

# Assessment of Deforestation Level in Some Selected Forests in Nigeria. A Case Study of Duddurun Gaya Forest Reserve, Gaya Local Government Kano State, Nigeria

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The study aimed to assess the level of deforestation by anthropogenic activities in Duddurun Forest Reserve, Gaya local Government of Kano state Nigeria. By using Landsat Thematic Mapper images of three-decade 1986, 1990 and 2017, geographical information system (GIS) was adopted and Normalized difference vegetation index (NDVI) was used to derive images of the study area aimed at classifying, producing maps and quantifying the vegetation changes. Information about the anthropogenic activities of the inhabitant was collected using a structured questionnaire and focus group discussing. The result indicates that the study area is massively affected with illegal cutting down of trees which account to be 22.66% and 43.08% of vegetation which affected a total size of 41.77 km<sup>2</sup> and 93.70 km<sup>2</sup>

from the total size of the forest reserve with a total size of 184 km<sup>2</sup>. Information from the respondents revealed that; the major drivers that lead to the reduction in the forest were increased in demography, poverty, inadequate government policy and implementation, massive firewood and animal grazing. The research recommends that: Government and other agencies should introduce reforestation program to replace and regenerate the lost species in the forest reserve. Illegal cutting down of trees should be avoided and improve wood stoves should be introduced so that to reduce the level of wood consumption.

**Keywords:** Duddurun Gaya, vegetation change, Landsat, NDVI image, deforestation, forest reserve

## INTRODUCTION

According to the food and agricultural organization (FAO, 2005), Nigeria has the highest rate of deforestation in the world. From the year 2000 to 2005 the country lost 55.7% of its primary forests, and the rate of forest change increased by 31.2% to 3.12% per annum. The problem of deforestation in Nigeria was as a result of bush burning, irregular logging, and rapid urbanization, use of wood as cooking fuel, soil erosion, agricultural practices and oil spillage. Investigation conducted by the Department of Forestry of the Federal Ministry of Environment, in

Nigeria on brief summery outlook of Nigerian forest in the year 2000, estimated that, the forest estate in Nigeria has been degraded by illegal feeling of logs. It was projected that the trend of forest degradation in the natural forest of Nigeria could be completely depleted by the year 2004 to 2005. Looking at the energy sources in the country, fuel wood and charcoal only account for 50% of the total per capita consumption of energy, the per capita consumption of energy used in rural and urban areas were 393kg/annum and 256kg/annum respectively.

Household in southern and northern part of the country depend on fuel wood as their major source of energy for domestic use which account for 90% and 98% respectively (FAO, 2005).

Deforestation can be defined as an illegal act of cutting down of trees for human uses. Nigeria as a developing country relies seriously on wood for fuel wood as a major source of energy for cooking and other domestic and industrial uses. Sambo, (2005) said Nigeria is using 80 million cubic meters of fuel wood per annum for cooking and other domestics uses. Presently, 76% of Nigerian household are using fuel wood as their major sources of fuel (Babanyara and Saleh, 2010).

This issue has tremendous consequences on the environment due to the fact that, illegal cutting down of trees in the forest without replacement is what we mean by forest exploitation. Although, the history of man right from the Neolithic era used branches, leaves, stems, bark to ignite fire, fry his food and for warmth. This passed through centuries up to date, as the wood from forest are cut to meet man's various energy requirement example cooking, heating, lightening, other purposes such as construction of road, houses and Agricultural practices. It has been acknowledged that over one third of the world's population depend on wood as their main primary energy source, and this estimation is higher in rural African, Asian and other developing countries such as Nigeria. Research conducted by the Federal government of Nigeria (1991) shows that the rate of fuel wood consumption as alternative source of energy is estimated at 80% to 85% these huge amounts is harvested from the forest in spite of its huge oil resources of the country. This is due to the high level of poverty among the citizens, because majority of the citizens especially these that are leaving in rural area believed that kerosene, gas, coal etc is beyond their ability to afford. This rapid forest exploitation in Nigeria had made the environment to respond through escalated erosion, desertification, food shortage, biodiversity lost/ extinction and the most important consequences which is climate change (Ijatuyi, 2005).

The Dudduru Forest was reserved as part of watershed and a grazing ground near the river Duddrun Gaya. For many years the forest was reserved and kept in a good shape. The only human action prevalent in the forest reserved was grazing by the inhabitant domestics animals in the surrounding villages and the Fulani pastoralists both local and visitors. In the recent years it was reveal that, massive fuel wood harvesting and activities by arrogant politician elites who used to give out part of the forest as a gift to people for agricultural purpose and other wood exploitation. This gives room for the abuse of the reserve by the neighboring farmers and massive exploitation of the resources in the forest.

This research work attempts to understand the rate of deforestation, the anthropogenic causes and the environmental response. With reference to the research

conducted at Gaya town and some other villages surrounding Duddurun Gaya Forest. The content of the report is divided into five chapters. The first chapter is general introduction of the whole research, followed by chapter two which is literature review, chapter three is devoted to an overview of the methods used in the process of conducting the research (methodology) chapter four shows the outcomes or finding of the research and the discussions. The last which is chapter five displayed the summary, conclusion and general recommendation of the research.

The recent trend in forest exploitation and stress by artificial and natural phenomena on global natural ecosystem has call for better and serious management strategies, especially in the drier areas of the world (savannah and desert environments). Trees are destroyed rampantly for minor benefit, without looking at their countless potentials and benefits of preserving the natural environment. Although the situation is common throughout the world, but it is more common in African countries where over 80% of the woods are harvested which was highly link with rapid environmental degradation, where the commonest and worst part of it were fuel wood and agricultural land expansion (Cunningham, 2006).

Nigeria is one of the countries in the world that experience the highest rate of primary forest exploitation with 5.7% compared to the world with 3.3% annual average per annum. It has been observed that, the natural forest cover in the country had been decline from 25,5952km<sup>2</sup> in 1976 to less than 10,114km<sup>2</sup> in 2005, this indicate a loss of about 53% of the total forestland (Meduna *et al.*,2009).

The aim of this work is to assess the level of Deforestation in Duddurun Gaya Forest reserve. While the specific objectives are to determine the vegetation cover change between 1987 to 2017 in the study area, identify the major drivers of deforestation in the study area, identify the factors responsible for involvement of the local people in wood exploitation in the forest reserve. And finally were to determine the environmental consequences of the exploitation in the study area.

### Research hypothesis

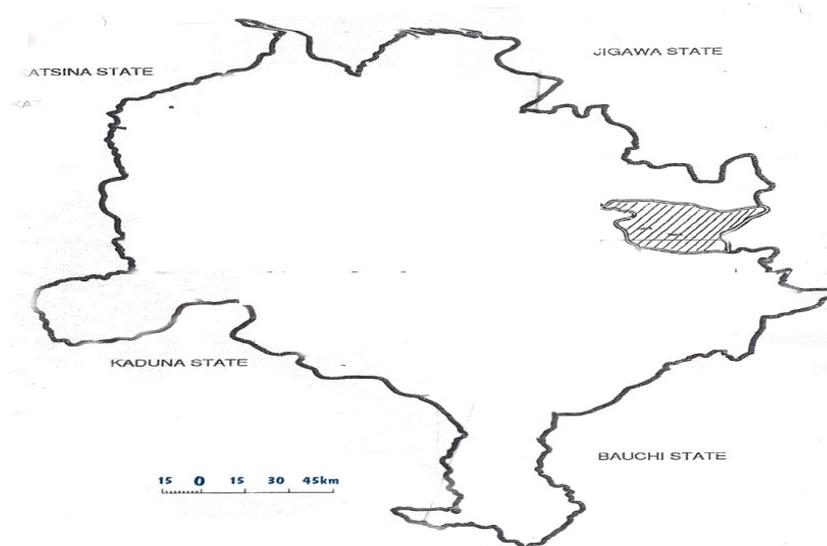
Null Hypothesis (Ho) = there is no significant change in vegetation index in the study area

Alternative Hypothesis (H<sub>A</sub>) = there is significant change in vegetation index in the study area.

## METHODOLOGY

### The study area

Gaya town which is the immediate town to the Dudduru



**Figure 1.** Map of Nigeria showing the study area (Duddurun Gaya).

forest reserve is the headquarters of Gaya Local Government Council, which is located on longitude  $9^{\circ} 02^1E$  and latitude  $1^{\circ} 52^1 N$  and situated at 65 kilometres east of Kano metropolis. From the north, the local government shares boarder with Ajingi Local Government and extends southward to Albasu local government, it bordered Wudil Local Government from the west (Figure 1).

### **Types and sources of data**

The data for this study were collected from 2 main sources, primary source and secondary source. The raw data for this research were generated field survey which involves the use of structured questionnaire, Focus Groups discussion, and coordinates measurement using GPS. While the Secondary Source were generated from, theses, Maps, Journals, Internets, conference Proceedings and other documentary sources.

### **Techniques of data collection**

#### **Reconnaissance survey**

Reconnaissance survey was conducted to identify the interested places, factors, phenomena's and people so as to have basic knowledge of the area.

#### **Selected villages**

The villages for this research were selected for being

the immediate community to the forest, and they are the major beneficiaries of the reserve in terms of agricultural activities, fuel wood, grazing the forest and the other activities in the forest. The total number of the respondents was selected based on the total population of the study area. Purposive sampling techniques was adopted and 11 villages namely Famfon Fulani, Gidan Sarkin Noma, Dumawa, Tsaida, Kwanar Kalle, Injuwa, Fan'idau, Rindatozo, Kawari, Kauyus and Muna-Muna, this was due to the existence of large tract of the forest in their territories and the high number of inhabitant dependant on the forest product

### **Sampling frame and technique**

The sampling frame adopted in this research is purposive sampling procedure, where areas were purposely selected to represent the whole for there been the affected areas during the field surveys. And the respondents were drawn at random within these selected villages. Total number of inhabitants living near Duddurun Gaya Forest was 35,120 (2006 census). Based on the population of the inhabitants, 1.5 percent was taken which gives a total of 422 questionnaires; these were targeted to interview the respondents for this research to collect information about their anthropogenic activities in the forest reserve (Table 1). The respondents were selected randomly.

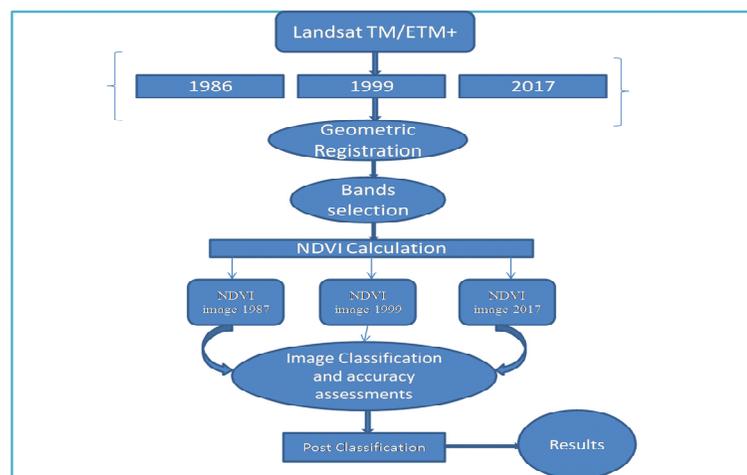
### **GPS measurement and use of satellite imagery**

The direct measurement and recording of coordinate of

**Table 1.** Targeted villages and there population (2006 census).

Villages	Population	Percentage	Respondents	whole number for respondents
Famfon F	968	1.5	11.62	12
S/Noma	1564	1.5	18.76	19
Dumawa	2684	1.5	32.21	32
Tsaida	5137	1.5	61.64	62
Kwanakalle	3502	1.5	42.02	42
Injuwa	831	1.5	9.97	10
Fan'idau	10,927	1.5	131.124	131
Rindatozo	3056	1.5	36.67	37
Kawari	2911	1.5	34.93	35
Kauyus	1707	1.5	20.48	21
Muna-Mun	1707	1.5	22.71	23
Total	35,120			422

Source: NPCC 2018.

**Figure 2.** Steps for calculating normalize difference vegetation index.

the study locations (the Forest Reserve) were taken using the instrument of GPS. Also Google Earth was used to clearly ascertain the changes in vegetation cover for of the forest reserve between the targeted years (1986, 1990 and 2017). However, Normalized difference vegetation index (NDVI) were used to see the images of the study area for the years 1986, 1999, and 2017 to see the level of forest change in terms of reduction or increase in vegetation index.

$$NDVI = NDVI (2017) - NDVI (1999) - NDVI (1989)$$

These techniques are used to compare between two or more different images of different dates. The individual normalize vegetation index (NDVI) were generated using range of values that is -1 and +1 this mean that values from negative means there is reduction of vegetation and value from +1 to above shows positive change which is increase in vegetation of the targeted area. This is as

adopted by research conducted by Tucker, 1979 and Michael, 1990.

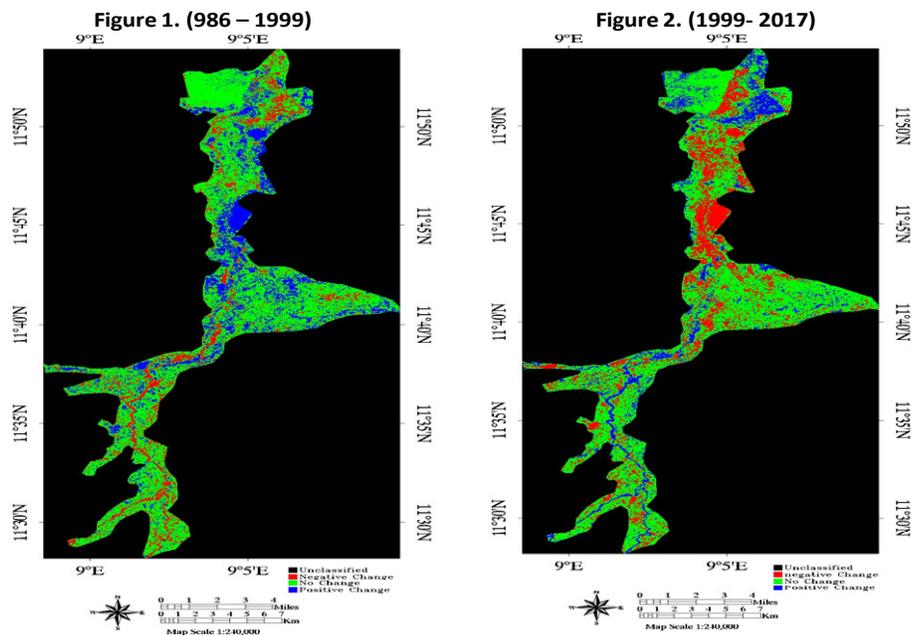
### Data analysis

The data were analyzed using descriptive statistics to answer objectives 2 and 3 using SPSS software. NDVI normalize distribution vegetation index software was used to analyse the remaining objectives and started scientific questions for the purpose of this research (Figure 2).

## RESULTS

### NDVI images from the study area showing vegetation changes between 1986, 1990 and 2017

After conducting differential analysis on the two images



**Figure 3a and b.** Showing the change in vegetation index from 1986 to 1999 and 1999 to 2017 respectively.

the NDVI indicated that there are differences between the vegetated area and un-vegetated areas. Regions that experienced negative changes (Deforestation) are assigned red colours, area with blue represent positive change changes (increase in vegetation) while areas with green colours represent no changes within the stipulated periods. The main areas that showed negative changes in the study area between 1986 and 1999 were showed in (Figure 3a) were significant changes are experienced which are evenly distributed in the forest reserve. It can be seeing that there are positive changes in increase in vegetation of the study area, this was as a result of level of government commitment in controlling the forest reserve and low demand of wood by the forest inhabitants due to low population in the study area at the previous years. This corresponds with the findings of (Geist, 2002) who state that increase in population is one of the major agents/ causes of illegal felling of trees. While (Figure 3b) which showed the level of changes in 1999 - 2017, from figure 3b, there are more red colours, indicating reduction in vegetation of the study area compared with the (Figure 3a). The main changes were in the agricultural area around the main town of Gaya city, approximately all the vegetation has been depleted. It can deduced from the interaction conducted with the respondents that are near the forest reserve and the focus group discussion that, the problems occurred as a result of failure government and corruption where vast land were allocated to individuals for farming practices and extraction for construction purposes. However it can

also explained that there is huge increase in the population and level of poverty in these areas, which triggered the local inhabitant to fell down the trees for their farming practices, and Domestic uses. From Table 2 it can be deduced that, the actual percentage of vegetation change in terms of negative, positive and area where there is no change from 1986 to 1999. The vegetation reduced to 22.66% which covers 41.77 km<sup>2</sup> from the total size of the forest. In the same year increase in the vegetation account to 13.91% which covers 25.63 km<sup>2</sup>, while 63.42% remain unchanged that is 116.9 km<sup>2</sup> of the forest reserve. However, from 1999 to 2017, the forest has huge negative change of 43.08% and the total area affected where 62.52 km<sup>2</sup> this resemble with the finding by FAO that From 2000 to 2005 the country (Nigeria) lost 55.7% of its primary forests, and the rate of forest change increased by 31.2% to 3.12% per annum (Table 3).

## DISCUSSION

The study aimed at determining the vegetation cover change in Duddurun Gaya forest reserve in Gaya local government area of Kano state Nigeria from 1987-1999 and 2017. Three survey instruments were used to answer the four stated objectives of the research. Geographical Information System (GIS), questionnaires and focus Group Discussion were used to acquire information from the people around the study area. The results shows that,

**Table 2.** Changes in percentages and areas (km<sup>2</sup>) from 1986 to 1999.

Change in the Forest	Percentage	Area (km <sup>2</sup> )
Positive	13.91	25.63
No change	63.42	116.9
Negative change	22.66	41.77

Source (NDVI, 2018).

**Table 3.** Changes in percentages and areas (km<sup>2</sup>) from 1999 to 2017.

Change in the Forest	Percentage	Area (Km <sup>2</sup> )
Positive	15.18	27.97
No change	41.75	62.52
Negative change	43.08	93.70

Source (NDVI, 2018).

negative changes were identified between 1999 to 2017 43.08% reduction in tree cover were identified which affected 93.70km<sup>2</sup> of the total size of the forest. However, some part of the forest shows positive change from 1999 to 2017 which account for 15.18% which covered 27.97km<sup>2</sup> of the forest reserve. The research also indicated that, there is small minimal changes in the study area from 1986 to 1999, with negative change of 22.66% that affected 41.77km<sup>2</sup> of the forest, while 13.91% (25.63 km<sup>2</sup>) and 63.42% (116.9 km<sup>2</sup>) account total positive change and area where there are no change respectively. It has been deduced from the study that Duddurun Gaya forest Reserve is massively affected by cutting down of trees. This justify that the null hypothesis is rejected and we accepted our alternative hypothesis. The survey revealed that, the major drivers of deforestation in the study area are, over population, Agricultural expansion, poverty, lack of government policy, insecurity and animal grazing. Over population has been identified from the study as a major factor responsible for deforestation in the study area. It has been earlier reported form the survey that, 88.2% of the respondents are married with ten or more children whose activities are seasonal and subsistence farmers, in adequate to cater for their family demand. So they have to look for additional income to shoulder the responsibilities if their family. As such they engaged in forest exploitation of forest to sale the wood to use for domestics use (firewood). This of course is in line with finding by (Geist, 2002) who believed that, increase in population is the major driver of deforestation in the tropics. This is as reported by (Lambin et al. 2003; Lepers et al. 2005).

Poverty from the survey it has been observed that, majority of the respondents were subsistence farmers account to 77.7%, with low income and extended family, only few of them are commercial farmer. It has been elicited during focus group discussion that majority of the

respondents are seasonal farmer, they only cultivate during rainy season, and it was however revealed that, more than half of the respondents lack formal education as such there is lack of technical knowhow that will help them to improve their production. This finding resemble with research conducted by (Tasi'U, 2011) "on Role of Afforestation for a sustainable Environment, A paper presented at annual conference of National Association of Geography students, Kano University of Science and Technology Wudil. Inadequate government policy and implementations in Nigeria in this regard there is less commitments and concern on forest restoration and policies that will protect the forest against degradation. It was revealed from the survey that there is no awareness given to the respondents on impact of illegal felling of trees by government or other bodies. And there is no any existing or acting rules and regulation that protect the forest from degradation this could be as a result of corruption by political leader and other stockholders. Insecurity the information generated from the survey revealed that, there is less control measures of the forest by policy makers. This is because 69.9% of the respondents reported do not seek for legal permission before cutting down trees in the forest, only 30.1% are seeking permission before cutting down trees in the study area through "Malamindaj" Animal grazing due to proximity of the forest it was reported that 82.0% of the respondents are engaged in animal production and majority revealed that they used free range management in feeding their animals. About 60% of the respondents relied solely on Duddurun Gaya forest reserve and nearby farm land to feed their animals.

## Conclusion

In view of the major drivers that lead to decreased in forest cover of Duddurun Gaya forest Reserve in recent

years in combination with other natural factors had become a potential source of certain environmental changes which are all negative these are: Decrease in tree cover change, Reduction or extinction of biodiversity, environmental pollution and climate change.

### Recommendations

The recommended ways that will be essential to protect Duddurun Gaya forest reserve are:

Combating the existing exploited area to oppose negative impacts aimed to reverse the trend or freezing the process. This can be achieved in the study area by:

- (i) Avoiding the illegal cutting down of trees to stop further deforestation.
- (ii) Provision of improved wood stoves to reduce the level of energy consumption.
- (iii) Government and agencies should introduce reforestation program to replace and regenerate the lost species in the forest reserve.
- (iv) Provision of incentives to the local people whose plant trees in their farms, homes through given them improve variety of trees.
- (v) Organizing regular public lecturers, seminars on awareness campaign to enlighten them about the effect of deforestation to their environment.
- (vi) Re-conversion of area that are converted to agricultural land to agro forestry land.
- (vii) Government should join hand together with villages heads, hamlets and enact law governing forest conservation example cut one and plant three.
- (viii) From the research it was proved that, Majority of the inhabitant are poor farmer inadequate to cater for their demands, there is need for Nigeria governments to revive and enlarge Duddurun Gaya dam for the farmers to use during dry season for their farming activities. This will of course improve the standard of living of the communities near the study area, by having job throughout the year and will assist them to generate income and prevent them from complete reliance on wood as their major source of energy.

### Authors` declaration

We declare that this study is an original research by our research team and we agree to publish it in the journal.

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