International Scholars Journals

African Journal of Geography and Regional Planning ISSN 2736-1586 Vol. 8 (8), pp. 001-008, August, 2021. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Land use changes and forest reserve management in a changing environment: South-western Nigeria experience

O. O. I Orimoogunje*, O. Ekanade and F. A. Adesina

Department of Geography, Obafemi Awolowo University, Ile-Ife, Nigeria.

Accepted 17 September, 2020

This paper investigates how human activities have influenced and altered land cover. It also indicates that the nature of cultural substitution of the indigenous forest species have significance for the functioning of the earth system. It therefore attempts to quantify the ecological implication of land cover change consequent upon land use. The paper integrated a topographical map of 1969 and satellite imageries from Landsat MSS 1972, and Landsat TM 1991 and 2000 with ground truthing and socio-economic surveys to assess changes in forest resource use and land cover in south- western Nigeria. The study argues that land cover modification and conversion is directly related to loss of biodiversity and has negative effect on the ecological setting and that there is need to develop more environmentally and socially equitable approaches to forest management.

Key words: Land covers, land use, human-induced, sustainable management, changing environment.

INTRODUCTION

Forests perform a broad range of environmental functions, including ground water recharging. It provides habitats for plants and animals which generate economic, aesthetic, industrial and religious benefits to man. However, economic development pressures often lead to the conversion of forest ecosystem without consideration for both the long-term economic costs and the implications of the immediate loss of biodiversity, ecosystem structure and function. (WRI, 1987; Williams, 1990).

Presently, Nigeria's rainforests harbour about 4,000 different species of plants, including those with medicinal values (Gbile et al., 1981). There are also animals, including birds that cannot be found elsewhere, except Nigeria. These include the Ibadan Malimbe, the Anambra waxbill, the Jos indigo bird, the white-throated monkey, the Niger Delta pigmy hippo and the Niger Delta colobus monkey (Orimoogunje, 2000). Forests are valuable and important to the livelihood systems of rural communities built around them. Loss of ecosystem structures has far-reaching adverse consequences for these communities.

At the present, the tropical rainforest is under attack, both from within and from without. This is due to socio-economic development in every sphere and the need of meeting the ever - increasing demands for forest products as population increases (the two parts of the sentence mean the same thing) . For instance between 1981 and 1994, Nigeria lost 3.7 million ha of its forests (Orimoogunje, 2000). At the present, less than 4% of Nigeria's untouched rainforest cover is left (Nwoboshi, 1986; Orimoogunje, 2005). More frightening is the fact that the loss is continuing at the rate of more than 3.5% annually (Orimoogunje, 2005). This implies a colossal loss of biodiversity. The greatest threats to forests in Nigeria have been bush burning and illegal logging, which have been rife in the study area (see section for study area) over the years. The degradation process in the forest area of Nigeria has been found to be significant in terms of the disappearance of the three crowns layers of trees characteristic of the region (Ekanade, 1991; Salami et al., 1999).). The focus of this paper is, there-fore, to investigate how human activities have influenced and altered tree cover; and to suggest the need for conservation and sustainable management of forest

*Corresponding author. E-mail: orimoogunje2@yahoo.com. Tel: +234 803 585 5946.

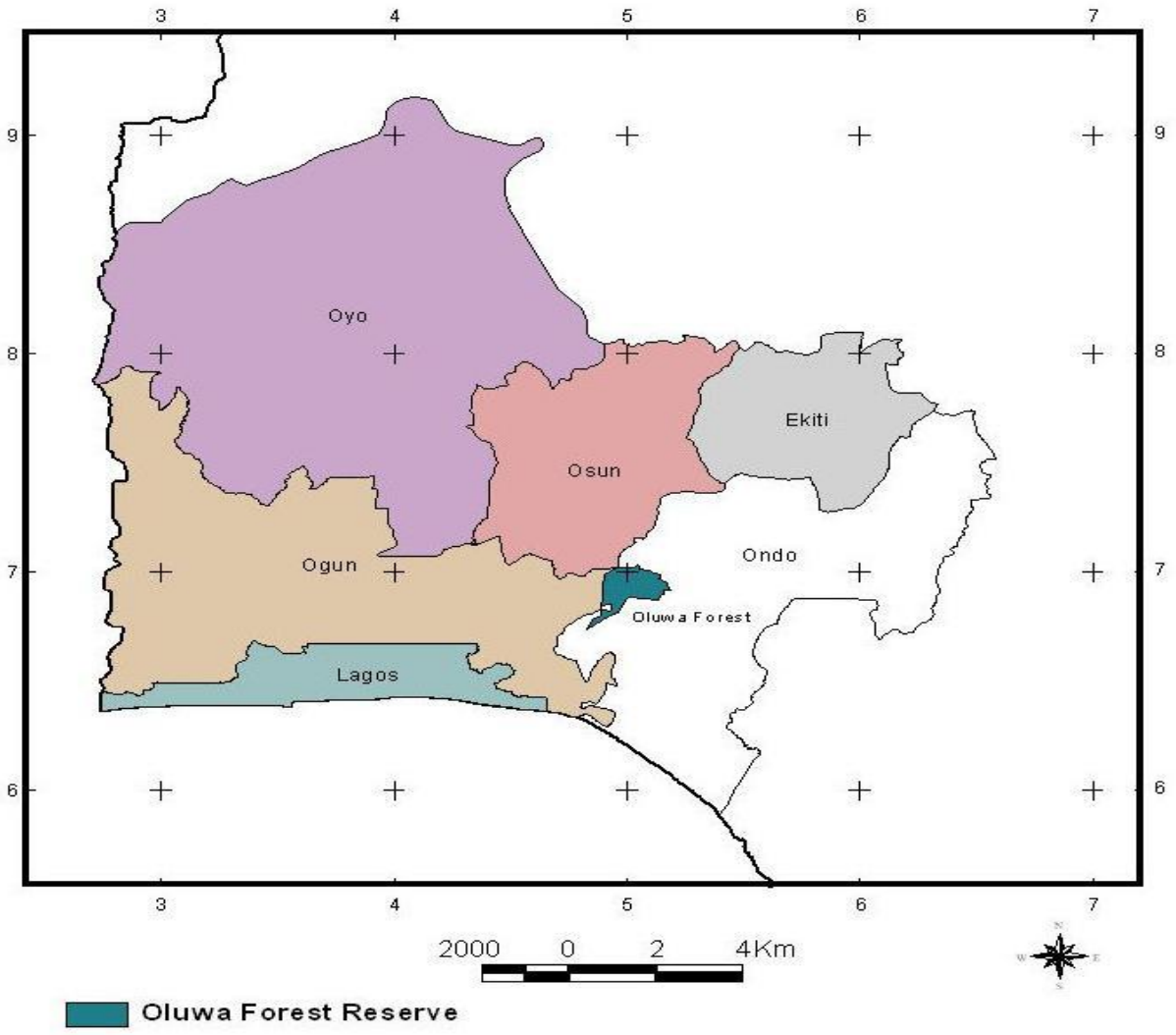

Figure 1. South-western Nigeria showing the study area.

resources.

STUDY AREA

The study area is Oluwa Forest Reserve in the south-western part of Nigeria (See Figure 1) . It lies approximately between latitudes 6° 37' and 7° 20' North and longitudes 4°27' and 5° 05' East, the area is part of the western plains and ranges of Nigeria with much of it lying approximately between 300 and 600 metres above mean sea level (Fosberg, 1961; Gaenier, 1961; Iloeje, 1981). Most rivers and streams draining this area originate from the southern part of the study area. Notable among the rivers are Oni, Oluwa, Ominla and Owena. The study area is under the influence of Koppens Af humid tropical rain forest climate. Mean annual rainfall ranges from 1,200 to 1450 mm and temperatures are high throughout the year with a mean of about 27°C with annual range of 3°C (Nigeria Meteorological Observation, 1962) . The natural vegetation of the area is tropical rain-forest characterized by emergent with multiple canopies and lianas. Some of the most commonly found trees in the area include *Melicia excelsa, Afzelia bipindensis, Antiaris africana, Brachystegia nigerica, Lophira alata, Lovoa trichiliodes, Terminalia ivorensis, Terminalia superba,* and *Triplochiton scleroxylon*. However, the natural vegetation of the area with the exception of the areas devoted to forest reserve has now been reduced to secondary regrowth forest thickets and fallow regrowth at ranging stages of development or replaced by perennial and annual crops (Osunade, 1991). These perennial crops include cocoa, kola and citrus. Most of the rural settlements in the study area came into existence between 1920 and 1950 and by 1970; human colonization of the area had been completed or tending

Table 1. Areal extent of land use types in the study area between 1972 and 2000.

Land use type	1972		1991		2000	
	Areal extent (ha)	% of total	Areal extent (ha)	% of total	Areal Extent (ha)	% of total
Dense forest	130,774.00	70.79	110,826	59.99	19,383	10.49
Exotic trees plantation	49,034.40	26.54	55,683	30.14	22,276	12.06
Arable crop cultivation	-	-	2,671	1.45	56,229	30.44
Tree crops cultivation	-	-	5,505	2.97	55,943	30.28
Settlement/ open space	4,932.60	2.67	10,056	5.45	30,911	16.73
Total	184,741	100.00	184,741	100.00	184,741	100.00

Source: Landsat imagery classification.

towards completion (Adejuwon, 1971).

METHODOLOGY

A map of the study area was compiled from appropriate topographical map Sheet and satellites imageries of that part of Nigeria. The study area was demarcated on the map and gridded into 5 × 5 km^2, which gives a total of 25 square grids out of which 10 square grids were selected using the table of random numbers. Each grid was again gridded into 1 × 1 km^2 out of which 10 were again picked randomly. Ten quadrants, 40 × 25 m^2 in dimension were demarcated from each of the selected 1 × 1 km^2 grid for vegetation analysis. This quadrant falls within the range of quadrant sizes suggested by Weshoff and Maarel (1978), which was used by Aweto (1978), Ekanade (1985), Adejuwon and Adesina (1988) and Salami (1995) and Orimoogunje (2005) for vegetation sampling in the tropics. In all, one hundred quadrants were selected altogether. All tree species occurring in each quadrant were identified and recorded.

Digital image processing was carried out on Landsat MSS 1972, Landsat TM 1991 and 2000, using Multiscope software package. Land uses were identified and classified from the Landsat imageries based on colour, texture, shape and size using the Integrated Land and Water Information Systems (ILWIS) 3.4 software. Training parcels were sampled based on ground survey after the contrast enhancement. The classes of training sites include: the arable crop cultivation, tree crop cultivation, exotic tree plantation, dense forest and settlement/open space. The maximum probability algorithm was used for final classification. The mathematics of the maximum likelihood decision rule, which was applied, has been explained by Tatsuoka (1971). The result of the classification of Landsat 2000 image was cross-checked with ground truthing of the land cover in the study area. The precision was above 90% while the overall accuracy was 89.63, 87.43 and 90.88% for 1972, 1991 and 2000 respectively. This shows that the classification method was reliable.

RESULTS

Table 1 summarises the trend of land use and land cover changes in the study area between 1972 and 2000 (Figures 2 and 3). Table 1 shows that the area covered by exotic plantation cover class increased from 49,034.4 ha in 1972 to 55,683 ha in 1991, but decreased to 22,276 ha in 2000. This indicates a decrease of 60% between 1991 and 2000 with a degradation rate of 6.7% per year.

The areal coverage of forest cover class has declined from 1972 to 2000. By 1972, 130,774 ha of this unit cover had declined to 110,826 ha in 1991. This decreased by 19,948 ha that is 15% in 1991 compared with situation in 1972. Its degradation rate is 0.8% per year. By 1991, this unit cover has declined from 110,826 to 19,382 ha; its rate of degradation was 9.17% per year. These results show that the degradation of forest cover class have been existing in Oluwa Forest Reserve before 1991 but after 1991 its degradation rate started to increase because the demand for both minor and major products of the forest reserve was on the increase.

The area of coverage by tree crop cover class had an increased trend. Between 1991 and 2000, this cover class has increased by 49,438 ha, which was 85.39% of the area covered in 1991. Its increasing rate was 9.49% per year. The result showed that the tree crop cover class was taking over or encroaching into the forest reserve land. If this trend should continue, the forest reserve may be totally taken over by this class cover.

The area of coverage by settlement cover class has increased. The areal extent of this cover unit from 1972 to 1991 increased by 5,123.4 ha (that is, 50.95%) of the area covered in 1991. And between 1991 and 2000, it has increased by 20,855 ha that is about 67.47% of the area covered in 1991. The result shows that settlement cover class was in the increasing trend. This shows that more and more people are settling within the forest reserve enclosure, which is supposed not to be so. According to the field survey most of these settlers are illegal farmers and poachers.

The trend shown by this analysis indicates that there is serious encroachment into the forest reserve area. If the trend should be allowed to continue at the rate shown by this analysis, it is estimated that the forest reserve would have gone totally by the year 2010. It was observed during the field study in 2005 that the pocket of natural forest still existing in the area is due to inaccessibility or rugged nature of the terrain existing in the study area.

DISCUSSION AND IMPLICATIONS

The analysis shows that the mode of incursion into the forest reserve is mainly through tree and arable crops

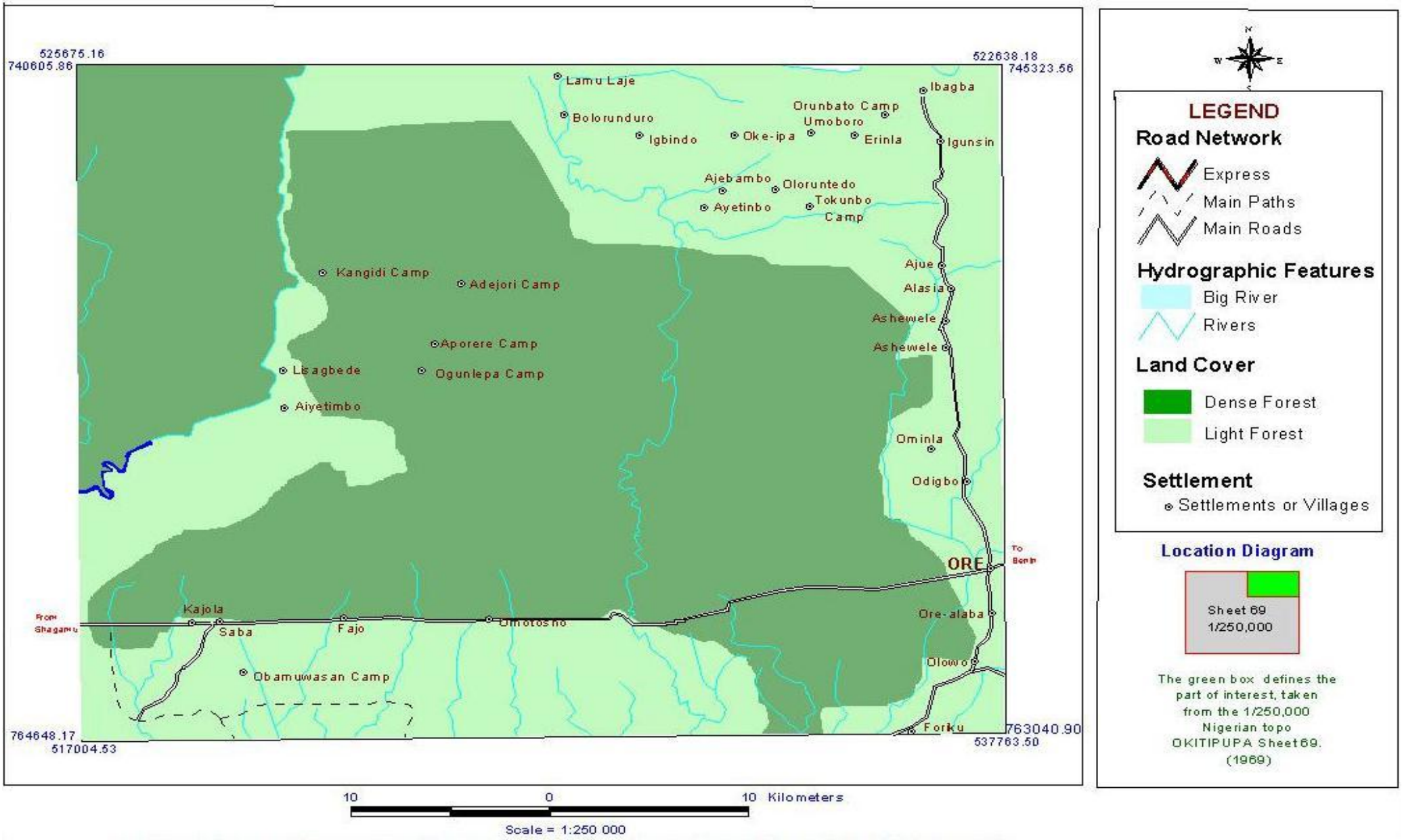

Figure 2. Land use map of Oluwa based on Landsat MSS 1972.

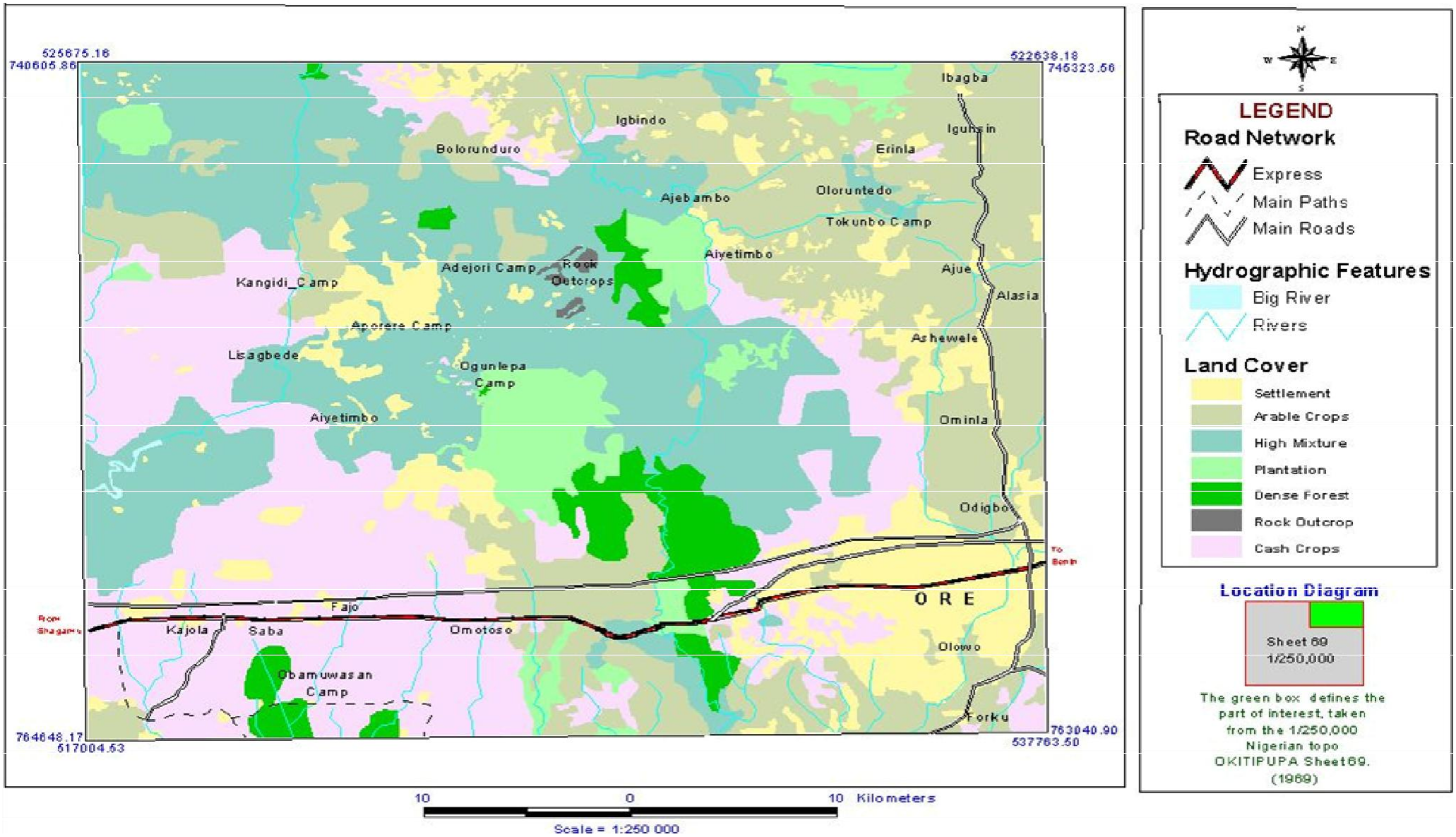

Figure 3. Land use Map of Oluwa Based on Landsat TM 2000.

Plate 1. Forest destruction by bush clearing and burning.

cultivation. This finding confirms the view of the World Bank (1991) that most of the tropical forests cleared each year are due to agricultural practices. It also lends credence to the hypothesis of Bilsborrow (1994) that deforestation is largely due to intensification of agriculture, involving clearing the land of trees to plant crops. Although taungya system, which was encouraged by the Forestry Department, has been noted to be similar in its appearance to forest ecosystem but its cover closure is obviously not the same as mature or high forest (Adejuwon and Ekanade, 1988).

The study area, which falls within the tropical rain forest, was once described by White (1983) as an area consisting essentially of a continuous stands of varied trees with canopies varying in height from 10 to 50 m. He further reveals that the crowns of individual trees overlap each other and are often interlaced with lianas. This description contradicts the present state of the study area (Plates 1 and 2).

The high forest is highly variable with regard to species composition and stocking. Hall (1977) suggested that the variation could be associated with soil differences. Hall shows further that the use of ferralitic soil for intensive plantation establishment is not advisable unless adequate precautions are taken to compensate for sub-stantial nutrient removal from the cycle during harvest.

Also the inventory of fauna's population compiled from the study area shows that monkey is absent on the list and monkeys are indicator of the presence of original forest in a particular place (Gbile et al., 1981) . This shows that the natural forest is dwindling in the study area. Buffalos and antelope are also at the point of extinction in the study area. This shows that the problem of forest destruction is directly related to loss of biodiversity.

As a result of low yield and problems encountered in improving the productivity of the natural forest and

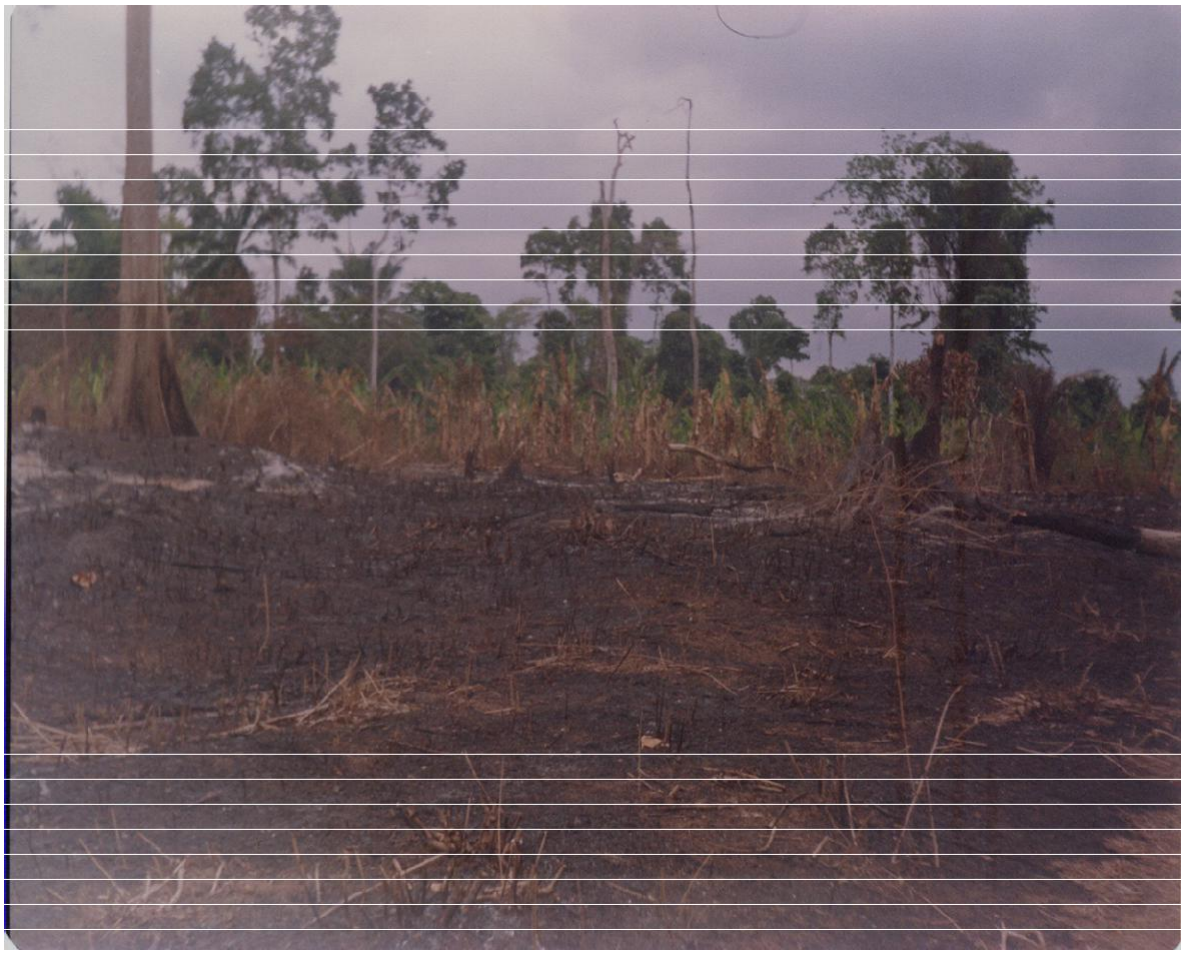

Plate 2. Fallow land cleared for agricultural activities.

increasing demand for wood and wood products, large area of Oluwa Forest has been converted to monoculture plantations of exotic and indigenous tree species. For instance, 30 ha have been established in the Nirowi quarters through taungya system and Lisagbede area of the forest reserve which has been totally changed to Ondo State Afforestation Project. The following ha of high forest in the study area have been cleared and replaced with pulpwood plantations within the last 27 years: 1) 1980 - 1996: 8,201 ha were cleared and planted to *Gmelina*; 2) 1989 - 1996: 6,546 ha were cleared and planted to *Gmelina*; 3) 1989 - 1996: 119 ha were cleared and planted to *Pines*; 3) 1987 - 1996: 197 ha were cleared and planted to *Cattapa* and *Cashew*; 4) 1987 - 1996: 1,100 ha were cleared and planted to *Tectona grandis*; 5) 1989 - 1996: 843 ha were cleared and planted to *T. superba, Terminalia ivorensis and M. excelsa*; 20 ha were cleared and planted with *Elaeis guineensis.*

It was observed that the indigenous tree species under this section of the reserve were cleared to give way to exotic ones in order to meet the demands of Iwopin Paper Mills located in Ogun State which was owned by the Federal Government of Nigeria. Adams (1978) and Chijioke (1980) reported that total biomass removal, which invariably is the practice in tree harvesting for industrial use accounts for a tremendous loss in the nutrient status of the soil environment.

The area of farmland within the study area covered 56,229 ha for arable crops cultivation (Table 1). Farming encroachment accounted for 30.28% of the area in 2000. Indiscriminate burning of the natural forest in the area has led to depletion and destruction of natural forest in the area as it could be seen from the Plates. According to Ola-Adams (1981), the dangers of losing genetic diversity are greatest in the high forest ecosystems where there is great diversity of species and where forest destruction is more rapid. Ekanade (1991) reported that this might affect the ground surface albedo. Clayton (1958) and Adesina (1997) demonstrated the possibility of a total degradation of the forest reverting to a grassland ecosystem as a result of tree crop cultivation, which might encourage weed infestation and appearance of grasses. It is not difficult to understand therefore that changes in vegetation components over Nigeria, as elsewhere, have definite and significant specific components. Already, many plant species known to be

endemic in this part of the world have become endangered or in some cases completely extinct. This fact was supported by Federal Environmental Protection Agency's (FEPA's) (1992) finding that gave a list of 484 species of plants as endangered in Nigeria. This figure could be on the increase as a result of the intensification of human activities in the forest reserves. Even this study confirmed that from all the sampled plots *M. excelsa* was totally absent because it was in high demand by the commercial timber contractors while the forest reserve is now turning to a monocultural species plantation.

Land degradation, through agricultural activities will drain the soil of its life sustaining nutrients. A trend observed here is that once the land has been exhausted it is abandoned and the cycle then continues as more forest is cleared to provide more productive agricultural land. This is the problem cycle between ecological sustainability and economic and social prosperity.

Conclusion

The findings of this study have shown that the study area is under serious threat by human activities, the evidence of which include the loss of about 84% of the forest reserve to human activities especially agriculture, loss of biodiversity and genetic resources, loss of protection which plant gives to soil and increasing carbon dioxide which have complicated environmental warming crisis. Therefore, successful conservation programme in the study area that would depend upon ecologically sound rural development technique or method that lessens the pressures for the destruction of the remaining natural forest resources should be embarked upon. The government and other stakeholders should place emphasis on promoting, strengthening and sensitizing communities as a strategy to invigorate environmental conservation and management. This should go with implementation of sound strategies on poverty eradication as this is highly tied with unsustainable resources utilization and environmental degradation.

There should be need to look into the possibility of combining *in situ* conservation with wildlife conservation, education, tourism and commercial forestry provided the aims and the objectives do not conflict. This practice can itself help to instil public confidence in the overall strategy of management and hence in the policy of strict protection of the core areas. Also public enlightenment campaigns and workshop for farmers should be intensified.

REFERENCES

Adejuwon JO (1971). Agricultural colonization in twentieth century in Western Nigeria: Distribution and vegetation characteristics. J. Trop. Geogr., 39:1-10.

Adejuwon JO, Adesina FA (1998). Components of cover changes in Tropical Africa: Nigeria experience. Ife. Soc. Sci. Rev., 15(1): 147 – 161.

Adesina FA (1997). Vegetation degradation and environmental changes in the Tropics. Ife Res. Pub. Geogr., 6(1,2):68-78.

Aweto AO (1978). Secondary Succession and Soil Regeneration in a Part of the Forest Zone of Southwestern Nigeria Unpublished PhD. Thesis, University of Ibadan, Nigeria.

Bilsborrow RE (1994). Population development and deforestation: some recent evidence. In: Population, Environment and Development, edited by the United Nations (New York: U.N.) pp. 117-134.

Clayton WD (1958). Secondary vegetation transition to Savanna near Ibadan, Nig. J. Ecol., 46: 217-238.

Ekanade O (1985). The Impact of Cocoa Cultivation on Soil Characteristics in Southwestern Nigeria. Unpublished PhD. Thesis, Department of Geography, University of Ife, Ile-Ife, Nigeria.

Ekanade O (1991). Degradation of the physical elements of the rural environment resulting from tree crops cultivation in the Nigeria cocoa belt. Singapore. J. Trop. Geogr., 12: 82 - 94

Federal Environment Protection Agency (FEPA) (1992). Transition to Sustainable Development in Nigeria. FEPA, Abuja

Fosberg FG, Garnier BJ, Kuchler AW (1961). "Delimitation of humid tropics". Geogr. Rev. 51: 333 – 339.

Gaenier BJ (1961). Mapping the humid tropics – "climatic criteria". Geogr. Rev., 51: 339 - 346

Gbile ZO, Ola-Adams BA, Soladoye MO (1981). List of Rare Species of the Nigerian Flora. Research Paper (Forest Series) N0. 47. Forestry Research Institute of Nigeria, Ibadan.

Hall JB (1977). Forest types in Nigeria: An analysis of pre-exploitation forest enumeration data. J. Ecol., 65: 187 –199.

Iloeje NP (1981). A New Geography of Nigeria. Longman, England 201pp

NEST (1991). Nigerian's Threatened Environment: A National Profile. NEST, Ibadan.

Nwoboshi LC (1986). "Meeting challenges of the deforestation in Nigeria, through effective reforestation". In: Oguntala, AC (Ed.) The Challenges of Deforestation in Nigeria. Proceedings of the Forestry Association of Nigeria Conference, pp. 225-239.

Ola-Adams BA (1978). Dry matter production and nutrient contents in a stand of Coppiced *Cassia siamea* Lam. in Ibadan Fuel Plantation. Nig. J. Sci.,12(1,2): 293 – 301.

Ola-Adams BA (1981). Strategies for conservation and utilization of forest genetic resources in Nigeria. Nig. J. For., 11(2) :32-39.

Orimoogunje OOI (2000). Vegetation: A sustainer being endangered. Paper Presented at National Conference on Environmental Education held at Ekiadolor College of Education between 15th and 17th Nov. 2000.

Orimoogunje OOI (2005). The Impact of Land Use Dynamics on Oluwa Forest Reserve in Southwestern, Nigeria. Unpublished PhD. Thesis, Department of Geography, Obafemi Awolowo University, Ile-Ife.

Osunade MAA (1991). Agricultural change by supplanting process in a traditional farming system. Int. J. Ecol. Environ. Sci., 17: 201-209.

Salami AT (1995). Structural Changes in Vegetal Cover in Ife and Ede Regions of Southwestern Nigeria between 1963 and 1993. Unpublished PhD. Thesis, Department of Geography, Obafemi Awolowo University, Ile-Ife

Salami AT, Ekanade O, Oyinloye RO (1999). Detection of forest reserve incursion in Southwestern Nigeria from a combination of multi-date aerial photographs and high-resolution satellite imagery. Int. J. Remote. Sens., 20(8): 1487-1497.

Tatsuoka MM (1971). Multivariate Analysis Techniques for Educational and Psychological Research. (John Wiley: New York)

Westhoff F, Maarel E V (1978). "The Braun-Blanquet Approach", in R.H. Whittaker (Ed.) Classification of Plant Communities, The Hague, pp. 287 - 399

Williams M (1990). Forests. In: Turner BL, Clark WC, Kates RW,Richard JF, Matthews JT, Meyers, WB (Eds.), The Earth as Transformed by Human Action. Global and Regional Changes in the Biosphere over the past 300 years. Cambridge University Press, Camb, pp.179-201.

World Bank (1991). Forest Sector Policy Paper. The World Bank. Washington. DC.

World Resources Institute (WRI) (1987). World Resources 1987. Basic Books New York.