascribed value for vegetation (UNFCCC, 2009). It has been predicted by some scientists that unless significant measures are taken on a worldwide basis, by 2030 there will only be ten percent of a global forest area remaining, with another ten percent in a degraded condition, 80% will have been lost, and with them hundreds of thousands of irreplaceable species. In West Africa, 90% of the coastal rainforests have disappeared since 1900 and several countries have declared their deforestation a national emergency (UNFCCC, 2009).

Deforestation affects the environment in many ways.

Atmospheric impact

The decay of cleared vegetation and burning of same releases stored carbon back to the atmosphere and may cause carbon stores held in soil to be released. Hence, deforestation is a contributor to global warming and a major cause of the enhanced greenhouse effect which is basically due to excessive carbon gases in the atmosphere.

Hydrology and soil

Flooding, erosion and landslides occurs because deforestation reduces the cohesion of soil and reduces or removes the protective cover of the soil thereby increasing the amount of runoff. The use of mechanized equipment for site clearing also contributes to erosion.

Aridity takes place when part of a forest is removed, because the trees no longer evaporate and release into the atmosphere water extracted from their roots, resulting in a much drier climate. Deforestation reduces the content of water in the soil and groundwater as well as atmospheric vapour. These could all culminate in desertification. The extension of the Sahara desert into Niger, Sierra Leone, Liberia, is partly due to the absence of vegetation. (Michael, 2003)

Ecological impact

It has been estimated that 137 plants, animal and insect species are lost every single day due to rainforest deforestation, which translates to 50,000 species a year, (UNFCCC, 2009). The removal or destruction of areas of forest cover has resulted in a degraded environment with reduced biodiversity leading to wildlife extinction and adversely affecting medicinal conservation (with forest biotopes being irreplaceable source of new drugs such as taxol).

Economical impact

Forest industry is a large part of the economy in every country. Short-term economic gains made by conversion of forest for various reasons, typically lead to loss of long-term income and long term biological productivity. The amount of money

spent on labour employed in logging and the cost of battling natural disasters resulting from deforestation causes billions of dollars of losses to national economies annually. (Hibbard, 2001)

Deforestation is caused by various human activities, such as agriculture, construction, logging and fuel wood removals. This research, however examines construction activities as a major cause of deforestation. Construction activities which have resulted in deforestation include:

Timbering or lumbering: timber is a major building material, serving as building components such as roof trusses, window and door frames, partitioning, flooring, and building such as scaffolds and formworks. It is also used for furniture works and joinery in interior decoration. The cutting down of trees to obtain timber constitutes deforestation.

Site clearing: this is carried out in the preparation of land for construction. It involves the clearing of trees, grasses and other vegetation from a land, before the commencement of excavation. Site clearing is usually carried out for various reasons, some of which are:

- To provide access routes to the site for transportation of materials and labour, and the movement of machinery.
- To erect temporary structures such as stores and site offices.
- To create the area of land where the required building will be constructed.
- To rid the area from possible harmful animals such as reptiles.

Site clearing activities include:

- Removal of all forms of vegetation, manually or mechanically depending on the density and type of vegetation to be cleared and the area of the land to be cleared.
- Grubbing, this is the removal of tree stumps and roots, requiring the use of machinery.

As an effort to contribute to the knowledge to further researchers, the aim of this study is to establish a percentage rate at which deforestation occurs in Minna, as a result of site clearing activities prior to construction as a contribution to knowledge. The objectives led to the achievement of the aim defined above

- Identify areas / land affected by deforestation
- Perform calculation showing number of trees per plot cut down
- Predict possible future changes in clearing trees for building construction.

Study area

The study focuses on Minna, the state capital of Niger state. According to the 2007 estimate by the National Population Commission census, Minna has a population of 304,113, which is made up of two local government areas, which are Bosso and Chanchaga local government areas. Minna is a rapidly growing city and various construction projects have been carried out within the last 20 years, prominent of which is the construction of housing estates. This has led to a lot of land clearing activities, which has consequently resulted in deforestation.

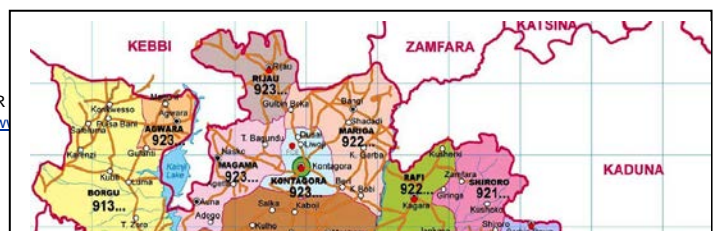


Fig 1. Map of minna showing the local government area where the two housing estates are located in Minna.

Source: Online, nigeriaipcodes.com (2016)

Minna has a vegetation type classified as guinea savannah characterised by the presence of few scattered trees and dense grass cover. There are few rivers located within Minna, and the regions near the river valleys abound in trees.

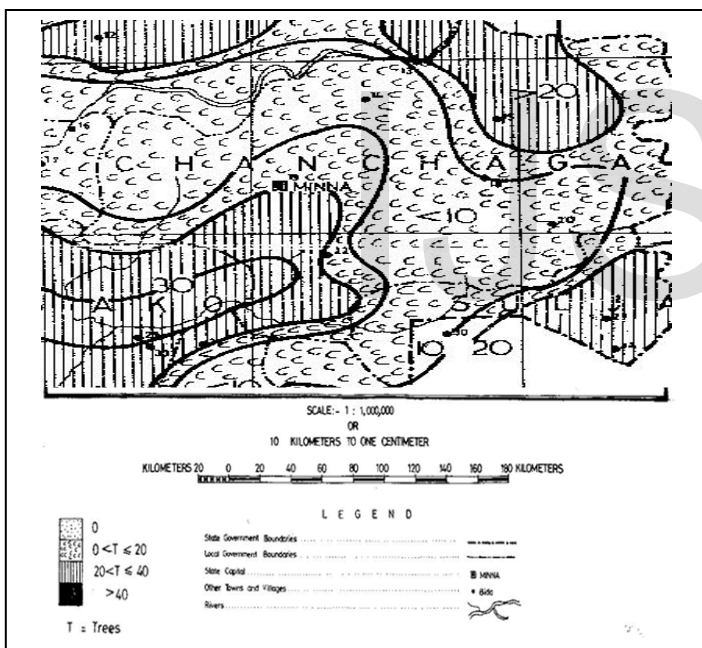


Fig 2 Map showing the percentage distribution of trees in Chanchaga local Government Area, Minna, Niger state.

Source: Department of Geography, Federal University of Technology, Minna (2016)

In an attempt to obtain relevant information on the forestation of Minna, an interview was conducted with Abdullahi Toroko, the Deputy Director, Department of Forestry, Ministry of Environment, Niger State, on August 10, 2015 which revealed that:

- Only 2.3% of the forests areas in Minna are forest reserves protected by the government which implies that 97.8% of the forests in Minna are not protected by the government.
- There are no policies and instruments to check the construction activities (site clearing) that tend towards deforestation

in the unprotected areas.

- Occasionally the protected areas are de-reserved by the government for the construction of mass housing projects or other projects though alternative forests are marked out before this occurs.
- There are no policies and instruments to check deforestation during construction once a protected area has been de-reserved.
- There are no records validating the occurrence of deforestation in Minna.

Methodology

Surveys of two housing estates selected by random sampling from each of the local governments were carried out. The estates are Abdulsalam estate in Bosso Local government area, and Intermediate quarters in Tunga low-cost, Chanchaga local government area, both estates having evolved within the last 20 years. The estates comprise of 24 and 20 households respectively.

5 (five) steps were used to determine the extent of deforestation in each estate. It is assumed that other forms of vegetation including household gardens were absent.

- 1 Establishment of the number of plots of land allocated to each estate in the master plan, from the State's Ministry of Housing.
 - 2 Determination of the average number of trees per plot of undeveloped land in Minna, by counting the no of trees in at least two undeveloped plots from each local government and obtaining the average using the equation 1.
- $$\text{Mean} = \frac{\sum_{i=1}^n x_i}{n} \dots 1$$
- 3 Determination of the average number of trees per plot of developed land in Minna, by counting the number of trees in at least two developed plots from each local government and obtaining the average using the equation 1.
 - 4 Estimating the total no of trees felled per plot in the developed area by induction from obtained average.
 - 5 Determination of the total number of trees felled in each estate, and obtaining the percentage deforestation.

$$\text{Total no of trees felled} \div \text{total no of trees in estate} \times 100$$

Where:

$$\text{Total no of trees cleared} = \text{no of trees cleared per plot} \times \text{no of developed plots}$$

$$\text{Total no of trees in estate} = \text{total no of trees in undeveloped plot} + \text{inducted total no of trees cleared from developed plots.}$$

Data Analysis

Standard plot size in Minna is 15 meters by 30 metres, making an average plot to be 450sqm

Source: Ministry of Housing and Urban Development (2016)

1. Establishing the area of land allocated to each estate.

TABLE I: Showing the total no of plots allocated to each estate

Estate	Total area of land (sqm)	No of plots
Abdulsalam estate	11250	25
Intermediate quarters	9450	21

Inclusive of setbacks (at 3 meters) and access routes

Source: Ministry of Housing and Urban Development (2016)

2. Calculating an average number of trees on an undeveloped site in each local government in Minna.

i. Bosso local government

Plot A= 4 trees

Plot B= 6 trees

From equation 1

$$\text{Mean no of trees} = 4+6 / 2, = 10/2, = 5$$

Thus, 5 trees in Bosso L.G

ii. Chanchaga local government

Plot A= 4 trees

Plot B= 6 trees

From equation 1

$$\text{Mean no of trees} = 3+4 / 2, = 7/2, = 3.5$$

Thus, 4 trees in Chanchaga L.G

iii. Average no of trees in Minna

$$\text{From equation 1, Mean} = \frac{\sum_{i=1}^n x_i}{n}$$

$$= 5+4 / 2, = 9/2, = 4.5$$

Thus, averages of five (5) trees are present per plot of undeveloped site (450sqm) in Minna.

3. Calculating an average number of trees on a developed site in each local government in Minna.

i. Bosso local government

Plot A= 0 trees

Plot B= 2 trees

From equation 1

$$\text{Mean no of trees} = 0+2 / 2, = 2/2, = 1$$

Thus, 1 trees in Bosso L.G

ii. Chanchaga local government

Plot A= 0 trees

Plot B= 1 trees

From equation 1

$$\text{Mean no of trees} = 0+1 / 2, = 1/2, = 0.5$$

Thus, 1 trees in Chanchaga L.G

iii. Average no of trees in Minna

$$\text{From equation 1, Mean} = \frac{\sum_{i=1}^n x_i}{n}$$

$$= 1+1 / 2, = 2/2, = 1$$

Thus, average of one (1) tree is present per plot of a

developed site (450sqm) in Minna.

4. Calculating the total number of trees felled in each estate during site clearing, by induction from the obtained average of undeveloped site.

Given that there are 5 no of trees per plot of undeveloped site

TABLE II: Total no of trees felled in each estate

Estate	No of plots	Total no of trees cleared
Abdulsalam estate	25	125
Intermediate quarters	21	105

Source: Author's Field Survey (2016)

The result in the table shows that;

- i. One hundred and twenty five (125) trees were cut down in the preparation of land for Abdulsalam estate.
- ii. One hundred and five (105) trees were cut down in the preparation of land for Intermediate quarters.

5. Calculating the total no of trees either re-planted or left uncut from each estate, by induction from the obtained average of developed site.

Given that there are 1 no of trees per plot of undeveloped site

TABLE III: Total no of trees left in each estate

Estate	No of plots	Total no of trees left
Abdulsalam estate	25	25
Intermediate quarters	21	21

Source: Author's Field Survey (2016)

The result in the table shows that;

- i. Twenty five (25) trees were either re-planted or left uncut in Abdulsalam estate.
- ii. Twenty one (21) trees were either re-planted or left uncut in Intermediate quarters.

6. Calculating the percentage deforestation in each estate.

TABLE IV: Percentage rate of deforestation in each estate

Estate	Percentage of trees left	Percentage of trees cleared
Abdulsalam estate	16.6%	83.3%
Intermediate quarters	16.6%	83.3%

Source: Author's Field Survey (2016)

The result in the table shows that about 83% of trees were cut down in each estate.

Summary of results:

It can be deduced from this survey that 125 trees were cut down from Abdulsalam estate in Bosso Local Government Area, (as seen from Table 11) which translates to 92% of the total number of trees that were originally on the site, prior to construction (as seen from table 1V). 25 trees (an equivalent of

16.6 %) were left uncut or replanted by residents after construction.

Similarly, it can be inferred from this survey that 105 trees were cut down from intermediate quarters in Chanchaga Local Government Area (as seen from Table 11) which translates to 83.3% of the total number of trees that were originally on the site, prior to construction (as seen from table 1V). 25 trees (an equivalent of 16.6 %) were left uncut or replanted by residents after construction.

Conclusion

From the analysis carried out in this study, it can be deduced that deforestation as a result of site clearing, takes place at the rate of 83% with 16% of reforestation, during the construction of housing estates in Minna. This can be ascribed to the lack of government interest in the site clearing activities been carried out by developers, outside the government forest reserves and disregard or ignorance of the developers and private builders on the intrinsic value of vegetation.

Recommendations

In a bid to forestall deforestation due to site clearing in Minna, the following are recommended:

- Government directives should instruct developers to cut down trees only in the areas where actual construction is to take place and not the entire site.
- Adequate supervision of ongoing construction sites by forestry officials and environmentalists to monitor site clearing activities.
- Afforestation by landscaping should be carried out by developers before the construction project is completed to balance the effect of deforestation carried out at the preparation stage
- Formulation of favourable policies on deforestation with monitoring instruments and measures which will be incorporated into the town planning laws of the state. This proposal can be forwarded by the ministry of environment in liaison with the ministry of urban housing and development, Niger state.

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