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Tropical Forest Landscape Change and the Role of Agroforestry Systems in Southern Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author ECM designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author YAT helped with the revision and GIS mapping. Authors JW and CR managed the analyses of the study. Author CR managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The paper analyzes tropical forest landscape change and deforestation trends in Nigeria. Emphasis' are on the issues, the environmental analysis of the trends, factors influencing it, and community agroforestry efforts. The time frame and setting for the study runs through the west African nation of Nigeria during the periods of 1976 through 2005 at the national and state levels. In fact, Nigeria was once covered by widespread vegetation comprising of humid tropical forests in the south and savannah grasslands in the north rich in biodiversity. A great percentage of this luxurious vegetation has been cleared by the pressures mounted by human activities with eventual degradation. In terms of methods, the paper uses mixscale approach based on descriptive statistics, temporal spatial analysis and mapping, and photographic images to analyze the trends associated with tropical deforestation. The results show visible changes in the form of large scale decline of Nigeria's forest landscape over the years. This resulted in the disappearance

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of forest resources and vegetation cover with mounting threats to sensitive natural areas. Aside from the socio-economic elements linked with the problem, community efforts at the margin using agroforestry systems showed some promise with many benefits to stem the tide of deforestation. To remedy the problems, the paper offered some recommendations ranging from policy overhaul to education.

Keywords: Deforestation; forest landscape change; tropical forest; agroforestry systems; degradation; biodiversity; environment; Nigeria.

1. INTRODUCTION

1.1 Background Information and the Issues

In the context of Nigeria's popular literature, from the works of Tutola (1953); and Achebe (1958); Nigeria's tropical moist forest occupies an enviable place as has been attested to in scholarly discourses on the country. The themes and characters of these literary studies were set in environments deeply entrenched in forest life. To understand the relevance of forest ecology and implications of deforestation in the nation, look no further than the covers and content of tropical biology text books that flourished in the past to see. These texts succinctly epitomized the essence and the role of the nation's forest as a major repository of knowledge and biodiversity. Yet as we move further into the opening decades of the 21st century, the forest landscape of the nation continues to be under a recurrent siege. As the nation grapples with the growing menace of tropical forest landscape degradation, the forests' role as an ecological treasure in the life of the nation should no longer be ignored.

Additionally, Nigeria was once covered by widespread vegetation and forests. These comprised of the humid tropical forests in the south and savannah grasslands in the north. A great percentage of this luxurious vegetation has been cleared by the pressures mounted by human activities. Presently, forest reserves cover about 10 percent of the nation, mostly of the savannah woodland type. The southern rain forest, the source of the country's timber resources, covers only two percent of the total land area of Nigeria. It is being depleted at an annual rate of 3.5 percent. The annual rate of change in total forest area from 1990-2000 stood at 4.0 million hectares (CIA, 2000; FORMECU, 1996; FAO, 2001; Mantu, 2001; UNEP, 2002).

Going by a biennial report of the Food and Agriculture Organization of the United Nations (FAO), tropical deforestation rates continue to accelerate at an alarming pace. From the report, yearly loss of forest cover peaked in the developing world -- particularly in Africa, which saw 9 percent of its forests vanish between 2000 and 2005. During this period in which Nigeria lost (-410,000 hectares), Africa suffered the second largest net loss in forests with 4.0 million hectares cleared annually. Nigeria and Sudan emerged as the two largest losers of natural forest during the 2000-2005 periods, largely from subsistence activities (FAO, 2005; Burtler, 2005).

The continuous degradation of the forest reserve base in that way has major effects on other segments of the economy and the environment. This can be manifested with the rapid disappearance of forest cover leading to erosion, loss of biodiversity, soil degradation, and unfavorable hydrological changes (Aweto, 2000, 2001; Aweto and Ekuigbo, 1994). The forest reserves have for sometime been seriously neglected and have received little or no

improvement in terms of investment and management (FAMNR, 1996b; FDF, 1998). While several efforts were made in the last decades of the 20th century through national agricultural programs to revitalize the sector (FAMNR, 1996a), overdependence on massive imports of fertilizers and pesticides created policy failures and environmental deterioration in the form of reduced water resources, and migration of rural population to urban areas (Pro Natura, 2001).

Another twist to the ongoing anomaly is that Nigeria's forests serve a broad variety of forest sectors, including the formal and informal sub-sectors. Many citizens of Nigeria rely on these sectors hence putting enormous strain on the dwindling forest resources of the country. The formal sector is fundamentally timber based and reasonably well developed and encompasses mechanical lumber industries, counting sawmills, coating and plywood making. The others consist of particle board, pulp and paper board makers. Furniture making thrives also at a minor stage. The informal forest sector which encompasses an informal timber based sub-sector stands as the nation's major consumer of wood, (much of them are burnt as firewood) and the non wood forest products sector. Such institutionalized nature of forest use in Nigeria plays a prominent role in deforestation (Arufor, 2000; FAO, 2000).

Notwithstanding these anomalies, agroforestry can play a meaningful role in minimizing the vicious circle of deforestation, soil erosion and other environmental problems facing the ecological zones of the country. In the literature, agroforestry refers to the combination of agriculture and forestry within a farming system. As a land-use formula, it serves the diverse needs of individual farmers in harnessing the natural resources around them, as this cannot be reconciled by the traditional crop system. It involves the combination of trees and crops that increase the medicinal, environmental, and economic value of land with the much-needed profit and food security (Arbor, 2001; Griffiths et al., 1998; Huxley, 1999; CaoZhi and Dawson, 2004).

Having endured recurrent plundering of the forests for decades, reconnaissance survey has been carried out within the ecological zones of Nigeria to evaluate the various land use practices in order to determine the agroforestry models most suitable to each of them (Mende, 2003). In another study, Salami (2003) confirms that the traditional agroforestry system can be better maintained in tropical countries such as Nigeria with different soil types to enhance fertility. He showed how soil mineral nutrients are effectively used in agroforestry through mycorrhizal inoculation and strategic pruning. Elsewhere, Adesina (1999) estimated the potentials of agroforestry in the mitigation of CO₂ emission in the country. See the Appendix for more on agroforestry.

1.2 Purpose and Organization

This paper examines the growing incidence of deforestation in Nigeria. Emphasis is on the issues, the environmental analysis of the trends, factors fuelling the problems, and the growing role of community agroforestry in the Southern region of the nation. The paper has four objectives. The prime objective of the paper is to present a simple approach for analyzing tropical deforestation. The second objective is to identify the current agroforestry systems and their role in addressing the problems in a developing nation. The third objective focuses on the elements behind the disappearing forests while the fourth objective is to update the literature and design a management tool for decision-making. The paper is divided into four sections. The first section contains the introduction and background information; the second section is devoted to the materials and methods. The third section

highlights the discussions and results of the environmental and spatial analysis of the trends, factors of change, and community efforts through agroforestry. The fourth section presents the findings with some recommendations.

2. MATERIALS AND METHODS

2.1 The Study Area

The study area Nigeria in Fig. 1.0 occupies one of the largest land areas in the West African subregion, it covers a total land area of 923,769 km² with a population of 140,431,790 in 2006. In 2008 as Table 1 shows, the numbers jumped to over 151 million (NPC, 2009); (UNTCP, 1998); Pro Natura, 2001; Nigerian Population Commission, 1999; Mantu, 2001; CIA, 2000). Because of its large mass of land area, the country has diverse climatic and ecological zones where forest land areas once thrived. The population of the country rose from 1990 to 2008 by 57 million at the rate of 60% (FAOSTAT, 2008).

Being the most populous country in the continent of Africa the nation accounts for 18% of Africa's overall population. According to the United Nations population figures in 2009, the nation's number of residents stood at 154,729,000. The breakdown of the population among city and country side shows a close split of 51.7% for rural residents and 48.3% urban, coupled with a population density of 167.5 people per square kilometer. With the current demographic build up, Nigeria's rapid population increase is the 7th highest globally. From the UN forecasts, Nigeria is among 8 other nations projected to account for about 50% of the global population spike between 2005 through 2050 (FAOSTAT, 2008). This would further accentuate natural resources dependency with pressures on the environment and forest resources of the country already stretched beyond its limits from deforestation.

Furthermore, Nigeria has a vast reservoir of biodiversity, made up of rare species of fauna and flora. The taxonomy of these different life forms encompasses about 20,000 species of insects, close to 1,000 species of birds, 247 species of mammals, 123 species of reptiles, around 1,000 species of fish and nearly 7,895 species of plants (Federal Government of Nigeria, 2001). Being a nation once covered by 360,000 km² of forest in 1975, now it presides over the reckless destruction of forests at the rate of about 600,000 hectares per year. Accordingly, the country runs the risks of seeing its once precious timber resources depleted in the next few years (NEST, 1992; Usman, 2010). The IUCN Red List of Globally Threatened species contains 148 animal and 146 plant species found in Nigeria. Included in the list are 3 animal species and 15 plant species classified to be critically endangered (IUCN, 2010). The information Table 1 also indicates that, amongst the 13 species of amphibians at risk in the country, 5 are only located in the nation (Usman, 2010). Knowing that habitat conservation of these rare flora and endangered faunas correlate directly with the unsustainability of forest ecosystem, the country needs to strengthen the current land use regulations to save the species thriving in the remaining forests from extinction. See the Appendix for more on the study area.

2.2 Methodology

This paper stresses a mix scale approach involving the integration of primary and secondary data provided through government sources and data bases from other organizations. This involves the generation of different categories of change under the rubric of environmental analysis and abbreviated spatial analysis of the trends. The source consists of The Food and

Agricultural Organization (FAO), The Federal Department of Forestry, the United States Geological Survey and the University of Maryland Online Free data unit. Accordingly, the spatial data and the single satellite image used in the research were procured through the United States National Aeronautical and Space Administration NASA. Part of the mix scale approach also involves the use of descriptive statistics, mapping of the areas under threat, the analysis of demographic elements and the photographic display of field images showing the problems of deforestation in some parts of the study area. The methodology also drew largely from a keyword literature search for the relevant documents on deforestation, agro-forestry in Nigeria and access to the archives of the Federal Republic of Nigeria.

2.2.1 Identification of variables, data acquisition, design and temporal spatial analysis

Identification of variables: The first step involves the identification of the variables needed to assess forest landscape change at the national level. The variables consist of socioeconomic and environmental information, including amount of total forest area; other wooded land, primary forests; plantations, 11 vegetation types, global deforestation rates, highest annual average of primary forest lost, wetlands of significance in hectares, number of endangered species, 12 changing land use variables, population, sawmills estimated capacity, and the demand for some wood (Tables 1 and 3). This process continued with the design of data matrices for the variables covering the various periods from 1976, 1993, 1995, 1990, 1998 2000 and 2005. In addition, to the design stage, access to databases and abstracts that are presently available within the Federal archives in Nigeria, The Food and Agricultural Organization, (FAO); The United States National Aeronautical and Space Agency (NASA), the University of Maryland free Online Data Services and host of other organizations helped facilitate the search and the design process. The spatial data acquired from NASA consists of one raw Satellite image for the separate periods of 2011, while the information from the University of Maryland covered the data for the base maps.

2.2.1.1 Descriptive statistics

In the second stage, under the rubric of environmental analysis descriptive statistics were used to analyze the socioeconomic and environmental variables presented in their absolute and transformed forms of percentages, ratios and rates. This process generated the parameters for establishing, the extent of change or forest landscape loss for the study area in order to facilitate the gradual measurement and comparison of the trends in the area. This approach allows for the detection of the levels of change. The tables as presented in the environmental analysis provide a highlight of the changing landscape trends affecting the study area. The remaining steps involve spatial analysis and output (maps-tables-text) covering the study period.

2.2.1.2 Temporal spatial analysis

The third stage involves spatial-temporal analysis and output (maps-tables-text) covering the study period, using ARCVIEW GIS. The spatial units of analysis consist of the nation and some of its states and cities located in the south east region. From the process the outputs for the areas were then mapped. The production of the maps in ARC VIEW GIS also required the common geographic identifier codes for the states and the selected cities. The fact that the cities stayed unchanged made it imperative to assign common geographic identifier codes that quickened the production of maps for analytical coherency. This approach was vital considering the record pace of new state creations and the impacts of boundary adjustments in enabling the emergence of new cities or local government areas.

Surely the spatial boundaries of the core cities or counties of local government areas of interest under analysis remained constant within a common geo identification code. This process helped delineate the location of the sensitive areas in space that are gravely impacted by the menace of deforestation induced by human activities.

Table 1.0 The distribution of population from 1971-2008

The Population Figures Over The Years	
Year	Million
1971	55.1
1980	71.1
1990	94.5
2000	124.8
2004	138.0
2008	151.3

Source: FAO Stat, 2011.

Table 1.1 Nigeria's changing land use trends 1978-1995

The numbers	Land use category	Annual rate of change (ha/year)
1	Agriculture (Intensive/Extensive)	554,657.10
2	Floodplain Agriculture	67,616.10
3	Grass land	131,224.60
4	Dominantly trees/woodlands/shrubs	-858,720.40
5	Dominantly shrubs and grasses	-104,974.30
6	Dominantly grasses	6166.16
7	Forest	-104,231.00
8	Freshwater marsh/swamp	-69,453.05
9	Forested freshwater swamp	1707.86
10	Mangrove forest	-14,982.77
11	Water	45,474.02
12	Bare surface	129,113.70

Source: FAO 2000.

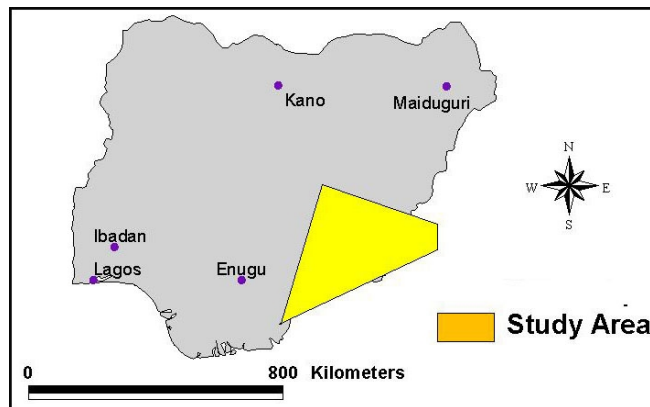


Fig. 1.0 The study area of Nigeria with highlight of the biodiversity rich South



Fig. 1.1 The impacts of deforestation



Fig. 1.2 Image of deforestation impacts

3. RESULTS AND DISCUSSION

This section of the paper presents the results of temporal-spatial and environmental analysis of the changing forest landscape trends in the study area. The focus centers around the forest land use distribution, the annual rate of change and the total change leading to deforestation in the country between 1990 through 2005. Others include the status of vegetation change from 1976-1995 as well as spatial analysis of the trends in the Southern Nigeria region. The global flavor to Nigeria's deforestation rates and the ecological threats to biodiversity and the critical wetland habitats of national significance experiencing disturbance in the study area are also covered. The final portion of the section delves on the factors fuelling deforestation and the community efforts at the margin to deal with the issues.

3.1 Environmental Analysis of the Trends

To understand the forest land change analysis, consider the information on Table 2.0 made up of the classification, area and the change components. There are also variables such as total forest area, other wooded land, primary forests and plantations. In terms of the breakdown of the forest land distribution, note that in the periods of 1990, 2000, and 2005, the total forests landscape area in the country dropped from 17,234,000 hectares in 1990 to 13,137,000 hectares in 2000. In the ensuing five years, the numbers dipped further to about 11,089,000 hectares in 2005. As if these dismal figures are not enough, the county further saw its other wooded land area of 9,717,000 hectares fall to 6,902,000 hectares, and 5,495,000 hectares under a fifteen year span of 1990 through 2005. Even other variables like primary forests that were not spared of the catastrophic scale of change seemed visibly plundered. The primary forest area estimated at 1,556,000 hectares in 1990 fell to 736,000 and 326,000 hectares respectively in the periods of 2000 through 2005. Notwithstanding the meager rebounds of 251,000, 316,000 to 349,000 hectares prompted by the forest plantations during the fifteen year period of 1990 through 2005, Nigeria appeared to have squandered her forest estates considering the recurrent pace of losses (Table 2.0).

Turning to the annual change rate in total forest areas, other woodland, and primary forests, the numbers for the ten year span of 1990-2000 show that the country lost

enormous areas of -410,000 hectares, -281,500 to -281,500 hectares at the rate of -2.7, -2.9, -5.27 percentage points. With almost identical numbers in the ensuing five years 2000-2005, the rates of change for the three core variables stood firm at -3.3, -4.08, -11.14 percent. The only slight instances of gains came under the plantation classes of forest land estimated at about 6,500 to 6,600 hectares at the rates of 2.59 and 2.09% not really enough to reverse the endless losses over the years.

In summing up the total change over the different periods, the right hand side of the table helps bring to light some interesting facts. Overall the nation between 1990 to 2005, lost about -6,145,000 hectares of total forest area at a rate of -35.66% while the unaccounted numbers for other wooded lands reached -4,222,000 hectares. This represents a change rate of -43.45. The total losses for primary forests under the same period stood at -123,000 hectares at the rate of -79.05%. Even though the plantation rounds up the numbers with the addition of 98,000 hectares at the rate of 39%, they are still not robust enough to reverse the sequence of depletions that occurred previously.

Another measure of deforestation in Nigeria stems from the changing status of vegetated areas of the country from 1976 to 1995 under the 11 vegetation types in its ecozones. The various attributes of the eleven vegetation types from their areas in Km^2 , % of the country and changes in area are highlighted in Table 2.1. From the change column on the far right of the table, the nation experienced multiple losses in the areas of all vegetation types with the highest in tens of thousands of Km^2 being dominantly shrub/grasses and trees/woodlands/shrubs. While these two variables changed by -32,186 and -69,990 Km^2 . Among the other categories, one notices the disappearance of -13837 Km^2 in undisturbed forests, -7651 Km^2 in freshwater swamp areas, -3148 km^2 of riparian forests and -4011 Km^2 in fresh water marsh. There were also notable losses in predominantly grass and alluvial vegetations areas estimated at -566 to -218 km^2 between 1976 through 1995 (Table 2.1).

The same pace in losses are also evident in other vegetation types in the various ecozones from mangrove forest to the others. The implication is that when senseless squandering of forested landscapes remains unabated, the biodiversity habitats are not only threatened, but the different life forms therein become endangered. Just as Tables 2.1-2.3 show, the country's forests in the different ecozones, stand as repository of the most endangered and rarest biological species in the world. See Table 2.4 and Fig. 2.0 for information on the status and the spatial location of some of these species. The threats to biodiversity in Table 2.4-2.5 from forests landscape disturbance does not come as a surprise. Taking into consideration Nigeria's ranking in various categories of deforestation among countries of the globe. One notices that the country experiences the highest forms of deforestation. Of all the top 10 nations having highest rates in primary forests disappearance, Nigeria leads with a deforestation rate of 57%. On the global distribution of deforested areas from 2000 to 2005, Nigeria ranks among the top ten countries experiencing primary forest area loss (Table 2.2-2.3).

While all these trends have gross implications in biodiversity habitat protection and the environment, note that the southern region of the nation has vast amount of wetlands and forest landscape of importance threatened by land clearing activities (Table 2.5). Part of the major concerns facing the ecosystem of the Delta region of Southern Nigeria as mentioned before emanates from the growing pressures mounted by development activities in the region (United States Department of Energy, 2003). Because of improper management, various materials and effluents discharged into the marine environment contain drill cuttings, drill muds and fluids used for stimulating oil production. In addition to the direct pollution

caused by oil production, the oil industry has had a profound effect on the environment of the Niger Delta.

To facilitate road construction, wetlands and waterways are frequently dredged and diverted to other uses at the expense of nature protection (Achi, 2003; Worgu, 2000). Canals built by oil companies on seasonal flood plains, whose ecology depends on the changing hydrological conditions have been creating permanent flooding, leading to the destruction of fishponds and the loss of community income in the region. The growing networks of seismic lines cleared of vegetation for pipelines or seismic surveys have turned into informal roads that allow access to previously inaccessible forest region. The seismic lines cut by Shell Petroleum since its operation ripped through an area containing over 56,400km of mangrove of forests in the region. This problem has been compounded by the loss of 5-10 percent of the mangrove forest from the intensification of settlements or oil activities (Human Rights Watch, 1999).

3.2 Abbreviated Spatial Analysis of Change

In light of these problems, the impacts of human and oil activities on the forest landscape of the study area, merits a rigorous environmental analysis with the appropriate techniques as has been done herein. The map in the Fig. 2.0 contains the locations of some of the habitats that have come under siege in the last several years from energy development induced deforestation. Spatial display here is essential for managers in tracking the deforestation hot spots and areas under siege. Note that much of the areas are located around the moist tropical forests with large mangrove vegetation and vast species richness.

Furthermore, consider the information on the Fig. 2.1 NASA satellite image of the country showing the various classes of land use types of the country differentiated in diverse colors. From the classification of the image, the green colors implies vegetation and forested areas, white and grey segments show human settlement and development while the red image denote desert and bare surface. The blue color on the hand covers water bodies. The thing to glean from the spatial distribution of the different land uses is that due to the pace of deforestation in place over the years, the nation's forestlands remain unevenly distributed. Looking at the image, the distribution of vegetation and forest landscape along the Northern region seemed quite patchy and fragmented. While the southern tip of the Niger along the east and western region of the county have numerous areas in space where the forest vegetation seemed prominent. Note the thick presence of human settlements and activities in milky white color known to degrade the forest environment within close proximity along the delta area in the Deep South known for its moist tropical forest ecosystem. These observations do reaffirm the points made earlier that the Nigeria's rain forest environment has been turned into an ecosystem under stress with incessant deforestation and landscape degradation Fig. 2.1.

Table 2.0 Deforestation data for Nigeria, 1990-2005

Classification Period	Area			Annual Change Rate				Total Change	
	1990	2000	2005	1990- 2000	1990- 2000	2000- 2005	2000- 2005	1990-2005	1990-2005
Units	Ha	Ha	Ha	Ha	%	Ha	%	Ha	%
Total forest area	17,234,000	13,137,000	11,089,000	-410000	-2.7	-410000	-3.3	-6,145,000	-35.66
Other wooded land	9,717,000	6,902,000	5,495,000	-281500	-2.9	-281,400	-4.08	-4,222,000	-43.45
Primary forests	1,556,000	736,000	326,000	-82,2000	-5.27	-82,2000	-11.14	-123,000	-79.05
Plantations	251,000	316,000	349,000	6,500	2.59	6,600	2.09	98,000	39

Source. FAO 2005, Burtler 2005

Table 2.1 The status of vegetation in Nigeria from 1976 to 1995

Vegetation Types along the Eco-Zones	1976/78		1993/95		Changes in km ²
	Area (Km ²)	% of country	Area (km ²)	% of country	
Dominantly Shrub/Grasses	113880	12.5	81694	9.0	-32186
Dominantly Trees/Woodlands/Shrubs	151293	16.6	81386	9.0	-69907
Forested Freshwater Swamp	18316	2.0	16499	1.8	-1817
Undisturbed Forest	25951	2.9	12114	1.3	-13837
Dominantly Grasses	12549	1.4	11983	1.3	-566
Mangrove Forest	9994	1.1	9977	1.1	-17
Shrub/Sedge/Graminoid Freshwater Marsh/Swamp	16899	1.9	9248	1.0	-7651
Montane Forest	6762	0.7	6759	0.7	-3
Riparian Forest	7402	0.8	5254	0.6	-2148
Graminoid/Sedge Freshwater Marsh	4882	0.5	871	0.1	-4011
	487	0.1	269	0.1	-218

Because these threats do not occur in a vacuum, the factors fuelling them are multifaceted. They consist of mounting pace of environmental degradation and demographic element of population growth, uncoordinated land use policy and lack of well defined policy. There is also widespread underfunding and limited forest protection personnel (See Appendix B). Apart from the problems of deforestation and environmental degradation emanating from the agricultural practices in Nigeria, in the last several years communities at the margin in the southern states of Delta, Oyo, and Abia have undertaken various agroforestry related projects with a view to enhancing forested areas. Some of the efforts range from integrated farming, education, and peri-urban agroforestry (Appendix C). For more on the factors and the efforts among communities at the margin see the Appendix B and C.

Table 2.2 World deforestation rates of primary forests, 2000-2005. All countries

Global Ranking	Nations	Deforestation Rate
1	Nigeria	55.7%
2	Viet Nam	54.5%
3	Cambodia	29.4%
4	Sri Lanka	15.2%
5	Malawi	14.9%
6	Indonesia	12.9%
7	North Korea	9.3%
8	Nepal	9.1%
9	Panama	6.7%
10	Guatemala	6.4%

Source: FAO 2005, Burtler 2005;

Table 2.3 Highest average annual deforestation of primary forests, 2000-2005, by area. All countries

Global Ranking	Nations	Acres Size
1	Brazil	-3,466,000
2	Indonesia	-1,447,800
3	Russian Federation	-532,200
4	Mexico	-395,000
5	Papua New Guinea	-250,200
6	Peru	-224,600
7	United States of America	-215,200
8	Bolivia	-135,200
9	Sudan	-117,807
10	Nigeria	-82,000

Source: FAO 2005, Burtler 2005;

Table 2.4 Number of species of plants and animals under threat

Biodiversity	Species threatened	Species found only in Nigeria
Plants	171	??
Mammals	29	3
Birds	12	3
Reptiles	3	1
Amphibians	13	3
Fresh Water Fish	21	1
Invertebrates	1	??

Source: USAID/Nigeria 2008

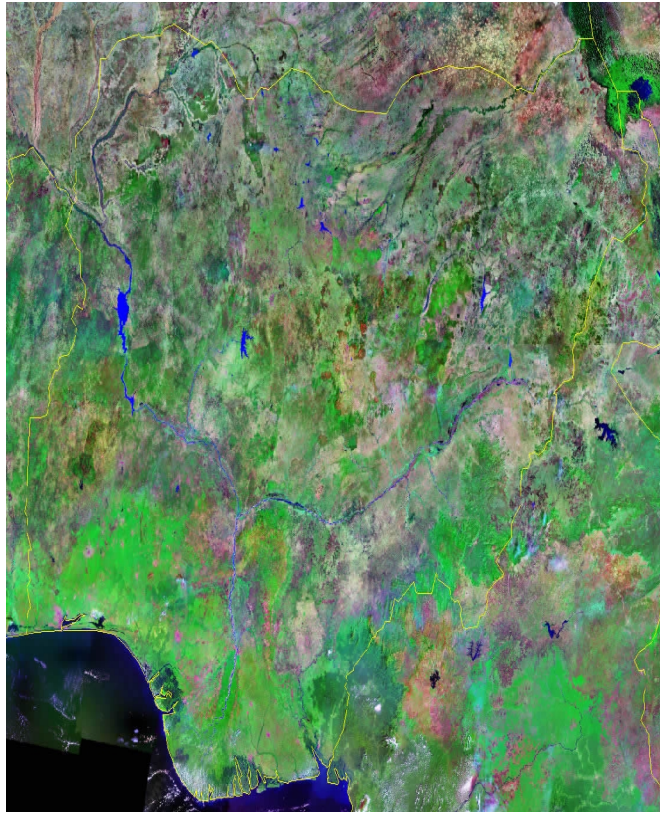


Fig. 2.1 The satellite image of Nigeria's changing forest land

3.3 Discussion

Going by the current analysis based on a mix scale approach connected to descriptive statistics, spatial mapping and field photographic images of forest landscape disturbance. It is evident, the nation was once fully endowed with the tapestry of a very vibrant forest vegetation. Today the Nigerian forest landscape remains an ecosystem under siege. Its share of the world's highest deforestation rates of primary forests rose alarmingly high in 2005 (FAO Food and Agriculture Organization of the United Nations (FAO 2005); Burtler 2005). As an indication of the gravity of the trends, between 2000 and 2005 the country lost 55.7 percent of its primary forests. By this we mean forests with no visible signs of past or present human activities. Part of the far reaching ecological implications or impacts of the changing forest landscape trend in the nation stems from the growing risks posed to natural habitats for biodiversity. This is critical considering, the disappearance of rare and endangered flora and fauna along the nation's ecozones especially in the southern region east of the Niger. While the problems do not operate in a vacuum, they seem rooted in a whole set of economic and socio-cultural factors.

The environmental analysis of the study area using a mixscale method for gauging change on a set of forest landscape variables (area, primary forests, wooded land) reechoed the dismal state of the nation's forest landscape. The nation experienced recurrent declines in the size of the forest landscape variables under the fifteen year span from 1990 through

2005. The individual breakdown of the deforestation show that in the periods of 1990, 2000, and 2005, the total forests landscape area in the country plunged drastically from 17,234,000, hectares in 1990, to 13,137,000 hectares in 2000. While the area under forest fell further to 11,089,000 hectares in 2005, the nation further saw its other wooded land area of 9,717,000 hectares fall to 6,902,000, 5,495,000 hectares in a fifteen year span of 1990 through 2005. Under this setting, other variables like primary forest area estimated at 1,556,000 hectares in 1990 fell to 736,000 and 326,000 hectares respectively in the periods of 2000 to 2005. The rates of change in the various categories show that the country posted notable annual losses in total forest areas, other woodland, and primary forests. The losses estimated at -410,000, -281,500, -281,500 hectares in a ten year span of 1990-2000 came at the rates of -2.7, -2.9 and -5.27 percentage points. With corresponding numbers in the subsequent five years of 2000-2005, the rates of change in the core forest landscape variables stayed firm at -3.3, -4.08 and -11.14 %. The same thing can be said of the status of the nation's vegetation from 1976 through 1995. All these have serious implications for the environment.

From the analysis of the changing vegetation status of the nation from 1976-1995, note that the areas in Km^2 of all the 11 vegetation types prominent in the various ecozones of the country were in constant decline. The same level of losses found in other vegetation types in the ecozones, were felt among the mangrove forest types often found in the sensitive ecosystems of the south and the others. All these raise the risk levels for both human and natural environments containing rare species of flora and fauna that are currently on the verge of extinction in some areas. The risk communications as outlined in the brief spatial analysis also reaffirm additional problems posed to the mangrove forest environment and the wetlands of national significance in the south east from energy development.

Because the incidence of forest landscape disturbance does not occur in a vacuum, the paper identified the socio economic factors fuelling it. Furthermore, the paper went on to show valuable efforts at the margin to remedy the problems through agroforestry practices of communities. Accordingly, several studies were carried out including a reconnaissance survey on all the ecological zones of Nigeria to evaluate the various land use practices. The intent was to determine the potentials of agroforestry models most suitable to each zone. Community based efforts in the three southern states reveal a mix of similarities and divergence in methods, priorities and accomplishments to stem the tide of deforestation.

Furthermore, the farmers in Uroboland area of the Niger Delta practiced integrated farming that uses palm trees along side other crops to maintain soil fertility (Aweto, 2000). In Ilesha, the Leventis Foundation through a joint venture provided a major boost to education when it backed up its commitment to sustainability by establishing Ilesha Agricultural School to educate farmers. One of their major accomplishments involves the design of agroforestry nursery that distinguishes medical, fruit, and wood trees (Pro Natura, 2001). Elsewhere, a large majority of households in Abia State showed their awareness of the positive impacts that trees and agroforestry systems bring to their environment (Odurukwe, 2004). They were involved in community-based efforts to improve soil fertility and the reduction of erosion as well as food security and income earning potentials. The geographic locations of these sites are evident on the lower edge of the maps in the deep Southern slope of the country (Aweto, 2000).

Going by the present forest landscape change analysis herein, it is evident that the entire forest assets of the nation are vanishing substantially. Notwithstanding the nation's size, growing population and vast pool of biodiversity and its prominence on the global stage, at

11.1%, Nigeria's annual deforestation rate of natural forest is the highest and worst in the world and puts it on pace to lose virtually all of its primary forest within a few years. With Nigeria experiencing the largest deforestation rate of primary forest globally. The way out of the murky years ahead in such an unforgiving environment hinges on an honest recourse to sustainable management of the country's forest estate under the aegis of agroforestry. This is now more essential than ever before it is too late.

4. CONCLUSIONS

This part of the paper focuses on the closure along with some future lines of actions through recommendations. To address some of the concerns that were identified in the current research, future commendations ranging from education and research to policy reform are hereby made as part of the remedies. See the Appendix for a detailed analysis of these recommendations.

In essence this paper has explored tropical forest landscape change with a major focus on the Sub Saharan state of Nigeria. The paper presented the issues along with a profile of the study area, an environmental and mini spatial analysis of the trends and the ecological impacts on southern Nigeria. The other focus consists of the factors fuelling the problems and community efforts at the margins through the practice of agroforestry. Considering the rate at which the country has been losing her forested land areas, agroforestry has gradually emerged as a viable tool to minimize the trend. To analyze these issues the paper used a mix-scale method of temporal spatial analysis involving the descriptive statistics, spatial mappings and photo images of the forest landscape.

Based on the analysis, it is evident that Nigeria was once covered by widespread vegetation comprising of humid tropical forests in the south and savannah grasslands in the north. A great percentage of this luxurious vegetation has been cleared by the pressures mounted by human activities. Additionally, the forest reserves which functioned much of the time under serious neglect lacked improvement in terms of investment and management. Presently, forest reserves cover about 10 percent of the nation, mostly of the savannah woodland type. The southern rain forest, the source of the country's timber resources, covers only two percent of the total land area of Nigeria. It is being depleted at an annual rate of 3.5 percent. Accordingly, tropical deforestation rates continue to accelerate with mounting ecological impacts in sensitive natural areas making the nation one of the major losers of natural forest from 2000-2005 periods. This is largely attributed to subsistence activities and host of other socio-economic variables.

The continuous degradation of the forest reserve base in that manner has major effects on the already fragile coastal environment in the Delta area of the south east; this is evident with the rapid disappearance of forest cover leading to erosion, loss of biodiversity, the threats to wetlands of national significance, habitat loss, soil degradation, and unfavorable hydrological changes. Compounding the matter is the absence of a comprehensive mix scale analysis of the state of the nations forest landscape using temporal spatial analysis anchored in the use of descriptive statistics, landscape field photographic images and spatial mapping highlighting the locations of natural areas threatened by landscape disturbance.

The results show continual fluctuations and the growing skid in Nigeria's forest landscape over the years. This has resulted in the disappearance of forest resources and vegetation cover with growing threats to sensitive natural areas. Notwithstanding the linkages between some socio-economic elements and deforestation, community efforts at the margin using

agroforestry techniques seemed to have paid off with some promising benefits. The usefulness stems from the capacity of this technique in minimizing the threats of forest landscape disturbance. To remedy the problem, the paper offered some recommendations ranging from policy overhaul to education.

In the context of popular imagination of the nation, the vicious cycle of forest siege is a major tragedy for the nation and communities especially in the South East of the Delta. The forests contain some many life-saving materials that are crucial for our survival. Putting the experience of the homeland into perspective in that setting means that, squandering the forests and its different life forms would one day amount to some kind of self annihilation for several reasons. To begin with, the forest ecology of the area has for years served the indigenes of these areas in every facet of life most of which have been captured in both popular and scholarly discourses of the age. Being a major repository of knowledge for years, images and creatures of the forest remain fully entrenched in every part of tropical biology text books. In that light, the cover and content of text books in that field seemed deeply predicated on forest life showcased in many colors.

Why then must Nigeria destroy her vast forest estates if she knew the essence?. This is a question that everyone needs to answer. But before we wait for the answer, let one not forget that some of the epic novels of the past century in the nation from Tutola's, *Feather woman of the Jungle*, and Achebe's *Things Fall Apart* drew extensively in terms of themes and characters from settings deeply entrenched in environments where forest life stayed prominent. What about the aesthetics appeal and beauty of the forest, its pristine nature and innocence, the aroma and the bird songs you barely hear again in villages along the south east of the Niger. If the decision makers are still in denial of this, then I would call it self destruction.

Going by the outcome of the present forest landscape resource analysis herein, it is evident that that the forest estate of the nation has been greatly squandered. Notwithstanding the nation's size, rising population and vast pool of biodiversity and its prominence on the global stage, at 11.1%, Nigeria's annual deforestation rate of natural forest is the highest in the world and this puts it on track to surrender nearly much of its primary forest in the years ahead. With Nigeria experiencing the worst deforestation rates of primary forest in the world, whether, the ravagers of the nation's forest want it or not, the forest ecosystem can only resurrect again if the right policies are implemented in the coming years.

In light of these findings, it is evident that the recourse to agroforestry would enhance the tools available to resource managers in gauging the problems posed by deforestation in the country's ecological zones. Given the lack of research in showcasing the potentials of community-based agroforestry in minimizing these problems, this study helps fill an important gap in the literature. The analysis herein, offers decision makers the tools to identify the environmental and economic benefits of agroforestry as a road map in the design of viable indices to guide managers craft appropriate strategies for dealing with the disappearance of the nation's forest (Caozhi and Dawson, 2004). Finally, this is the choice policy makers and administrators must have to make for posterity in order to revive the forest ecology of the nation in the years ahead.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX-A

The Background on Nigeria

Nigeria ranks among the most enterprising nations in Africa and her potential as an exporter of agro-industrial products and manufactured goods continues to draw major interests from the international business community. At the pinnacle of her economic power last century, Nigeria was one of the most highly sought destinations for Global multinationals in search of a vibrant terrain for investment. The ubiquitous energy radiated by her economic success prompted by oil revenues was felt on different areas within the orbit of international capital. The country accounts for 54 percent of West Africa's population and 51 percent of its Gross Domestic Product (GDP). In Nigeria oil generates 80 percent of government revenue and 10.6 percent of GDP at factor cost. At the same time, agriculture is still the activity of many Nigerians constituting 40 percent of the GDP. While the current policy framework emphasizes the development of non-oil sector, especially agriculture, Nigerian agriculture faces a set of challenges common across Sub Saharan Africa such as limited capital, small size landholding, declining soil fertility, deforestation and unsustainable land use (WTO, 2004). Notwithstanding the enormous revenues generated from oil, some of the factors fuelling the continuous economic stagnation in the Nigeria center around the neglect of renewable natural resource sector such as agriculture and forestry and the focus on oil in the country.

APPENDIX-B

STUDY AREA

Accordingly, land is one of the major factors of production deeply fundamental in the composition and functions of the forest ecology and it is accorded a high value in all parts of the country. The core categories of land use in the country can be grouped as forest land, grass land, woodland, agricultural land or farmland, and other lands. Other classes of land consist of land for urban consumption, mining, and for infrastructural development. In the country, agriculture is responsible for about 40 percent of land use and it is one of the major factors involved in deforestation. For visual images on the extent of deforestation in the country see Figs. 2 and 3. Additionally, Nigeria's natural vegetation mirrors the nation's diverse climate and topography. The vegetation cover can be classified into two major types: the tropical forests, which cover one-sixth of the country and found mostly in the south, and the savannahs, located mainly in the north (Adesina, 1999). The information in 2.1 shows the current vegetation types of the country with some of the changes from 1976 through 1995.

Of all the indicators of deforestation, as of 1978-1995 the annual land use type changes dominant in Nigeria show, the country loses substantial amount of its forest land base on a yearly as shown in Table 1.1. Note also that competing land uses like agriculture gulped about 554,657.10 to 67,616.10 hectares in agriculture and floodplain agriculture likely to threaten adjacent forest land areas. Among the land use categories from trees / woodlands and shrubs to flood plain agriculture as Table 1.1 shows, note that the losses in hectares for Nigeria were about -858,720.40 hectares of wood shrubs, -104,974.30 hectares of shrubs and grasses, -104,231.00 hectares of forest, coupled with -14,982.7 hectares of mangrove forest. The situation is further compounded by the risk posed to the sanctuaries of biodiversity and the rare species now endangered in the forest ecosystem from the recurrent disturbance due to deforestation. In the absence of an environmental resource analysis, forest land managers run the risk of overlooking the gravity of the threats to ecology of the forests. There is also the danger of managers basing forest resource policy and conservation on improper blue prints likely to accentuate the problems with the eventual disappearance of the nation's forest landscape as predicted in recent years.

APPENDIX-C

AGROFORESTRY IN NIGERIA

Using a simulation model, (Aturamu, 2005), demonstrates the feasibility of a nationwide agroforestry policy option for Nigeria. This technique as traditionally practiced in Nigeria has the potentials to address slash and burn agriculture and current anthropocentric forces that are causing forest degradation. Agroforestry has gradually enhanced the socioeconomic livelihood of rural Nigeria by boosting income earning potentials, human welfare, food and nutritional security as well as provision of fuel wood, fodder for animal consumption and employment (Mende, 2003). In addition to these, the ecological benefits include watershed protection, soil stabilization and improvement and carbon sequestration.

Apart from these potentials, there exist several limitations. The choice of a suitable model in Nigeria is compounded by the location specific nature of the various models as a number of factors such as different ecological zones limit the adoption of a single model for the entire country (Mende, 2003). So far, only limited effort has been made in current research to showcase the success stories and the state of traditional agro-forestry systems and practices in rural communities of Nigeria. In light of these, recent interest in agroforestry has been generated against a background of rapidly deteriorating problems of forest exploitation, and conservation in the forest ecosystems of Nigeria. Considering that conventional methods of forest regenerations, were previously used as ways of combating the problems with dismal results (FAMNR, 1996a,b; FDF, 1998). The best approaches may be through a universal application of agro-forestry techniques in communities so that forest destruction is arrested at the source (NERC, 2002; Aiyelaagbe, 1998; Griffith, 2000; Bohringer, 2001; Klein, 2002; Aweto et al., 1992).

APPENDIX-D

3.3 Factors Responsible for Forest Landscape Change

From the analysis, there is a vast array of factors, fueling the pace of deforestation. This segment of the paper describes those factors. They consist of environmental degradation by human activities, uncoordinated land use policy, absence of well defined policy, lack of funding and well trained personnel.

3.3.1 Environmental degradation by human activities and demography

The role of environmental degradation in fuelling deforestation has been fully noted. Currently, roughly 1,000 forest reserves in the nation are listed in the International Union for Conservation of Nature (IUCN) Global Data Base on Protected Areas. Still, many of these reserves are fatally degraded while the remaining forests in some have been cleared (USAID/Nigeria 2008). Moreso, the majority of protected areas in the country that are devoid of full protection now face the threats of unlawful logging, infringement by farmers and cattle rearers, Furthermore, biofuel harvest and poaching still linger in the areas. A case in point is the growing pace of poaching and encroachment in many protected areas across the nation (Oseni, 2007; USAID/Nigeria, 2008; Meduna et al., 2009). In the same way, the Wildlife Conservation Society uncovered the existence of nearly 600 unauthorized farms adjacent to forested areas within a Wildlife Sanctuary (WCS 2010). Even if the proportion of protected sanctuaries to total surface area is growing in Nigeria, numerous species of flora and fauna remain critically endangered due to human activities and the rapid population growth in country. The information in Table 1 and Fig. 3.0-3.1 highlights the population trends and distribution and the dangers they pose to forest ecology.

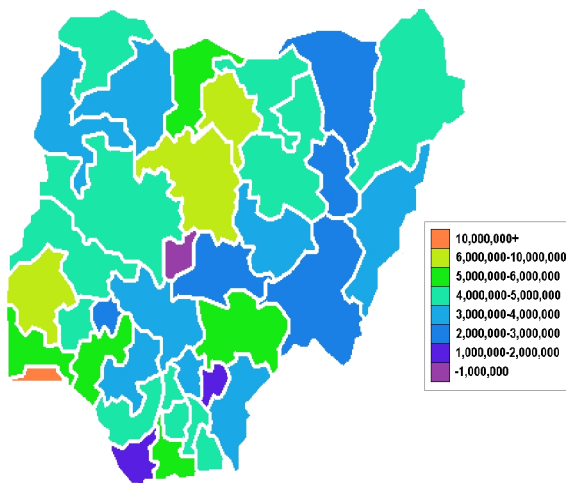


Fig. 3.0 The Nigerian state populations in 2006

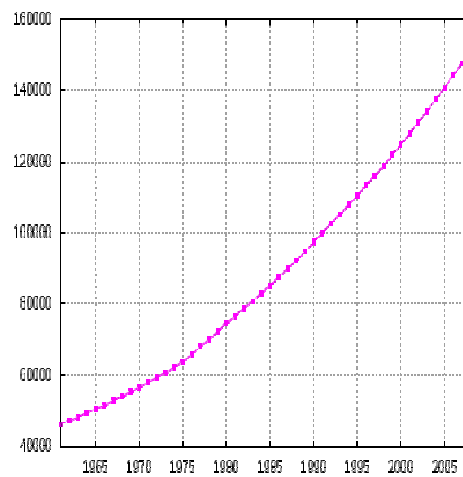


Fig 3.1 The population trends in 2008

3.3.2 Uncoordinated land use policy

One of the roles of any effective land use policy is to enhance the quality of life and environmental resources such as forested land areas in a sustainable manner at the local level. Yet one major factor contributing to forest resources degradation in the country stems

from the uncoordinated land use policy in place. In other areas of the world cities have the mandate and jurisdiction over land use policy coordination. Even where zoning techniques are in use, vegetation/ land cover including forest and natural habitats are shielded under protected natural corridors with no prospects for development or disturbance by human activities. In the case of Nigeria, where land use policy is sometimes adhoc, conventional land use coordination remains elusive. Some of the land use programs of the past such as the land use decree failed partly under the military due to the undemocratic manner in which the governors solely managed the issuance of certificate of occupancy without involving others.

Such top down models in management complicates the efficient implementation of land policies since most land use problems are usually localized and better dealt with at the county level with collaborations among stakeholders and affiliated agencies at the local and federal level instead of handpicked appointees by governors that are completely detached from the problems. Looking at land use programs of government departments at the state, national and local level, you will notice the absence of a common approach to the menace of deforestation. In the absence of any policy measures by the government to stem the tide, there is no chance of sustainable farm land use in areas adjacent to forest sanctuaries (USAID/Nigeria, 2008). In that light, the country's natural forests are being destroyed by incompatible land uses such as agriculture, cattle grazing and construction activities for urbanization (FAO, 2000), despite numerous land policies. The incompatible uses could have been better contained if land use policy implementation were coordinated properly.

3.3.3 The absence of a well defined policy

Strongly associated with the previous factor already mentioned, is the absence of a properly defined policy and programs. Much of the policy and program activities geared at attaining the objectives of afforestation do not seem properly designed. A case in point is that many of the tree planting campaigns earmarked in the past lacked proper coordination throughout the nation. The issue is further compounded due to the problem of reluctance and lack of dedication to the policy. The constant change in the administrative governance in the nation hinders continual dedication towards the implementation of a nationwide reforestation programs. Pertaining to the tree planting project, just as it stayed typically ignored by several regimes, some made unenthusiastic efforts at revitalizing it. More so, some of the reforestation projects on insignificant lands are often used for cheap political gains. Main concerns are hardly ever given to areas requiring immediate attentions since they are regularly used to achieve political expediency (Usman 2010). This is compounded by the demand for wood products and the activities of the sawmills industry in the country (Table 4.0 -4.1).

Table 4.0 Sawmills' estimated capacity and production in 1993

Type	Number	Capacity (m³)	Production (m³)
CDs & Carriages	1,600	5,500,000	2,531,000
Portables	100	57,000	30,000
Pit Sawing	1,000	285,000	150,000
Total	2,700	5,842,000	2,711,000

Source: FAO, 2000

Table 4.1 Demand for some wood products

Wood Products	Annual Demand
Industrial Round wood (m ³)	7,523,772
Sawn wood (m ³)	2,429,870
Particle board (m ³)	30,948
Paper and Paper Board Imports (M.T.)	108,451

Source: FAO, 2000

3.3.4 Lack of funding and well trained forest protection personnel

An additional factor revolves around insufficient funding for institutions and forest biodiversity conservation programs in the nation. There exists also the issue of a shortage of skilled personnel to manage protected areas. The nation's conservation sector suffers limited availability of properly skilled foresters, forest biologists and other conservation experts able to effectively manage the nation's forest and wildlife resources landscape. Another problem is the absence of properly skilled forest and game rangers (WSC, 2010). Accordingly, protected forest land areas thus, lack properly skilled personnel, preparation and the gears needed for daily operation and management of the forest landscapes. This issue remains critical especially in places under the jurisdiction of state governments (USAID/Nigeria, 2008).

APPENDIX-E

3.4 Community Efforts through Agroforestry

Community initiatives are abound in the area of agroforestry practice in the southern part of the country

3.4.1 Integrated farming

There has been a growing effort among the communities along the Niger Delta area of Uroboland to promote integrated farming based upon the techniques of agroforestry. To actualize this initiative, the farmers in the community have protected and integrated the oil palm tree into their farms (Aweto, 2000, 2001). This tree is retained on the farm because of its economic importance. Oil palms also feature prominently in cultivated plots of cassava, maize, cocoyam and other field crops. While the retention of oil palms in cultivated arable land in the area serves agroforestry, however the beneficial value of the tree from an ecological standpoint is to protect the soil against erosion and provide communities with fuel wood. Considering the benefits, the community recognizes integrated farming as a tool for sustaining organic matter and nutrient buildup in the soil so as to improve soil fertility (Aweto and Ekuigbo, 1994; Aweto et al., 1992).

3.4.2 Joint venture in education

Seeing the viability of sustainable agriculture for rural communities, in 1987 the Leventis Foundation through a joint program with the European Union established the Ilesha Agricultural School to boost interest in sustainability within the agricultural sector. The school located on 234 hectares of land that was previously cleared for farming offers training in basic farming practices and farm management. The institution integrates agroforestry techniques with the existing knowledge of traditional land use systems. Previous knowledge and hands on experience gained during the course helped provide farmers with the right skills for a successful practice. During the program, the farmers not only acquired land as part of the course requirements, but they raised money from the produce they sold. This enabled them to purchase the essential farm tools for finishing the program instead of ravaging the forests (Pro Natura, 2001). See Table 5.0 for a summary of the benefits of the program.

Table 5.0 Some of the benefits of the agroforestry program in Ilesha

Numbers	Ecological Description	Benefits
1	Arboretum-to produce seeds and teach grafting techniques	Inter-cropped plot- to maintain soil fertility
2	Alley cropping practice	2 ha orchard planted
3	10 ha forest- to manage natural resources and collect wild seeds	Soil erosion control
4	Fuel wood production in the agro-pastoral systems	The beneficiaries of the program include 243 men and 64 women.

3.4.3 Agroforestry efforts in peri-urban cities

The agroforestry practices used in the southeastern state of Abia includes multistory home gardening and border planting. The reason why this method is used more is the security it provides in food production, the variety of crops obtained, the capacity to boost soil fertility, and the much-needed income. The essence of border planting on private- and government-owned land is enormous. While it enhances the aesthetic beauty of the area through boundary allocation, it helps control water and wind erosion. The other benefits are that it encourages live fencing, the supply of fodder and fuel wood. The choice of plants for this method includes timber species, fruit trees such as coconut, oil palm, mango, and bitter leaf. Under the labor division of production women and children focused their involvement in weed management, soil fertility maintenance and the watering of plants, while men helped in the production of multipurpose trees and shrubs (Odurukwe, 2004). Table 5.1 contains a list of the prevailing agroforestry practices in the area.

5.1 Agroforestry practices in Abia State

Agro-forestry Practice	Percentage of the Population
Multistory home garden	31
Woodlots	11
Amenity Planting	39
Live Fences	53
Alley cropping	0
Improved Fallow	5
Taungya system	18
Dispersed multipurpose trees	68
Border planting of trees	76
Trees and shrubs on eroding sites	58
Wildlife agro-forestry	9

APPENDIX-F

4.1 Recommendations

4.2.1 Promote education and research efforts

Forested land areas in Nigeria's different ecozones have experienced enormous degradation due to human activities for decades. This threat can be minimized by building upon the success stories of these communities by providing training and assistance in managing the forests for sustainable uses (NERC, 2002). This can be attained through education and research programs to acquaint farmers with the right practices to boost food security and techniques suitable for their respective ecozone in addressing the problems. The authorities and institutions can also work closely with these communities to develop action plans anchored on local needs in the areas of soil management and host of other priorities (Franzel et al., 2001). There also an urgent need for a nationwide education and enlightenment program to inform the populace about the dangers of deforestation.

4.2.2 Encourage local involvement

Nigeria's population has a rural component in close proximity to forested areas and the most fertile soil. The extent and nature of forest decline and a number of agricultural programs that failed to revitalize the food sector of the economy in the past due to the top down models are clear indications of the negation of rural communities who are much closer to the problems. While the socio-cultural practices in the country side and the informal sector has a role in deforestation, the nation should not make the peasant communities the problem as has been done in many World Bank land reform programs in West Africa. The authorities should involve local communities in agroforestry programs in the areas of sustainable harvesting and processing of forest products by offering assistance that can help develop village tree plantations in wood poor areas dependent on wood fuels for cooking and for poles and timber to meet local fencing and building needs. Just as this approach will be quite viable in communities that are yet to embrace the techniques of agroforestry, it would go a long way to address re-afforestation (Haggar, 2001).

4.2.3 Provide financial support and the right training for foresters

The successful implementation of agroforestry programs and forest protection initiatives as shown in this research requires availability of seedlings. The provision of adequate funding to secure a prompt supply of seedlings is highly indispensable in that it enables communities procure seedlings for tree planting initiatives. This effort can be supplemented by instituting programs that help farmers and the agroforestry teams gain knowledge and the skills to market their products in order to improve the socio-economic situation of people living on forests and farming activities. This will enhance income-earning potentials from small holder production and sale of products (Bohringer, 2001). Given the sorry state of forest management in the nation, adequate training and funding for forest rangers charged with the protection of forest areas should be encouraged.

4.2.4 Policy reforms

The history of program design and implementation with regards to agriculture land use and forestry in Nigeria show that they are adhoc and reactionary in nature with emphasis on

production rather than sustained yield over time. Urgent matters such as deforestation, food scarcity and rural poverty are only accorded topmost priority on the policy agenda when these problems have reached a calamitous proportion. This can be attributed to over reliance on obsolete policy instruments anchored in production. This is out of sync with the emerging ecological uncertainties and the recourse to sustained yield. The country's ministry of agriculture and forestry lacks a sophisticated network of policy infrastructure capable of eradicating problems facing agriculture and forestry. The right instruments such as incentives for rural farmers in agroforestry programs as well as a command and control mechanism to regulate land use activities should be incorporated in existing policies as part of the reforms under the aegis of sustainability (Mende, 2003; Aturamu, 2005; FAMNR, 1996a, b).



Fig. 4.0 Tree planting helping prevent erosion



Fig 4.1 Examples of tree planting



Fig. 4.2 Regeneration initiatives and use of poles



Fig. 4.3 Land prone to erosion



Fig. 4.4 Land surface with thin vegetation



Fig. 4.5 Land cover with some areas already degraded

Figs. 4 0-4.4 Field Images of landuse and vegetation change in Abia State

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