Forestry and Macroeconomic Accounts of Nigeria:

The Importance of Linking Ecosystem Services to Macroeconomics

Executive summary for decision-makers

January 2017

PREAMBLE AND ACKNOWLEDGEMENTS

This report summarises work conducted by UN-REDD Programme during 2016 to guide the development of policy instruments for the Government of Nigeria in order to combat deforestation within the country.

The work conducted comprised economic modeling and analysis with the purpose of linking the drivers of economic behavior, as it relates to deforestation, to the benefits of forest ecosystem services.

The work was highly reliant on data collection within Nigeria. The UN-REDD Programme, UNEP and the authors wish to sincerely thank our colleagues in Nigeria who participated in and supported this study.

This document is accompanied by a set of integrated environmental economic accounts, both in the form of a transparent set of Excel spreadsheet tables and a policy-modeling tool.

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ACRONYMS AND ABBREVIATIONS

AfDB	African Development Bank
CRS	Cross River State
ES	Ecosystem Service(s)
ESV	Ecosystem Service Valuation
FAO	Food and Agriculture Organisation of the United Nations
FEGS-CS	Final Ecosystem Goods and Services Classification System
FME	Federal Ministry of the Environment
FRA	Forestry Resource Account
GDP	Gross Domestic Product
GEF	Global Environmental Facility
Ha	Hectares
M	Million
m	meters
MAI	Mean Annual Increment
MEA	Millennium Ecosystem Assessment
MSY	Maximum Sustainable Yield
NTFP	Non-Timber Forest Products
SCBD	Secretariat of the Convention on Biological Diversity
TEEB	The Economics of Ecosystems and Biodiversity
UNEA	United Nations Environment Assembly

GLOSSARY / DEFINITIONS

Forest	Land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use (FAO 2015).
Mangrove	Area of forest and other wooded land with mangrove vegetation. This occurs on the muddy banks of creeks and in tidal channels in the upper portion of the zone of saturator influence where the water is brackish (FAO 2015).
Other Regenerated Forest	Naturally regenerated forest where there are clearly visible indications of human activities (FAO 2015).
Plantations	Forest predominantly composed of trees established through planting and/or deliberate seeding (made up of forest plantation and Teak/ Gmelia plantations) (FAO 2015).
Primary Forest	Naturally regenerated forest of native species where there are no clearly visible indications of human activities and the ecological processes are not significantly disturbed (FAO 2015).
Forest Ecosystem Services	The set of benefits that forests of different types produces and that provides benefits to the economy of a country, in this case Nigeria (MEA 2005, TEEB 2013).
Provisioning Services	Products obtained from ecosystems, e.g. fresh water, food, fibre, fuel, genetic resources, biochemical, natural medicines and pharmaceuticals (MEA 2005).
Regulating Services	Benefits obtained from the regulation of ecosystem processes, e.g. water regulation, erosion regulation, water purification, waste regulation, climate regulation and natural hazard regulation (e.g. droughts, floods, storms) (MEA 2005).
Cultural Services	Non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences, e.g. cultural diversity, knowledge systems, educational values, social relations, sense of place, cultural heritage and ecotourism (MEA 2005).
Supporting Services	Services necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on people. Some services, like erosion regulation, can be categorised as both a supporting and a regulating service, depending on the time scale and immediacy of their impact on people. Supporting services include primary production, nutrient cycling and water cycling (MEA 2005).

EXECUTIVE SUMMARY

The purpose of this study is to analyze the economic value of Nigeria's forest resources and demonstrate some policy instruments that would alleviate pressure on these natural forest systems. The methodology followed to conduct this analysis includes: (i) Development of a Forestry Resource Account (FRA); (ii) Ecosystem Service Assessment (ESA) mapping of socio-economic benefits provided by forest resources; (iii) Valuation of ecosystem services and linking these to the macro-economic situation in Nigeria; and (iv) Testing of some policy instruments aimed at combating deforestation.

In this regard, the results show that from 2000 to 2015, forest area in Nigeria has decreased from 13.1 million ha to less than 7.0 million ha which is equivalent to an annual average forest cover loss of 409,600 ha/a (FAO, 2015). This is a rapid and severe rate of deforestation, results from a range of cumulative effects fundamentally driven by the immediate availability of woody biomass in the form of timber, fuelwood and construction timber; and the opportunity to acquire land for significantly higher agricultural returns. Together, these drivers comprise a considerable economic incentive for deforestation.

The total value of forest ecosystem services based on valuations done between 2000 and 2015 is approximately 1,000,000 Naira/ha. Although value is derived through forest use, the unsustainable exploitation thereof and subsequent deforestation results in a net loss to the economy of Nigeria.

These losses will continue for as long as there is a disconnect between the cost-benefit decisions made by land holders, users and other indirect role players, where the net benefit of deforestation is highly positive; and the cost-benefit ratio at a national scale, which, as demonstrated above, is highly negative.
Thus, to address the unique deforestation challenges faced by Nigeria, this study not only uses accounting and valuation of natural capital, but also makes significant progress towards designing and testing policy instruments that goes to the heart of the country's deforestation problem
The analysis shows that the contribution of forests to the economy of Nigeria is underestimated in the national accounts.

Furthermore, the study demonstrates three economic policy instruments that seek to incentivise landholders to pursue sustainable forest management. These proposed policy options are not intended to be a comprehensive final set of options for Nigeria, but are rather used to demonstrate how these options could work, what they would cost, to what extent they would curb deforestation and what the relative costs and benefits to the economy of Nigeria would behe three preliminary policy options tested are: *(i)* Carbon trade; *(ii)* Certified plantation forestry and *(iii)* Agroforestry.

Carbon trade: The United Nations' REDD Programme program intends to provide incentives for combating deforestation. It does this through paying for carbon stock protection through paying land users for actions that prevent forest loss or degradation. These transfer mechanisms include carbon trading or paying for forest management. The source of funds can be from carbon trading, or other voluntary funds not dependent on offsets. The valuation of pure carbon mechanism applied in the Eastern Littoral basin in the Cross-River State (CRS), shows that although the annual rate of deforestation would be curbed by 70 % and a net positive ecosystem services value of 16,540 M Naira would be returned to the economy, the net direct economic effects are negative.

Certified plantation forestry: One of the key challenges central to a successful deforestation policy instrument for Nigeria relates to the productivity of land. The usable round wood of the total forest estate of Nigeria is estimated at 2 m^3/ha/a. Planted forests in Nigeria however can achieve MAIs of up to 15 m^3/ha/a. Thus, **a planted forest can yield up to 8 times larger yield of merchantable and usable round wood**. Certified plantation forestry therefore provides a potential economic policy instrument as it is fundamentally driven by a higher price incentive. Certified plantation forestry is also expected to increase timber yield, training and generally improved land management practices.

Agroforestry: FAO round wood production data for Nigeria shows a large reliance on fuelwood collection. Thus, to relieve fuelwood harvesting pressure on the natural forest estate, agroforestry focusses on fuelwood production may be an important policy instrument. A policy instrument could be developed that promotes planting of fast-growing tree species for timber production in conjunction with other crops. It is important to note that carbon sequestration is likely to be a positive spin-off of this policy instrument and therefore carbon benefits may accrue in addition to the agroforestry benefits.

The challenge for the Government of Nigeria is now to ensure:

- Development of suitable policy instruments such as those demonstrated here;
- Institutionalization of the policy instruments; and
- Continuing a working relationship with UN-REDD Programme to develop and implement suitable policy instruments as may be developed by the relevant authorities in Nigeria.

KEY MESSAGES

1.	Deforestation in Nigeria is continuing at a rapid rate. The most recent estimates by the FAO indicates a rate that exceeds 400,000ha/a in forest losses, since 2000. This results in severe losses of ecosystem services. These losses are ultimately to the detriment of the economy.
2.	The key forest ecosystem services at risk, as defined by the Millennium Ecosystem Assessment, include sustainable harvests of timber and non-timber forest products, genetic resources, eco-tourism, water regulation, water purification and waste assimilation, sediment regulation and climate regulation. Changes in these ecosystem services affect the economic production in the following economic sectors: agriculture, fishing, hydropower generation, the water sector, public administration, the health sector and various sectors comprising the tourism economy. Therefore, ecosystems services losses indirectly result in losses in GDP.
3.	The total losses in forest ecosystems services for the whole country was estimated at 91 900 million Naira in 2013. The total marginal value of these ecosystems services plus the sustainable timber harvest and non-timber forest products collections, was equivalent to 650,000 Naira/ha.
4.	The incentives for deforestation clearly far outweighs the value of losses in ecosystem services. Moreover, the ecosystem services losses are borne elsewhere in the economy. Nigeria therefore need to develop policy instruments that appropriately internalizes ecosystems services values into the economy.
5.	This study demonstrates how such policy instruments may be tested and their effects simulated. Examples included in this report include: carbon trade, certified plantation forestry and agroforestry. Additional policy options, such as eco-tourism, industrialization or other options, may be designed and tested by Nigeria.
6.	It is recommended that further work be conducted by the relevant authorities in Nigeria to improve forest cover data and to conduct the detailed design of appropriate policy instruments. Such design should include institutional design as well as decisions on where to invest the resource rents. The reinvestment of resource rents has a large impact on the policy effectiveness.
7.	The UN REDD Programme has a key role to play in facilitating these processes. This includes applying the carbon income to the bouquet of policy instruments.

1. INTRODUCTION

As natural features in the landscape, ecosystems provide environmental, social and economic benefits to communities. The value of ecosystems in providing these services are becoming increasingly evident and there is a growing recognition of their importance to human well-being.

Forests are ecosystems that represent almost 30% of terrestrial land cover worldwide (3 999 million ha), (Keenan et al. 2015, FAO 2015) containing 80% of all terrestrial biomass (Shvidenko et al. 2005) providing extensive benefits from a variety of ecosystem services (Foley et al. 2007, Gibson et al. 2011).

Forests function as major stores of atmospheric carbon contributing to the regulation of climate change. Global forest resources with an average storage capacity of 73 tonnes per ha store approximately 292 billion tonnes of carbon (FAO 2015). Forests also sequestrate atmospheric carbon and given the current extent of forests, the global sequestration rate is estimated at 2.4 billion tonnes of carbon per year (Pan et al. 2011). This makes them extremely important natural ecosystems in terms of climate regulation. Forests further play a key role in regulating water quantity, mitigating the effects of high flows in wet periods and low flows in the dry periods (Hodgson and Dixon 1988, Wiersum 1984). Increased infiltration regenerates local aquifers and surface streams are maintained providing water resources in drier periods.

These highly valuable systems are however under threat globally with a loss of 3% of global forests in the last 25 years (FAO 2015). This equates to a loss of 11 billion tonnes of stored carbon. These losses are a result of deforestation and forest degradation arising from activities such as land transformation, agricultural expansion, overgrazing, over exploitation and urbanisation (SCBD 2001).

Nigeria has one of the world fastest rates of deforestation having lost over 90% of its original forest resources (FME 2010). The loss is a result of long term pressures being placed on the resources through agricultural development, uncontrolled forest exploitation and urbanisation.

The Cross River State (CRS) contains approximately 31% of Nigeria's remaining primary forest (Fon et al 2014). It represents the highest density and largest continuous and undisturbed area of primary forests in Nigeria. Much of these forests are managed within protected areas with approximately 40% in the Cross River National Park, 38% found within the fourteen forest reserves and 22% are managed by local communities. This forms a significant proportion of the countries forest resources but are no exception to pressures and overexploitation.

The losses in forest resources have no doubt resulted in a large-scale loss of natural ecological benefits to the socio-economic wellbeing of the country. The distribution, value and extent of ecosystem services provided by Nigerian forest resources have never been determined. That's why it is important to understand the value of the ecosystem services provided by forests at a nation scale to better optimise decision making, effective management and sustainable utilisation of these resources.

The purpose of this study is to analyze the economic value of Nigeria's forest resources, placing, where possible, added focus on resources found in the CRS, and demonstrate policy instruments that would alleviate pressure on these natural systems. The methodology followed to conduct this analysis includes: *(i)* Development of a Forestry Resource Account (FRA) for Nigeria's forest ecological infrastructure; *(ii)* Ecosystem Service Assessment (ESA) mapping of socio-economic benefits provided by forest resources;

(iii) Valuation of ecosystem services and linking these to the macro-economic situation in Nigeria; and *(iv)* Testing of effective policy instruments aimed at combating deforestation.

By understanding the relationship between the socio-economic climate and the contribution by forest ecosystem services by using market value linkages as a valuation approach, the study allows for better informed decision making that would both protect and stimulate the benefits received by forests rather than limit them. It is important to note however that the results, which are presented financially, are only done so to provide insights into the relationships between natural systems and the wellbeing of beneficiaries. Caution must be taken when likening the results as financial values on these systems in terms of pricing of the ecological infrastructure.

The first step in the process is to conduct a Forestry Resource Account (FRA) for Nigeria. The FRA is a national and regional account of the spatial and temporal characteristics and context of the country's forest reserves. FRA development is data intensive and data is largely sourced from the Food and Agricultural Organisation of the United Nations (FAO), focussing on the period of 2000 to 2015

The next step is to conduct an Ecosystem Services Valuation (ESV). This process identifies services provided by the country's forest ecological infrastructure and measures their socio-economic value to the country. Due to the close relationship between forest resources and hydrological systems, this ESV is done per basin.

The resultant integrated environmental-economic model is transparent and user-friendly and enables easy policy analysis simulations. This allows for an understanding towards informing the resource allocation and decision-making processes. Furthermore, the model is used to run a series of scenarios informing the design of policy instruments aimed at mitigating against deforestation and forest degradation in Nigeria.

2. THE NIGERIAN ECONOMY AND THE ROLE OF FORESTS

2.1. Overview of the Economy

Although 2016 has been a difficult year from an economic growth perspective, Nigeria remains the largest economy in Africa, and is forecasted to rapidly grow and develop **(Figure 1)**.

During 2015 and 2016, the Nigerian economy has been adversely affected by a fall in the global price of crude oil. This situation has been aggravated by an inadequate supply of foreign exchange and exacerbated further by foreign exchange restrictions, which has resulted in production and labour losses in some sectors.

Nevertheless, the 2017 outlook by the AfDB is positive, for economic recovery, albeit at a slow rate, as various reforms are expected to take effect. The AfDB expects a medium to long term shift away from a traditional focus on natural resources towards a more exploratory focus on opportunities for a manufacturing and economic diversification.

Nigeria in particular, has seen a significant diversification of its economy with agriculture and primary sectors' relative contribution to GDP reducing by 16-17% and services sectors' relative contribution increasing by 24%.

Nigeria also faces a rapidly increasing population due to very high birth rates **(Figure 2)**. At the same time this growth is largely skewed by migration to urban areas with the rural population now standing at approximately 53%.

Associated with economic diversification, population growth and migration resulting from security concerns, is a rapid rate of urbanisation and fast-growing mega-cities, especially Lagos and Kano. It is envisaged that Nigeria will have a strong focus in future on developing sustainable cities, which will be driven by structural transformation and integrated urban planning to minimise risk of unemployment and income inequality often associated with rapid urbanisation.

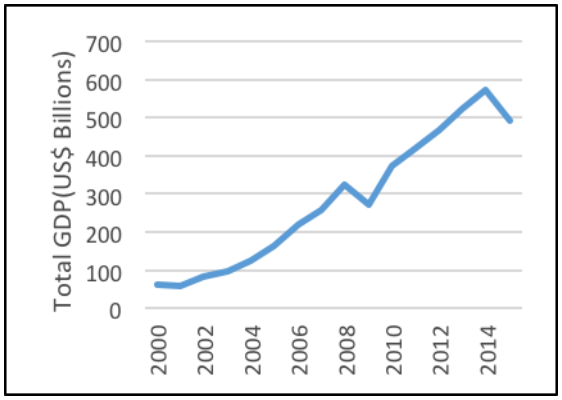

Figure 1. Growth of Nigeria's Gross Domestic Product (GDP) between 2000 and 2015 (Source: World Bank)

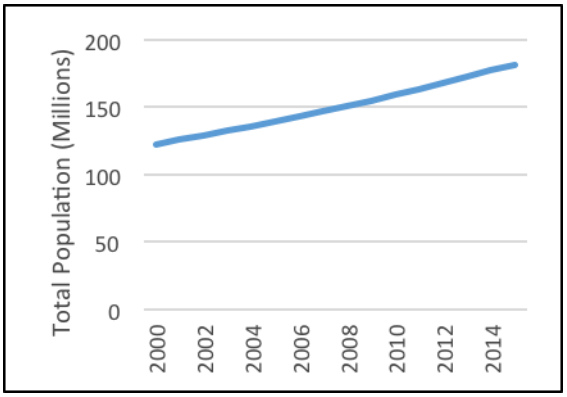

Figure 2. Growth of Nigeria's population between 2000 and 2015 (Source: United Nations)

2.2. Role of Forests on the Nigerian Economy

The macro-economic and demographic trends have several impacts on the forest sector:

- Firstly, the commercial forest sector is small (0.25% of GDP), about 100 times smaller than the agricultural sector and
- Secondly, it is likely that forests face increasing cumulative anthropogenic pressure as a resource for agricultural land, timber and fuelwood. In another hand, unplanned urban expansion can also endanger wetlands' ecosystems, in the case of Nigeria mangroves and freshwater swamps. Urban expansion around Lagos, Nigeria, caused losses of wetlands in four local government areas of 38- 100% between 1986 and 2006 (Adelekan, 2009).

Pressure on forest resources result in a reduction in forest cover. However, well-planned development help to reverse forest ecosystem service losses. In Nigeria, significant investments in infrastructure, labour reform policies, national poverty reduction policies, expenditure and revenue-sharing frameworks seeks to drive equitable and inclusive growth in cities.

Figure 3 provides a visual representation of the chains of causality linking forests and the economy in Nigeria.

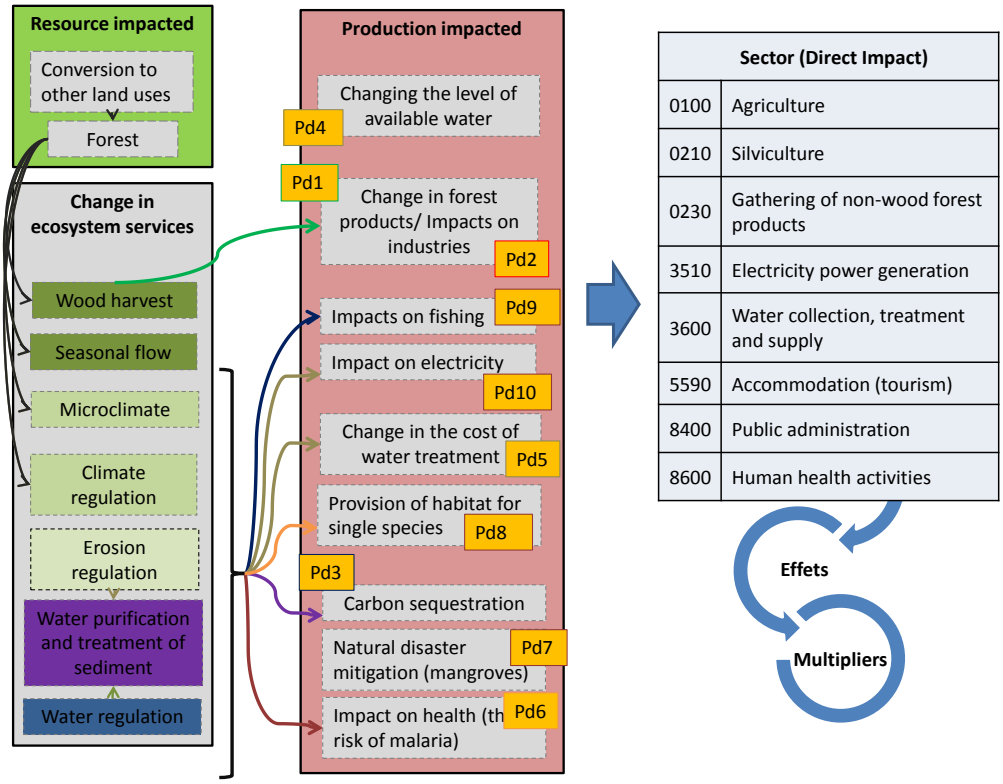

Figure 3. Visual representation of the chains of causality linking forests and the economy in Nigeria. The labels Pd1 – Pd10 denotes the production function developed.

2.3. Deforestation in Nigeria and its drivers

The past 15 years has shown a significant decrease in the Nigeria's forest resources **(Figure 4)**. The total rate of loss in terms of area (especially primary, and other naturally regenerated forests) has remained consistent at just above 400,000 ha/a between 2000 and 2015 (FAO 2015) and can be seen across basins in Figure 4[1]. The corresponding loss in biomass was 42%, which equates to almost 2 billion tonnes of carbon.

The direct drivers of deforestation and degradation include **(Figure 5)**: *(i)* Agricultural expansion (including pasture development); *(ii)* Unsustainable wood extractions (timber and fuelwood); *(iii)* Infrastructure extension (roads, settlements, pipelines, mining and hydroelectric dams); and *(iv)* Forest fires. Indirect drivers of deforestation and degradation are included in annex 1.
The expansion of various land use activities at an economic and spatial scale may reveal more clues into the source of direct gains and losses to forest resources. As an example, although industrial wood removals and the rate of burning has remained relatively stable over the years, the extent of removal of wood for fuel purposes has increased by an average of 366 000 m^3 per year since the year 2000 (FAO 2015).

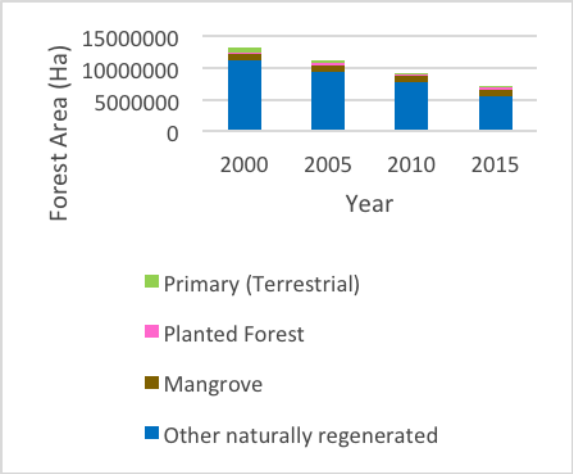

Figure 4: Nigerian forest cover and type by year (FAO, 2015)

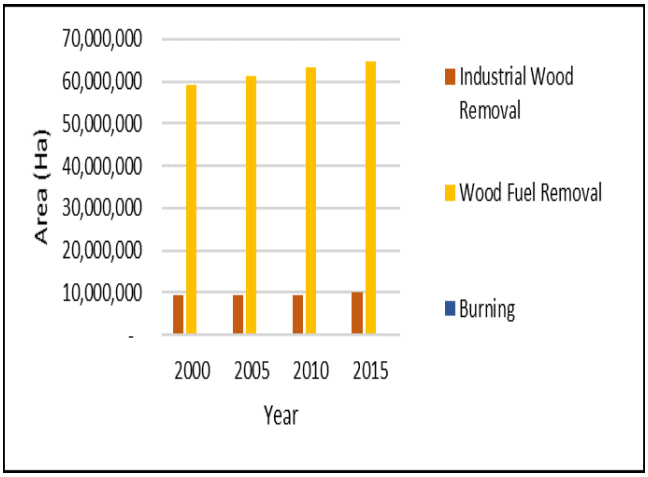

Figure 5: Direct losses to forest resources for the periods of 2000, 2005, 2010 and 2015 (FAO, 2015)

2.4. The impact of deforestation on the economy

Unique combination of geomorphologic, hydrologic and vegetative characteristics provides for the ecological infrastructure present in forests, allowing them to provide a range of ecosystem services. These ecosystem services are real benefits provided to people and the economy. The Millennium Ecosystem Assessment (2005) Framework and the TEEB Assessment classify ecosystem services into four general categories: supporting (denoted by the support service provided by habitats in TEEB 2013), regulating, provisioning and cultural services. A list of ecosystem services provided by forests is given in annexe 2.

The growth in the Nigerian economy has coincided with a loss in forest resources. The negative influence means that as land use expands (such as agriculture) and extractive activities intensify, the loss

[1] It is clear from the FAO results that the annual rate of deforestation is based on an estimate. It is strongly advise that

in forest extent and condition result in an indirect loss of ecosystem services and the value they provide. To ensure sustainability and understand the true cost of development, the impacts on forest systems (and their value) must be internalised into the benefits provided by developments. This will inform trade-offs between socio-economic development goals and forest loss and degradation.

Results of the study show that the value of forest ecosystem services (excluding timber extraction) to be approximately 566,000 Naira/ha (

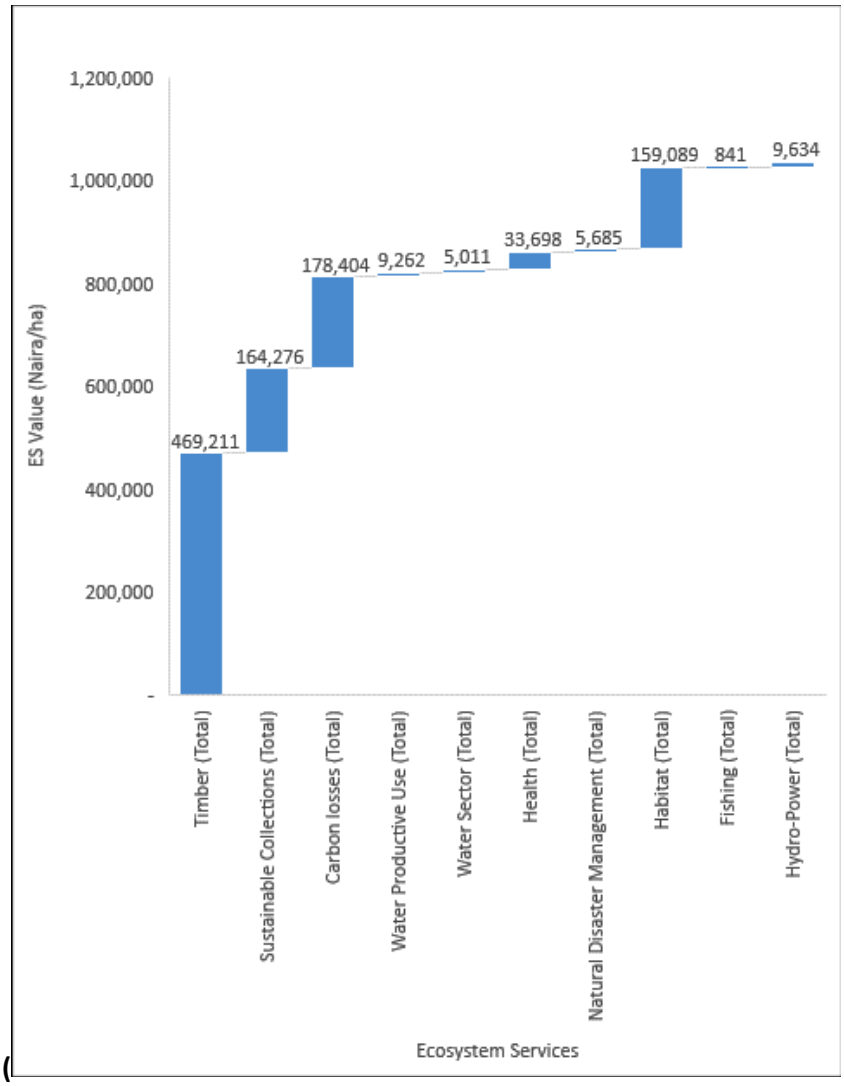

Figure 9**).** The sustainable harvesting of timber is valued at 87,000 Naira/ha meaning the cumulative benefits of other services outweigh the value received by sustainable timber extraction

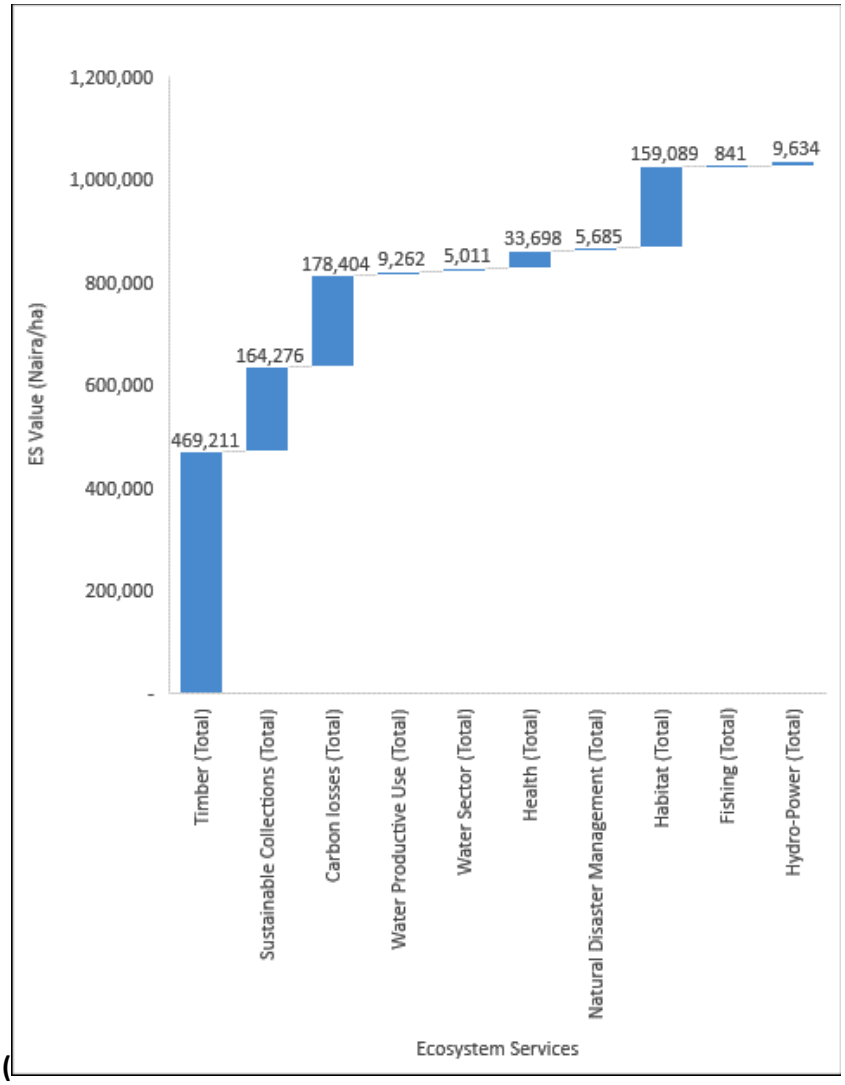

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Figure 9).

Currently, however timber harvest is unsustainable with a current value of 469,000 Naira/ha (530% over harvested) still indicating that the value gained through over-exploitation is still below the value of other services (

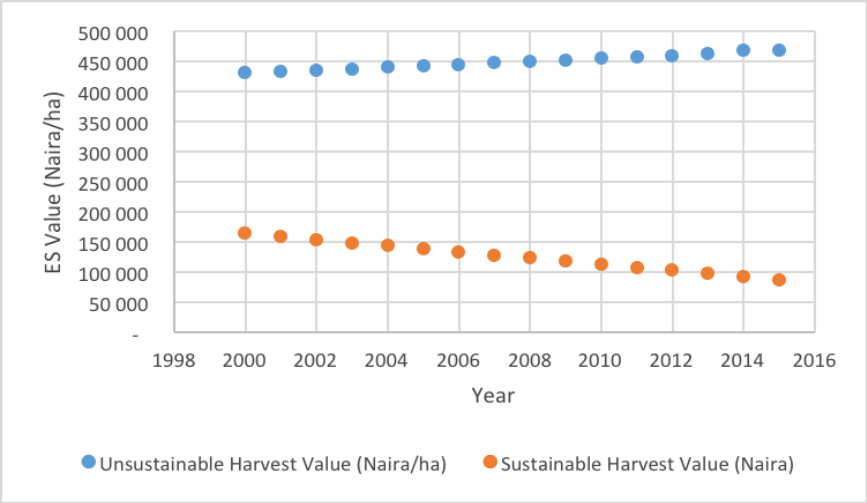

Figure 6). The problem here is through this unsustainable use there is a decrease in total forest stock and subsequent loss of value received by other services.

Furthermore, timber extraction is an extractive activity meaning that if done unsustainably, there will be a loss in total forest stock and thus the quantity (and value) that can be sustainably harvested. For example, as the total existing stock decreases through over extraction, there is a decrease in the amount of timber and fuelwood that can be harvested sustainably (among other services). Note in

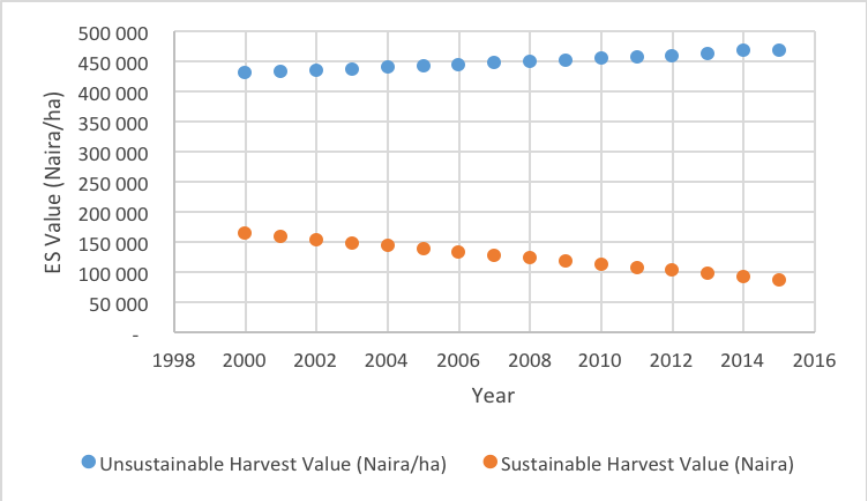

Figure 6 as the current unsustainable harvest continues there is a subsequent decrease in the value of timber that can be sustainable harvested.

The total stock of Nigeria's existing forests has decreased by 42% since 2000 (through a variety of impacts). This means that the total available yearly sustainable harvest has decreased from approximately 26 mil m^3/a (in 2000) to approximately 14 mil m^3/a (in 2015). This is a 47% decrease in the yearly timber available to be sustainably harvested in the last 15 years.
It is vital that relationships between development and forest resources are understood to move towards increasing the sustainability of both their utilisation and benefits received. The next section proposes policy instruments that will aim to improve the sustainable utilisation and management of forest resources warranting the preservation and conservation of natural benefits received by them.

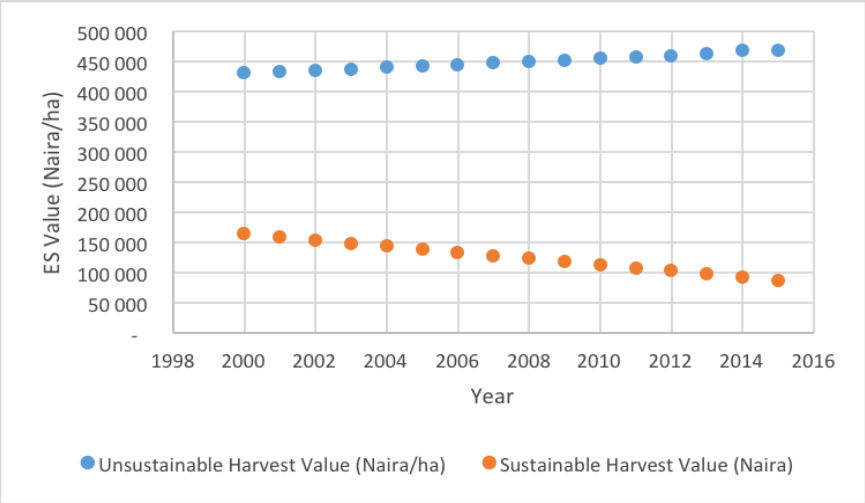

Figure 6: Value/ha of current timber harvest (unsustainable) and sustainable timber harvest in Nigeria between 2000 and 2015

2.5. The value of Nigeria's Forest Ecosystem Services

Ecosystems are highly complex systems of which Nigeria's forest systems are no exception. The quantification of these interconnected and interlinked systems is not always as straight forward as quantifying the service provided (ecological infrastructure) and identifying beneficiaries of services for a given period. There are various paradigms which are characteristic of natural ecological systems which must be considered. One such paradigm is that of relative value due to changing extent.

This can best be described in terms of impact accumulation whereby impacts on ecological infrastructure over a given period result in cumulative losses or gains of benefits resulting in a change in the relative value of benefits provided.

As the forest resources decrease there is a marginal increase in the value provided by these systems due to cumulative impacts due to their loss (Figure 8). The increasing marginal value is both a reflection of increasing scarcity of forest resources as well as the cumulative effect of regulating ecosystem services. This is an important consideration when making decisions in terms of the costs already incurred to date through loss of ecological infrastructure and the subsequent loss in value of natural benefits.

The timber provisioning service is shown to be the single largest ecosystem service at a value of 469,000 Naira/ha (

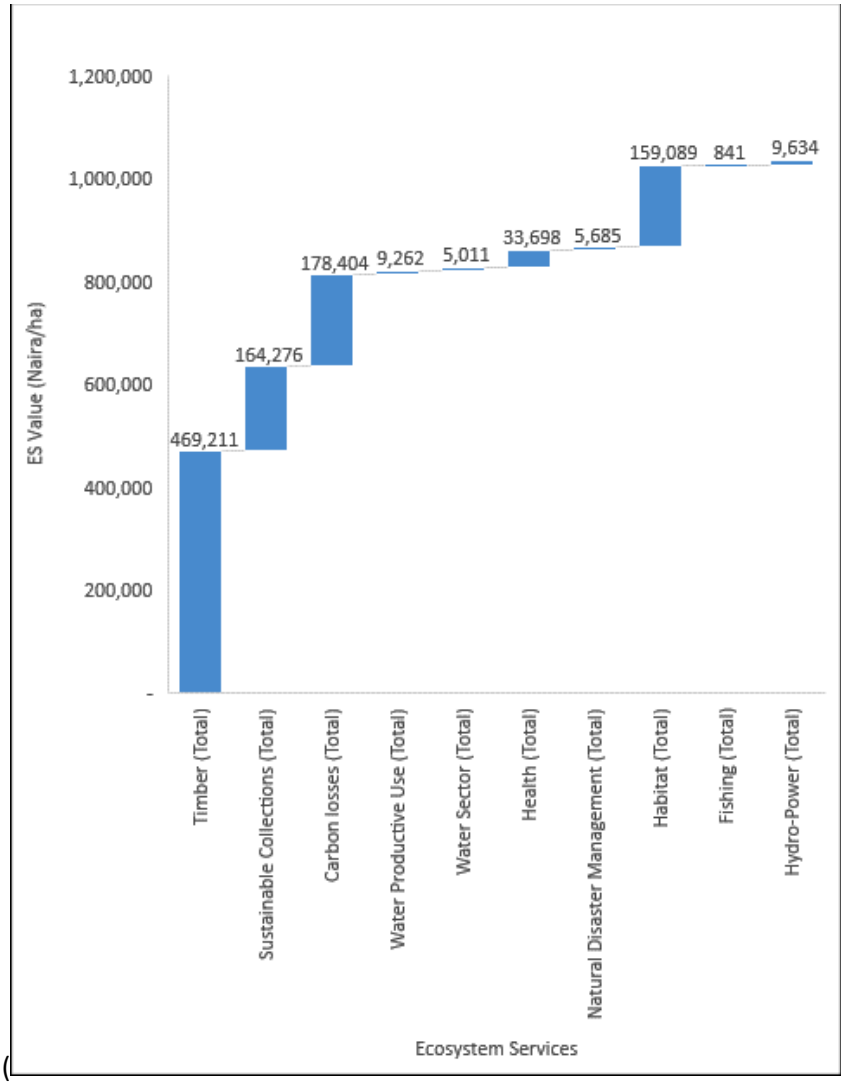

Figure 9). It is this value, combined with the use value of the deforested land, which is the fundamental economic driver of deforestation.

The values resulting from sustainable collections (i.e. collection of non-timber forest products (NTFP)), carbon losses and support by habitat are 164,000, 178,000 and 159,000 Naira/ha respectively. The

health service reflects a value of 33,000 Naira/ha while the other (still highly significant) services display values below 10,000 Naira/ha (

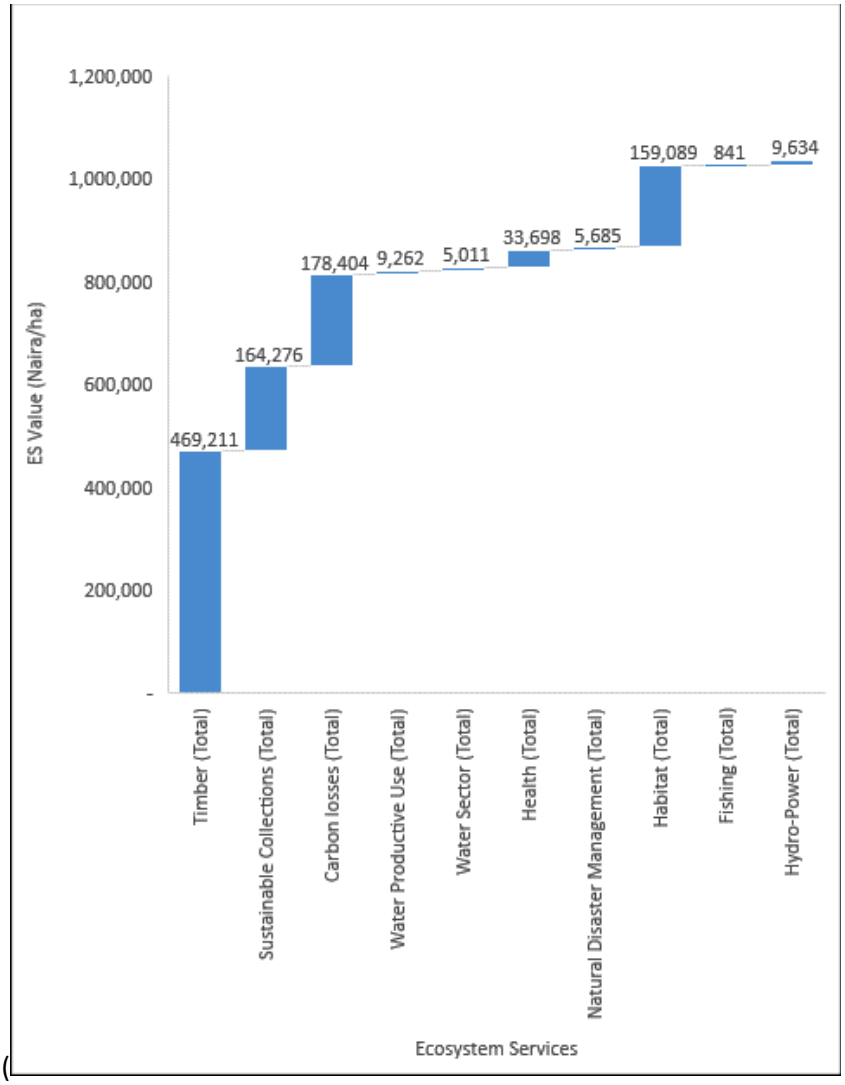

Figure 9). The total value of forest ecosystem services based on valuations done between 2000 and 2015 is approximately 1 million Naira/ha

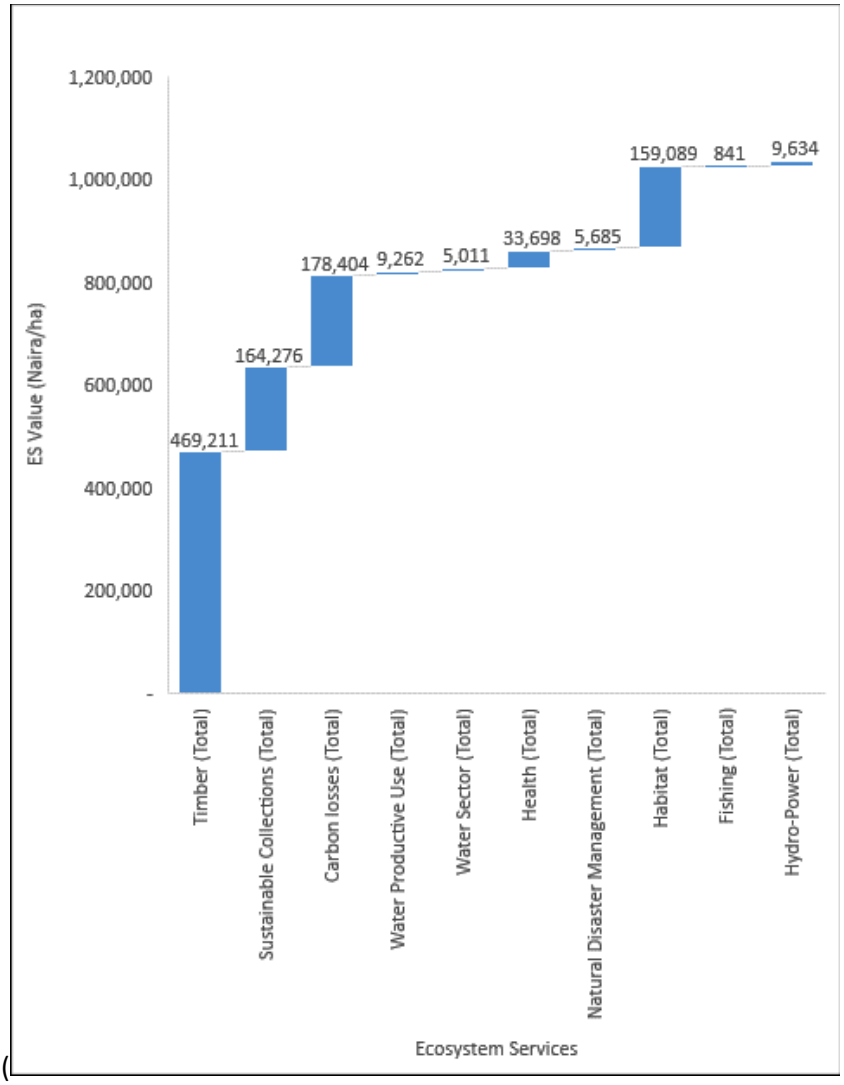

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Figure 9).

Looking across the basins this value varies with the extent of forests present within the basin with, as expected, the southern basins displaying higher values. This shows that these basins which contain the greater extent of forest resources receive increased benefits from them.

Carbon sequestration is an extremely valuable service provided by forests with benefits being provided at a global scale. In the case of Nigeria, although this service does have a comparatively large value.

Of interest is the ecosystem service multiplier effect of carbon. The analysis shows that for every 1 Naira of carbon sequestration value, there is a multiplier of 2.25 Naira (1+1.25) for the accompanying value of the other ecosystem services.

The analysis shows that over the 2000 -2015 year period, there was an increase in the value of harvested timber, which is categorized as a provisioning service, a decrease in forest cover and a decline in the total value of forest ecosystem services. This means that even though there was a rise in value gained from harvesting timber there was a greater corresponding loss in other ecosystem services.

The value of other provisioning services i.e. collection of NTFP (such as building materials, medicinal products, and foodstuffs), the productive use of water and fishing has decreased significantly over the 2000 to 2015 period and can be likely attributed to the loss of forest cover. The loss of the fishing provisioning service could be attributed to the loss of terrestrial forest cover as well and the resultant increased sedimentation into downstream waterways and aquatic systems.
Deforestation and the subsequent loss of forest cover across all forest types have significant impacts on the delivery of ecosystem services. This has considerable impacts on the economy of Nigeria as well as the communities who depend on the forest ecosystem.

The analysis shows that the contribution of forests to the economy of Nigeria is underestimated in the national accounts.

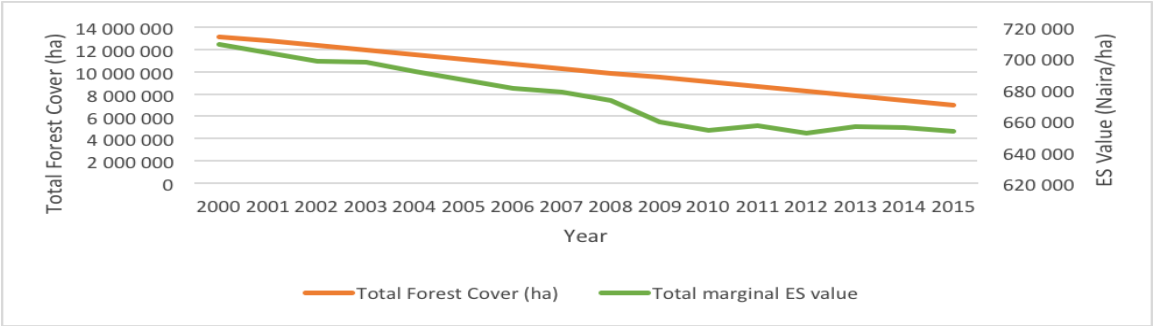

Figure 7: Forest area and corresponding ecosystem service value per ha in Nigeria between 2000 and 2015

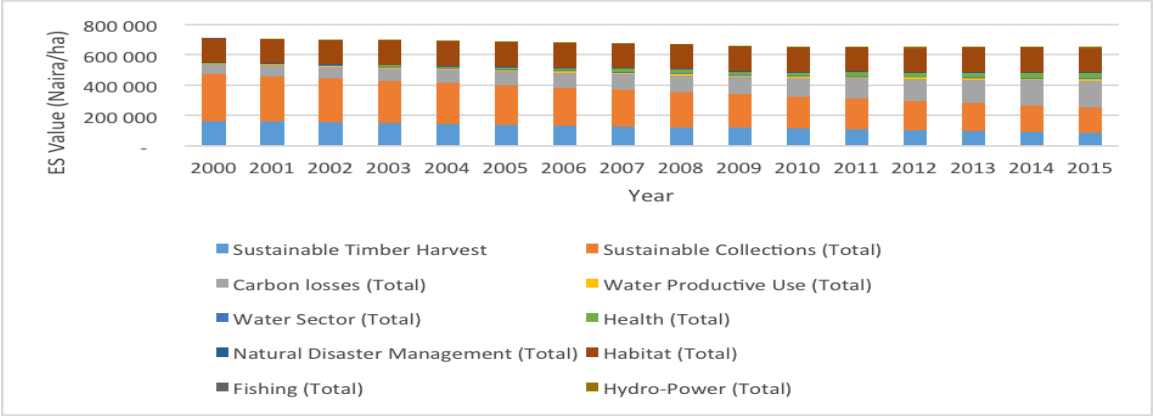

Figure 8: Marginal forest ecosystem service value per Ha between 2000 and 2015

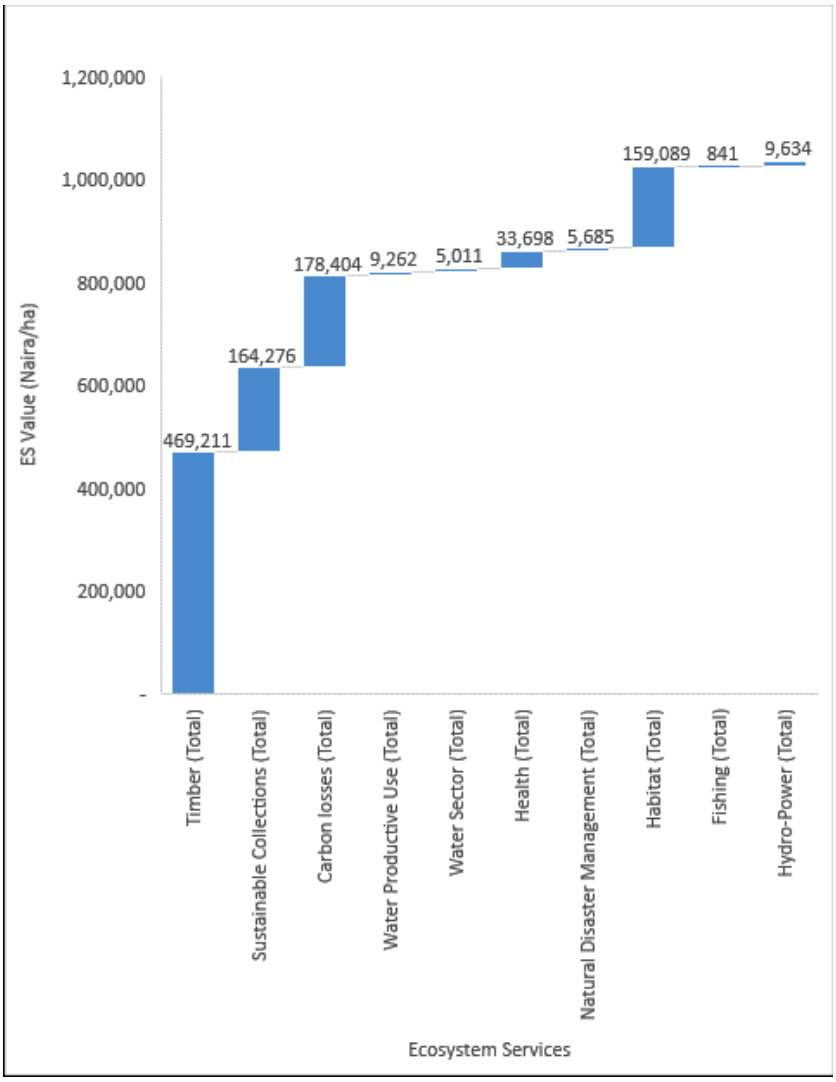

Figure 9: Forest ecosystem service value per Ha in 2015 in Nigeria

2.6. Deforestation in the CRS

Forest resources in the CRS (Tropical high, open, freshwater swamp and mangrove forests) covered a total area of 860 000 ha in 2001 (40.8% of CRS) (FME 2010). Currently total forest cover in in the Eastern Littoral basin is approximately 1.4 million ha of which 4 109 ha is primary, 184 000 ha mangrove and the rest other regenerated forests (Annex 3). It is assumed that a large proportion of this can be found within the CRS.

The rate of forest loss in CRS between 1991 and 2001 has occurred at a slower rate of a loss of 4.5% Tropical High forest (FME 2010). Between 2000 and 2015 deforestation has occurred at a much greater rate in the Eastern littoral basin with a total loss of forest cover at 47%. This indicates as it does for the rest of Nigeria, the need for improved management to reduce deforestation and the loss of valuable forest infrastructure. Further research is needed to determine a more accurate up to date indication of the specific forest loss in the CRS.

3. POLICY RESPONSE TO DEFORESTATION

3.1. Overview: Policy instruments in context

This study moves beyond the mere accounting and valuation of natural capital but makes significant progress towards designing and testing policy instruments that tackle the heart of the deforestation problem. This section therefore provides important background on policy instruments in general and the scope for policy instrument development to combat deforestation in Nigeria.

“Policy instruments” is the term used to describe some methods used by governments to achieve a desired effect.

Regulatory instruments are by far the most commonly used policy instruments internationally. Examples of these instruments include laws of a rationing or prescriptive nature; and regulations that permits or licenses resource use, planning controls or performance standards. A ‘Command and control’ approach is mostly exercised in conjunction with laws and regulations. ‘Command’ refers to standards or targets set and that is to be complied with; and ‘Control’ refers to the enforcement of compliance. Regulations and standards generally desire to achieve a uniform level of control, but they can be an inflexible.

Economic instruments attempt to influence behavior and decision-making through introducing economic incentives or disincentives into economic decision-making processes. Typically, these instruments use values and prices to achieve policy objectives. These are used as a way of influencing the actions of individuals and corporations through monetary and fiscal instruments.

Suasion instruments are ethical or discretionary instruments that use moral and direct persuasion to promote appropriate behavior. Moral suasion is defined in the economic sphere as "the attempt to coerce private economic activity via governmental exhortation in directions not already defined or dictated by existing statute law. The 'moral' aspect comes from the pressure for 'moral/social responsibility' to operate in a way that is consistent with furthering the good of the economy. Voluntarism and corporate social responsibility are additional key suasion instruments. Education and information instruments are also very important key suasion instruments**.**

In developing appropriate policy instruments to combat deforestation, it is useful to consider policy instruments that focus primarily on economic behavior, but that also combines with appropriate elements of regulatory and suasion instruments.

3.2. Proposed preliminary policy instruments for combating deforestation in Nigeria, policy impact analysis and interpretation of results

This study proposes three economic policy instruments that seek to incentivise landholders to pursue sustainable forest management. These proposed policy options are not intended to be a comprehensive of final set of options for Nigeria but are rather used to demonstrate how these options could work, what they would cost, to what extent they would curb deforestation and what the relative costs and benefits to the economy of Nigeria would be.

The three policy options tested are: (i) Carbon trade; (ii) Certified plantation forestry and (iii) Agroforestry.

In evaluating the effectiveness of policy instruments below, two biophysical indicators and five several macro-economic indicators are of interest.

1. The net value of ecosystem services preserved measures the monetary value of forest ecosystem services gained or (lost),
2. The sustainability contribution indicator measures the extent to which the deforestation trend is reversed. If this is a 100% it means the deforestation trend (which has an average annual value of 409,600ha/a) is exactly mitigated, if it is >100% it means forest cover is increasing.
3. GDP (Gross Domestic Product) measures the change in conventional growth of the economy including the indirect effects of forest ecosystem services.
4. Compensation of employees is a component of GDP and measures change in total salaries paid.
5. Balance of Payment measures the net change in international trade (exports and imports). If this value is positive it means exports increases relative to imports and Nigeria's national balance sheet increases.
6. The fiscal effect measures the effect on the income of the Government of Nigeria. If this value is positive Government revenues increase.

Finally, several of the macro-economic indicators have both direct and total effects. Direct effects are the direct impacts taking place in the economy, whereas the Total effect is the combination of the direct effects and the multiplier effects that follow.
All analysis was done for 2010, as this was the year for which formal supply and use tables was available.

3.3. Carbon Trade as a policy instrument

The United Nations' REDD Programme intends to provide incentives for combating deforestation. It does this through paying for carbon stock protection through paying land users for actions that prevent forest loss or degradation. These transfer mechanisms include carbon trading or paying for forest management. Accordingly, this study tested a carbon trade policy instrument.

Many scenarios may be tested, but in this case, we demonstrate a scenario where a pure carbon mechanism is applied in the Eastern Littoral basin in the Cross River State. In this scenario the CRS returns 25% of the area deforested since 2000 (i.e. 285,000 ha) to forest area through a long-term forest rehabilitation program. This scenario makes several critical assumptions. Firstly, it assumes a voluntary carbon trade takes place at a value of 4US$/ton carbon, and this revenue is invested into the Program. Secondly, it assumes that the 285,000 ha can be made available and rehabilitated at a cost of 150,000 Naira/ha. Thirdly, it assumes that the required funding is raised through a corporate income tax.

The output of the analysis (Table 1) shows that although the annual rate of deforestation would be curbed by 70% and a net positive ecosystem services value of 16,540 M Naira would be returned to the economy and the net direct economic effects are negative. Therefore, not a workable policy instrument is used in isolation.

Of interest in this analysis is the Total GDP effect, which is positive. This indicator is positive because of the indirect effects of ecosystem services in the economy. The challenge would therefore be to find one

or more policy instruments that is affordable and has positive direct effects, which would then be further supported by the positive externalities of forest ecosystem services (the Total Effect).

Table 1: This scenario demonstrates a pure carbon mechanism applied in the Eastern Littoral basin (Cross River State), where the CRS returns 25% of the area deforested since 2000 (i.e. 285,000 ha) to forest area through a long-term rehabilitation program.

Macro biophysical indicators		
Net ecosystem service value gained	*Million Naira/a*	16,540
Sustainability frontier		70%

Macro-economic impacts		**Direct Effect**		**Total Effect**	
Indicator	**Unit**	**Change**		**Change**	
GDP	*Million Naira/a*	-2,901	-0.01%	6,653	0.01%
Compensation of employees	*Million Naira/a*	-1,507	-0.01%	1,602	0.01%
Balance of payments	*Million Naira/a*	399	0.00%	-2,539	-0.03%
Fiscal effect	*Million Naira/a*	1,665	0.19%	7,169	0.84%

3.4. Certified plantation forestry as a policy instrument

One of the key challenges central to a successful deforestation policy instrument for Nigeria relates to the productivity of land. The weighted average means annual increment (MAI) of the total forest estate of Nigeria is estimated at 2 m^3/ha/a (Alderman and Abayomi, 1994). Planted forests in Nigeria however can achieve MAIs of up to 15 m^3/ha/a (FAO 2003). Thus, a planted forest can yield up to 8 times larger yield of merchantable and usable round wood.

Although plantation forests do not produce the same forest ecosystem services as natural forests, they do enable more effective land use and thus could "free up" additional land for natural forest regeneration, while increasing timber production per hectare.

Plantation forestry certification also exist which promotes sustainably and ethically produced timber products that provide assurance to markets that principles of sustainable production has been applied.

Certified plantation forestry therefore provides a potential economic policy instrument as it is fundamentally driven by a higher price incentive. Certified plantation forestry is also expected to increase timber yield, training and generally improved land management practices. In addition, price premiums may also be available for certified products.
The implementation of crop certification is not without its challenges; however, it presents an excellent precedent for a policy instrument to combat deforestation.

Once again, many potential scenarios may be tested, but in this case, we demonstrate a scenario which may be akin to a single large project, to be implemented anywhere in Nigeria where annual rainfall exceeds 800mm/a. In this scenario a private investor establishes a plantation forest estate of 100,000 ha, comprising a fast-growing species of at least 15 m^3/ha/a. This scenario assumes an average crop rotation of 15 years and an average timber value of 22,000 Naira/m^3. We further assume that the relevant authority establishes a project implementation office at a cost of 1,000 million Naira per year.

The analysis also assumes a steady state situation (it is to be noted that plantation forestry investment is a long-term investment that may take many years to mature).

The output of the analysis (
Table 2) shows that the deforestation would be reversed. The sustainability contribution indicator is 159% indicating that the natural forest estate increases in size and a net positive ecosystem services value of 134,614 M Naira would be returned to the economy, which would serve to further, strengthen GDP growth.

The net direct economic effects are all positive. The analysis only shows negative indicators for Balance of Payments indicating a reliance on imported products and services to make the project work.

Table 2: This scenario demonstrates a certified plantation forestry project implemented anywhere in Nigeria where rainfall exceeds 800mm/a.

Macro biophysical indicators		
Total ecosystem service value preserved	*Million Naira/a*	134,414
Sustainability frontier		159%

Macro-economic impacts		**Direct Effect**		**Total Effect**	
Indicator	**Unit**	**Change**		**Change**	
GDP	*Million Naira/a*	46,664	0.09%	100,716	0.18%
Compensation of employees	*Million Naira/a*	17,661	0.12%	36,871	0.25%
Balance of payments	*Million Naira/a*	-400	0.00%	-6,371	-0.08%
Fiscal effect	*Million Naira/a*	5,794	0.68%	21,045	2.46%

3.5. Agroforestry as a policy instrument

FAO round wood production data for Nigeria shows a large reliance on fuelwood collection. Thus, to relieve fuelwood harvesting pressure on the natural forest estate, agroforestry focusses on fuelwood production may be an important policy instrument.

Agroforestry is a well-established farming practice incorporating trees in fields, and there is scope to improve this practice to improve productivity and diversify livelihoods, especially in the production of timber for fuel use and construction. A policy instrument could be developed that promotes planting of fast-growing tree species for timber production in conjunction with other crops. It is important to note that carbon sequestration is likely to be a positive spin-off of this policy instrument and therefore carbon benefits may accrue in addition to the agroforestry benefits.

As before, many potential scenarios may be tested, and in this case, we demonstrate a scenario which is akin to a single large project, to be implemented anywhere in Nigeria. In this scenario the relevant authority implements a large-scale Agroforestry initiative comprising distribution of fast-growing, wood producing tree species accompanies by extension services. It is assumed that the initiative is suitable certified as a sustainable forest management activity. The relevant authority establishes a timber-producing agroforestry estate of 100,000 ha, comprising a fast-growing species of at least 12 m^3/ha/a.

This scenario assumes an average crop rotation of 10 years and an average timber value of 11,000 Naira/m^3. We further assume that the relevant authority establishes a project implementation office at a cost of 1,000 million Naira per year. The analysis also assumes a steady state situation (as in the case of plantation forestry it is to be noted that agroforestry investment is a long-term investment that may take many years to mature).

The output of the analysis (

Table 3) shows that the deforestation would be reversed. The sustainability contribution indicator is 122% indicating that the natural forest estate increases in size and a net positive ecosystem services value of 103,395 M Naira would be returned to the economy which would serve to further strengthen GDP growth.

The net direct economic effects are all positive. As in the plantation forestry case, the analysis only shows negative indicators for Balance of Payments indicating a reliance on imported products and services to make the project work.

Table 3: This scenario demonstrates a certified agroforestry project implemented anywhere in Nigeria.

Macro biophysical indicators		
Total ecosystem service value preserved	*Million Naira/a*	103,395
Sustainability frontier		122%

Macro-economic impacts		**Direct Effect**		**Total Effect**	
Indicator	**Unit**	**Change**		**Change**	
GDP	*Million Naira/a*	35,478	0.06%	78,763	0.14%
Compensation of employees	*Million Naira/a*	9,393	0.06%	23,841	0.16%
Balance of payments	*Million Naira/a*	12,560	0.15%	-3,611	-0.04%
Fiscal effect	*Million Naira/a*	7,149	0.83%	19,280	2.25%

3.6. Other policy instruments

The outputs of this work enable practitioners to simulate additional policy options and instruments.
It is to be noted however that economic policy instruments are not suitable to all policy imperatives. This is especially so in the case of conservation of scarce habitat. In such cases, a combination of regulations and command-and-control would be required. Conservation through sustainable forest management of protected areas, may for instance be combined with an eco-tourism enabling policy instrument. Eco-tourism, a cultural ecosystem service, would make use of the benefits of habitat protection, and creates additional income for a host of economic sectors, such as transport, accommodation, restaurants, retail and a host of associated sectors.

In addition, value addition to forest products may offer interesting policy options. In the scenarios tested above, it is notable that the Balance of Payment indicators under the Total effect column are often negative. This indicates a large reliance on imported products and services associated with each scenario and this is less than desirable. The economy of Nigeria would therefore benefit from a focused value addition strategy downstream in the value chain. In this case, as the forest sector grows, and

sustainable time production increases it would be desirable to also increase value addition in the rest of the forest value chain.

4. PRELIMINARY RECOMMENDATIONS

Many challenges exist in developing and implementing successful policy instruments, and these need to be considered.

In the first instance, the most appropriate policy instruments need to be designed at a strategic level, to ensure that the benefits of deforestation are of significant magnitude. The tools developed by the UN-REDD Programme and UNEP in this study plays an important role in this policy instrument design.

In addition to the strategic design of the policy instruments, there also exists an important design requirement at a tactical level, most likely to be dealt with within a framework such as the UN-REDD Programme's Biotrade approach. These tactical considerations involve institutional and operational arrangements and logistics required to address the barriers to combating deforestation. The main barriers are effective networking, finding sufficient cash for initial investment requirements (whether private sector, donor or domestic sources), and difficulties to set up and maintain the required internal control systems.

Much work is therefore still required to ensure that the policy instruments can be effectively implemented.

The challenge for the Government of Nigeria is now to ensure:

- Development of suitable policy instruments such as those demonstrated here;
- Institutionalization of the policy instruments; and
- Continuing a working relationship with UN-REDD Programme to develop and implement suitable policy instruments.

5. ANNEXURES

Annex 1. Indirect drivers of deforestation and forest degradation in Nigeria (FME 2010).

Sector	Indirect Driver	Description
Macro-Economic Factors	Profitability of agriculture	High profitability of agriculture compared to that of sustainable utilization of forest resources is a major economic driver of deforestation and forest degradation.
Governance Factors	Outdated forest laws	The National Forest Policy (1988) fails to effectively provide the enabling environment for sustainable wood production and expansion of forest protection. It also fails to recognize the relationship that rural communities have with forest resources and the role they play in forest management.
	Lack of integration of relevant ministries	Although mechanisms that integrate biodiversity into the economy are present, the national planning processes do not effectively consider the impact of developments on the greater environmental and forestry sectors.
	Land tenure laws are not appropriately focused	The tenure of land by communities is not formally recognized thus removing any sense of responsibility toward utilized land.
	Capacity limitations	The Federal Department of Forestry has had a lack of capacity development and this has influenced a lack of funding and capacity for forest management at a state level.
	Absence in forest management planning	Forest management in forest reserves by state forestry departments has been seen to be virtually non-existent. There is a lack of policies which effectively regulate the use of these resources in a sustainable manner.
	Lack of communication from the top down	Timber removal forms a large part of various states annual revenue. The low cost of timber has resulted in the over-exploitation of forest resources to achieve revenue targets. Furthermore, annual revenue targets are set at an administrative level from where there is a gap in understanding of the state and extent of remaining forest resources.
	De-reservation of forest resources	Pressures by economic role players on governments result in various forest reserves being de-reserved. These occurrences create the impression that this is a potential option for land utilization and development.
	The ban on timber export	The ban on timber exports from Nigeria has prevented timber from realizing international competitive prices. Low prices of timber have been shown to contribute to both inefficient use of timber in industry and massive losses in appropriate revenue.
Other Factors	Demographic drivers	Rapid population growth has increased demand for resources and ultimately places pressure on available land and remaining natural resources. Further migration to subsistence agriculture places increased pressure on forest resources.
	Technologic drivers	Advances in extensive agricultural technologies affects the rate of deforestation.
	Cultural drivers	Communities are often compromised by timber extractors which negatively effects the resources ability to provide benefits. Once the benefits from forests is reduced, agriculture often becomes the alternative to supporting communities which further impacts the resource. A lack of knowledge of sustainable utilization methods is also a limitation within local communities.

Annexe 2. Ecosystem services provided by various forest types in Nigeria (Adapted from MEA 2010, TEEB 2013 and Adeka and Mitchell 2011)

Ecosystem Service Category	General ecosystem services	Description	References
Provisioning	Food	Sustainably produced/harvested crops, fruit, wild berries, fungi, nuts, livestock, semi-domestic animals, game, fish and other aquatic resources etc.	Davies et al., 2009, Fentiman 1996, Nwadiaro 1984
	Fresh water	Agricultural and tree crops (cassava, yam, cocoyam, rice, maize, ogbono, cocoa, etc.).	Omofonmwan and Odia 2009, Umoh 2008, World Bank 1995
	Raw Materials	Sustainably produced/harvested wool, skins, leather, plant fibre (cotton, straw etc.), timber, cork, firewood, biomass etc.	Alogoa 2005, McGinley 2008, NDDC 2006, World Bank 1995
	Genetic materials	Forests and their biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources	Ndukwu and Ben-Nwadibia 2005
	Other products	Bush meat, and other products including raffia, snail, spices, mangrove salts, reeds and sedge.	Luiselli 2003, Luiselli et al., 2006, UNDP 2006, World Bank 1995
Regulating	Climate regulation	Carbon sequestration, maintaining and controlling temperature and precipitation	Brooks et al. 2000
	Water regulation (hydrological flows)	Regulating surface water runoff, aquifer recharge, river and stream recharge etc.	Cugusi and Piccarozzi 2009
	Water purification and waste treatment	Decomposition/capture of nutrients and contaminants, prevention of eutrophication of water bodies etc.	Abam 2001, Uluocha and Okeke 2004
	Erosion regulation	Maintenance of nutrients and soil cover and preventing negative effects of erosion (e.g. impoverishing of soil, increased sedimentation of water bodies)	Dupont et al. 2000
	Biochemical control	Forests are important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.	Arimoro and Ikomi 2009
	Natural hazard regulation	Flood control, drought mitigation.	Abu and Dike 2008, Benka-Coker and Ekundayo 1995
Supporting/Habitat	Habitat for species	Habitats provide everything that an individual plant or animal needs to survive: food; water; and shelter. Each ecosystem provides different habitats that can be essential for a species' lifecycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their movements	USAID 2008
	Maintenance of genetic diversity	Genetic diversity is the variety of genes between and within species populations. Genetic diversity distinguishes different breeds or races from each other thus providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock. Some habitats have an exceptionally high number of species which makes them more genetically diverse than others and are known as 'biodiversity hotspots'	USAID 2008
Cultural	Recreational and tourism	Hiking, camping, nature walks, jogging, canoeing, rafting, recreational fishing, diving, animal watching etc.	Jonathan 2006
	Aesthetic (Spiritual and inspirational)	Amenity of the ecosystem, cultural diversity and identity, spiritual values, cultural heritage values etc.	Anderson and Peek 2002, Bisina 2006, Isichei 1982
	Educational	Education, art and research	Ebeku 2004World Bank 1995

Annexe 3. Total forest cover by type and basin in Nigeria (2015)

Hydro-logical Area	Basin	Total Forest	Primary (Terrestrial)	Mangrove (marine and freshwater)	Other naturally regenerated (excluding mangroves)	Planted Forest	Percentage of Total
	Units	ha	ha	ha	ha	ha	%
1	Niger North	263,576	754	-	209,414	15,830	4%
2	Niger Central	383,258	1,096	-	304,502	23,019	5%
3	Upper Benue	646,824	1,850	-	513,908	38,848	9%
4	Lower Benue	198,901	569	-	158,029	11,946	3%
5	Niger South	1,371,260	3,922	445,185	1,089,478	82,358	20%
6	Western Littoral	2,418,375	6,917	367,426	1,921,420	145,248	35%
7	Eastern Littoral	1,436,746	4,109	184,389	1,141,507	86,291	21%
8	Chad Basin	274,059	784	-	217,742	16,460	4%
Total	**Nigeria**	**6,993,000**	**20,000**	**997,000**	**5,556,000**	**420,000**	**100%**

Annex 4. Trends in Nigerian Forest Cover

Primary forest decreased by 97% between 2000 and 20015 (FRA 2015). Mangroves have been seen to remain stable over this period. Other naturally regenerated forests have reduced by 50% (FRA 2015). Plantations on the other hand have increased by 33% over the same period.

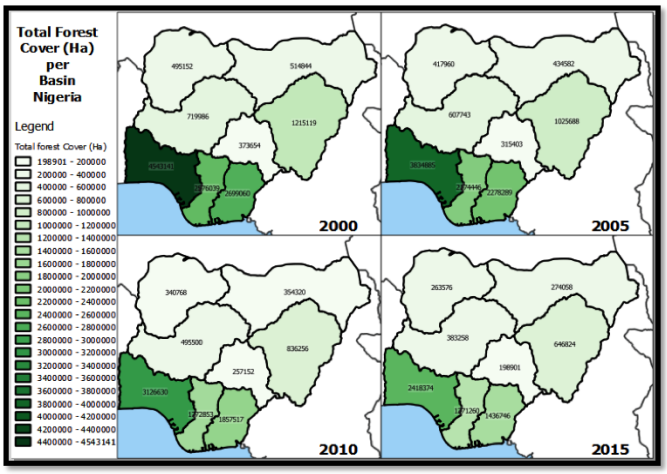

Figure 10: Total forest cover (Ha) in Nigerian basins for the years 2000, 2005, 2010 and 2015

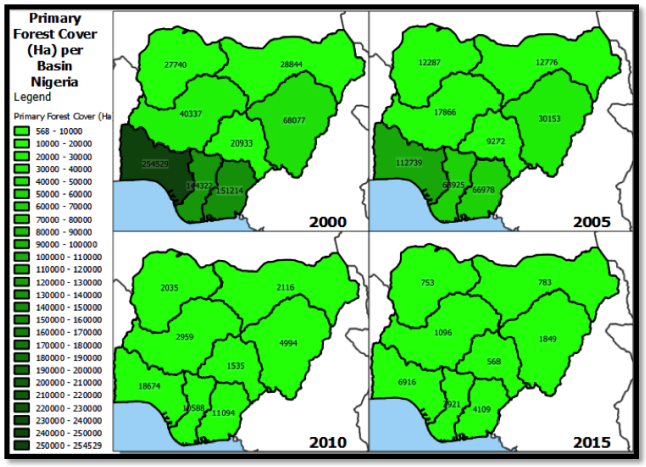

Figure 11: Primary forest cover (Ha) in Nigerian basins for the years 2000, 2005, 2010 and 2015

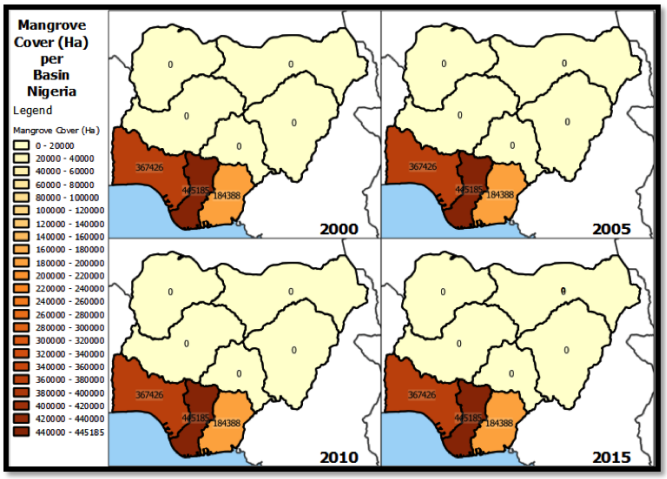

Figure 12: Mangrove forest cover (Ha) in Nigerian basins for the years 2000, 2005, 2010 and 2015

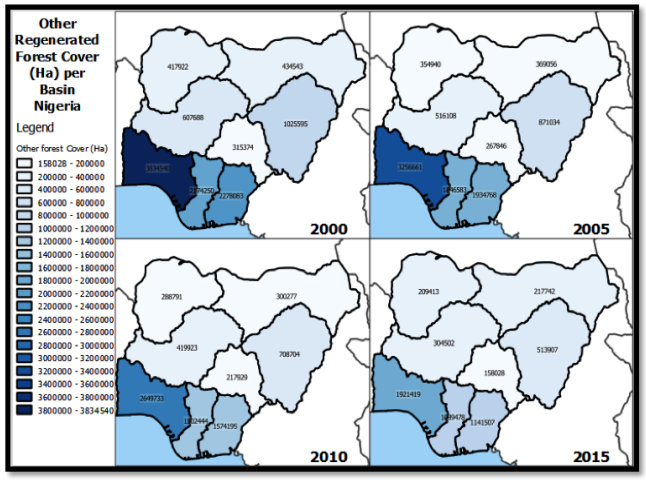

Figure 11: Other naturally regenerated forest (excluding mangroves) cover (Ha) in Nigerian basins for the years 2000, 2005, 2010 and 2015

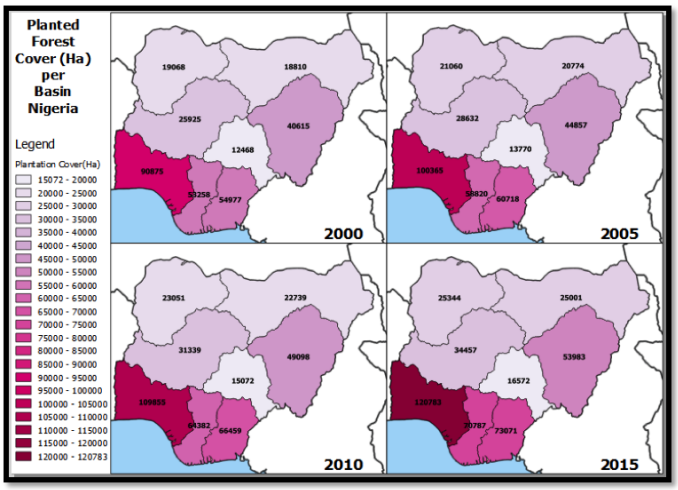

Figure 13: Plantation forest cover (ha) in Nigerian basins for the years 2000, 2005, 2010 and 2015