Journal of Forest Science & Environment

J. For. Sci. Env. 2025, Vol. 10 (1): 7 – 14
https://doi.org/10.63693/jfse.v10i1.24
Available at www.jfse.org.ng

ISSN: 2635 - 3296

SPATIO-TEMPORAL ASESSMENT OF DEFORESTATION IN UMUAHIA NORTH LOCAL GOVERNMENT AREA OF ABIA STATE, NIGERIA (2002-2022)

Uzonu, I.U[1]., Chikwendu, M.U[2]. and Cletus, D[1].

[1]Department of Environmental Management and Toxicology Michael Okpara University of Agriculture, Umudike
[2]Department of Forestry and Environmental Management Michael Okpara University of Agriculture, Umudike

*Corresponding author: Email: uzonu.ikenna@mouau.edu.ng Phone: +2348077621966.

ABSTRACT: This study undertook a broad assessment of deforestation within the Umuahia North Local Government Area of Abia State from 2002 to 2022. The assessment employed a multifaceted approach, including GIS analysis, demographic evaluation, spatial evaluation, spatial analysis and community perceptions. Through the examination of socioeconomic characteristics, the demographic profile of respondent was established thus highlighting the diverse range of stakeholders involved in the issue of deforestation. The study showed that in 2002, Forest Area had the highest proportion of the total land accounting for 95.06 km^2 representing (41%) of the total land. In 2022, the Forest Area reduced significantly accounting for 67.13km^2 representing (29%) of the total land. The deforestation rate during this period stood at 1.47 %. The study also concluded that the factors leading to deforestation in the study area include fuel wood extraction, farming activities, over population and poverty. Others are bush burning, road construction, over grazing and lack of value for forest. It was also found out that the ecological effects of deforestation in the study area include increase in soil erosion, increase in wind erosion, air pollution, and reduction in biodiversity, loss of tree species, reduction in forest resources and depletion of soil fertility. The study recommends consistent afforestation practices to mitigate adverse effect on the environment.

Keywords: Biodiversity, Deforestation, GIS, NDVI, Spatio-Temporal

INTRODUCTION

Forests are among the most vital natural resources, offering various economic, socio-cultural and ecological benefits. The livelihoods of hundreds of millions of people worldwide have been dependent on forest products either directly or indirectly. Forests have a vital safety net role in time of needs (Popoola, 2014). In addition to contributing to the overall macroeconomic growth of the nations, it also used by persons who depend on forest resources for their basic livelihood needs. This is especially true for the poor and rural populations. So the forest functions depend on the daily livelihood needs of people living close to it (Adebisi, 2008).

Forests provide a wide variety of ecological, economic and social services, including the conservation of biological diversity, carbon storage, soil and water conservation, provision of employment and enhanced

livelihood, enhancement of agricultural productivity and improvement of urban and per urban living conditions. That means that forest is an intricate system made up of plants and trees that protect biodiversity, providing home to terrestrial biodiversity and improving the quality of life forms on earth (Popoola, 2014). While some services are immediately visible, others are long term in nature and take their full sense only in the perspective of inter-generational equity. These services are at risk where they are most needed, especially in fragile ecosystem which characterized many poor countries and areas in the developing countries due to forest loss.

Deforestation is one of the major environmental issues not only in directly affected countries and locations, but also from global perspective; the degree of international attention to deforestation is appropriate with the role of forests in the global, national and local ecosystems. There is increasing societal concern about the impact of deforestation especially in this 21st century because of the mixed effects; socio-economic benefits and negative effects that it produces. On the positive side, the loss of the world's forest resources has contributed to the fulfillment of households' livelihoods and provided other socio-economic, cultural and spiritual benefits. It is identified that about 500 million to 1.6 billion people live in and around forests and benefitting partly from the forests for their livelihoods (Ezeali, 2015).

The main cause of deforestation globally is the growing world population. More people are dependent on the forest as resource (Nzeh, 2012). In tropical areas, forests are increasingly subjected to deforestation and degradation through anthropogenic activities. Even though the world since Stockholm conference in 1972 agreed to combat deforestation (Agenda 21), there seems to be limited passion from developing countries, including Nigeria, where incompetence, particularly as regards the implementation of environmental laws, has been the greatest bane to a sustainable environmental practice (Lines *et al*. 1997; Ibah 2001).

The Nigerian vegetal resources over time has not been sustainably used or managed; this is because many local residents in the past have treated the forest resources with ignorance. Many local residents in the past have treated the forest resources with ignorance. In the course of an intensive search, it was learnt that poverty, illiteracy and ignorance continue to stir people with an impulse towards exploiting even the relics of the remaining forest resources (Ladipo, 2010).

The forest ecosystems are disappearing at an alarming rate; between 1990 and 2005, 79% of these forests were lost (FEPA, 2011). Since 2000, Nigeria has been losing an average of 11% of its primary forests each year. According to the Food and Agriculture Organization (2011), these losses explained Nigeria as having the greatest deforestation rate in the world. Uzonu and Dogo (2016) calculated the deforestation rate of the Federal Capital Territory to be 0.279% thus leading to the loss of 374.023ha. This represents a loss of 13.83ha per annum.

The degradation of forest resources has remained ongoing in Abia State not withstanding its importance in maintaining environmental balance. This is impacting adversely on the capacity of the forests to mitigate climate change, conserve biodiversity, safeguard wildlife and protect land and watershed (Ezeali, 2015). Ezeali (2015) continued to harp that forest management programmes in Abia State have not been participatory but left solely in the hands of government that has done little or nothing in this regards. . It is against this background that this study was initiated to assess the impacts of deforestation in Umuahia North Local Government Area, Abia State.

STUDY AREA

Umuahia North Local Government Area is located within Latitude 5° 20'N, of the Equator and Longitude 7° 40'E of the Greenwich meridian. It is located in the Southeast Agro-ecological zone of Nigeria. Umuahia North LGA is characterized with wet climate zone with a heavy rainfall of 2500-3000mm per annum, temperature range of 29°-38°C and high relative humility of 89%. It is a topographic land with a maximum height of 150m above sea level. Umuahia shares boundaries with Bende and Ikwuano LGAs. It is in the region of the tropical rain forest with temperatures highest between February and April. Rainfall is seasonal and mainly occurs between May and October and annual rainfall ranges from 167 to 235cm^3. It is cold during rainy season, dry and dusty in harmattan and hot in dry season.

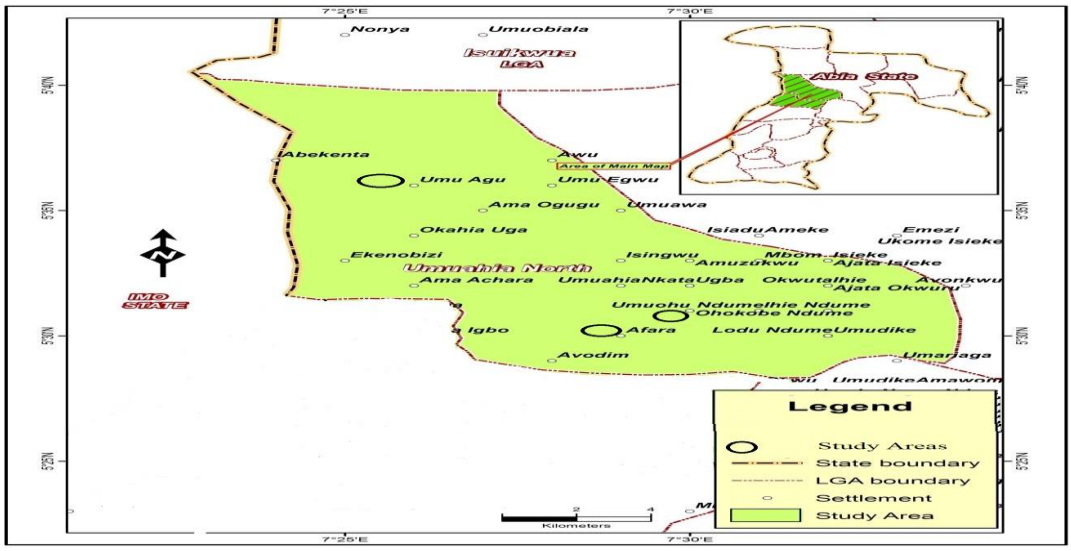

Figure 1: Umuahia North LGA showing major communities.

METHODOLOGY

Three communities within the Local Government Area were purposively selected: Ohokobe Ndume, Afara and Umuagu. The total numbers of respondents selected were 60individuals. That is, 20 respondents (compromising male and female) from each community. Data were collected through the use of such tools as GIS, questionnaires, interviews and field observations. Landsat TM images for 2002 and 2022 of Umuahia North were acquired and processed with the ERDAS image software version 10.1. Because it was difficult to obtain ground point coordinates of the study area, the study employed unsupervised classification method to delineate the images into three classes to analyze the extent of forest cover and loss in the respective years. Deforestation rate was calculated using the FAO formula;

$[Q=((A2/A1)1/(t2-t1)) -1]$.

Where Q = deforestation rate, A2 and A1 are areas covered for periods t1 and t2: t1 = 2002 and t2 =2022.
GIS (Geographical Information System) was subjected to NDVI (Normalized Difference Vegetation Index) for analysis.

RESULTS AND DISCUSSION

The land cover class of the area in 2002 was characterized into five classes, namely, Forest Area, Green Area, Bare land, Water body and Built-up area (Fig. 2 and 3).

Land Cover Distribution of Umuahia North, Abia State in 2002

Table 1 shows that Forest Area has the highest proportion of the total land accounting for 95.06 km^2 representing (41%) of the total land. This is followed by Green Areas with 69.02 km^2 (30%), bare land has 25.2 km^2 representing 11% while water body and built-up area amounted to 4.36 km^2 (2%) and 36.33 km^2 (16%) respectively. This shows that more than half of the total land mass in Umuahia was composed of vegetal cover while the built-up area occupied less than 1/5th of the total land area (16%). This is in line with the findings of Umezuruike *et al* (2017) who observed that forest and green areas made up a greater percentage of the land cover in Umuahia in earlier years.

The findings are consistent with those of Okali *et al* (2001) and Ifatimehin *et al* (2006) who studied the urban and peri-urban areas of Aba and Lokoja respectively. According to Okali *et al* (2001), the basic economic activities that were prevalent during the period under discourse were commercial activities within the Umuahia urban area and agricultural activities at the peri-urban fringes of Umuahia. This explains why the findings of this study (as shown in Table 1 and Figure 2) show less built-up area within year of 2002.

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Table 1: Land cover distribution in 2002 (km^2)

Land cover	Area cover (KM^2)	Percentages %
Built up Area	36.3364651	16%
Water Bodies	4.3627463	2%
Bare Land	25.234756	11%
Green Area	69.0217713	30%
Forest Area	95.0697658	41%
Grand Total	**230.0255045**	**100%**

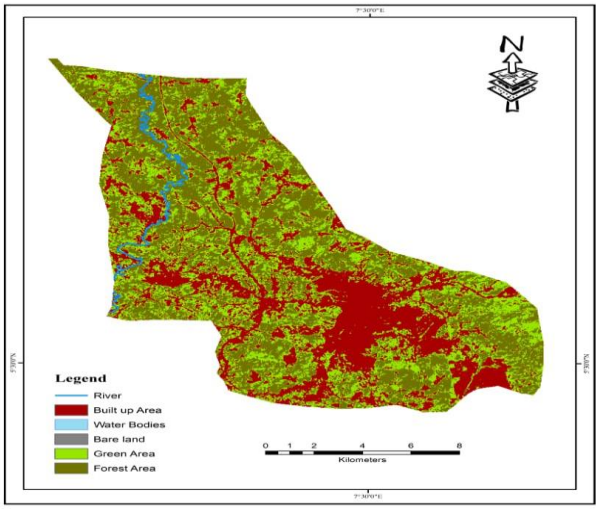

Figure 2: LULC for Umuahia North 2002

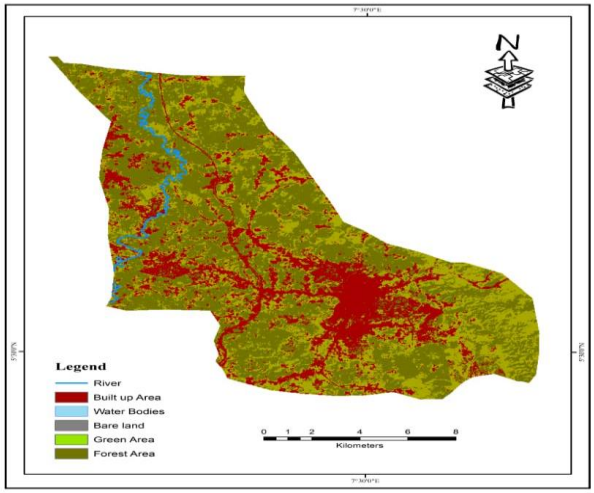

Figure 3: LULC for Umuahia North 2022

Table 2 shows the proportion of the total area occupied by each land cover class in 2022 in Umuahia North and an accurate assessment of the classified image. It shows that Forest Area has the highest proportion of the total land accounting for 67.13km^2 representing (29%) of the total land. This is followed by Green Areas with 76.13 km^2 (33%), bare land has 31.13 km^2 representing 14% while water body and built-up area amounted to 4.11 km^2 (2%) and 51.85 km^2 (23%) respectively.

Table 2 Land cover distribution in 2022

Land cover	Area cover ha	Percentage %
Built up Area	51.8567935	23%
Water Bodies	4.1134321	2%
Bare Land	31.134726	14%
Green Area	76.13177362	33%
Forest Area	67.13336464	29%
Total	**230.3700899**	**100**

DEFORESTATION RATE

Deforestation rate was determined using the FAO formula as shown below

$Q = \left(\frac{A2}{A1}\right)^{1/t2-t1} - 1 = Q = \left(\frac{67.13}{95.06}\right)^{1/20} - 1 = 0.98 - 1 = 0.02 \text{ X } 100\% = 2\%$

The annual deforestation rate (r) is recommended because it is more intuitive than the formula used by FAO

Q = Annual deforestation rate

A1 = Initial Forest cover area= 95.06

A2 = Final Forest cover area = 67.13

$\mathbf{t_2 - t_1}$ = Difference in duration = 2022- 2002 = 20

The deforestation rate in Umuahia North as calculated is 2%. This finding is corroborated by findings presented in Table 3 as it shows a high level of forest loss. The findings in Table 3 shows that the Forest Area reduced in size from 95.06 km^2 (41%) in 2002 to 67.13 km^2 (29%) in 2022 while an increase in bare land patches from 25.23 km^2 (11%) to 31.13 km^2 (14%). Also, green area increased from 69.02 km^2 (30%) to 76.13 km^2 (33%), the in Bare Land was due to the clearing of Green Areas by farmers for cultivation, while the decrease in Forest Size was due to the accelerated deforestation of the Forest.

These findings are in line with Umezurike *et al* (2022) who observed that there were very significant changes in the land cover in Umuahia North with the built-up area appreciating from 11.40km^2 in 1999 to 61.40km^2 in 2015. Their study also reported that forest land cover lost significantly between 1991 and 2015 (from 151.20km^2 to 120.90 km^2), while farmland appreciated from 10.10km^2 to 18.40 km^2 as a result of forest land cover being converted to agricultural land and built-up area. This period coincides with the period when political and developmental activities became very active in Umuahia. It is within this period that the Third Republic came into life along with the large population that is attracted to the State's seat of government through elected officials (State House of Assembly members, and other political appointees along with their families, aides and cohorts). The finding of this study is also in agreement with the observations of Okali *et al*, (2001) and Ifatimehin *et al*, (2006).

Similar research was made by Uzonu (2018) who observed that the urban area of Bwari Abuja had forest loss amounting to 56888ha was very significant, thus a 65599-ha increase in urbanization coincided with a decrease of 56888 ha in forest size. Uzonu and Bala (2016) agree that the government is the greatest agent of deforestation in Nigerian Cities. They also agreed that 56% of the cooking fuel used in Abuja as a result of population explosion and demands comes from timber.

Okali *et al* (2001) noted that the tremendous decreases in the Forest Area is a result of massive deforestation caused by increased lumbering activities and an increase in built up area due to estate development in the recent few decades in the area. The increased in bare land to Green Areas was due to the clearing of Green Areas by farmers for cultivation, while the decrease in forest size was due to accelerated deforestation of the Forest.

Table 3: Changes in LULC of Umuahia North between 2002 and 2022 (KM^2)

Legend	Area (2002) (KM^2)	Area (2022) (KM^2)	Change in Area (KM^2)	Percentage Change in Area (%)
Built up Area	36.3364651	51.85679	15.52033	6.747382
Water Bodies	4.3627463	4.113432	-0.24931	-0.10839
Bare Land	25.234756	31.13473	5.89997	2.564981
Green Area	69.0217713	76.13177	7.110002	3.091037
Forest Area	95.0697658	67.13336	-27.9364	-12.1452
Grand Total	230.0255045	230.3701		

Factors Influencing Deforestation in the Study Area

Table 4 shows that 81.67% of the respondents indicated fuel wood extraction as one of the factors of deforestation in the study area. Research finding of Aliyu et al (2020) corroborates this research finding.

Osoba *et al* (2019) who also made similar findings in Ogun state noted that fuel wood extraction is one of the causes of deforestation since fuel wood is being used as the main household cooking fuel in most developing

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nation such as Nigeria is due to the high cost of other fuel alternatives (kerosene, gas and electricity). This finding is in line with that of Mustapha *et al.* (2012), who opined that lack of alternative fuel could promote the effect of deforestation

Also 96.67% of the respondents indicated fuel wood extraction and farming activities as one of the deforestation factors in the study area. Osoba *et al* (2019) made similar findings in Ogun state and observed that the reason for fuel wood extraction being a factor of deforestation is because majority of the residents of the area are primarily farmers; consequently, with increase in population, there is demand for land which leads to deforestation. This finding lends credence to that of Mohammed *et al*. (2015) in Bangladesh and Ladipo (2010) in Nigeria.

The Table shows that 95.00% of the respondents also indicated that over population and poverty is one of the deforestation factors in the study area. Mustapha et al (2012) made similar research findings and noted that in the process of feeding, sheltering and improving human well-being, the poor have to depend immensely on resources from their own local environment, leading to deforestation. About 91.67% and 98.33% of the respondents indicated bush burning and road construction/development projects respectively as the factors of deforestation in the study area. Also 81.67%, 78.33% and 71.67% of the respondents indicated overgrazing, lack of value for forests, corruption and political causes respectively. This is similar to the findings of Mohammed *et al.* (2015).

Table 4 Other Factors Influencing Deforestation in the Study Area

Deforestation Factors	Frequency	Percentage
Fuel wood extraction	49	81.67
Farming activities	58	96.67
Overpopulation and poverty	57	95.00
Bush burning	55	91.67
Road construction/ development projects	59	98.33
Overgrazing	49	81.67
Lack of value for forest	47	78.33
Corruption and political causes	43	71.67

*Multiple response

Ecological Effects of Deforestation in the study area.

Table 5 shows that 91.67% and 95.00% of the respondents indicated that increase in erosion and depletion in soil fertility respectively. This finding is similar to that of Adekule (2019) as he noted that deforestation in Ondo State led to increase in soil erosion and loss of soil fertility. Bisong (2020) noted that the direct impact on soil and accelerated runoff in areas without vegetation cover leads to serious soil erosion and the consequent development of extensive gulley which may extent over a very large area. Many examples of gulley and sheet erosion have been reported in many parts of Umuahia after long term deforestation. Osoba *et al* (2019) noted that soil erosion arising from deforestation has more damaging effects as the areas with high soil erosion are also more vulnerable to flooding, mudslides, dust storms, and water pollution.

Also 96.67% of the respondents indicated that that deforestation in the study area has led to increase in wind erosion while 80.0% indicated air pollution. The findings is similar to that of Oseoneoba (2022) as he observed that deforestation removes an essential source of cleaner air (trees) and releases the stored carbon, worsening the air quality. The responses on air pollution as an effect of deforestation in Umuahia were supported by International Institute of Tropical Agriculture. (2018) as they noted that Forests are essential to clean air as the leaves of trees take in carbon dioxide and water and give out oxygen hence the removal of these trees will reduce oxygen in the environment and increase Carbon dioxide.

Furthermore, 98.33%, 93.33% and 98.33% of the respondents indicated that deforestation in the study area has led to reduction in biodiversity, loss of trees species and reduction in forest resources. The findings is similar to that of Aliyu *et al.* (2020) as they observed that deforestation in Nassarawa State led to loss of plant and animal biodiversity as deforestation removed the natural habitat of these organisms and made the environment unfit for these organisms. International Institute of Tropical Agriculture. (2018) further noted that destruction of forests could create a situation in which some forest animals and plants could go completely extinct if they cannot adapt fast enough.

Table 5 Ecological Effects of Deforestation in the Study Area

ECOLOGICAL EFFECTS	Frequency	Percentage
Increase in soil erosion	55	91.67
Increase in wind erosion	58	96.67
Air pollution	48	80.00
Reduction in biodiversity	59	98.33
Loss of tree species	56	93.33
Reduction in forest resources	59	98.33
Depletion of soil fertility	57	95.00

*Multiple response

CONCLUSION

Based on the study's findings, it can be concluded that there was increase in built up areas, bare land and green areas while the size of forested areas significantly reduced. The Forest Area has reduced in size from 95.06 km^2 (41%) in 2002 to 67.13 km^2 (29%) in 2022 indicating a loss of forest more than 27 hectares of forest to deforestation. Deforestation rate was observed to be 2 % within the study time range.

The study also concluded that that the factors leading to deforestation in the study area include fuel wood extraction, farming activities, over population and poverty, bush burning, road construction, over grazing and lack of value for forest.

The ecological effects of deforestation in the study area include increase in soil erosion, increase in wind erosion, air pollution, and reduction in biodiversity, loss of tree species, reduction in forest resources and depletion of soil fertility.

RECOMMENDATION

These studies recommend afforestation practice to mitigate the adverse effect of deforestation in the environment.

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