FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 4 No. 2, June, 2020, pp 308 - 316
DOI: https://doi.org/10.33003/fjs-2020-0402-198

ASSESSMENT OF FUELWOOD HARVESTING AND ITS IMPLICATION ON VEGETATION LOSS IN OFU LOCAL GOVERNMENT AREA, KOGI STATE, NIGERIA

[1]Jenkwe, E. D. and [2]Iyeh, O. P.

Department of Geography and Environmental Management, University of Abuja, Nigeria

Authors Email: elizabethjenkwe@gmail.com[1] and omachipius@gmail.com[2]

ABSTRACT

The economic drive of the people in exploiting forests resources to earn income has in different ways impacted the natural environments of Kogi State leading to vegetation loss and environmental degradation. The study assessed fuelwood harvesting and its implication on vegetation loss in Ofu Local Government Area of Kogi State from 1989 to 2019. The objectives of the study are to; map out deforested areas and ascertain the rate of deforestation between 1989-2019 using Landsat images, identify the relationship between fuelwood consumption and vegetation loss in the area, and determine the pattern of land use/land cover change between 1989-2019 in the study area. Primary and Secondary Data were used. Landsat images of 1989, 1999, 2009 and 2019 obtained from the United State Geological Survey (USGS) with Medium resolution. The result show that the cumulative value of total vegetation lost with decrease of -78 sq km from 1989-1999 which decreases to -145sq km from 1999-2009 and similarly decreases to -508 sq km from 2009-2019 shows that the study area vegetation cover lost is 47.8% spread throughout the three decades. Thus, the total area is 1,680 km^2 compared to the -430 km^2 of the total vegetation lost. In all, the NDVI result shows a drastic reduction by 0.1647 from 1 to 0.0676 for the periods of three decades. The study suggested that; Government should try to stabilize the provision of other alternative sources of energy (electricity, fossil fuels and coal) at an affordable price, which will encourage people to stop using fuelwood.

Keywords: Fuelwood, vegetation loss, Landsat imageries, NDVI model.

INTRODUCTION

The rate at which trees are fell is by far more than the rate at which they are planted, and this is due largely to high demand for the commodity brought about by soaring prices of kerosene and gas used for domestic energy generation. Many households remain dependent on fuelwood due to socio-economic, demographic and location attributes (e.g. proximity to sources of modern and traditional fuels) in addition to fuelwood availability (Onoja and Idoko, 2012).

Forests are important natural resources that are supportive to the existence of both plants and humans alike (Food and Agricultural Organization, FAO, 2005). They cover approximately one third of the earth's surface which is equivalent to 4 billion hectares. Forests comprises a wide variety of ecosystem that range from open savannah woodlands to dense tropical rain forest and they are some of the most biological diverse system on the planet (FAO, 2005). These forests ecosystem does not only provide a range of environmental services that include soil, watershed conservation and carbon sequestration, but also extensive economic benefits from timber, energy, industrial development, medicine and recreation among others. The present day forest cover is approximately half of what existed in pre-agricultural times, the majority of which has been lost in the last three decades (FAO, 2010; Magaji and Areo, 2017).

One of the most useful forests resources consumed by man is fuelwood. Fuelwood is the primary energy source used for cooking at the household level and cooking accounts for more than 80% of the energy use of households of sub-Sahara, excluding South Africa (IEA, 2014). Fuelwood is a source of energy derived by burning wood materials like logs and twigs and is common among the rural dwellers. It is a traditional source of energy which has remained the major source of fuel for over half of the world‘s population (Aminu, 2016).

Over 13 million hectares of forest have been converted for other uses or destroyed by natural causes. Up to 28,000 species can go extinct in the next quarter century due to deforestation (World Counts, 2014). While deforestation slowed down between the year 2000 and 2005, nonetheless the process is progressing at an alarming rate with forest loss estimated at 7.3 million hectares per year predominantly in Africa and South America (FAO, 2005). The world's largest consumption of charcoal is on the African continent with attendant air emissions related environmental problems (Kituyi, 2002). The extraction of timber for wood fuel account for 61% of total wood removals (FAO, 2010), this highlights the importance of these fuels in the energy mix of many countries. This decline has been attributed to various factors that include changing livelihood patterns, such as the transition from hunter-gathering to sedentary agriculture (Sunderlin *et al.*, 2005) and socio-economic demands of development for timber, wood fuels, fibres and urban expansion (Middleton, 2008).

Notably, Nigeria has a unique geographic location which endows her with a biodiversity that comprises the savannas (Sahel, Sudan and Guinea); forests (lowland rainforest, freshwater swamp forest, mangrove forest and coastal) and mountain along the Eastern border with Cameroon and Central Nigeria (UNDP, 2004). Energy consumption patterns shows that Nigeria is challenged by limited alternative energy sources even though she is potentially endowed with sustainable energy resources. The patterns of energy use in Nigeria's economy were categorized in industrial, transport, commercial, agricultural, and household facets (Energy Commission of Nigeria, 2003). Among the energy resources in Nigeria include oil, gas, lignite, and coal bio-fuels, solar hydropower, and wind (Okafor and Joe-Uzuegbu 2010).

With increasing demand for fuel wood in urban areas and rural areas of Nigeria (Remedio, 2004) a market system was being developed for the product thus creating new business opportunities that is capable of reducing poverty among the rural farmers who have access to the Savannah and forest vegetation of Nigeria where fuel wood is mostly found. The problem of cooking fuel scarcity was exacerbated by increasing energy crisis in the world which makes conventional fuel derived from crude oil less affordable. Whereas the fossil-fuel crisis affected mainly urban households in developed countries, the firewood crisis was said to be affecting rural households in developing countries. It manifested itself as a severe shortage of firewood, the main cooking and heating fuel used by such households (Arnold, Kohlin, Persson and Shepherd, 2003; Magaji and Arao, 2017).

The major energy-consuming activities in Nigeria's households are cooking, lighting, and use of electrical appliances. Cooking accounts for a staggering 91% of household energy consumption, lighting uses up to 6%, and the remaining 3% can be attributed to the use of basic electrical appliances such as televisions and pressing irons (ECN, 2005). The predominant energy resources for domestic and commercial uses in Nigeria are fuelwood, charcoal, kerosene, cooking gas and electricity (Famuyide, Anamayi, and Usman, 2011).

Specifically, in Ofu Local Government Area, fuelwood harvesting remains one of the dominant socio-economic activities engaged by both the young and old in their struggle to earn a living. This socio-economic drive of the people in the exploitation of forests resources to earn income has in different ways impacted the natural environment of the area majorly in the form of vegetation loss resulting in soil erosion, air pollution, noise pollution, and indirectly depletion of ozone layer concentration. No doubt, vegetation furnishes the area with a wide range of essential goods such as wood, food, bush meat folder, medicines in addition to providing job opportunities for recreation, educational research and other services. But today, vegetation cover is under pressure from increasing demand for land based product and services which frequently lead to the conversion of forest into several forms of land use (Edicha and Abdullahi, 2016). However, it is against this background that the assessment of fuelwood harvesting and its implication on vegetation loss in Ofu Local Government Area of Kogi State became imperative.

AIM AND OBJECTIVES

This study assessed fuelwood harvesting and its implication on vegetation loss in Ofu Local Government Area, Kogi State, Nigeria. The specific objectives are to:

i. map out deforested areas and ascertain the rate of deforestation between 1989-2019 using Landsat images.
ii. identify the relationship between fuelwood consumption and vegetation loss in the area.
iii. determine the pattern of land use/land cover change between 1989-2019 in the study area.

Study Area

The study area lies between latitude of 7º20¨ N and longitudes 6º55¨ (GSP reading, census 2006 Enumeration Area Demarcation Exercise). Ofu Local Government area covers an area of 1,680 km².Ofu Local Government Area is one of the 21 Local Government Areas in Kogi State, with head quarters in Ugwolawo; it is one of the oldest Local Governments created since 11th of May, 1989.Ugwolawo is the headquarter of the Local Government being the seat of powero Ofu the Ejeh of Ofu, the paramount traditional ruler of the Local Government. (Ukwedeh, 2003).

The Local Government area is bounded to the North by Bassa and Dekina Local Government Areas, to the East by Ankpa and Olamaboro Local Government Areas, to the South by Igalamela-Odolu Local Government Area, and to the west by the River Niger. The area enjoys both wet and dry seasons. The wet season lasts from April to October with a short break in the middle of August tagged (August break). The dry season lasts from November to March. The total annual rainfall ranges from 1000mm to 1500mm. The average temperature is 26.8C and relative humidity of 30% in dry season and 70% in the wet season. Average daily wind speed is 89.9km/hr and usually at its peak in March and April. Average daily vapor pressure is 26%. About 747mm of precipitation fall annually. The study area lies within the Guinea savanna forest belt of Nigeria. (Ofu Master Plan, 1979). The soil of Ofu is dominated by lateritic soil type and some patches of hydromorphic and rich loamy soil (Ifatimehin and Ufuah, 2006). The lateritic soil, in its reddish colour, is formed at Ejule, Ogbulu Okokenyi areas. The Loamy soil which is very which fertile supports the cultivation of crops such as yam, cassava, maize, groundnut, sweet potatoes, Okra among others. The geomorphologic evolution of the area is influenced predominantly by sedimentary terrain. The prominent topographic features in the area consist of an undulating topography occupied by sandstone and lowlands by shale. The highest part of the study area lies in the Northwest with height of 271m above sea level.

The Aji River and Ola-Ofu River constitutes the main drainage system in the area forming dentritic drainage pattern. The Ofu River sources its water from somewhere north-west of the study area and flows southeast (Ofu Master Plan, 1979).The population of Ofu Local Government Area was put at 191,480 by the 2006 Population Census with 96,671 males and 94,809 females. The 2019 projection shows that Ofu has 281,190 population estimate with an average of 5 persons per households (National Population Commission, 2006).

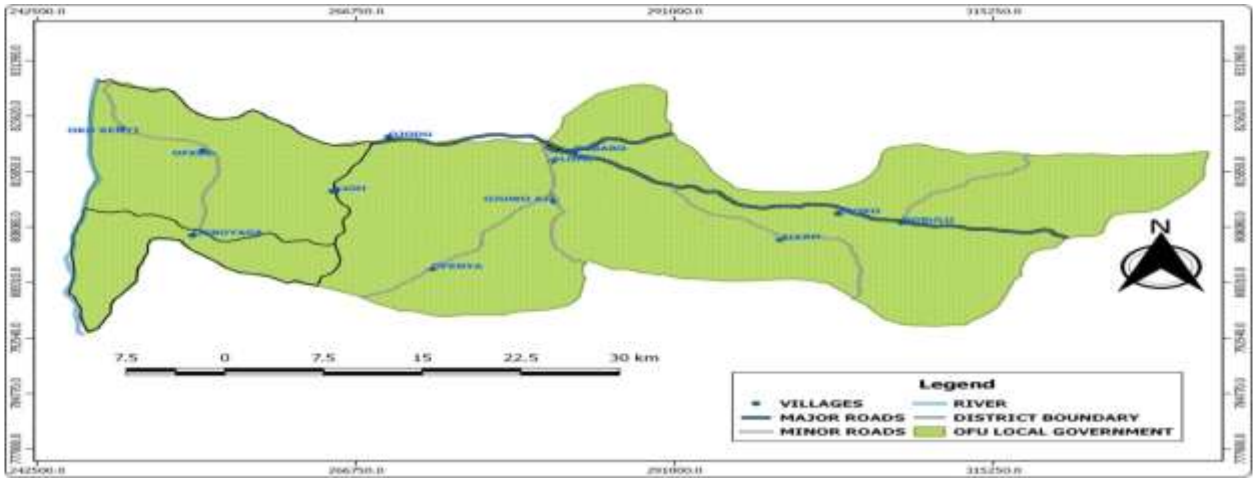

Figure 1: Map of Ofu Local Government Area, showing the Study Area.
Source: GIS Lab. Kogi State University, Anyigba, 2018.

RESEARCH METHODOLOGY

Both Primary and Secondary Data were used for this study. The primary data were collected via the use of Global Positioning System (GPS). The secondary data were obtained from local and international journals, conference papers, internet, and Landsat images of 1989, 1999, 2009 and 2019 obtained from the United State Geological Survey (USGS) with Medium resolution satellite imageries using Normalized Difference Vegetation Index (NDVI) model.

Table 1: Satellite Imageries Used for the Study

S/N	Satellite Type	Dates	Resolution	Source
1.	landsat Image ETM	2019	$30M^{ETM+}$	USGS
2.	Landsat Image ETM	2009	$30M^{ETM+}$	USGS
2.	Landsat Image TM	1999	$32M^{TM}$	GLCF
3.	LandSat Image TM	1989	$32M^{TM}$	GLCF

Source: Researcher's Compilation, 2019.

METHODS OF DATA ANALYSIS

Change in Fuelwood Harvesting

To determine the percentage change, the change is calculated by subtracting the initial value (1999) from the former value (1989) of the same land use class; i.e. Change in square kilometres = the latter area coverage of land-use/land-cover type of interest minus the former area coverage of the same land-use/land-cover type (for example, the area coverage of built–up in 2019 minus the area by built - up in 2009).

The Percentage Change was obtained by subtracting the initial value from the former value and dividing by initial value multiply by 100 (Yeates and Garner; 1976) as shown in the formula;

$$\text{Percentage Change} = \frac{\text{Formal} - \text{Initial}}{\text{Initial}} \text{ X } 100$$

Also expressed as:

$$\text{Percentage change of class} = \frac{\text{Observed change}}{\text{Base year}} \text{ X } 100$$

To determine the annual rate of change (AR), the Percentage Change (PC) was divided by the number of study year, multiplied by 100, (Yeates and Garner; 1976). The number of study years between (1989-1999, 1999-2009, 2009-2019, = 10 years interval with 30 years cumulative.

$$\text{AR} = \frac{\text{PC}}{\text{No of Years}}$$

Where; AR = Annual Rate
PC = Percentage Change

To determine the Annual Change Rate in percentage, the Percentage Change is divided by the number of study years multiplied 100, (Yeates and Garner; 1976).

$$\text{AR} = \frac{\text{PC}}{\text{No of Years}} \text{ X } 100$$

The yearly MODIS NDVI data were re-projected from the global projection (-180 to +180, -90 to +90 global extent) to Universal Transverse Mercator (UTM). Subset images of the study area were clipped out of the global data using the Ofu LGA provincial provisional boundary. Noise (cloud, effects of satellite sensors, off NADIR angles and atmospheric contaminations), which is one of the major challenges in seasonal trend data was reduced during processing of the analysis.

The change map was obtained by overlaying the map of urban extent of 1989-1999, 1999-2009 and 2009-2019 and also the map of vegetation extent of 1989-1999, 1999-2009 and 2009-2019. Normalized Difference Vegetation Index (NDVI) is an important index in Remote Sensing technology. It is most widely used in vegetation studies as an indicator of vegetation health and density. It has also gained a wide usage as an indicator of vegetation degradation.

It uses the principle that healthy vegetation absorbs most of the incident visible light emitted by the sun, and reflects a larger portion of the near Infra-red light. Unhealthy or sparse vegetation reflects more visible light and less near-Infrared light. The difference between healthy or well stocked vegetation and that of unhealthy or sparse vegetation can be assessed by means of the NDVI as;

NDVI = (NIR – RED) / (NIR + RED) OR NDVI = (NIR Band − RED Band) / (NIR Band + RED Band)

Where: NIR is the near-Infra red reflectance and RED is the reflectance of the Red portion of the visible light in the Electromagnetic Spectrum (EMS). The NDVI is a dimensionless index, so it values ranges from -1 to +1 (Meneses-Tovar, 2011) with higher value indicating denser and healthier like in tropical forests, moderate values showing shrubs and grassland, while very low values of 0.1 and below are typical to water and non-vegetated areas. In order words, high values are indicators of high photosynthetic activity and low values are indicators of low photosynthetic activities.

RESULT AND DISCUSSION

Fuelwood Harvesting Locations in Ofu LGA

One hundred locations of fuelwood commercial points were found within the study area. The major source areais Alla-Ejima village (26.7%), Ogbulu, (21.3%) corresponding to eighty locations, Iboko (17.2%) corresponding to sixty-five locations, of the source areas were fuel wood are obtained were found to be in Ogbabo (12%) corresponding to fourty-five locations, Ofeke, (5.3%) corresponding to twenty locations, Ajoh, Alome ejule, Ofenya, Ogboyaga, Ojodu, and Ojuwo-aji,(2.7%) corresponding to ten locations and Oko-enyi, (1.3%) corresponding to five locations. The study area is made up of twelve villages but only four of thevillages that the entire Ofu LGA solely depend for fuelwood. Figure 1 shows the mapped area of commercial fuelwood harvesting area in the study area.

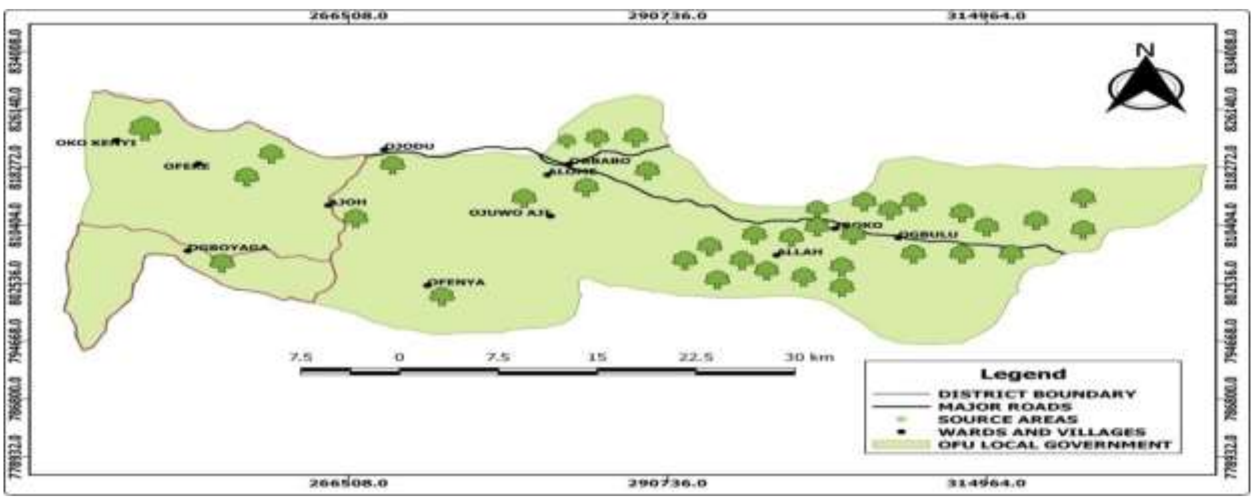

Figure 2:Areas Where Fuelwood are Obtained
Source: Field Work, 2019

Normalized Difference Vegetation Index (NDVI) Vegetation Change detection and Land Cover Patterns

The NDVI Results shows that there was a reduction in the vegetation cover of the study.

From 1989-1999, the bare land is reduced by 287 Km^2, sparse vegetation by 351 Km^2, moderate vegetation by 464 Km^2, high vegetation by 545 Km^2,while bare land reduced by 106 Km^2, sparse vegetation is reduced by 201 Km^2, moderate vegetation by 389 Km^2, high vegetation by 402 Km^2 with difference of 584 Km^2.

Also, there was a reduction in vegetation cover from 1999-2009, bare land is reduced to 106 Km^2, sparse vegetation reduced to 201 Km^2, moderate vegetation is reduced to 389 Km^2, high vegetation reduced to 402 Km^2, while bare land is reduced to 77 Km^2, sparse vegetation reduced to 221 Km^2, moderate vegetation reduced to 287 Km^2, high vegetation reduced to 391 Km^2 with difference of 162 Km^2.

Similarly, there was a slight increase in vegetation cover from 2009-2019 with increase of bare land 77 Km^2, sparse vegetation 221 Km^2, moderate vegetation 287 Km^2, high vegetation 391 Km^2 , while bare land 50.5 Km^2, sparse vegetation 129.3 Km^2, moderate vegetation 208.5 Km^2, High vegetation 287.5 Km^2 with increasing margin of 291.2 Km^2 within the years respectively. This increase is as a result of planting of some economic trees such as cashew (*anacardium accidentale*).Overall, the NDVI images further revealed that the resulting values was drastically reduced by 0.1647 (from 1 to 0.0676) for the periods of three decades (1989 to 2019).

The vegetation change maps are in figures 3, 4, 5 and 6 with the total area of 1,680 km^2. Figure 5 (2009 map) shows a massive reduction in the vegetation cover with areas around Allah-ejule in the central area, Ogbonicha and Igo in the South-East, Aloji and Ochadamu in the North-East and Ugwolawo in the North-West of the map all having their vegetation cover reduced compared to similar places in 1989 (figure 3), 1999 (figure 4), 2009 and 2019 (figure 6).

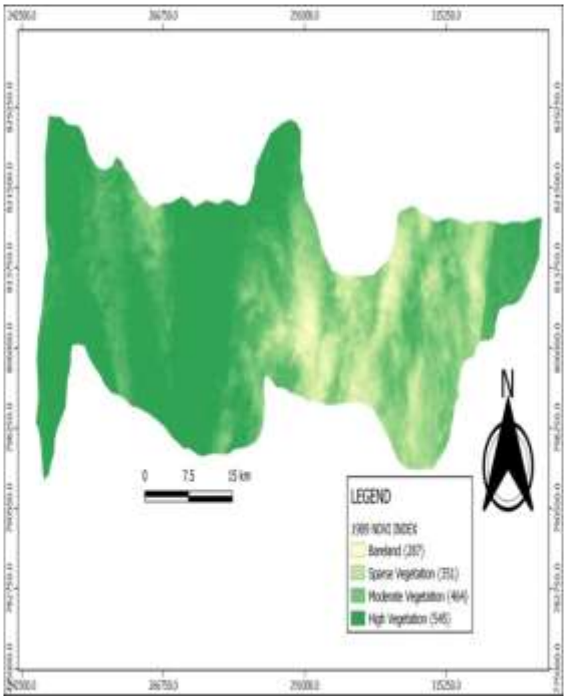

Figure 3: NDVI Resulting Image 1989

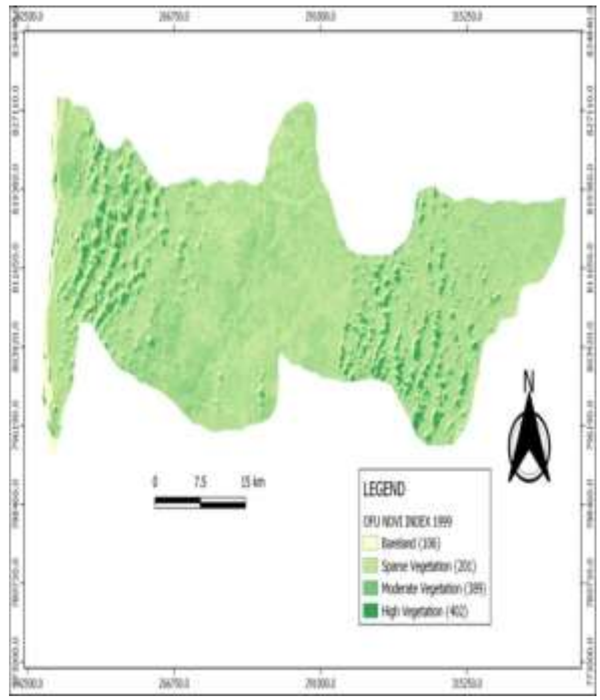

Figure 4: NDVI Resulting Image 1999

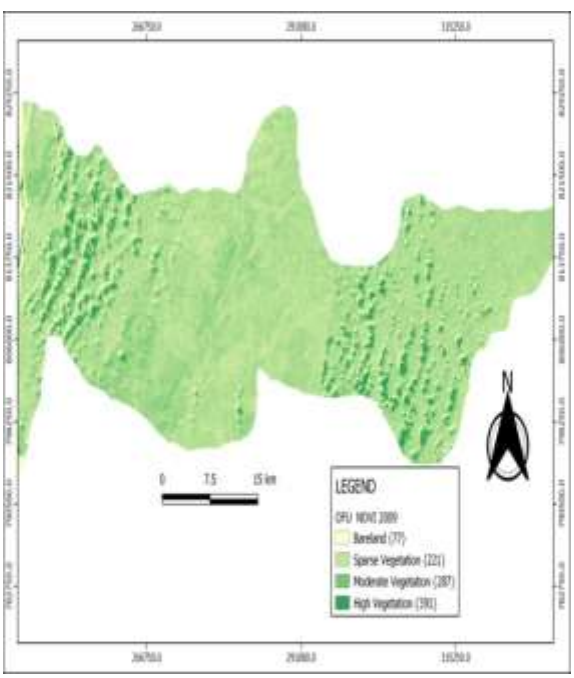

Figure 5: NDVI Resulting Image 2009

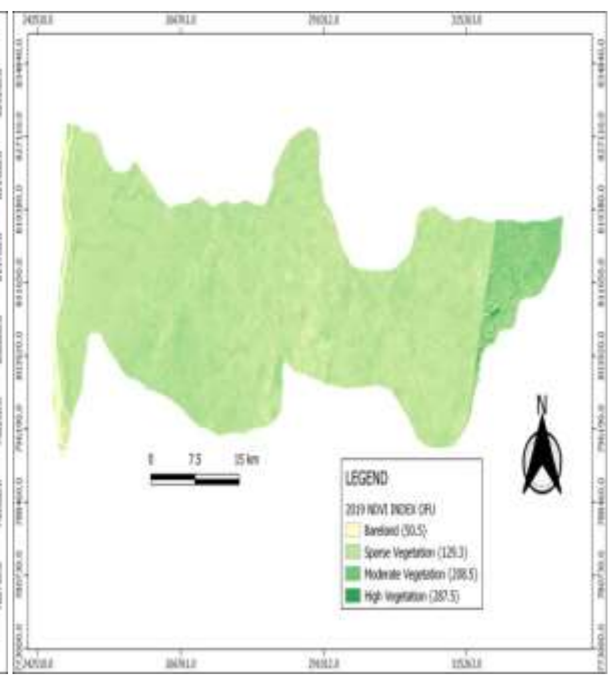

Figure 6: NDVI Resulting Image 2019

Figures 7, 8, 9 and 10shows the thematic map of classification analysis which indicates visually the changes that occur in the study area from 1989-2019 (30 years). In the three decades, forested area has declined rapidly by 17.5% with its larger percentage being converted to non-forested area and water bodies. It is clear that there is a downturn in the water bodies by 16.4% in the area as the emergence of rivers and creeks with the formation of new water channels. This is mainly attributed to the demand for firewood for domestic use and timber for construction purposes facilitated by cutting of trees in the forested areas. Between 1989-2019, non-forested area has increased by 66.1%, this is due to the pressure imposed by the demand for food as the population of the area increases.

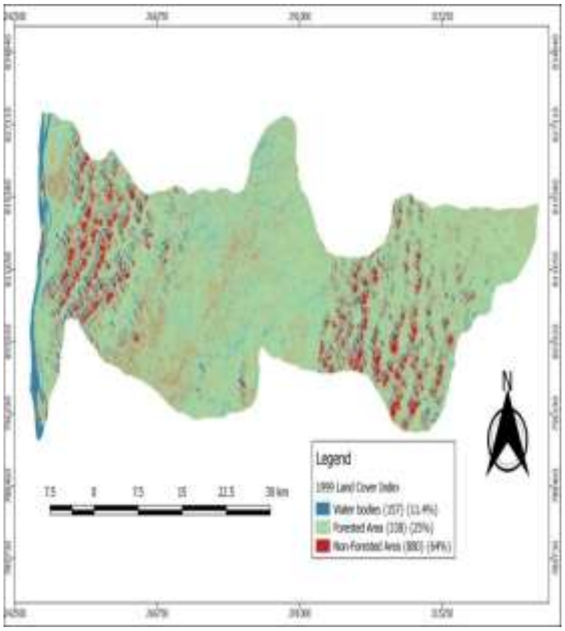

Figure 7: Vegetation Pattern 1989

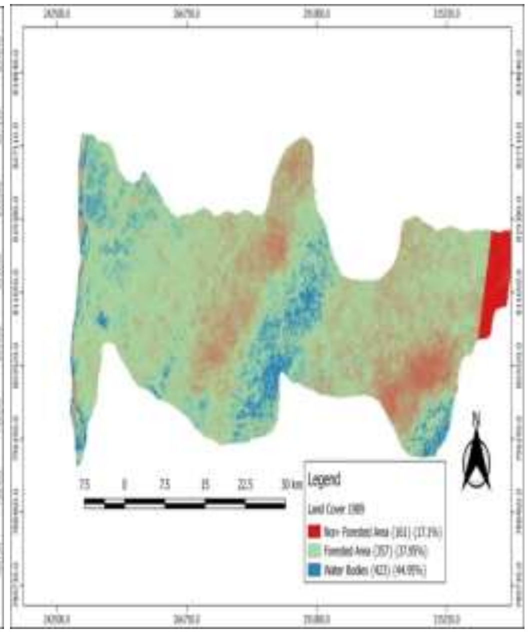

Figure 8: Vegetation Pattern 1999

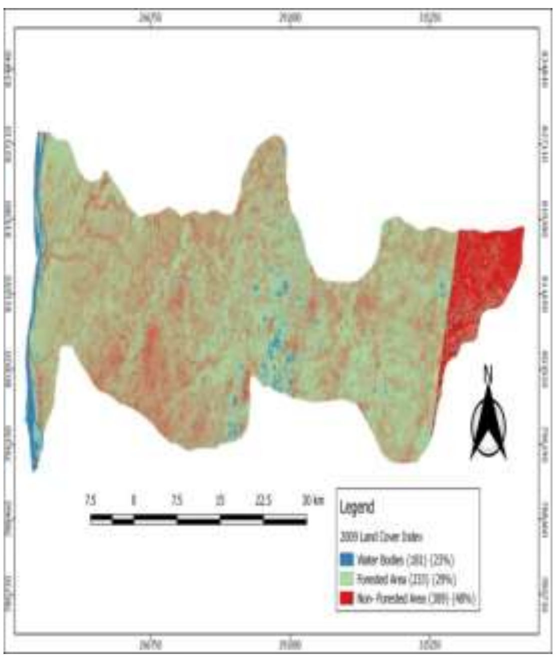

Figure 9: Vegetation Pattern 2009

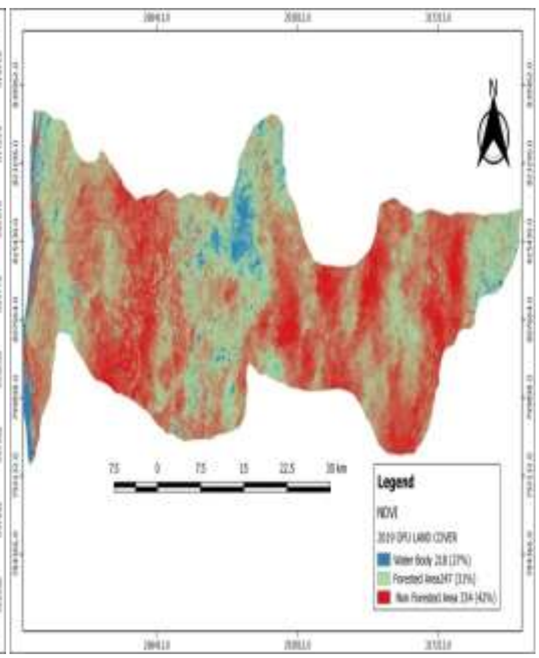

Figure 10: Vegetation Pattern 2019

Figures 11 and 12 show the area of vegetation change patterns in square kilometers (Sq. Km) from 1989-2019. The results which followed a similar pattern with the area percentage change noted in figures 7, 8, 9 and 10 showed that the study area's vegetation cover has reduced to -848 km^2 to -1,331 km^2 respectively from 1989 to 2019.

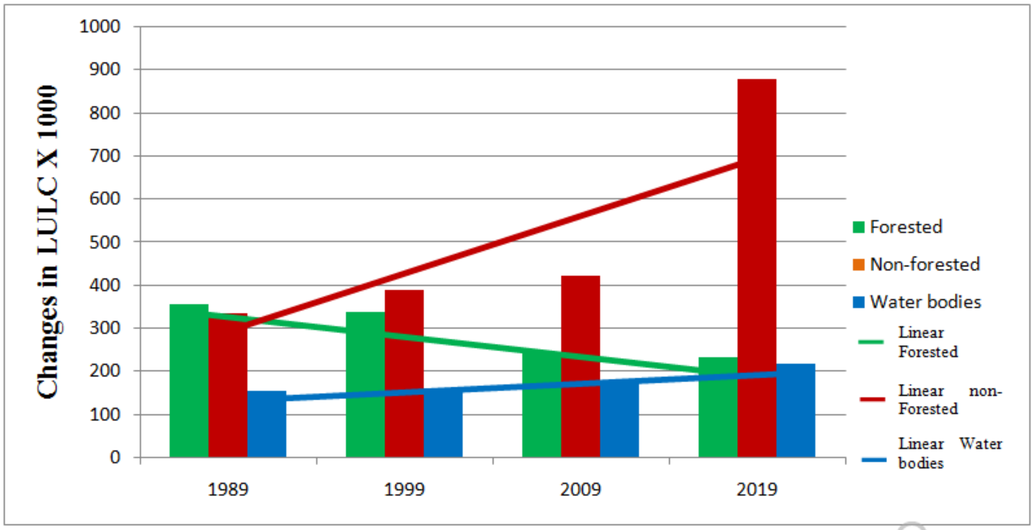

Figure 11: Water bodies, Forested and Non-forested Areas in sq km and Percentages from 1989-2019
Source: Field Work, 2019.

In figure 11, the non-forested area increased by 66.1% in the area, this is attributed to fact that most of the forested land are been cut-down mainly to be used as fuelwood, burnt while clearing the land for farming or being grazed by animals. Also, as trees have been cut-down there is systematic afforestation of some new economic trees like cashew which shows a simultaneous increase of vegetation cover in-line with deforestation.Also, a linear trend line was constructed for each thematic class; time (years) was used as an independent variable (x) while thematic classes were used as a dependent variable (y). The trends lines illustrate a steady decline in forested area while non-forested and water body increases drastically.

In figure 12, the forested area of 19 sq km (24.4%) was lost from 1989-1999 and increase to 91 sq km (62.8%) from 1999-2009 which decreased to 14sq km (2.8%) from 2009 to 2019. Consequently, this shows that there is increase in afforestation in the last decade as the result of increase in the number of cashews trees plantation. There was a lost in water bodies which is 4sq km (-5.1%) from 1989-1999 and increased to -20sq km (13.8%) from 1999-2009 which finally increased to -37km sq (-7.3%) respectively. Thus, the total area of Ofu Local Government Area 1,680km^2 compared to the -430 Km^2 of the total vegetation lost.

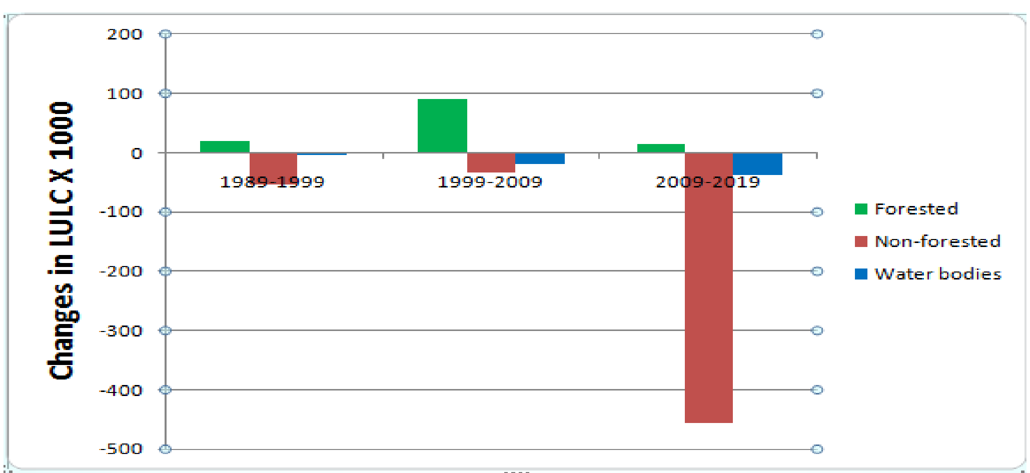

Figure 12: Rate of change and percentages from 1989-2019
Source: Field Work, 2019.

DISCUSSIONS

The result of this study is in accordance with the findings of Adeyemi and Adereleye (2016) who investigated the determinants of household choice of cooking energy in ondo state, Nigeria. The study identified available energy sources to include kerosene (45%) and LPG (12%) and also found that 63.7% and 22.9% for rural and urban households respectively use fuelwood for cooking. This study is also in agreement with the findings of Ocholi, Idoko and Ogidiolu, 2015 on Human Induced Change Characteristics of Selected Vegetation Variables in Parts of Kogi East, Nigeria where the study revealed that substantial hectares of the forest landscape have been logged and rendered less productive. Over a 100,000 hectares of vegetation cover was lost annually, most of which were deliberately removed to make way for agriculture, mineral exploitation, urbanization and expansion of settlements among others. Reforestation efforts replenished only 25,000 hectares. Analysis of the vegetation revealed that the vegetation in the area have suffered significant damage / changes in terms of its structure, density and characteristics. Also, the findings of Magaji and Areo (2017) on Fuel wood and Charcoal Harvesting as a means of Poverty Alleviationamong Gwagwalada Residence is in line with the findings of this study which the results show that the main sources of cooking energy in Gwagwalada Area Council is fuel wood and charcoal which served 23.2% of the respondents, as their major source; and 73.6% claimed that they acquire the fuel wood and charcoal through purchase from the marketers with a response mean score of mean=2.78, standard deviation of 1.15 and coefficient of variation of 41.67%, implying that the their responses are having diverse views, this cuts across all the socioeconomic groups, however, their awareness on the environmental impacts was very low.

Summary of the Findings

NDVI images values described the dimension index of the study area‘s vegetation cover in each of the three decades (1989-2019) in terms of bare land, sparse vegetation, moderate vegetation and high vegetation respectively. In all, the value drastically reduced by 0.1647 from 1 to 0.0676 for the periods of three decades. The result of LULC images portrays that the cumulative value of total vegetation lost with decrease of -78 sq km from 1989-1999 which decreases to -145sq km) from 1999-2009 and similarly decreases to -508 sq km from 2009-2019 shows that the study area vegetation cover lost is 47.8% spread throughout the three decades. Thus, the total area is 1,680km^2 compared to the -430 Km^2 of the total vegetation lost.

CONCLUSION

The study conclude that there was a massive reduction in the vegetation cover with areas around Allah-ejule in the central area, Ogbonicha and Igo in the South-East, Aloji and Ochadamu in the North-East and Ugwolawo in the North-West of the study area in 1999, 2009 and 2019 compared to similar places in 1989. The forested area of 19 sq km (24.4%) was lost from 1989-1999 and increase to 91 sq km (62.8%) from 1999-2009 which decreased to 14sq km (2.8%) from 2009 to 2019 while the non-forested area increased by 66.1% in the area, this is attributed to fact that most of the forested land are been cut-down mainly to be used as fuelwood, burnt while clearing the land for farming or being grazed by animals.

RECOMMENDATIONS

The study recommended that;

i. The farmers and the fuelwood suppliers in the study area should be encouraged to practice a selective method of cutting the trees, which will help in monitoring the progress of their tree resources.
ii. Government should try to stabilize the provision of other alternative sources of energy (electricity, fossil fuels and coal) at an affordable price, which will encourage people to stop using fuelwood.
iii. Government should enforce laws that will discourage the cutting down of trees, and encourage planting of more trees where necessary.
iv. Government should provide more job opportunities for people in the country, in order to improve their purchasing power of the alternative energy sources.

REFERENCES

Aminu, D. A. (2016). Impact of Fuelwood Consumption on Vegetation Cover in Zaria and its Environs, Kaduna State, Nigeria: Unpublished MSc. Degree Project, Ahmadu Bello University, Zaria-Nigeria.

Arnold, M., Kohlin, G., Persson, R., Shepherd, G. (2003): Fuel wood revisited. What has changed in the last decade? *Center for International Forestry Research Occasional Paper*, No.39.

Edicha, J. A. and Abdullahi, M. (2016). Analysis of Tree Height, Tree Girth and Canopy Cover in Estimating Volume of Wood in Kuje Area of Abuja, Nigeria. *Nigerian Journal of Tropical Geography vol* 7 (2).

Energy Commission of Nigeria (ECN) (2003). *National Energy Policy.* Federal Republic of Nigeria, Abuja.

Energy Commission of Nigeria (ECN) (2005). *Renewable Energy Master Plan.* Federal Republic of Nigeria, Abuja.

Famuyide, O. O., Anamayi, S. E., and Usman, J. M. (2011). Energy Resources Pricing Policy And Its Implications On Forestry And Environmental Policy Implementation In Nigeria. *Continental J Sustainable Development 2*:1-7.

FAO (2005): Global Forest Resources Assessment 2005.

Ofu Master Plan (1979). *Master Plan of Ofu and Idah Local Government Area Kogi State.* Kogi State Town Planning and Development Board.

Onoja, A.O. and Idoko, O. (2012): Econometric Analysis of Factors Influencing Fuel Wood Demand in Rural and Peri-Urban Farm Households of Kogi State. Consilience: The Journal of Sustainable Development Vol. 8, Issue 1, Pp. 115-127.

Food and Agriculture Organization of the United Nations (FAO). 2010. *Criteria and indicators for sustainable wood fuels*, vol. 160. 2010.

International Energy Agency (IEA). 2014. *An assessment of energy CO_2 related emission in Africa.* October 2014.

Magaji J.Y. and Areo I.O. (2017). Fuel wood and Charcoal Harvesting as a means of Poverty Alleviation among Gwagwalada Residence. Confluence Journals of Environmental Management. Kogi State University.

Kituyi, E (2002). "Towards Sustainable Charcoal Production and Use: a Systems Approach." Proceedings of a Regional Workshop on Woodfuel Policy and Legislation in Eastern and Southern Africa. RELMA, Nairobi, Kenya.

Middleton, N. (2008). *The Global Casino: An introduction to Environmental Issues.* London, Hodder Education.

National Population Commission (NPC) (2006). *Annual Abstracts of Statistics*. National Population Commission, Kogi State, Nigeria.

Ocholi, I. U., Idoko, O., Ogidiolu, A. (2015). Human Induced Change Characteristics of Selected Vegetation Variables in Parts of Kogi East, Nigeria.*International Journal of Science and Research (IJSR).* Index Copernicus Value (2015): 78.96 | Impact Factor (2015): 6.391.

Okafor, E.C.N. and Joe-Uzuegbu, CKA. (2010). Challenges to Development of Renewable Energy for Electric Power Sector In Nigeria. *International Journal of Academic Research 2(2):*211-216.

Sunderlin, W.D; Angelsen, A; Belcher B; Burgers P; Nasi R; Santoso, L; and Wunder, S. (2005): Livelihood, Forest and Conservation in Developing Countries; An Overview. *World Development* 33(9), 1383-1402.

Ukwedeh, J.N. (2003): History of Igala Kingdom; Ahmadu Bello University Press Ltd; Zaria- Nigeria.

United Nations Development Programme (UNDP) (2004). *Nigeria Development Profile.*

Yeast, N. and Garner, S. (1976). An Analysis of Urban Expansion and Its Impacts on Air Quality using Geospatial Approach. *Journal of Urban and Environmental Engineering*. 11(1). 153.

©2020 This is an Open Access article distributed under the terms of the Creative Commons Attribution 4.0 International license viewed via https://creativecommons.org/licenses/by/4.0/ which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is cited appropriately.