CHANGING FOREST BIODIVERSITY IN SOUTH WEST NIGERIA BETWEEN 1985 AND 1995: A CASE STUDY OF ONDO STATE

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ABSTRACT

The value of forest in any given society can not be overestimated for meaningful development to be achieved and sustained. In realization of the values of the forest biodiversity, this paper therefore examines the changes that have occurred in the area of the forest sizes and species types. Relevant literatures and models were examined to show that over the years there has been decrease in the area size of the forest in the study area and if not curtail might have grave consequences on the economic and ecological wellbeing of the people. Finally, conclusion was drawn with the recommendations that new strategy of forest management will allow the rural populace to have a say in the decision making on the products found in their locality.

Keywords: forest biodiversity, livelihood pattern, economic and ecological wellbeing

INTRODUCTION

Forest resources biodiversity refers, in a broad sense, to species abundance, richness, and variety within the living world as well as to the ecosystems and ecological processes to which they belong. The maintenance of biological diversity of forest resources at all levels is fundamentally the maintenance of viable or identifiable populations of species, which is commonly referred to as critical species. The loss of these critical species may tend to trigger fundamental transformation processes to an ecosystem. The great threat to forest resources biodiversity is a cause of concern mainly because of its direct as well as indirect contribution to society and the trade off between development dependence of man on forest biodiversity and its conservation which has been the major issue conservation debate.

A growing body of evidences indicates that virtually all forests on planet earth have been substantially influenced by man, most for at least several thousand years. Studies by foresters, ecologists, historians and anthropologists have shown that forests in the tropics, temperate and boreal regions conclude that forests and people have evolved together over thousands of years, with people planting the trees they prefer, using fire to burn forests to improve hunting conditions and man forest falls to maintain their agricultural fields. For example, before the voyages of Christopher Columbus which brought North American resources to the attention of Europe, the people living in the eastern woodlands of the United States were in a "potent if not crucial ecological factor in the distribution and composition of the forest" [Williams, 1989]. While forest ecosystems are "natural", humans are an essential part of this "nature", hence building resilience into forest ecologies requires building resilience into the human management systems, enabling them to adapt to changing conditions.

As Nigeria became internationally identified as a poor nation immediately after the introduction of structural adjustment programme in 1986, the scourge of poverty also became rampant and obvious among the people. The rate of poverty in the country increased from 43.0% in 1986 to 69.2% in 1997 [CBN, 1999]. It was discovered that poor people, particularly the rural poor who represent about 60% of the total rural population in Nigeria depend on forest resources for agricultural and monetary income by gathering forest products for sale. The biodiversity values include both flora and fauna in many societies, also form a very important part of the cultural heritage of the people. Several studies have attempted to estimate the extent to which poor people, particularly in the rural areas depend on forest resources for their livelihood [Cavendish, 1999]. Cavendish [1999] also reports that poor households in Zimbabwe derive up to 40.5% of their aggregate household income from forest resources. Poor rural households in Nigeria are also expected to derive up to that percentage of their total income from natural resources.

Nigeria occupies a unique geographical position in Africa and its biodiversity in climatic and geographic features endows it with one of the richest biodiversity in the continent. Its diversity of natural ecosystems ranges from the tropical rainforest to montane forests, rich seasonal floodplain environments, rain forest swamps, savanna and freshwater swamp forests and diverse coastal vegetation. Unfortunately, studies have noted that of the species including plants, terrestrial and aquatic invertebrates, small mammals, reptiles, amphibians, fish, etc in the country remain undocumented. As published in 1992 by Federal Environmental Protection Agency (FEPA), Nigeria possesses more than 5000 recorded species of plant, 22,090 species of animals including insects, 889 species of birds, and 1,489 species of microorganisms. authorities also estimated that 0.4% of the plants species threatened and 8.5% endangered, together with 0.14% of the animals and insects threatened and 0.22% endangered.
Natural and man-made threats, socio-cultural problems as well as direct and indirect consequences of socio-economic development have contributed to the erosion of bio-diversity at all levels. Within the last 25 years, it is believed that about 43% of the forest ecosystem has been lost through human activity. Nigeria, with population growth rate of more than 3.5% and increasing poverty level, especially in rural areas, have put severe demands on the country’s natural resources. There has also been a general institutional weakness and lack of technical capacity to effectively tackle the nation’s environmental issues, including threats to biological diversity.

Though forest and its various diversities are of great importance in the ecological, economical and social interactions of tropical peoples, but growing human populations and development pressure put these forest habitats at serious risk. In line with the above fact, it becomes necessary to carry out an inventory investigation of the forest biological species in order to be able to ascertain the level of species diversity taken in to consideration the effects of human interference in forest development due to urbanization rate. Also, large tracts of land in the tropics have been set aside for conservation, but even if these areas were adequately protected from conflicting uses (which many are not), reserving forests alone cannot guarantee the protection of tropical biodiversity.

Literature also shown that till date, no effective indicators have been developed which provide solid measures of ecological or genetic sustainability. While forest management may include a variety of measures intended to minimize the impact of extraction on the biodiversity of the forest (such as directional felling, cutting and diameter and volume limits on harvest), they are generally based on guesses about what levels of extractive activity might prevent damage to both the resources and the economic returns, and there is as yet no clear evidence of their effectiveness in conserving biodiversity. The lack of measurable indicators for estimating the impacts of different management options on important variables for biodiversity is a problem in developing countries in the general and Nigeria in particular. In line with the above problem as evidenced in the literature, correct naming of things is the basis of science and a prerequisite for their proper use and conservation [Helgason et al., 1996].

The aim of this study is to examine the trends between forest bio-diversity and the livelihoods patterns of the people living around forest reserves in the study area. In order to actualize this goal, the following objectives will be addressed:

1. To examine the changing biodiversity of forest reserves coverage in terms of area and specie types between 1985 to date.
2. To evaluate the forestry contributions to the human livelihood in south western Nigeria.
3. To examine the effects of the changing forest biodiversity on the livelihood patterns of the inhabitants in the study area.

The exploration and use of forest resources is central to any meaningful pragmatic and dynamic forestation and conservation policies, thus, if forest and conservation planning programmed are tailored towards sustainable development of environmental resources, then a thorough understanding of effects of the use and conservation of floral diversity on rural live-lihood of community around forest will be crucial to the formation and design of public policies on forest resources management. In another vein, since rain forest ecosystem is the building block upon which life sustenance hinges – especially rural dwellers with distinct values and aspirations towards the environment in which they inhabit, then it is proper and just that a study interested in unraveling the distortion of these ideals and value is one in the right direction which should draw attention of government and its agencies.

From another perspective, a research of this nature will in no small measure enhance inter-disciplinary, cross-cultural research endeavor among scholars. Resources management in general and forest resources studies in particular being no singular discipline, no matter how sharp its scientific tools of analysis is that can solve the ever-increasing and multifarious problems plaguing our resources. As a result the cross-fertilization of ideas in complex studies of nature is very invaluable in advancing the frontiers of knowledge about a forest ecosystem, which sustains human life. It is also realized that previous studies have been anchored on the general forest clearance without due consideration to the types of floral species that are mostly degraded by human ecological activities and the effects on the livelihood. Finally, this study is timely, as increased and an explosive rate of human influence on the dipterocarp forests of South Western Nigeria during the last two or three decades is posing a very serious threat to survival and viability in their natural form beyond the next few decades. It is therefore that this work will go a long way in assisting people of the study area to understand, appreciate and conserve viable sample of their forest species are able to manage them sustainable for the generation yet unborn.

Biological diversity (or biodiversity) refers to the natural variability among living organisms, the ecological complexes in which they naturally occur and the ways in which they interact with each other and with their physical environment [OTA, 1987]. Biodiversity can be partitioned into levels - ecosystem diversity, species within-species diversity, and genetic diversity - all of which are essential to environmental health and human well being. Resource management on the other hand implies the control - amount, quality, timing, availability and the general direction of resource development. According to O'Riordan [1971] and Omara-Ogunu [1992] resource management may be defined as “a process of decision - making whereby resources are allocated over space and time according to the needs, aspirations, and demands within the framework of his technologies, inventiveness, his political, social institutions and his legal and administrative framework”.

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The review of existing and current literature in this research will bring the existing issues on the problems and strategies of biodiversity management in general and forest resources biodiversity in particular especially in developing countries into the context of resource management. In line with the above submission, resource biodiversity management studies take the physical environment as first basic departure point, the human and the interaction between the physical and human attributes as the third basic departure point. The Physical attributes are discussed under various ecological approaches that dominated environmental studies during the 19th and early part of the 20th centuries while the human attributes are usually examined under various ethnological approaches. Glacken [1967] identified three Western intellectual responses to nature and management of resources. These are the views of nature as something that dominate; something to be dominated by; and something to live in harmony with.

There are various and diverse research works on Resource diversity study in general and forest diversity management in particular because of the multi-disciplinary nature of the resource which revolve around social, physical and ecological sciences to mention a few. Previous theories presume that users of common property resources are incapable of organizing viable resource diversity management strategies to avoid over harvesting [Hardin, 1968]. Currently, however, researchers increasingly argue that common property can also be a viable resource diversity management system. They noted that groups of people are demonstrably capable of crafting rules and following harvesting patterns that encourages sustainability in forest use under a range of conditions, especially when user groups and forest territories are stable and clearly defined. While social and economic change can destabilize these resource-diversity management systems, a supportive policy environment, new technologies, better information and increasing scarcity can also create invigorating new possibilities for collective action leading to viable common property management. Furthermore, many groups with long histories of forest use and forest culture have a wealth of cultural institutions upon which to draw in adapting to change [Ostrom, 1999; Berkes et al., 1989]. The common property systems offer an intriguing social context in which to seek forest-conserving management systems with global implications for carbon mitigation, biodiversity conservation, and rural development. Community forest management provides a setting that potentially overcomes many of the social obstacles facing conventional concession forest management. In a common property situation, forest management for timber production provides the means and incentives for communities to develop and strengthen local enforcement capabilities. It provides security of operation and operational control, so that forests are not converted to other uses following logging, and so that low-impact logging techniques are correctly applied.

Agent-Based Dynamic Spatial simulation (ADSS) model is a general research that can be used to model the complexity of human-environment relationship [Manson, 2003:9]. In the recent times, however, men have been one of the major driving forces of global environmental change. Human activities like especially forest resources use, arising from exploration of the earth’s natural resources, are contributing to changes in atmosphere and climate, land use, vegetation cover, desertification, rapid loss of biological and cultural diversity, shifting patterns of human livelihood. Environmental change sometimes results from infrastructural development, population pressure, market opportunities, resources allocation, and environmental or resource policies [Stern et al., 1992]. Individuals and societies are experiencing the impact of changes.

The above impacts manifest in human’s natural environment, upon social, economic and political situations. According to Jager [2000:33] impacts may include water and food shortages, naturally affected by environmental change. The present research reconfigures these foci as a three-component “actor-institution-environment” conceptual framework (Fig 1) in the context of forest resources management and its effects on rural livelihood in south west Nigeria. Actors are the community members that exploit these resources for their own livelihood, the foresters and the lumberers who are often the chief actors of change in the forest use. The conceptual framework draws on research in decision making, bounded rationally, and the effects of resources actor on decision making [March, 2003:2]. The second component, socio-economic institutions, affects decision making. Simultaneously, artifacts, dynamic processes and institutions conspire and are constituted by regularized behavior [Ostrom, 1990]. Institutions influence actor decision making by modifying actor resource profiles and decision making variables. For example, introduction of new land tenure rules changes access to land in actor profiles and affects decision making variables [Bohle, 1993]. Nigeria, the Land Use Decree/Act of 1978 regulated community access to communal or open access land and they were primarily promulgated to restrict access to such land, while at the same time making it possible for multination investors to have unrestricted access to explore economic trees unchallenged on sacred land [Oyawakura, 2000]. Both actors and institutions interact with the third component of the conceptual framework, the biophysical environment [Manson, 2003:2]. The iterative nature of human-environment interaction suggests the need for all three components of the actor-institutions-environment conceptual framework as illustrated on Figure 1.

This framework unlike many other environmental-man interactions more adequately account for the complexity of, and relationships among socio-economic and environmental factors [Turner, 1990]. The framework places human-environmental relations at the intersections of theories dealing with land use, decision making, the environment, and socio-economic institutions [March, 2003]. It is also an example of “computational human geography” that brings the theoretical and empirical conceptions of what constitutes geographical inform science and geography in general [Openshaw, 1998]. The major issue with the model is that often times; it has been applied at the global scale and sometimes country level [Jager, 2000; Bohle, 1993], while limited effort has been made
The researcher embarked on reconnaissance and ground truth survey to the study areas to have on-spot-assessment and get familiar with the forest environment and sampled villages within and around forest reserves in the study area. The study makes use of one set of data. This is classified as spatial data. Ayeni [2003] defines spatial data as any data that occupies space in terms of having a specific location according to some geographical referencing system. This location may be a point location, it may be linear in nature or it may be an area with a defined boundary. On the other hand, non-spatial data refers to the attributes of spatial entities.

The Landsat MSS 1978 and SPOT MSS 1994 satellite images on the scale of 1:250, 000 were used. These images are Radar mosaic/Slam mosaic produced by World Bank for FORMECU, Abuja [FORMECU, 1999]. Besides, NIGERIA SAT-1 2003 obtained at NARSDA, Abuja were used along with Landsat MSS 1978 and SPOT MSS 1994. These images were used because of the spectral information of the study area they contain. Besides, they are only available images the researcher can lay his hand upon as at the time of the study. They were used to assess changes in forest reserves coverage over time.

For the objective on the spatial dynamics and biodiversity status of reserves, land use imagery of 1985 and 1995 taken by FORMECU and NIGERIA-SAT 1 obtained by NARSDA in 2003 were used to map the spatial patterns of the reserves in south west. The images were also used to generate some attributes concerning the biodiversity status of the reserves in terms of forest area and specific types and other attributes that will be used to determine differences in biodiversity status of individual states as set up in the objectives above. Due to fact that researchers have access to imageries of 1985, 1995 and 2003 only, it of primary data to supplement the existing data becomes imperative in order to able to carry out temporal analysis over a period of twenty years though with limited area of coverage due to logistical limitations.

In order to determine the effects of the forest bio-diversity on the economic livelihood of the people living within and around forest environment, analysis of data gathered using livelihood assessment methodology involves quantitative analysis, interpretation, cross-checking and synthesis is imperative [Ashley & Hussain, 2000]. This become inevitable due to the nature of objectives of the study and it is therefore desirable that the analysis follows articulated procedure.

The potential of satellite imageries and GIS technology are relied upon for the analysis and testing of the first hypothesis on biodiversity status of each of the three study area. The Landsat MSS 1978, SPOT MSS 1994, NIGERIA SAT-1 2003 are saved in a format that is adaptable to ARC-VIEW 3.2a software. With Arc View GIS 3.2a, it is possible to make strong separations between layers and maps. Layers are elementary geographic teams that is either raster or vector in nature. They are the raw data upon which the analysis modus act. By associating one or more of these layers with a graphic, a created. A map is thus, a graphic portrayal of a set of layers. Arc View GIS can also keep track of all changes and additions one makes to the compositional model. With these possibilities a classification scheme was developed to identify land pattern, its spatio-temporal changing pattern and the occurrence of biodiversity. The technique of overlay was however used to show changes occurred in the forest coverage in the study area between 1985 and 2003 (per 21 years). Besides, the method enables the study to measure the extent biodiversity changes in the study area.

The researcher will carry out the data processing and analysis with Arc-View GIS packages for the spatial analysis and mapping of the forest reserves in South West Nigeria, comprising Lagos, Ogun, Oyo, Ondo, Ekiti and Osun states, the most developed area of its size in the country. It is also known as the south geopolitical zone of Nigeria. The area lies between longitude 2° 31’ and 6° 00’ and latitude 6° 21’ and 8° 37’ N [Agboola, 1979] with a total land area of 5,042 km² and a projected population of 28,767,752 in 2002 [NPC, 1991]. The study is bound in the East by Edo and Delta states, in the North by Kwara and states; in the West by the Republic of Benin and in the South by the Gulf of Guinea. The study area has 85 constituted Forest Reserves with a forest area of 793,266 Ha [FDF, 1998].

Figure 1. Actor-Institution Environment Conceptual Framework [Manson, 2003]
southern Nigeria and this drier period tends to become less marked from south to north.

Under present climate conditions, lowland rain forest is the native vegetation, even in the northern districts of Ekiti. A heavy biotic pressure due to centuries of human occupation has, however, reduced the forests to dense savanna, particularly in the drier northern fringes and in areas having soils with poor moisture retaining qualities. Substantial areas of Ibadan and Ondo provinces are now under this grassy vegetation but field investigations by the research team confirm that the forest-savanna boundary has been relatively stable in the last few decades. Gallery forests along stream sides are common in the derived savannas of Ibadan, Ede-Oshogbo and Ikirun Districts. These forests feature such conspicuous species as the Brachystegia eurycomana.

The southwestern margin lies wholly within the area underlain by metamorphic rocks of the Basement complex, which outcrop over most of Western State. The land-surface is generally undulating and descends gradually from latitude of over 1,600 feet in Ekiti Division in the north to 400 feet far south in Ondo and Ijebu Provinces. In the southern part of the region the landscape which is heavily forested, consists of a dissected plain developed on terraces and sediments. Elsewhere, but particularly in areas of very resistant rocks or those protected from weathering by a capping of lateritic ironstone, the characterised landscapes consists of old plains broken by steep-sided inselbergs, which occur singly or in groups.

The region is drained by many north-south flowing rivers of which Ogun, the Oshun, the Shasha and the Owena are the more important. The rivers normally flow all round the year, but there is a marked seasonal variation in their volume and in exceptionally dry years many of them may be reduced to a series of pools maintained by surface flow. The smaller tributaries are dry for periods varying from a few weeks to several months. Navigability of main river channels is restricted to their lower reaches where they form part of coastal creeks, but in general these rivers constitute an impediment to east-west road communications.

Large forest reserves exist in Ondo and Ijebu provinces and are exploited much the same way as the forest of the Benin Lowlands. A forestation scheme practiced by the Forestry Department as well as by local farmers, the plantations being concentrated in the derived savanna areas where they intended to provide building poles and fuel. The Olokeji teak plantation at Ibadan has been an important source of telegraph poles since the early 1950's.

The character of soil profiles in the region is determined largely by nature of the parent rock and good cocoa soils are generally limited to areas where the parent material consists of rocks of the Basement complex. The great variety of Basement complex rocks give rise to a large number of ferruginous soil types.
which are acidic but much more fertile than the acid sands of the Udi Plateau. These ferruginous soils also have a high clay content and good drainage.

In Ondo State, different size and forest types were identified and these include disturbed forest, forest plantation, forested fresh water Swamp, Riparian forest, Teak/Gmelina forest and undisturbed forest (see Table 2). Based on available data on the area size of the forest type, it is discovered that in 1995 teak/gmelina forest recorded the highest coverage with 6858 km² while riparian forest recorded the least with 20.45 km². In 1995, a period of ten years, biodiversity status in terms of forest areas size change with disturbed forest having the highest area coverage with 2036.2 km² while undisturbed forest recorded the least with 19.64 km². There are great implications of the changes which both physical environment in terms of climate, edaphic, fauna and flora development as well as the effect of these on the human sustainable development in the area of economic, socio-cultural and political development of the inhabitants of the various towns and villages found within and around the forest reserves in Ondo State as it concern their livelihood status.

### Table 3. Ondo State Reserve Area (1985 & 1995) and Reserve Name

<table>
<thead>
<tr>
<th>Reserve Name</th>
<th>Reserve Area (km²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1985</td>
</tr>
<tr>
<td>Akure</td>
<td>386,716</td>
</tr>
<tr>
<td>Akure-Otosu</td>
<td>391,777</td>
</tr>
<tr>
<td>Ala</td>
<td>627,169</td>
</tr>
<tr>
<td>Eba Island</td>
<td>22,987</td>
</tr>
<tr>
<td>Eigbohini</td>
<td>20,445</td>
</tr>
<tr>
<td>Ekinolor</td>
<td>247,521</td>
</tr>
<tr>
<td>Idate</td>
<td>1,694,623</td>
</tr>
<tr>
<td>Ifon</td>
<td>1,119,097</td>
</tr>
<tr>
<td>Ipeli-Isoani</td>
<td>66,895</td>
</tr>
<tr>
<td>Irele</td>
<td>36,435</td>
</tr>
<tr>
<td>Isie</td>
<td>157,948</td>
</tr>
<tr>
<td>Ohousu</td>
<td>2,060,996</td>
</tr>
<tr>
<td>Okeluse</td>
<td>169,640</td>
</tr>
<tr>
<td>Okomu</td>
<td>12,572,994</td>
</tr>
<tr>
<td>Oluwa</td>
<td>3,328,077</td>
</tr>
<tr>
<td>Oni</td>
<td>120,321</td>
</tr>
<tr>
<td>Onisheru</td>
<td>115,126</td>
</tr>
<tr>
<td>Ora-luole-Ozalla</td>
<td>57,446</td>
</tr>
<tr>
<td>Owan</td>
<td>308,309</td>
</tr>
<tr>
<td>Owo</td>
<td>481,622</td>
</tr>
<tr>
<td>Owinho</td>
<td>35,571</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>24,021,715</strong></td>
</tr>
</tbody>
</table>

It has also been discovered through interaction with the inhabitants that these reduction in the forest types in terms of area coverage could be attributed to the seal for economic development as well as high rates of urbanization which are common all over the state. A compromise between human activities and wilderness need to be done at short notice.
biodiversity conservation which affects negatively their standard of living and livelihood pattern.

According to the 1985/95 FORMECU imagery, there are 22 capture forest reserves, out of these, Okomu has the highest forest areas with 12,573 km² in 1985 while Ejigbomi forest reserve has the least with 20.45 km² of forest area. In 1995 in Ondo State, the total forest areas was 2372.9 km² Idanre forest reserve recorded the highest area with forest area of 492.86 km² while Owan forest recorded the least with 444.98 km². In general assessment, there were drastic reductions in the forest area of Ondo State within a short period of ten years. In 1985 the total coverage stood at 24,021.7 km² but later reduced to 2,372.87 km² in 1995 with a difference of 21,648.85 km² which represent 9.87% (see Table 3).

Though the total reduction in the forest area is not much but when you look at individual forest reserves, you will discover that most of the reserve areas very close to the urban centers and major towns has been greatly deforested due to high rate of urbanization which has led to high demand for land being used for commercial and administrative purposes. Akure, Akure-Ofosu, Irelu, Idanre and Owo forest reserves with urban status were greatly reduced in area between 1985 and 1995. The implication of these drastic changes in the biodiversity status of forest resources are felt on the physical environment such as climate, biosphere, atmosphere as well as changing patterns of the economic status of the people whose source of livelihood originally depend both timber and non-timber forest products.

CONCLUSION

As a follow up to the above data and the discussion that follows, it is evidenced that there is significant changes in the biodiversity status of forest in terms of area coverage and forest types across the southwester part of the country. Also in the same vein is the fact that there is significant relationship between the changing spatial pattern and the livelihood activities of the inhabitants of the forest environment since their sources of livelihood is directly attached to non timber forest products which is being degraded. As a result of this, income as well as their standard of living become eroded and this make them vulnerable to a lot of economic, social, cultural, political and ecological vices which are detrimental to their well being.

It is recommended that governments, donor agencies and other forest stakeholders should come to rescue these vulnerable groups whose lives depend on this resource from being starve to death. Also, various government and international organizations in charge of policy formulation for forest use and management should jettisoned the current centralized management policies which gives all power to the central government and their agencies at the expense of the rural dwellers who live and relied on this resources for their daily livelihood. In that vein, a new policy strategy of political decentralization of forest use management which depict the bottom-top approach where all forest stakeholders who live and depends on forest resources are democratically elected to take charge of the administration and management of forest resources within their geographic enclave. It is when this is done that we can be sure of abating the current rate of deforestation which has led to pauperization of the rural inhabitants as well as its effect on the national economy in general. It will also bring about the demand for sustainable forest management which is the goal of all government forest bodies over the world.

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