Threats to Sustainable forestry Development in Oyo State, Nigeria.

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Abstract

Oyo state has a huge forest resource. The rural communities depend on the forest for their livelihood, while it is a source of revenue for the government. Presently, the forest resource is faced with a decline in quantity and quality. In order to address this decline, this study has been designed to investigate the threats to sustainable forestry development. The data were generated from Oyo state forest resource inventory. The triangle of sustainability and International Tropical Trade Organisation (ITTO) criteria and indicators for sustainable forest management were used to discuss the impact of factors affecting sustainable forestry and evaluate forestry in Oyo state, respectively. The study indicated that forestry in Oyo state has not been able to meet the criteria for sustainable forest management. Major factors hindering sustainable forestry were socio-economic, such as unclear tenure and property right, inefficient use of resources, inadequate information about the forest, weaknesses in implementation of the forest management plan and enforcement of the forestry law. These factors have led to some impacts such as loss of revenue, economic insecurity and instability, loss of biological diversity, depletion of the forest resource and disempowerment of the rural communities. Major suggestions made are that the indigenous communities should be actively involved in forest management operations, customary laws should be incorporated into formal land allocation laws and a comprehensive environmental education campaign should be undertaken.

Key words: Sustainable forest management, rural communities, environment, triangle of sustainability, ITTO criteria and indicators.

Contents

1. Introduction

Over the years sustainable management of the tropical forest resources has been of primary concern due to its potential impact on biological diversity and importance in maintaining global ecological functions. In spite of its importance, the natural tropical high forest has continued to diminish rapidly in the African continent, thus dwindling sustainable forest management. The African continent could face the possibility of timber and fuel wood scarcity towards the end of the century. The tail end of this century may witness widespread disaster arising from misuse and over exploitation of forest resources in the African region.

It has been assumed that at the onset of 19th century, humans had little or no impact on the environment. A rich and varied vegetation, dominated by trees and heterogeneous fauna developed and maintained itself within a complex ecosystem. The diversity of the African tropical rainforests and the rich genetic pool they contain provided a resource of vast potential that the metropolitan powers were later to recognise and exploit with little or no regard for conservation.

Most of the African timber rich zones are faced with diminishing forest resources due to forest degradation, human and animal population pressures, mismanagement and other forms of exploitation. It has been predicted that within the next thirty years, unless adequate measures are taken, most humid tropical forestland area in Africa could be transformed into unproductive land and the deterioration of the savannah into desert will be accelerated (Kio, 1980).

The level of nutrition of a community is sometimes linked to fuel wood availability and cost. A majority of the people residing on the African continent use fuel wood as source of energy for cooking. In many areas, the present population is so large that the existing wood resources are over exploited. It is claimed that there are now places in the Sahel region where fuel wood has become so expensive that it absorbs about half the monthly budget of some poor families in urban areas. Some families could only afford one meal per day as a result of high cost of fuel wood and other alternative sources of energy for cooking.

With extensive deforestation, villagers are compelled to walk long distance to fetch fuel wood and eventually tempted to substitute dried animal dung and crop residues for fuel wood. This tends to have serious consequences for local agricultural production and productivity because; the rural communities also rely on this substitute for improving soil fertility. Apart from the deterioration in the quality of life associated with forest degradation, there are other more insidious effects that endanger the future of humans on this planet. Climate is determined by physical factors near the earth's surface set in motion by the solar energy. Vegetation influences the earth's surface in two ways: by reducing wind velocity and by intercepting the solar radiation (albedo). But climate is one of the main vegetation forming factors, causing differences in the vegetation cover of the earth. This relationship suggests that a feedback mechanism exists and that changes in vegetation, including those induced by humans may result in irreversible changes in climate.

Vegetation cover, socio-economic growth and development are positively correlated in nations with agriculture and forestry based economies, as reported by Embaye (2001). Therefore, it becomes eminent for developing countries to embrace sustainable forest management geared toward meeting the demand for goods and services for the ever-teeming human population.

Introduction of sustainable forest management in developing countries may lead to an increment in the short-run cost. But it could result in cost reduction in the long run as a result

of decreased operating cost and improved production level. A central aspect of sustainable forest management is the need to optimise the mix of products and services from the forest. Optimising benefits in the long term involves making trade-offs between benefits, which can be reaped today, and those, which should be left for the future as, argued by Higman *et al.*, (1999).

Nearly 500 million people around the world depend on forest for their livelihood; among them are a high number of forest and wood workers. Sustainable forestry management must include safe, stable jobs with adequate wages and working conditions (Bowling, 2000).

1.1. An overview of forestry development in Nigeria

Forestry development began in Nigeria in 1889 with emphasis on forest reservation and regulated timber exploitation (Geomatics, 1997). In 1980's, demand for forest products, especially timber became insatiably high as a result of increasing human population pressure and economic growth. This led to unregulated forest exploitation, thus resulting in degradation of the forest resources in the country. FORMECU (1993) reported that, the average annual rate of deforestation in Nigeria between 1980 and 1990 was 3.5%, while Enabor (1986) argued that, land clearance for cropping by subsistence farmers in shifting cultivation account for about 80% of the deforestation in Nigeria.

Nwoboshi (1986) reported that, in 1876 it was estimated that 60 million hectares of the total land area of Nigeria was forested, while in 1985, this figure declined to about 9.4 million hectares. Anadu and Green (1990) observed that Nigeria has lost more than 90% of its primary moist Lowland forest. Presently, Nigeria has 15% forest cover (FAO, 2004).

It has been estimated that only about 360,000 km^2 (25.6%) of Nigeria land mass is under forest and woodland/shrubs cover (FAO, 2003). In an attempt to preclude total depletion of the forest resources, the federal government of Nigeria has geared effort towards increasing 10% (91,000 km^2) of the total land area under forest reserve to 20% towards meeting the FAO specification of 25% in the future.

In 1990's, the area of industrial forest plantations in Nigeria was about 160, 000 ha while the area of environmental plantations was 48,000 ha (Oyebo and Okiriguo, 1999). Rubber constitute about 50% of the plantation, *Gmelina arborea* - 30%, while *Pinus caribaea* account for about 1%. Other broadleaved tree species such as *Tectonia grandis,* and *Eucalyptus* species are also regenerated in the forest plantation. Lack of forest management plan, primitive silvicultural operations, under-utilisation of resources and high rate of illegal logging in the forest plantation resulted in alarming failures (FDF, 1998).

In 1960's and early 1970's, over 60% of the national export earnings were from forest produce. During this period wood supply was far greater than demand, but presently the country is unable to meet export demand for most tropical hardwood species from the natural forest (Geomatics, 1997). The mismanagement of the forestland in the course of logging activities and agricultural production resulted in the formulation of forest reservation policy. But the policy that emerged was not based on adequate knowledge of ecology, biology and silviculture of the natural forest ecosystem as argued by Osemeobo (1998). There was pervasive tendency to either over-value or under estimate the economic, social and ecological cost of forest utilisation.

1.2. Background information of forest resources in Oyo state

Oyo state had about 41.2% forestland area in 1978, but this diminished to 27.7% (783,221 ha) in 1995 as reported by FORMECU (1998). Oyo state has an average population density of 124 people/km2 while; the annual population growth rate is 2.7% (Adamu, 2000). The estimated population and forestland area is depicted in Table1.

Table 1. *Forestland area and human population dynamics in Oyo state*

Year	Land area (ha)	Forest cover (ha)	Forest cover %	Human population	Forest area per capita (ha)
1991	2,784,800	808,638	30.9	3,463,837	0.234
1992	2,784,800	802,221	30.1	3,559,956	0.225
1993	2,784,800	795,853	29.3	3,658,742	0.218
1994	2,784,800	789,537	28.5	3,760,269	0.210
1995	2,784,800	783,221	27.7	3,864,613	0.202
1996	2,784,800	789,537	28.4	3,971,613	0.199
1997	2,784,800	783,221	27.7	4,084,069	0.192
1998	2,784,800	776,955	26.9	4,192,285	0.185
1999	2,784,800	770,739	26.1	4,305,477	0.180
2000	2,784,800	764,573	25.3	4,421,725	0.173
2001	2,784,800	758,457	24.5	4,541,112	0.167
2002	2,784,800	752,389	23.7	4,663,722	0.161
2003	2,784,800	746,369	22.9	4,789,642	0.156

Ezebilo (2004)

The state is divided into 33 Local Government areas for administration. The Yoruba ethnic group is the dominant tribe in Oyo state. Most Yoruba's are urbanised, but some still maintain farms in the rural areas. There are also significant groups of city-dwelling Hausa, and Fulani, as well as smaller communities of several other cultural groups residing in Oyo state. Urban area settlement account for more than 32, 500 ha. Ibadan, the capital of Oyo state is the largest city in West Africa.

1.2.1. Agro-pastoral and forest resource use

Oyo state is agriculturally oriented. Farming systems are mainly slash and burn followed by bush fallow. Cassava, and maize are the major food crops while; major tree crops are oil palm, cola, cocoa, rubber, and citrus fruits. Tree crops serve as the primary source of income for the farmers. The Fulani people who reside in the northern part of the state are livestock farmers. They keep cattle, sheep and goats.

Agricultural activities utilise more than 65% of the total land area of the state. Lowland Rainforest account for about 6%, while trees/woodlands/shrubs covers about 22% of the total land area of the state. Most people in the state depend on fuel wood as energy source for cooking while, poles are used for supporting electricity cables, and sawn wood are utilised for production of furniture, pulp, paper and building houses.

1.2.2. Ecological zones

Oyo state is divided into three major ecological zones based on the differences in the vegetation type. The ecological zones are the following:

- The Guinea savannah ecological zone is located in the northern part of the state. The vegetation consists of open woodland, tall grasses (1 to 3 m high) and trees that are less than 15m in height. Animal husbandry dominates this ecological zone.
- The Derived savannah ecological zone is found in the southern half of Oyo state. This zone developed as a result of intense deforestation due to agricultural activities on the forest area. Areas left to re-grow favours grasses and shrubs that are susceptible to fire. Arable cropping dominates this ecological zone.
- The Lowland Rainforest ecological zone occupy south of the derived savannah zone. Lowland Rainforest portray three stratum/storeys. This comprises of the top with isolated wide spreading crowns; the middle with a large number of species with small crowns; and the under storey made up of woody climbers and short trees with spreading crowns. Most of the tree species are used for timber production. Tree crop agriculture the dominant land use in this zone.

The Lowland Rainforest is believed to be rich in biological diversity. This forest type contain many tree species of commercial importance such as: *Terminalia glaucescens, Lophira lanceolata, Afzelia africana, Daniella oliveri, Triplochiton scleroxylon, Khaya ivorensis, Stercula tragacantha, Lovoa trichiloides, Cylicodiscus gabunensis, Lophira alata*, and *Cola cordifolia*, while the forest plantation comprises of the following exotic tree species: *Tectona grandis, Gmelina arborea, Eucalyptus spp*, and *Cedrela odorata*.

Major Nigeria's charismatic mega fauna such as the African elephant (*Loxodonta africana*), African buffalo (*Syncerus caffe*), and hippopotamus (*Hippopotamus amphibius*) are found in Oyo state. Other prominent mammals; are duikers (*Cephalophus spp*), drill (*Papio leucophaeus*), chimpanzee (*Pan troglodytes*), gorilla (*Gorilla gorilla*) and vast species of primates such as the white-nosed monkey (*Cercopethecus nictitans*)

Happold (1987) reported that about 57% of the Rainforest mammals are rodents and bats such as fruit bats (*Eidolon helvum*), hairy slit-faced bats (*Nycteris hispida*), Gambian giant rat (*Cricetomys gambianus*), and three–striped mouse (*Hybomys trivirgatus*). Only one large carnivore, the leopard (*Panthera pardus*) occurs in the Rainforest due to limited number of suitable prey. The small carnivores comprises of the long-nosed mongoose (*Crossarchus obscurus*) and genets (*Genetta spp*). The rain forest zone is home for about 200 bird species such as blue plantain eater (*Corytheola cristata*), grey parrot (*Psittacus erithacus*), green pigeon (*Treron australis*), barbets, bulbuls, flycatchers, warblers, and sunbirds as reported by Nason (1992). Micro flora, and invertebrate species are not well documented.

1.3. Problem statement and objectives of the study

The population of Oyo state is ever teeming, while the forest resource is diminishing rapidly. The forest industry in the state is in the verge of collapse due to the increasing scarcity of the major wood forest products. The rural society in the state is also dependent on varied non-timber forest products and services that are currently being jeopardised. In an attempt to arrest this decay and looming catastrophe, it becomes necessary to study threats to sustainable forestry development. This study has been formulated to investigate:

1. Whether or not forestry in Oyo state meet criteria for sustainable forest management.

2. The factors that militate against sustainable forestry and the impact they could have on the various dimensions of sustainability.

3. What could be done to achieve sustainable forestry

The information generated from this study is intended to help policy and decision makers to communicate the status of the effort towards sustainable forest management more effectively to the public. Hopefully, it could also assist in developing policies and strategies for sustainable forest management and in focussing research efforts where knowledge is deficient.

2. Materials

The data for this study were gathered from Oyo state forest resource inventory report conducted by Beak International Inc., Lagos and Geomatics International Inc., Ibadan (1999). The forest inventory was carried out on behalf of Forest Management, Evaluation and Co-ordination Unit (FORMECU), Federal Department of Forestry (FDF), Abuja- Nigeria.

The International Tropical Trade Organisation (ITTO) criteria and indicators for sustainable management of natural tropical forests, 1998, and the triangle of sustainability developed by Munasinghe (1993) and relevant literature reviews were also used.

2.1. Oyo state setting

Oyo state is located in latitude 6º55'– 8º45'N and longitude 2º50'–3º56'E respectively in south-western Nigeria, West Africa. It is bound by the Republic of Benin, Kwara state, Osun state and Ogun state on the west, north, east and south respectively.

The state has a tropical climate type with distinct periods of wet and dry season. The mean annual temperature is 21ºC while the annual rainfall ranges from 1000 mm to 1500 mm. The wet season is between 230 to 260 days/year.

Most soil in Oyo state belongs to the savannah group of soil (Oyo state soil survey Division, 1990). In undulating areas, the soil is composed of sand, and sandy loam, while in areas that are nearly level, savannah soil comprises of sandy loam with some gravel. Rainforest soil is found in the southeast part of Oyo state. The soil consists of loam, sandy loam, and clay loam.

2.2. Land Use Act (1978)

Land ownership in Nigeria is subject to a range of diverse customs, cultural and traditional practices. Land can be classified according to the following broad categories:

- Community land, or land commonly referred to ancestral land, is owned by all the indigenous people.
- Communal land consists mostly of under-developed forests and is owned by nobody. Those who clear it first claim the ownership.
- Clan or family land is owned by clans and families, as the name suggests
- Institutional land: land allocated to traditional institutions such as traditional authorities and chiefs.
- Individual land: land acquired by an individual, which may be inherited by the immediate family, depending on customary practices.

The above traditional land ownership systems was distorted by the introduction of legal instruments within the body polity of the modern nation-state. Land Use Act (LUA) originated as a decree of military government in 1978, which advanced as a rationale for its introduction, the "limiting, inhabiting and divisive nature of land tenure in the country" (Fajemirokun, 2002). The relevant portion of the Act reads:

All land in the territory of each state (except land vested in the Federal Government or Agencies) is vested in the Governor of the State, who holds such land in trust for the people and would henceforth be responsible for the allocation of land in all urban areas to individuals resident in the State and to organisations for residential, agricultural, commercial

and other purposes while similar powers with respect to non-urban areas are conferred on Local Government (FGN, 1978).

By abolishing private ownership of land, proponents of LUA believed that it would:

- Facilitate access to land for public and private use
- Promote tenure and security
- Curb land speculation, which had been driving land values upwards and out of reach of most Nigerians.

Under the LUA the highest interest in land is a right of occupancy. This can either be statutory right, which is granted by the State Governor in respect of land in both urban and non-urban areas or a customary right of occupancy, which is granted by a Local Government in respect of land in non-urban areas. Designation of urban and non-urban areas of a state is the exclusive responsibility of the State Governor.

The State Governor can only grant proof of the right of occupancy, which is known as a certificate of occupancy. This legal document last for 99 years after which new application could be filed. Consequently, any person who holds a customary right of occupancy is still required to apply in the prescribed manner to the State Governor for certificate of occupancy. Under the LUA, section 2 (1) (a), Local Governments are only charged with the control and management of land in non-urban areas and are entitled to grant customary rights of occupancy in such areas. However, they are not expressly conferred with power to issue any proof of the right of occupancy and are in other significant respects subject to the overall control of State Governors (FGN, 1978).

LUA provides that the State Governor and Local Government can grant rights of occupancy for any purpose. But the consent of the State Governor is required for any grant of customary right of occupancy for agricultural purposes if the area of land exceeds 500 hectares or if granted for grazing purposes, the area of land exceeds 5000.

The Federal Government does not play a role in land administration other than in relation to federal land. This is comprised of land holdings vested in the Federal Government prior to the commencement of LUA and which it retains free of the requirements of the LUA (FGN, 1978).

2.3. Forest type and volumes

The natural forest type can be classified into two, namely; Lowland Rainforest, and riparian forest as shown in Table 2.

Table 2. *Gross timber volumes by forest designation and forest type in Oyo state*

Forest designation	Forest type	Area (ha)	Gross volume(m^3)
Forest Reserve	Lowland rain	17,561	2,207,221
Free Area	Lowland rain	129,824	16,807,543
	Riparian	2,298	161,728
Game Reserve	Lowland rain	1,869	311,118
	Riparian	5,492	386,513
National Park	Lowland rain	23,026	3,832,962
Total		180,070	23,707,085

The forest tree plantation occupies 6,743 ha accounting for 2,169,567 m^3 by volume. Oyo state has 18 forest reserves as indicated in appendix 5.

- The forest reserves are all forestland, which earlier belonged to indigenous communities but constituted into forest reserves by law. It is the production forest managed and controlled by the state forestry department an. The revenue generated from this forest goes directly into the coffer of the state government.
- Game reserve and the National park are protected areas set aside for conservation of biological diversity, environmental protection and preservation of cultural heritage. They also serve as centre for tourism and recreational activities. The government controls all operations taking place in the forest-protected areas.
- Free area is forestland 'earmarked' to be controlled by the indigenous communities. They are not allowed by law to fell and convert any tree to timber without getting clearance from the government. However, they could destroy 'their' forest and convert them to farms without any legal implications.

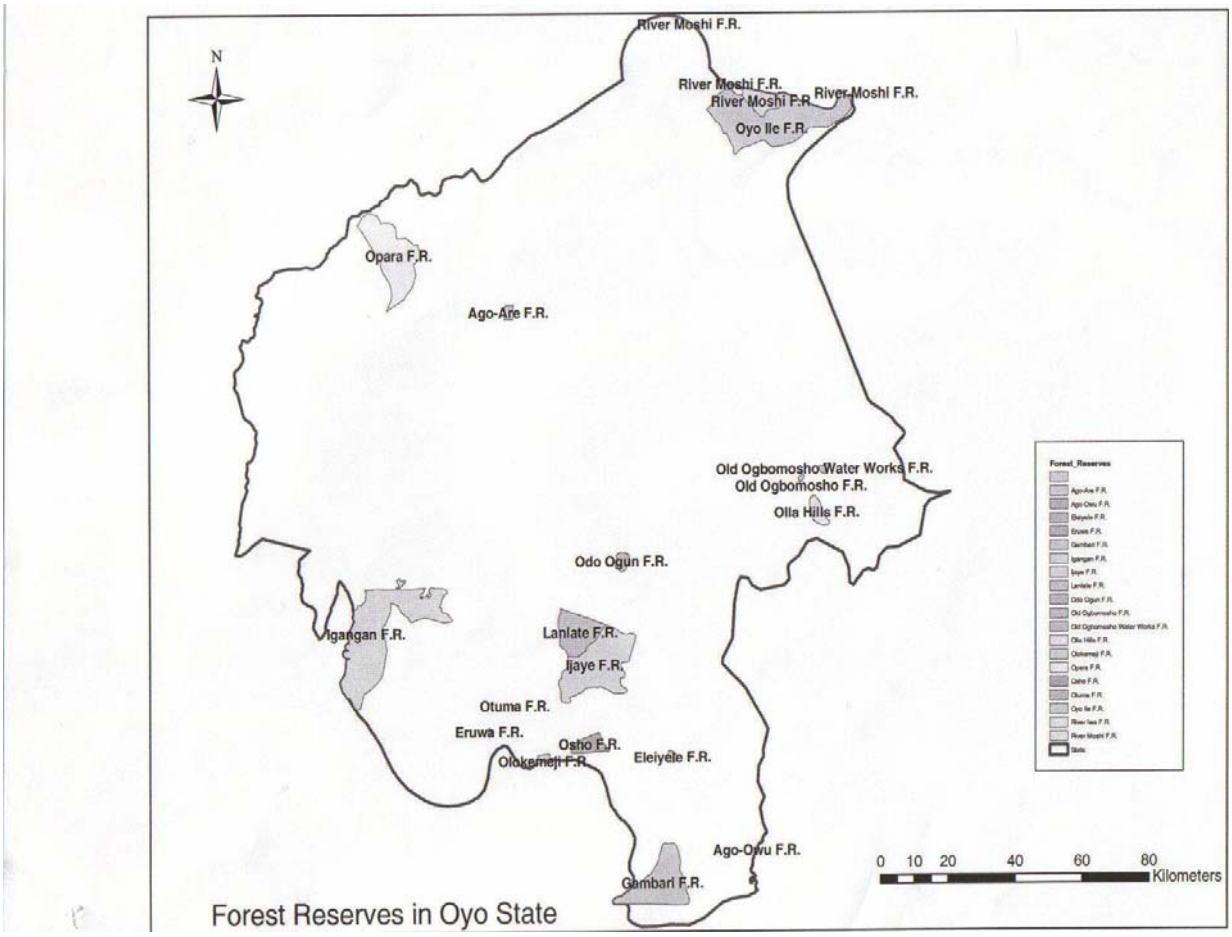

Figure 1. Map of Oyo state showing location of the forest reserves (Beak and Geomatics, 1999).

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3. Methods

Forests and forestry in Oyo state were evaluated using ITTO's criteria and indicators 2, 4, 5 and 7 for sustainable forest management of natural tropical forest. Factors militating against sustainable forestry development were identified during the evaluation.

The impact of the factors threatening sustainable forestry in Oyo state was discussed using the triangle of sustainability developed by Munasinghe (1993), while, recommendations were made based on brainstorming and some analogies drawn from relevant literatures.

3.1. ITTO's criteria and indicators for sustainable forest management in natural tropical forests

ITTO's criteria and indicators provide tool for assessing changes and trends in forest conditions and management systems at the national and forest management unit levels. Indicators identify the information needed to monitor change, within the forest (outcome indicators) and outside the forest (input and process indicators). If the values of any indicator are placed in a time sequence, they provide information on the direction of change, either towards or away from sustainable forest management. Suffice to say that indicators cannot by themselves establish whether management is or not sustainable. Higman et al, (1999).

ITTO's criteria for sustainable forest management are the following:

- Criterion 1: Enabling conditions for sustainable forest management
- Criterion 2: Forest resource security
- Criterion 3: Forest ecosystem health and condition
- Criterion 4: Flow of forest produce
- Criterion 5: Biological diversity
- Criterion 6: Soil and water
- Criterion 7: Economic, social and cultural aspects.

ITTO's criterion 2 shown in Table 3 portray the extent to which a country has a secure and stable forest estate to meet the production, protection, biological diversity conservation and social needs of the present and future generations.

ITTO's criterion 4 depicted in Table 4 is concerned with forest management for production of wood and non-wood forest products. It highlights that such production can only be sustained in the long-term if it is economically and financially viable, environmentally sound and socially acceptable.

ITTO's criterion 5 in Table 5 correlate to the conservation and maintenance of biological diversity, including ecosystem, species and genetic diversity.

ITTO's criterion 7 in table 6 deals with the economic, social and cultural aspects of the forest, besides those mentioned under criteria 4 and 5. As a renewable resource, the forest has the potential, if managed in sustainable manner, to make an important contribution to the sustainable development of the country.

The study could not use criteria 1, 3, and 6 presented in appendices 1,2 and 3 during the evaluation due to inadequacy of credible data. The concept area (institutional framework). In criterion 1 need to be surveyed critically before any assertion could be made. The concept areas; area of forest damaged by human activities and degree of damage, and degree of forest

damaged by natural causes located in criterion 3 (appendix 2) requires further research as the available data is inadequate to grapple with these indicators. Indicator 6.1 was investigated in criterion 5. Indicators 6.2 to 6.5 and 6.7 to 6.9 in Criterion 6 (appendix 3) need further research for a credible inference to be drawn.

Table 3. *ITTO's criterion 2: Forest resource security.*

Concept area	**Indicators**	**Sub-indicators**
Description of resource base	2.1. Extent (area) and % of total land area under:	(a) natural forest, (b) plantation, (c) permanent forest estate, (d) comprehensive integrated land-use plans
	2.2. Extent (area) and % of total land area under each forest type. 2.3 Length and % of external boundaries of permanent forest estate demarcated or clearly defined. 2.4 Area of the permanent forest estate converted to permanent non-forest use	
Protection procedures	2.5 Existence of procedures to control encroachment, fire, grazing, and illegal exploitation of forests.	

Table 4. *ITTO's criterion 4. Flow of forest produce.*

Concept area	**Indicators**	**Sub-indicators**
Resource Assessment	4.1 Extent and % of forest for which inventory and survey procedures have been used to define; 4.2 Estimate of the level of sustainable harvest for each main wood and non-wood forest product for each forest type 4.3 Quantity(volume) of wood and important non-wood forest products harvested for each forest type	(a) the quantity of the forest products, and (b) resource rights and ownership
Planning procedures	4.4 Existence and implementation of; 4.5 Extent and % of; (a) production forest covered by management plans. (b) Compartments harvested by harvesting plans 4.6 Existence of long-term projections, strategies and plans for production, including the use of plantations. 4.7 Availability of historical records on the extent, nature and management of forest	(a) forest management plans (b) forest harvesting plans
Management guidelines	4.8 Availability and implementation of management guidelines for each of the main wood and non-wood forest products to be harvested, to cover; 4.9 Availability and implementation of procedures to monitor and review the management guidelines 4.10 Availability and implementation of guidelines for reduced/ low impact logging to minimise damage to residual stand.	(a) the assessment of natural regeneration (b) measures to supplement natural regeneration where necessary
Monitoring and evaluation	4.11 Availability and implementation of ; (a) procedures for comprehensive evaluation of the implementation of management guidelines (b) procedures to assess damage to residual stand (c) post-harvest survey to assess the effectiveness of regeneration. 4.12 % of area harvested for which; (a) management guidelines have been completely implemented (b) post – harvest surveys have been conducted to assess the effectiveness of regeneration	

Table 5. *ITTO's criterion 5: Biological Diversity.*

Concept area	**Indicators**
Ecosystem Diversity	5.1 Statistics of protected areas in each forest type; (a) number (b) extent (c) % of forest type covered (d) range of size of protected area (e) % of boundaries demarcated or clearly defined. 5.2 % of total number of protected areas connected by biological corridors or 'stepping stones' between them
Species Diversity	5..3 Existence and implementation of procedures to identify endangered, rare and threatened species of forest flora and fauna 5.4 Number of endangered, rare and threatened forest dependent species 5.5 % of original range occupied by selected endangered, rare and threatened species.
Genetic Diversity	5.6 Existence and implementation of a strategy for in situ and 7 or ex-situ conservation of the genetic variation with commercial, endangered, rare and threatened species of forest flora and fauna.
Management guidelines Monitoring and evaluation	5.7 Existence and implementation of management guidelines to: (a) keep undisturbed a part of each production forest, (b) protect endangered, rare and threatened species of forest flora and fauna and (c) protect features of special biological interest, such as seed trees, nesting sites, niches and keystone species 5.8 Existence and implementation of procedures for assessing changes of biological diversity of production forests, compared with areas in the same forest type kept free from human intervention

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Table 6. *ITTO's criterion 7: Economic, social and cultural aspects*

Concept area	**Indicators**
Socio-economic aspect	7.1 Value and % contribution of forestry sector to the Gross Domestic Product 7.2 Quantity (volume) and value of wood and non-wood forest products traded in; (a) the domestic market (b) the international market 7.3 Quantity (volume) and value of wood and non-wood forest products for subsistence use, including fuel wood 7.4 Ratio of the domestic log production to the processing capacity of wood based industries 7.5 Efficiency of utilisation in terms of the % of felled volume processed. 7.6 Existence and implementation of mechanisms for effective distribution of incentives and the fair and equitable sharing of costs and benefits among the parties involved 7.7 Existence and implementation of procedures to ensure the health and safety of forest workers 7.8 Employment in the forestry sector: (a) number of people employed (b) % of total work force (c) average wage rate (d) injury rate 7.9 Number and extent of forest sites available primarily for: (a) research (b) education (c) the direct use and benefit of local communities (d) recreation 7.10 Number of people dependent on the forest for subsistence uses, traditional and customary lifestyles. 7.11 Area of forest upon which people are dependent for subsistence uses, traditional and customary lifestyles
	7.12 Number of visitors to forest for recreational purposes 7.13 Total amount of carbon stored in forest stands
Cultural aspects	7.14 Number of important archaeological and cultural sites identified, mapped and protected
Community participation	7.15 Extent to which tenure and user rights over the forest are documented and recognised 7.16 Extent to which forest planning and management practices and processes consider and recognise legal or customary rights with respect to indigenous people and local communities, forest dwellers and other forest dependent communities 7.17 Extent of participation by indigenous people and local communities in forest-based economic activities 7.18 Number of agreements involving local communities in co-management responsibilities

3.2. Triangle of sustainability developed by Munasinghe. (1993)

The triangle in figure 2 illustrates the interrelationship between economic, social and environmental dimensions of sustainability. Each apex of the triangle represents one of the three dimensions of sustainability. If any of the apexes is missing, the triangle does not exist. The economic, social and environment dimensions are the corners of the triangle, and each corner is interrelated to the other two. The economic dimension focussed mainly on efficiency, economic growth and stable economic development.

Social dimension is aimed at poverty alleviation, consultation, empowerment of people and concern for cultural identity and heritage conservation. Environment dimension is concerned with biological diversity conservation and resilience of the ecosystem and prevention of pollution.

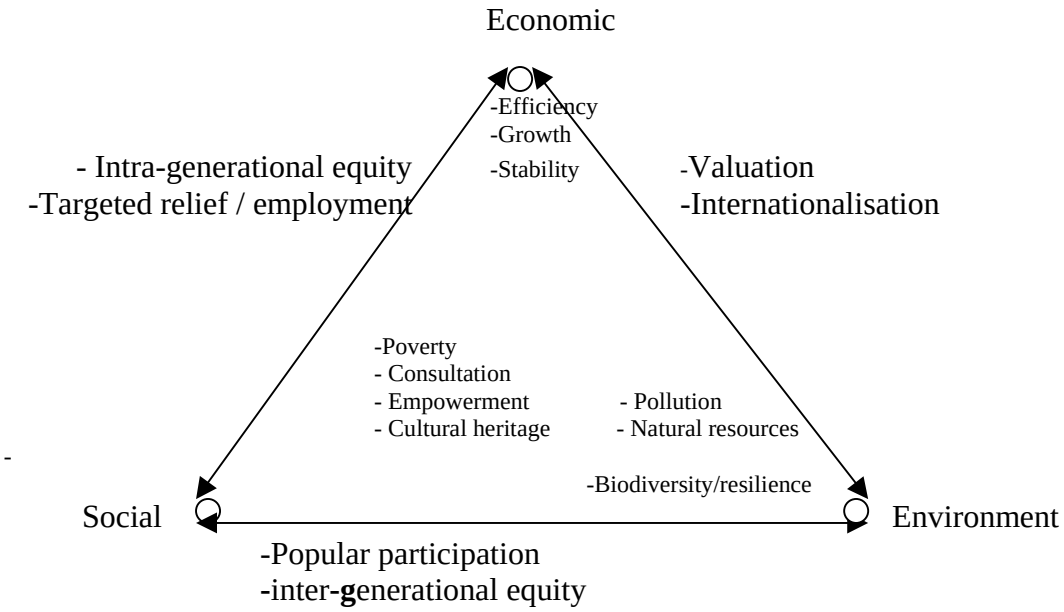


Figure 2. Triangle of sustainability

4. Results

Forests and forestry in Oyo state were evaluated using ITTO's criteria and indicators for sustainable forest management. The result of this assessment is the following:

4.1. Assessment of criterion 2: Forest resource security

- **Concept area; Description of the resource base**: The natural forest covers 200,070 ha (7.2%) while, plantation forest account for 6,743 ha (0.24%) and permanent production forest estate represent 175,616 ha (6.3%) of the total land area. Comprehensive integrated land-use plan is lacking in the state.

Table 7. *The area and percentage of each forest type in Oyo state*

Forest type	Land area	
	ha	%
Trees/woodlands/shrubs	609,467	22.
Lowland Rainforest	172,280	7.2
Riparian forest	7,790	0.3
Forest plantation	6,743	0.24
Non-forest land uses	1,988,520	70.26

It could be observed in Table 7, that trees/woodlands/shrubs account for a vast area of forestland. This could be as a result of intensified conversion of forestland to other land uses and over exploitation of the timber resource. Schmidt (1998) reported that the world is losing 0.8% of its tropical forests annually.

Nearly all the permanent production forest estate (175,916 ha) accounting for about 20% of the total production forest area has been demarcated and clearly defined.

Table 1 indicates that the average annual rate of deforestation in Oyo state is 6,916 ha (-0.8%). About 74,436 ha (44%) of the forest reserve is devoid of forest stand as shown in Appendix 5. This represents an average annual forest loss of 595 ha in the forest reserve (permanent production forest estate)

- **Concept area; Production procedures**: Exploitation of forest resources in the forest reserves is regulated by part 2 of the Ordinance, which is concerned, with the constitution of the government forest reserves and protected forests. Part 3, 4 and 5 of the Ordinance deals with the constitution of the Local Government council and Forest reserves and protected forest areas. This Ordinance forbade encroachment and illegal exploitation in the forest reserve. The Local Government is responsible for protection, control and management of the forest reserve and the forest protected area. The implementation and enforcement of the Ordinance backing up the establishment of forest reserves is lagging behind due to inadequacies of funds, personnel and inadequate co-operation of the indigenous communities. The free area representing

about 33% of total forestland area in the state lack procedures for the control of encroachment, fire and exploitation of the forest resource.

4.2. Assessment of criterion 4: Flow of forest produce

- **Concept area; Resource assessment:** 175,916 ha (about 20%) of the total forestland area defines the quantity of the main forest wood products, while 587,187 ha (about 67%) define the resource right and ownership.

Table 8. *Estimate of annual sustainable harvest and volume of main wood products harvested in the natural forest of Oyo state.*

Product	Sustainable harvest (m^3)	Actual volume harvested (m^3)
Fuel wood	3,309,716	2,469,937
Poles	11,891	8,874
Sawn wood	120,658	90,043
Veneer	117,154	87,429
Total	3,559,419	2,656,283

Table 8 depict that fuel wood represent major share (93%) while poles account for the least part (0.33%) of the estimated volume of actual harvest. Sawn wood and veneer represent 3.38% and 3.29% respectively. Estimated volume of actual harvest indicates 18% below the estimated sustainable harvest level. The figures presented in Table 8, could either have been under or over estimated because, credible data for the free area has been inadequate.

Table 9. *Estimate of annual sustainable harvest and volume of wood harvested in Oyo state forest plantation.*

Product	Mean annual sustainable harvest (m^3)	Actual mean annual harvest (m^3)
Fuel wood	32,016	29,105
Poles	31,891	28,992
Sawn wood	157,427	143,115
Veneer	0	0
Total	223,334	201,212

Table 9 shows that sawn wood represent 71%, fuel wood 15% and poles account for 14% of the annual harvest from the forest plantation. The total volume of actual harvest is about 10% below the estimated mean annual sustainable harvest from the forest plantation.

The actual volume of non-wood products consumed is not documented. However, attempt was made to list some major utilised non-wood forest products in Oyo state. These products are the following:

- Game meat: Snails, giant bush rats, squirrels, bats, cane rats, guinea fowls and porcupines are mainly consumed by the rural dwellers, while large games such as wild boar and antelope serve as source of income for hunters living in the rural areas.
- Nuts: Nuts of *Vittelaria paradoxa* are used for the production of sheabutter, while cola nut (*Cola acuminata* and *Cola nitida*) are used for cultural festivities. These nuts serve as source of income for the rural communities.
- Oils: Fruits of *Elaeis guineensis* are collected for the production of palm oil and palm wine. This is another source of income for the rural communities located in the forest areas.
- Medicines. Over 90% of the Nigerians in rural areas and about 40% of the population living in urban areas depend partly or wholly on traditional medicines Osemeobo (1993). It was reported by Cunningham (1997) that traditional medicine is extensively used in Ibadan, Oyo state. Chewing sticks harnessed from *Garcinia afzelii*, and *Garcinia mannii* are the widely used plant for dental health care in the rural areas.
- Leaves of *Elaeis guneensis*, and *Raphia* species are used for food storage, production of mats and bags. The rural communities use leaves of *Marantochioa flexuosa* for ropes.
- **Concept areas:** Planning procedures, management guidelines, monitoring and evaluation: Forest management plan and forest harvesting plans has been lacking. Exploitation of the forest resources has been demand driven. The government has ever seen the forest as a source of revenue and not as a natural resource capital that should attract proper management. However, attempt was made to develop forest management plan and forest harvesting plan during the forest resource inventory in 1999. Implementation of the forest management plan has been a mirage due to inadequacies of funds, trained personnel and inadequate information concerning the forest resource base. Inadequate land use plan, ambiguous tenure, and property right halt effective implementation of the forest management plan in the free area.
- Forest exploitation is managed under working plans prepared by the state forestry department. Almost all logging is designed and executed by the private sector. Concessionaires are controlled by area and by girth limit, which is 60-90 cm diameter at breast height (dbh) depending on the species. Volume extracted are carefully measured and recorded, while fees are charged on an area basis. The forest reserves were managed for timber production on a felling cycle of 100 years, it was reduced to 25 years and even less to make larger areas available for exploitation.

4.3. Assessment of criterion 5: Biological diversity

- **Concept area; Ecosystem diversity:** There are two major forest protected areas in Oyo state, namely; old Oyo National park- 211,761 ha and Opara Game reserve- 199,510 ha. Eleiyele forest reserve- 746 ha, and Okearemo forest reserves are minor ones. The total area of the protected areas is about 412,017 ha. The area of forest protected area range from 746ha to 211,761 ha.

Table 10. *Forest types found in protected areas of Oyo state.*

Forest type	Area	
	ha	%
Woodland	380,884	92.63
Lowland Rainforest	24,895	6.04
Riparian forest	5,492	1.33
Total	411,271	100

Table 10 shows that woodland dominates the forest protected area, while the Lowland Rainforest, and riparian forest attributed to be rich in biological diversity account for only 6.04% and 1.33% respectively. This implies that most forest dependent fauna and flora could be endangered or threatened. Species that requires savannah type environment could be favoured by the nature of the protected area.

There has been clearly defined boundary of protected areas, but the maintenance of the boundaries against encroachment has been inadequate due to insufficient technical facilities, skilled personnel, and funds. There has been inadequate information concerning the protected areas connected by the biological corridors.

- **Concept area; Species diversity**: There have been procedures to identify endangered, rare and threatened forest dependent species, but was met with weak implementation due to inadequate information concerning the species in question. The exact number of endangered, threatened and rare species has not been documented. Most documented endangered species were mammals such as; African elephant (*Loxodonta africana*), African buffalo (*Syncerus caffer*), western gorilla (*Gorilla gorilla*), drill (*Mandrillus leucophaeus*), red-belled monkey (*Cercopithecus erythrogaster*), chimpanzee (*Pan troglodytes*), leopard (*Panthera pardus),* and genets (*Genets spp).*Virtually all the indigenous forest tree species has been threatened as a result of over exploitation. The most threatened tree species are *Milicia excelsa*, and *Chlorophora excelsa* because, they have high commercial value. There has been inadequate information concerning the original range occupied by the endangered, rare and threatened species.
- **Concept area; Genetic diversity:** The protected areas (Game reserve and National park) were established for the conservation of biological diversity aimed at preservation of endangered, rare and threatened forest dependent species. Regional game laws were enacted by eastern Nigeria in 1916 and later by the western and northern regions in 1928 and 1963 respectively. The conservation and protection of wildlife is still governed by these laws. In 1973, a more unified and detailed nationalwildlife conservation law was drafted. Endangered species Decree No.11 (control of International Traffic and Trade) was promulgated in 1991 aimed at protecting endangered species, but was met with some constraints such as; poor implementation, inadequate basic information necessary for effective management of wildlife and protected areas, and inadequate infrastructural facilities. In the late 1980s, the Federal Natural Resources Conservation Council (NRCC) was created. NRCC provided coordination for conservation of natural resources, took direct measures to

secure the status of species and sites. NRCC was also mandated to monitor conservation activities within forestry and wildlife sectors.

- **Concept area; Management guidelines monitoring and evaluation:** There has not been management guidelines to keep part of the free area (forest controlled by the indigenous community) undisturbed. Such guidlines exist in the forest reserve but its implementation, monitoring and evaluation lags behind. The guidlines mainly exist in the protected areas, but its implementation has been questionable.

4.4. Assessment of criterion 7: Economic, social, and cultural aspects

- **Concept area; Socio-economic aspect:** The forestry sector account for less than 5 % of the Gross Domestic Product (GDP) of Oyo state. An estimated 2,886,151 m^3 and 852,853 m^3 total volume of wood products are sold in the domestic and inter state markets annually respectively. Estimated 141,649 m^3 and 274,544 m^3 forest wood products without fuel wood are traded in the inter-state and domestic markets respectively. It has been estimated that about 2,499,042 m^3 volume of fuel wood are consumed annually, while the annual per capita fuel wood consumption is 0.52 m^3 in Oyo state.
- Huge volume of fuel wood is mainly available for subsistence use. There has been inadequate information concerning the value and volume of non-wood products consumed. The major traded non-wood forest products in the domestic and inter-state markets are; cola nuts, medicinal plants, large game meat, palm oil, sheabutter and wild honey. Greater part of the non-wood forest products is available for subsistence.
- Most wood-based processing industries in the state operate at 64% of their processing capacity and about 30% wood utilisation efficiency. There has not been credible mechanism for equitable distribution of costs and benefits among forest stakeholders.

The protected areas (412,017 ha) are available for research, education and recreational activities. While the free Area accounting for about 284,038 ha (33%) of the total forest area is used by the local communities. Virtually all rural dwellers depend on the forest directly or indirectly for subsistence, while some people residing in urban areas depend on the forest for income.

Most people in the state have little value for recreational activities because, of inadequate information concerning using the forest for relaxation purposes. There has been inadequate information concerning the amount of carbon stored in the forest and number of visitors to forest for recreational purposes.

- **Concept area; Cultural aspects**: Its worth knowing that the old Oyo national park has many archaeological and cultural sites that have been protected against degradation, aimed at preserving the people's culture.
- **Concept area; Community participation**: Tenure and user rights are well documented but has not been respected especially, in the free area zone. Forest planning and management have not been able to incorporate customary rights of the indigenous people and other forest depedent communities. There has been very low degree involvement of the indigenous and local communities in forest based economic activities
- There have been several agreements involving local communities in co-management responsibilities such as; agroforestry (taungya), Traditional Use Zone (TUZ), Support Zone Activities (SZA), and community forestry. The taungya system comprises the

use of shifting cultivation to raise forest tree species. Peasant farmers are recruited by the forestry department to undertake arable farming in specified areas within the forest reserve. The farming cycle lasts for two years (until the seedlings are well established). The farmers controls weed, game and insect damage, while land was made available to the farmers by the forestry department for farming. Taungya flawed due to inadequate funds for reinvestment and poor management. The TUZ ushers privilege only to members of enclave villages to work with forestry officials in the course of managing the forest resources in a sustainable manner. In TUZ, the local communities located in the traditional use zones are allowed access to use the forest reserve for some activities such as; hunting, fishing, and gathering under the supervision of the forestry officials. SZA also attempt at assisting local populace affected by restrictions upon their productive activities due to their location near or within a forest reserve area. Community forestry was developed to facilitate local participation in forestry by mobilising rural people as communal entities. Rural people were responsible for regeneration (through community nursery and tree planting) and for conservation (by monitoring activities of local inhabitants). Community forestry flawed as a result of its infringement against the Land Use Act (LUA) which profess state property right. Community forestry encourages communal property right and private participation in the forestry sector.

5. Discussion

Human beings play various roles in the society controlled by an agreed set values and institutions. The society can be divided into segments based on different behaviours and values. Inferring from sustainability, the society, human roles and values can be structured into three blocks. Each block specifies an aspect of sustainability (economy, social and ecology). ITTO (1998) defined sustainable forest management as the following;

- Sustainable forest management is the process of managing forests to achieve one or more clearly defined objectives of management with regard to the production of a continuous flow of desired forest products and services, without undue reduction of its inherent values and future productivity and without undue undesirable effects on the physical and social environment..

Forest Stewardship council (FSC) criteria and principles serve as reference point for establishing standards geared towards sustainable forest management. The criteria emphasizes that in the course of developing standards for sustainable forest management, it should be an open, consensus-based and participatory process, which involves consultation with affected stakeholders. FSC principles and criteria are directed at integrating the three dimensions of sustainability aimed at halting forest destruction (FSC, 1996).

The investigation indicated that Oyo state has vast forestland area (about 29%) compared to other states in Nigeria. The huge forest protected area is also remarkable. It is evident that the government has been trying to encourage private sector participation in afforestation and reforestation projects through various incentive initiatives. However, the free area zone contains the largest area of merchantable timber resource, but exploitation and encroachment in this area has not been regulated and checked respectively. This could threaten forest resource security and stability. The forest area network in the protected area seem to be inadequate for interaction of mega fauna such as elephant, wild boar and buffalo, thus could result in their extinction and lowered biological diversity.

The extent of reforestation has not kept pace with the rate of deforestation thus, creating a negative balance. This could hitch the continuous flow of forest products and services. There has been very low degree private sector participation and involvement of indigenous community in forest management operation, thus social aspect of sustainability could be suspect.

- With respect to ITTO's criteria and indicators and the definition of sustainable forest management, forestry in Oyo state has not been able to meet the requirements of these criteria and definition., because it may not guarantee continuous flow of forest products and services and the social aspect has not been respected.

5.1. Factors militating against sustainable forestry development

The emergence of sustainable forestry requires some elements such as legal and policy framework, sustained and optimal production of forest products. Sustainable forestry also requires protection of the environment, and well being of people to be put in place. If any of these elements is lagging behind it could have a far reaching effect on the availability and utilisation of the forest resources. This could generate disequilibria in the forest ecosystem that may lead to the depletion of the forest resource. Evans (1982) reported that the causes of forest destruction in the tropics are; exploitation for charcoal and fuel wood, urban and industrial expansion, clearance for agriculture, and intensive logging for veneer and sawn timber.

Cleaver and Schreaber (1990) reported that rapid population growth and agricultural sector stagnation in sub-Saharan Africa lead to severe environmental degradation. Campbell *et al.* (1996) reported that the absence of proper definition of property and security of tenure renders forests in sub-Saharan Africa an open access resource, thus encouraging unregulated use of the forest resources. Campbell and Byron (1996) also observed that weaknesses in forest laws and lack of effective enforcement of measures aimed at protecting the forest, threatens the existence of varied forest dependent fauna and flora.

This study identified some factors derailing sustainable forestry development. These are the following:

- Weaknesses in implementation of forest management plan and enforcement of forestry legislation.
- Unclear land tenure and property right
- Inadequate land use planning
- Inadequate information about the forest resource base
- High fuel wood consumption and poverty
- Inefficient use of the forest resources
- Low degree private sector participation in forestry
- Denial of indigenous people's right
- Unequal distribution of benefits and costs for the use of the forest
- Deforestation
- Inadequate protected area network
- Politics.

It was observed that factors marring sustainable forestry in Oyo state were interconnected, as one factor could not operate in isolation as shown in Figure 3.

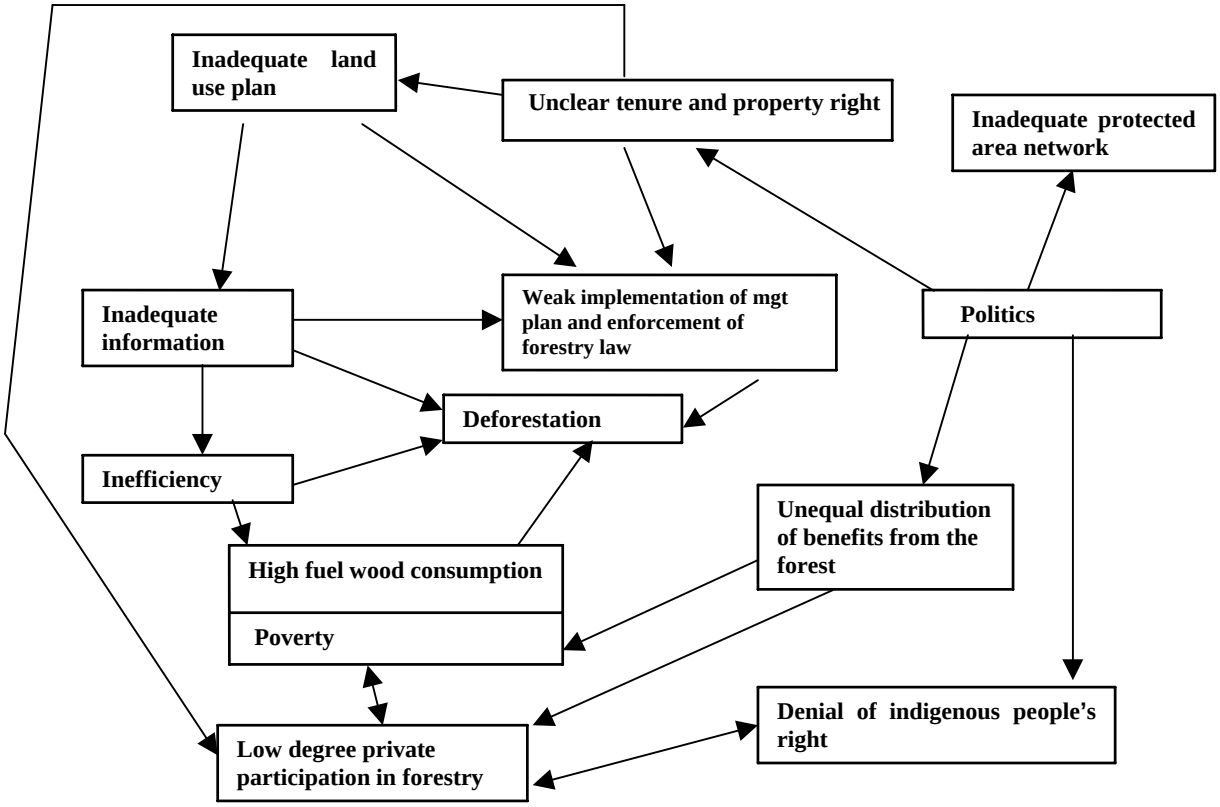


Figure 3. Interrelationship of factors threatening sustainable forestry in Oyo state

The rapid population growth, economic recession, north-south dichotomy and the multi – ethnicity evident in the state tends to make allocation of resources politically motivated. It could also recur in the distribution of benefits and costs for the use of the forest resource. The sitting of forest reserves and protected areas in the state could have been politically motivated, since they were established in areas dominated by shrubs, while areas dominated by the rich Lowland Rainforest located in the south are earmarked for unregulated exploitation. Forest reserves could have been sited in areas dominated by shrub/woodlands to preclude desertification and encourage natural regeneration. Political instability has made various programmes aimed at sustainable forestry to be short lived. Similarly World Bank (1991) reported that instability in the political and economic policies, as well as lack of political will to implement the right energy policies were some of the reasons leading to low response by potential investors in sub-Saharan Africa.

Local knowledge, experience and capacities are often overlooked by the state forestry department staff, thus foresters in sub-Saharan Africa portrays the image of being "policemen", whereas the civilians have often viewed by the foresters as potential crooks to be kept at bay (Harrison 1987). Although, local communities have become increasingly dependent on the forest for livelihood, policy formulation and implementation is usually a top-down approach. This is not equitably counter balanced by bottom-up approaches that should enable forest dependent communities to participate in decision making at equal footing, while incompatibility between traditional tenure rights and formal land allocation have often led to conflicting situations, resulting in mismanagement of forest resources. Furthermore, the Land Use Act (LUA) which nationalised land ownership make private individuals and local communities to shy away from forestry projects because they feel unsecured, cheated and can not guarantee the sustainability of the forest enterprise. Currently the costs and benefits derived from the forest resources are not equitably distributed because

of unequal access to the forest resource. The imbalance is often caused by unequal access to the resource, inadequate valuation methods and the lack of efficient marketing mechanisms (FAO, 2003).

Weaknesses in implementation of forest management plan and enforcement of forestry legislation could be as a result of institutional problems such as corruption, bureaucracy and mismanagement of resources. However, exploitation of the forest resource has ever been driven by market demand, the use of forest management plan is new to the forestry sector. Its implementation requires staff training, professional personnel, and improvement of infrastructures. There has been an inadequate fund to carryout all these readjustments. In addition, implementation and enforcement has been a mirage due to unclear tenure and property right, inadequate land use plans and insufficient public awareness and "top-down" approach in rural development projects. Manpower in the area of integrated environmental management, popular participation in project design and implementation are insufficient. This could have led to the presence of huge area of forestland in the forest reserve devoid of forest as shown in Appendix 5. However, enforcement of forestry law seem to be working in the forest reserves and protected areas because of the presence of defined boundaries in these areas as opposed to the free area.

It is estimated that the annual fuel wood consumption account for 2,88,151 m^3 (77.2%) while other wood products (sawn wood, poles and veneer) is 852,853m^3 (22.8%). Fuel wood has ever been the traditional energy source for cooking. The alarming rate of human population also called for an increased demand for fuel wood. Fuel wood in rural communities has been a free resource; therefore rural dwellers could find it difficult to use any other energy source that involves financial commitment. There has been inadequate public awareness on fuel wood energy conservation techniques. Income poverty in urban areas deprives most people from using other forms of energy (petroleum products, and electricity) for cooking. Foley (1985) reported that poverty seems to be linked with fuel wood consumption because; as people's income improved they shift from fuel wood to other forms of fuel such as kerosene, liquefied petroleum gas and electricity. Between 1985 and 1997 the incidence of poverty in south-western Nigeria increased from 42% to 74.1% (Central Bank of Nigeria / World Bank, 1999). Therefore, the consumption of fuel wood continued to swell. At present the demand for fuel wood indicate a deficit of –852,853 m^3. Inefficiency in the use of fuel wood continually swells the demand for fuel wood in Oyo state. Attempt has been made by the government to introduce fuel wood stoves aimed at increasing efficiency in fuel wood consumption, especially in urban areas.

The LUA was politically motivated, though it attempted to minimise communal conflicts generated by land and also to redistribute the land resource, thus making it available for every Nigerian. But the LUA generated unclear land tenure and property right, because the stakeholders were not involved in developing this Land Act and therefore, could not sanction it. Only about 67% of the forestland has clear property right, thus encroachment and unregulated exploitation continued to be the order of the day. Traditional land tenure system favours deforestation because, "*the more virgin forest a man clears, and the more he is respected in the community*".

Most saw milling firms in the state has been using obsolete equipments that encourage low lumber recovery rate and huge wastage of the timber resource. They had insufficient information on efficient use of timber resource. Most users of fuel wood use inefficient open-air method of cooking known to be only 13% efficient, thus paving way for huge loss of wood.

Inadequate land use planning could be as a result of unclear tenure and property right. The traditional farming systems (shifting cultivation and bush fallow) could not encourage a comprehensive land use planning. The rapid increasing population and urbanisation could lead to a huge capital investment in drawing a comprehensive land use plans, as people need to be compensated and relocated.

Inadequate information could be adduced to inadequate funds for research, forest resource inventory has not been common, inadequate professionals and the indigenous community who know much about the forest has not been involved in developing management plans. The government attempted to involve the local communities in forest management operations, through community forestry and agro forestry (taungya), but was flawed.

5.2. The impact of factors affecting sustainable forestry development

Management of the forest for a single product could affect the forest's ability to provide other services or products as a result of the relativity of the dimensions of sustainability (natural, economic, and social). For sustainability to materialise, the social and economic dimensions need to stay within the boundaries set by the natural dimension. The natural restrictions overrule economic restrictions in the long-term, while economic restrictions overrules social in the short-term. In this light, a scarce resource could be exploited as long as it exists, before the natural dimension enforces its limitation. Violation of the restrictions placed by the natural dimension could result in malfunctioning or disruption of the ecosystem. Sverdrup and Svensson (2002) argued that the biomass harvested is only sustainable when the removal of nutrients through harvest does not exceed the supply of these same nutrients through the atmospheric deposition, chemical weathering of rocks, and fertilisation supplied externally. They also defined total sustainability as the area of overlap of all the three types of sustainability: natural, economic, and social. Therefore any factor that could preclude the three dimensions of sustainability from overlapping will result in unsustainable development

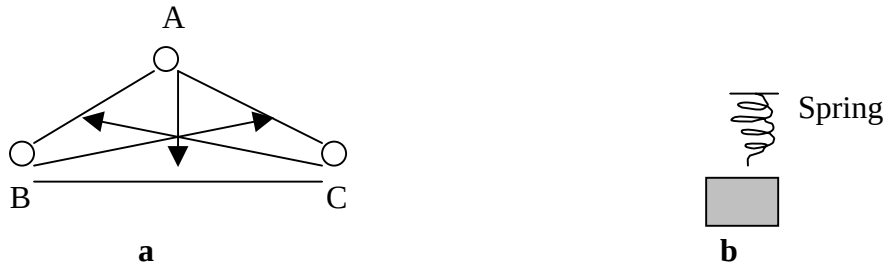
The triangle of sustainability proposed by Munasinghe (1993) in Figure 2 illustrate that any factor that could result in the shifting or removal of any of the side (s) of the triangle could destabilise the system, thus creating unsustainable use of resources. This implies that if the forest is managed mainly for production goal, the environmental and social dimensions could be threatened and vice-versa.

5.2.1. Conceptual model of sustainability

It is assumed that the triangle of sustainability tends to mimic the principle of Hooke's law. Hooke's law which points out that; "If a force of tension is applied to a wire, the length of the wire will increase slightly. When the force is removed, the length of the wire will usually return to its original length (Hooke, 1678). Suffice to say that Hooke's law can only hold if and only if the elasticity limit is not exceeded.

In this conceptual model of sustainability, the following assumptions were made:

- That a side of the triangle can move from its original position to another and could revert to its initial position, provided the elasticity limit is not exceeded.
- That each of the apexes (A= economic, B= social, C= environment) exerts a perpendicular force to the opposing side.
- That increasing any of the dimension (s) (economic, social and environment) could decrease other dimension (s).



a **b**

Figures 4 a and b. The envisaged original position of the triangle and the spring. Where A = Economic dimension , B = Social, C = Environment

a **b**

Figures 5 a and b. The envisaged position of the triangle and the spring when the economic dimension was increased

When the lumbering activities take cognisance of the three dimensions of sustainability it is assumed that the triangle and the spring take its original position as illustrated in figures 4a and 4b respectively. In this stage the dimensions of sustainability are harmonised and sustainable growth and development could be achieved. If the forest is managed towards achieving only one dimension such as economic. This could result in the shift of sides of the triangle away from its original position as shown in figures 5a and 5b. This could decrease the forest ability to meet social and environmental needs.

In this study, twelve factors militating against sustainable forestry were identified, but the first seven factors as depicted in 5.1 were of major importance. The impact of these factors are explained below.

5.2.2. Impact of weaknesses in implementation of forest management plan and enforcement of forestry legislation

Weaknesses in the enforcement of forestry law could encourage open access to the forest resource. This could also result in encroachment of other competing land uses such as agriculture and urbanisation, thus decimating the forestland area. About 6916 ha (0.8%) forestland is deforested, while a maximum of 1000 ha were earmarked for reforestation annually. It can be observed in Table 10 that the forest protected area contain about 92% woodland/shrubs while forest trees is only about 7.5% this development could be as a result of encroachment and illegal logging encouraged weakness in enforcement of law. continued decimation of forestland could lower biological diversity, recreation, eco-tourism opportunities, and economic development opportunities.

Weaknesses in implementation of the management plan could result in under or over exploitation of the forest resource, thus leading to inefficiency An estimated 45% (74,942 ha) of the forest reserve is devoid of forest trees. This could threaten economic stability and growth and food security.

Weaknesses in enforcement of forestry law could provide indigenous communities opportunities to reap benefits from the forests, which the government has denied them for the past years. Attempt has been made by the state government to incorporate the indigenous communities in the development of management plan and enforcement of forestry law.

5.2.3. Impact of unclear land tenure and property right

The communal land tenure system tend to favour deforestation because, most indigenous communities are agricultural farmers. Forestland is rapidly converted to agricultural land. The LUA has generated the state of mistrust and suspicion between the government and the general public. It could also favour unequal distribution of benefits and costs accruing from the forest resource. It is evident that the LUA gave the rich people opportunity to acquire vast area of land, while the poor were denied access to land. This seems to create a wide disparity between the rich and the poor and disempowers the indigenous communities, thus making them feel insecure. Nigeria's Gini index (a measure of inequality within a country) is close to 1 as reported by UNDP (2001).This reveals that a great proportion of the national income is eluding the poor, thus widening the poverty gap and a greater proportion of the nation's wealth is being concentrated in the hands of the wealthiest 20% of the nation, thus the incidence of poverty continued to expand.

Unclear property right could generate anarchy thus, limiting implementation of management plan and enforcement of law as evident in the free area.. World Bank (1992) reported that the main objective of the LUA is to make land easily accessible to every Nigerian for development purposes in any part of the country, and to vest the control of such development in the state Government so that the use of the land could be monitored and controlled. This has been defeated due to political instability and unpopularity of the Act.

Forestry production requires a long- time from investment to final harvest, therefore stability in the political and economic environment is necessary to gain the confidence of the potential investors in the forestry sector. Nigeria has been faced with economic and political instability since 1980's thus, providing unhealthy climate for investment in forestry.. In Oyo state, the government owns the land. The production of trees requires the producer to have a long- term ownership of land, any deviation from this could discourage private sector investment in the forestry sector.

5.2.4. Impact of inadequate land use planning

Inadequate comprehensive land use plan could impede enforcement of forestry law, thus paving way for unregulated exploitation and encroachment of other competing land uses such as urbanisation resulting in depletion of the forest resource. It was estimated in 1991 that 36% of the people in Oyo state lived in urban areas, it is projected to rise to 70% by 2020 as reported by Oxfam (2003). Okafor *et al.,* (1994) observed that increasing population pressure on the forest resource, destructive agricultural practices lead to fast depletion of timber and non-timber forest products. The income lost to illegal logging could deter economic growth and stability in the forestry sector. It could also result in loss of biological diversity especially in the free area. The government has implemented comprehensive land use plans in government residential quarters with remarkable success.

5.2.5. Impact of inadequate information of the forest resource base

Inadequate information concerning the forest resource base could be detrimental to biological diversity, because it may be difficult to identify hot spots and the species that are threatened.

It could be due to inadequate information that the protected forest areas in the state have been sited in places having inadequate forest network. Nilsson *et al*., (1994) reported that threatened tree-dependent lichen and beetle species are restricted to a particular forest stands, probably those with a continuous occurrence of big trees over long period of time. This type of forest stands could be found mainly in the free area marked with unregulated exploitation of forest resources therefore, most of the forest dependent species could be at risk of been threatened. The protected areas network is inadequate, particularly as most of it lies in the savannah biome as reported by Drolet (1990). Stuart and Adams (1990) reported that the protected areas that exist in forests in Nigeria are too small for viable population of many species.

Inadequate information could create a wide communication gap between the state forestry department and the public thus, generating social and economic strife in environmental related issues. It may deny users of wood and non-wood forest product the opportunity of getting access to vast array alternatives aimed at increasing the efficiency of forest resource utilisation. For example, making people aware of the presence of fuel wood stoves could result in saving huge volume of wood..

5.2.6. Impact of high fuel wood consumption and poverty

Income poverty could increase fuel wood consumption as the human population increases. The scarcity of fuel wood due to high demand could commercialise fuel wood production both in the rural and urban areas thus, could increase price index for food stuff linked to fuel wood. This could provide employment for the unemployed therefore, improving their standard of living. On the other hand it could be difficult for rural dwellers to pay for fuel wood that has been a free resource thus, they may be compelled to use another alternative source of energy which could be animal dung resulting in lowered agricultural productivity. Arnold (1978) reported that the loss of a tonne of animal dung reduces yields by 50kg/ha of potential grain output.

High fuel wood consumption could result in accelerated deforestation if not balanced by reforestation. This could lead to increased sickness due to scarcity of medicinal plants, streams and rivers siltation generating water scarcity during dry season and food shortages in rural areas.

5.2.7. Impact of inefficient use of forest resources

Inefficient use of resources could result in huge loss of income and alarming deforestation. The estimated mean annual fuel wood demand in Oyo state is 2,499,042 m3. Since most people patronise open air cooking method estimated to be 13% efficient. Therefore, 2,174,166m^3 of fuel wood are wasted annually. The loss of income as a result of wastage of wood resource could impair economic growth, stability, and provision of social infrastructures. It is during this period that oral history and cultural values are transferred to younger generation. Some people believe that open air cooking add inviting aroma to food such as maize. Abolishing open air cooking could mar the cultural heritage of the people. Attempt has been made to recycle wood shavings and other wastes generated in the saw milling industries.

5.2.8. Impact of low degree private sector participation in forestry

Government establishment has not been known to be a prudent manager of renewable resource due to lapses in supervision and management of human resource. As long as there is

low degree of private participation in forestry, inefficiency, weak implementation of management plan and enforcement of forestry law could be the order of the day. Low degree private sector participation in forestry could encourage deforestation especially in the forest reserve because, indigenous communities feel cheated and frustrated by the government action for keeping their forests for these many years without their benefiting from their naturally endowed resources.

Indigenous communities tend to sabotage the effort of state forestry department once they were not involved in forest management operations. Most state forestry department staff could feel unsafe to patrol the forests because, of the hostility of the indigenous communities so encroachment continued unabated.

6. Conclusion and recommendations

Indigenous people maintain social belief and norms about their lands and trees. They do not view land as a “commodity” which can be sold in the impersonal market. Most farmers could consider it unthinkable to sell family land that should be held in trust for future generations. It is the marginalisation of the peasantry by the social system, and not the behaviour of the peasantry itself, which appears as ultimate cause of environmental degradation. From previous experience lack of incorporation of indigenous knowledge in forest management and planning poses the greatest threat to implementation..

In addition, the increasing population calls for more mouth to feed and this can only be achieved by breaking new agricultural land. Poverty tends to encourage intensive use of fuel wood since it is almost a free resource available to rural dwellers. As long as this situation prevails, no forestry projects, no forestry legislation, no land use planning and no education could make any significant difference, since population growth, agricultural stagnation and environmental degradation are interrelated and inter-linked in a mutual reinforcing manner. Deforestation may continue at the present rate if precautionary measures are not taken, because the need for food will make that necessity. Unless urgent action is taken to arrest this situation the present trend could continue to impede sustainable forestry in Oyo state

Furthermore, introduction of sound sustainable forest management in Oyo state could have some socio-economic implications in the short-term such as; decline in the supply of forest products, unemployment in the forestry sector, and reduced revenue from the forestry sector as a result of decline in supply of forest products since the volume of the annual allowable cut need to be lowered to allow the forest to recover. In the long-term, it could result in steady supply of forest products, secured employment, increased income as a result of efficient use of resources, economic stability, economic growth, poverty alleviation, increase in biological diversity and pollution free environment. Benefit accruing from sustainable forestry in the long-term could surpass the short-term cost.

6.1. Recommendations

The following strategies have been proposed aimed at promoting sustainable forestry in Oyo state:

1. The government should make agricultural credit facilities available to farmers especially in the rural areas aimed at increasing agricultural productivity. This could minimise the rate of deforestation, because if productivity per unit land area increases, less land area will be required for agriculture.
2. There is need for urgent policy reforms and technical innovations aimed at poverty alleviation. Effort should be geared towards efficient use of the available fuel wood by introducing improved fuel wood stoves, which may produce up to 50% savings of fuel wood consumption.
3. Conflicting issues in tenure and legislation need to be harmonised and streamlined, whereby customary laws are incorporated into formal land allocation laws.
4. Rural communities should be involved in the management of the forests. Their roles and responsibilities in the management, conservation and use of the forests resource should be recognised and appreciated, since local communities are often highly dependent on this resource.

5. More areas of the Lowland and riparian forests need to be identified and protected to improve biological diversity status.
6. The state forestry department should undertake a comprehensive environmental education campaign that reaches all levels of the society, including state forestry staff and policy makers.
7. Better inventories and better access to, and dissemination of information should be encouraged to improve sustainable forest management.
8. Training should be provided for state forestry staff in forest management, planning and administration.

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Appendices

Appendix 1: ITTO's criterion 1: Enabling condition for sustainable forest management

Concept area	Indicators
Policy and legal framework	1.1 Existence of a framework of laws, policies, and regulations to govern: (a) national objectives for forest including production, conservation and protection, (b) the establishment and security of the permanent forest estate, (c) land tenure and property rights relating to forests, (d) the control of forest management, (e) the control forest harvesting, (f) the control of encroachment, (g) health and safety of workers, (h) participation of local communities
Economic framework	1.2 Amount of investment and reinvestment in the forest management, administration, research, and human development from: (a) national and sub-national governmental sources, (b) Bali partnership fund, (c) Other international governmental contributions, and (d) Private sources, domestic and foreign 1.3 Existence of economic instruments and other incentives to encourage sustainable forest management.
Institutional framework	1.4 Number and adequacy of institutions to support sustainable forest management. 1.5 Number and adequacy of trained professional and technical personnel at all levels to perform and support management, implementation, research and extension. 1.6 Existence and application of appropriate technology to practise sustainable forest management and the efficient processing and utilisation of forest produce. 1.7 Capacity and mechanisms for planning sustainable forest management and for periodical monitoring, evaluation and feed-back on progress. 1.8 Degree of public participation in forest management, such as in planning, decision making, data collection, monitoring and assessment. 1.9 Adequacy and timeliness of information to increase public awareness about forest policies, legislation and sustainable forest management practices.

Appendix 2: ITTO's criterion 3: Forest ecosystem health and condition

Concept area	**Indicators**
Area of forest Damaged by human Activities and the Degree of damage	3.1 within the permanent forest estate, the extent and nature of ; encroachment (b) agriculture (c) roads (d) mining (e) dams (f) unplanned fire (g) shifting agriculture (h) nomadic grazing illegal exploitation (j) hunting bad harvesting practices harvesting more than once during the cutting cycle (re-entry) other forms of forest damage such as drainage in hydrological regime, pollution, introduction of harmful exotic plant and animal species, browsing and grazing. (these should be specified)
Area and degree of Forest damage by Natural causes	3.2 within the permanent forest estate, the extent and nature of forest damage, caused by: wild fire (b) drought (c) storms or natural catastro pests and diseases (e) other natural causes
Conservation and Protection procedures	Existence and implementation of quarantine and phytosanitary Procedures to prevent the introduction of pests and diseases. Existence and implementation of procedures to prevent the introduction of potentially harmful exotic plant and animal species Availability and implementation of procedures covering: (a) use of chemicals in the forest, and (b) fire management

Appendix 3. ITTO's criterion 6: soil and water

Concept area	Indicators
Extent of protectio	Extent and % of total forest area managed primarily for the Protection of soil and water. Extent and % of area to be harvested for which off-site catchment Values have been defined, documented and protected before harvesting. Extent and % of the area to be harvested which has been defined as Environmentally sensitive (e.g very steep or erodible) and protected Before harvesting. Extent and % of area to be harvested for which drainage systems have been demarcated or clearly defined and protected before harvestin % of length edges of water-courses, waterbodies, mangroves and other wetlands protected by adequate buffer strips.
Conservation and Protection Procedures	Existence and implementation of procedures to identify and Demarcate sensitive areas for the protection of soil and water Availability and implementation of guidelines for forest road Lay-out, including drainage requirements and conservation of buffer Strips along streams and rivers. Availability and implementation of harvesting procedures: to protect the soil from compaction by harvesting machinery, and to protect the soil from erosion during harvesting operations
Monitoring and evaluation	Existence and implementation of procedures for assessing changes in the water quality of streams emerging from production forests as compared with streams emerging from the same forest type kept free from human intervention

Appendix 4. Demand and supply for timber in the forest reserves & plantations in Oyo state

Timber supply from natural forest in the forest reserve for Oyo State (m3/yr).												
Product	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fuelwood	290829	290829	290829	290829	290829	290829	290829	290829	290829	290829	290829	290829
Poles	1385	1385	1385	1385	1385	1385	1385	1385	1385	1385	1385	1385
Sawnwood	14053	14053	14053	14053	14053	14053	14053	14053	14053	14053	14053	14053
Veneer	13645	13645	13645	13645	13645	13645	13645	13645	13645	13645	13645	13645
Total w/o fuelwood	29083	29083	29083	29083	29083	29083	29083	29083	29083	29083	29083	29083
Total with fuelwood	319912	319912	319912	319912	319912	319912	319912	319912	319912	319912	319912	319912
Timber supply from plantations for Oyo State (m3/yr).												
Product	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fuelwood	24563	25640	26133	26932	27738	29611	29370	30194	31022	31852	32685	33518
Poles	24563	25343	26133	26932	27738	28551	29370	30194	31022	31852	32685	33518
Sawnwood	59174	336162	62738	64541	379536	126693	70010	284368	73690	103870	77377	79219
Veneer	0	0	0	0	0	0	0	0	0	0	0	0
Total w/o fuelwood	83736	361505	88871	91472	407274	155244	99380	314562	104712	135722	110062	112737
Total with fuelwood	108299	387145	115005	118404	435012	184855	128751	344756	135733	167574	142747	146255
Total Timber demand for Oyo State (m3/yr).												
Product	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fuelwood	3282422	3315520	3348618	3381716	3414814	3447912	3481010	3514108	3547206	3580304	3613402	3646500
Poles	84033	86660	89287	91914	94541	97168	99795	102422	105049	107676	110303	112930
Sawnwood	118160	126610	135060	143510	151960	160410	168860	177310	185760	194210	202660	211110
Veneer	7984	8610	9236	9862	10488	11114	11740	12366	12992	13618	14244	14870
Total w/o fuelwood	210177	221880	233583	245286	256989	268692	280395	292098	303801	315504	327207	338910
Total with fuelwood	3492599	3537400	3582201	3627002	3671803	3716604	3761405	3806206	3851007	3895808	3940609	3985410
Timber supply and demand balance for Oyo State (m3/yr).												
Product	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Fuelwood	-2967030	-2999051	-3031656	-3063955	-3096247	-3127472	-3160811	-3193085	-3225355	-3257623	-3289888	-3322153
Poles	-58085	-59932	-61769	-63597	-65418	-67232	-69040	-70843	-72642	-74439	-76233	-78027
Sawnwood	-44933		-58269	-64916	241629	-19664	-84797	121111	-98017	-76287	-111230	-117838

		223605										
Veneer	5661	5035	4409	3783	3157	2531	1905	1279	653	27	-599	-1225
Total w/o fuelwood	-97358	168708	-115629	-124731	179368	-84365	-151932	51547	-170006	-150699	-188062	-197090
Total with fuelwood	-3064388	2830343	-3147284	3188686	-2916879	-3211837	-3312742	-3141538	-3395362	-3408322	3477950	-3519243

Appendix 5. Natural forest types and areas within forest reserves in Oyo State.

S/N	Reserve Name	*Natural Forest Type*	Total Area of Reserve (ha)	Total Area Occupied by Natural Forest	
				Ha	%
1	Ago-Are	no forest	935	0	0
2	Eleiyele	no forest	746	0	0
3	Eruwa	no forest	184	0	0
4	Gambari	lowland rain forest	17,984	7,155	39.8
5	Igangan	trees/woodlands/shrubs	40,645	12,197	30.0
		lowland rain forest		3,608	8.9
6	Ijaye	trees/woodlands/shrubs	25,546	9,345	36.6
		lowland rain forest		3,581	14.0
7	Lanlate	trees/woodlands/shrubs	10,880	3,686	33.9
		lowland rain forest		584	5.4
8	Odo Ogun	no forest	1,654	0	0
9	Opara	trees/woodlands/shrubs	21,327	11,116	52.1
10	Old Ogbomosho	no forest	213	0	0
11	Old Ogbomosho Water Works	no forest	582	0	0
12	Olla Hills	trees/woodlands/shrubs	2,508	1,603	63.9
13	Olokemeji	no forest	654	0	0
14	Oloyan	no forest	14	0	0
15	Osho	lowland rain forest	3,822	2,633	68.9
16	Otuma	no forest	162	0	0
17	Oyo Ile	trees/woodlands/shrubs	36,207	34,136	94.3
18	River Moshi	trees/woodlands/shrubs	5,110	4,584	89.7
	TOTAL		**169,173**	**94,228**	**55.7**

FORMECU,1999