Accounting for Climate Change Implications of Deforestation: The case of Forest Reserves in Osun State, Nigeria

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Abstract

Deforestation has exacerbated the greenhouse gas emission and the consequent impact on climate change. Development efforts in the last five decades, has led to increased degradation of the environment. Forests play a crucial role in ameliorating the impact of greenhouse gases emitted by industries and households. This study examined the prevalence of deforestation, as an indication of environmental service base loss, and identified the nature of climate change impacts occurring in Osun State forests. Contingent Valuation Model (CVM) using the Willingness to Pay (WTP) was adopted to assess the climate change dimensions of deforestation and provide values for accounting purposes. Survey of stakeholders around the forest reserves in Osun State, Nigeria was undertaken. Data gathered and analysed showed that over 18,000 hectares of original forest reserves were deforested with a prevalence of 38.3%, growing at about 4.76%. There was significant difference in respondents' average WTP for carbon balance (N3,682.74) and greenhouse gases reduction (N3,573.68) at $p < 0.05$. It was concluded that deforestation is prevalent in the forest reserves of Osun state, Nigeria. The impacts of deforestation measured through CVM provides basis for modelling climate change implications for accounting purposes. It was recommended that tree planting should be accelerated while the activities of those who convert wood to charcoal should be discouraged. Conscious effort to boost carbon sequestration should be encouraged through expansion of forests.

Keywords: deforestation, climate change, Contingent Valuation Model, willingness to pay

Introduction

Deforestation is the permanent destruction of indigenous forests and woodlands which is often a result of conversion of forests and woodlands to agricultural uses such as development of cash crops and cattle ranching, commercial logging; through trees felling for firewood, and for building materials (Collins, 2001; Derouin, 2019). It occurs when vegetation is cut down without any simultaneous replanting for economic or social reasons (Balarabe, 2011). The consequences of deforestation is far reaching and includes desertification (Omofonmwan & Osa-Edoh, 2008). Derouin (2019), observed the current trends of rapid deforestation occurring in the tropics as a result of access made possible by the construction of new roads through the dense forests. She cited "a report by scientists at the University of Maryland that the tropics lost about 61,000 square miles (158,000 square kilometers) of forest in 2017 — an area the size of Bangladesh".

Various reports reviewing the rates of deforestation in Nigeria showed that it is among the highest in the world (One World, 2011; Mongabay, 2011 on www.rainforests.mongabay.com; Butler, 2011). Olanrewaju (2019), observed that most of the protected areas of the 50s were had been "deforested, degraded, encroached and converted to other land uses" for various reasons. Citing the Nigerian Conservation Foundation (NCF), Olanrewaju explained that Nigeria has lost up to "96% of its natural forest cover" and that current rate of deforestation is estimated at 11.1% per annum. These assertions have grave consequences for biodiversity and climate change. The significance of deforestation is one of opportunity cost- vital environmental services are lost to immediate income generation. These environmental services include those that are climate related such as carbon absorption and control of Greenhouse Gases (GHG) emissions. By its nature, forests take up carbon dioxide from the atmosphere and thus neutralises the adverse effects of other greenhouse gases produced from manufacture, transportation and domestic use of fossil fuel. When trees are felled the carbon stored in trees are released to the atmosphere, while new growth take up carbon more rapidly than old growth forests.

The current and future implications of climate change (as a cost factor) can be estimated and valued using methodologies similar to those employed in benefit-cost analysis for entries in the books of accounts. Conventional accounting lacks the methodology for capturing environmental impacts or costs in its costing and financial reporting. The evolution and adoption of environmental accounting makes it both worthwhile and possible to reflect the true costs of deforestation so as to promote decent/ responsible conduct towards forestry production and pricing of outputs.

The consequences of environmental degradation are quite impacting on the macro-economy, geophysical environment and well-being of citizens. Among the popularly discussed outcomes are global warming and climate change. Various reports have proven that Nigeria's experience of deforestation is phenomenal for as stated by Aminu-Kano (2020), Nigeria may have lost up to 96% of her natural forest endowments and rapidly losing forest cover of whatever else replaced the natural species. FORMECU (1996) had bemoaned the degradation of Nigeria's forest then occurring at rate of 3.5 percent annually but that rate had been surpassed by recent findings (Salami, 2009; Mfon, Akintoye, Mfon, Olorundami, Ukata & Akintoye, 2014; Mba, 2018). Olanrewaju (2019) identified among other things the problems of climate leading to frequent disasters in the world as outcome of deforestation, hence the call for sustainable forest management.

The challenge of sustainable forest management is embedded in determining the true value of lost environmental services of forests. It would seem that only what we are able to count that is valued and what is valued is what we treasure. Thus, unless and until some accounting procedure is able to estimate the loss accruable to deforestation in financial terms such that the bottom lines are in "clear red" showing how much of ecological footprints this generation is making vis-à-vis what is sustainable, there may be no significant change of attitude towards forest resources. As observed by The World Commission on Environment and Development (WCED) (1987), "Nations are drawing too heavily, too quickly, on already overdrawn environmental resource accounts to be affordable far into the future without bankrupting those accounts. They may show profits on the balance sheets of our generation, but our children will inherit the losses." The estimation of true cost of deforestation in terms of climate change is the thrust of this work.

It is pertinent to ask some questions in relation to the study area and the stakeholders' value of climate change implications of deforestation:

i. What is the rate of deforestation of the Forest Reserves in Osun State, Nigeria?

ii. What are the estimated costs associated with environmental service (climate regulation) lost to deforestation?

iii. How can these costs reflect in the accounts of the state?

The aim of this study is to identify the nexus between deforestation and climate change, and evaluate the cost associated with deforestation. It was also aimed to show how the cost is reflected in the accounts of the state.

Conceptual Clarifications. Forestry is the art and science of managing forests, tree plantations, and related natural resources (https://forestry.ca.uky.edu/what-is-forestry). Modern forestry is viewed as concerning itself with the following activities:

a.) assisting forests to provide timber as raw material for wood products,

b.) providing wildlife habitat and natural water quality management,

c.) serving as recreation, landscape and community protection,

d.) providing employment, aesthetically appealing landscapes,

e.) management of biodiversity, watershed, erosion control and

f.) serving as a 'sink' for atmospheric carbon dioxide.

Forest resources are those resources derivable from forests such as timber, wildlife, and fruits, nuts, medicinal plants and wood fuel. The uses of forests (including vegetative cover) are to prevent erosion, desertification, extinction of wildlife species, and the provision of biomass and to serve as tourists' attraction (encyclopedia.com, 2020). Bradley (2001) indicated that forest products possess many inherent advantages in that "they are renewable, recyclable, biodegradable and carbon neutral". Forests are among the few truly sustainable products (Olatunji, 2012).

Ashbey (1988) observed that non-timber forest products can play a vital role in food security and income generation. The World Bank (1992) noted that forests provide a wide range of social and ecological functions, such as providing livelihood and cultural integrity to forest dwellers and a habitat for a wealth of plants and animals. Other roles played by forests include protection and enrichment of soils, natural regulation of hydrologic cycle. By taking up carbon as they grow, local and regional climate is affected. The report continued by categorizing the world's forests into three broad types namely, tropical moist and dry forests, temperate forests and degraded forestland. It stated that tropical moist forest as the main concern for it is fast disappearing.

Forest Carbon Accounting: National Resource Canada (2007) identified human-induced disturbances to the carbon cycle as a driver of climate change (especially due to burning of fossil fuels and, land-use changes). The issue of greenhouse gas pollution has become an issue of grave concern all over the world. The report described carbon dioxide (an important greenhouse gas) interchange as arising through the processes of photosynthesis, respiration, decomposition, and emissions associated with disturbances like fire, insect defoliation, and timber harvesting. The approach to adopt in measuring climate change implications depends on the needs to be met and, crucially, on the geographical scale that needs to be considered, and on the resources available (Watson, 2015)

Deforestation: Deforestation is the elimination of forest and woodland areas on the large scale (Coc & Navickis-Francois, 2012). It is complete removal of forest cover over a land area and conversion of such land to other uses (Mba, 2018). Deforestation causes problems on both the evolutionary, social, and ecological scales. One of the major environmental hazards affecting the planet earth is deforestation, in terms of the nature and magnitude of the problem. The process of deforestation is widespread and is a major environmental concern that is addressed by Agenda 21 developed for the United Nations Conference on Environment and Development (UNCED) in June 1992. Deforestation is a much-used, ill-defined, and imprecise term that tends to imply quantitative loss of woody vegetation. There can also be qualitative changes in forests, from, say, species-diverse tropical forests to single-species eucalyptus or pine plantations, or to less species-rich secondary (regrowth) forests (Barrow, 1991).

Nunez (2019) stated that about 30 percent of the world's land area covered by forests, although this is threatened with rapid removal. The world lost 502,000 square miles (1.3 million square kilometres) of forest between 1990 and 2016 - an area larger than South Africa. It was estimated that 46 percent of trees have been felled globally and about 17 percent of the rainforest in the Amazon has been destroyed in the last 50 years. The role of trees is divers, among them is that they absorb the carbon dioxide that human breathe out, and also heat-trapping greenhouse gases emitted from human activities. Tropical tree cover is capable of providing 23 percent of the climate mitigation needed over the next decade to meet goals set in the Paris Agreement in 2015, according to one estimate.

Accounting for Climate Change Implications of Deforestation: Costs can be accrued to deforestation, arising from the concept of externality and the need for sustainability. However, it is clear from outset that the environmental cost of deforestation surpasses mere economic considerations, indeed much of the cost elements do not lend themselves to conventional measurements, hence the need to adopt contingent valuations and thereafter derive suitable format for future use. Measurements of environmental impacts of deforestation can be achieved for economic valuation through any or combination of travel cost calculation, market price, surrogate market or contingent valuation. Contingent valuation could be used through willingness to pay surveys to reflect the perceived impacts of deforestation on communities and resource

base. The mean amounts of WTP serve as per capita value of the resource and so can be projected over the population to obtain environmental total value (ETV) of forest service.

Theoretical Framework.

Theory of Natural Capital: Fisher (1904) depicted natural capital as lakes and rivers. He described the concept in terms of stocks and flows, whereby the natural capital is held as stock to be maintained at constant values while what accrues over and above this value can be viewed as what flows to society. Thampapillai and Uhlin (1997), depicted activities in relation to natural or environmental capital as comprising of those relating to investments and depreciation. Investment activities include reforestation of barren and exploited land; detoxification of contaminated soils; reclamation of rivers infected with sigul blown; and, creation of wetlands for de-nitrification. Depreciation activities include air filters and water filters installed in polluted environment; municipal waste removal and treatment; and, pollution control activities by firms. They went on to insist that following Hotelling (1925) and Keynes (1936) exposition of permanent income from a capital good, the adjusted value of national income can be sustainable if at least two conditions are satisfied.

The conditions to meet are:

i. that there is no diminution in the stock of environmental capital; and,

ii. the value of environmental depreciation is less than the rent generated by the stock of environmental capital (Thampapllai and Uhlin 1997). Ecosystem services are the benefits people obtain from ecosystems which include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits. These services are foregone each time forests are removed. Although a lot of dissonance and methodological in-consistence have beleaguered the choice of valuation basis for environmental services and products, opinions tend to converge around the adoption of contingent valuation methods. Most researches using these valuation methods tend to depend on the perception of respondents to determine the Willingness to Pay, Hedonic and sometimes Travel Costs (Barkmanna, et al, 2008). These respondents are often unfamiliar with the scientific terms and basis for determining ecological values associated with resource valuation.

Hicksian Theory of Income as Basis for Sustainability: Hicks (1946) described income as that portion that can be consumed by an individual while remaining as well off as he was before he undertook the consumption. The issue of sustainability is clearly captured here. It has to do with ensuring that the capital is maintained. In this case the capital is the forest. This was the basis of the capital maintenance theory, popularized by Hendriksen.

Environmental Kuznet's Hypothesis or the Impoverishment Theory: This theory is broadly known as the Environmental Kuznets Curve (EKC) argued that environmental degradation will eventually decrease as GDP increases, i.e., poverty or low level of economic development is closely related to environmental abuse. It is depicted by an inverted-U shaped curve: the argument is that developing industrial nations would pay little attention to environmental concerns and thus generate environmental pollution as by-products. After attaining a certain standard of living from industrialization and when environmental pollution is at its peak, the focus changes from self-interest to social interest. This awakening gives rise to remediation of environmental damages and reduction in the prevalence of degradation through adoption of right practices and clean technologies.

Controversies have trailed the theory. Some reasoned that it is important to consider if pollution actually abates as an economic threshold is attained and whether this is ethically done, or are the pollution and pollutants simply exported to poorer developing countries. Another critic observed that the model lacks predictive power because it is highly uncertain how the next phase of economic development will be characterized (Levinson,2000; Ogwang, 2005; Hauer & Ford, 2009). Even Grossman and Kruger (1993),

who initially made correlation between economic growth, environmental clean-up and the Kuznets curve, conclude that there is no evidence that environmental quality deteriorates steadily with economic growth. The hypothesis is however given credence in Nigeria more prominently in the Abacha years of fuel scarcity when the Agala hill forest reserve at Ibadan was plundered and virtually removed to facilitate unmet energy demands. Today, it is a sorry tale and one that the community would wish were reversible, but no. The entire forest site has been converted to other uses (Papka, 2005; Bada & Popoola, 2005; Salami, 2009).

Recent Works Reviewed

Mfon, et al. (2014) identified three schools of thought in the theoretical underpinnings of deforestation, namely the impoverishment school of thought, neoclassical school of thought or open access property rights, and the political-ecology group. The works of Kuznet belongs in the impoverishment school of thought. Accounting for climate change implication of deforestation rests on the Kuznet hypothesis and the sustainability theory of Hicks. Popoola and Tee (2006) defined valuation as the process of placing monetary value on goods and services that do not have prices or where prices are distorted. With regards to forests, Popoola (1995) posited that "reliable estimates and values have not been found for losses (both economic and environmental) incurred as a result of misuse or overuse of these resources. Problems associated with valuation of forest resources were identified as including information non-excludability, biological dimension, planning horizon and joint production. Popoola and Tee suggested procedures for valuing forest resources and indicated the following preconditions for the exercise:

i. Characterization of tropical forest resources according to objectives of management highlighting the products and service functions required and achievable.

ii. Prioritization of tastes and preferences of users as presented approximately by willingness to pay (WTP).

iii. characterization of the environment along socio-economic lines such as population density and access to market.

Bada and Popoola (2005) bemoaned the recklessness in the management of Nigeria's forest resources despite a history and bequeath that should have assured perpetual beneficial use of forests.

Methodology

Research Design: This study adopted the exploratory research method in its investigation. This involved the use of both primary and secondary data for the purpose. Secondary data was in relation to forest reserves sizes, states and decline, while the primary data was obtained through a survey of stakeholders for a contingent valuation through Willingness to Pay Method.

Sampling Frame: The sampling frame comprised the various categories of stakeholders. Although these categories of target respondents abound around the state, the statistics relating to each category is shown in Table 1.

Table 1: Description of Respondent Groups

S/No	Category of Respondents	Location	Total	Source
1	Timber Contractors	8 Forest reserves	1,185	Forestry Department/ observation
2.	Local Communities	8 Forest reserves	300,000	Estimates from Population Census
3.	Foresters on field	8 Forest reserves	84	Forestry Department
4.	Forestry Dept. Officers	Osogbo	09	Forestry Department

Source: Field Survey

Sampling Methods and Sample Size: Stratified random sampling technique was adopted. Four strata were identified for this study as shown in the sampling frame, namely:

Stratum 1: Registered Timber Contractors

Stratum 2: Foresters on Field and Log Control Unit

Stratum 3: Officers of Forestry Department- both at Zonal and State Offices.

Stratum 4: Local Communities

Sample Size Determination for local community in Willingness to Pay Survey: To determine suitable sample size for the purpose of this study, the following sample size formula was used. This formula is adopted for sampling in a population that is greater than 50,000 (Godden, 2004).

$n = (Z^2 * p * q) / (ME^2)$

where, n = sample size

p =level of precision anticipated in respect of the research problem. Since there is no precedence, i.e., 50%

q = 1-p

ME = Margin of Error that can be tolerated in this research is 5%.

Z = the alpha value is determined by calculating 1-confidence level, i.e. 1- 0.95 = 0.05 to estimate the critical value given as 1- (alpha/2). i.e., 0.975. The value is 1.96.

Thus, $n = [(1.96)^2 * 0.5 * 0.5 / (0.05)^2$

i.e., $n = 0.9604/0.0025 = 385$

Thus, a total of 385 respondents were selected for survey from the stakeholders i.e., WTP survey around the forests reserves.

Data Analysis Methods: Objective (i) examined the trends of deforestation in the forest reserves of Osun State, Nigeria. The number, sizes and state of the forest reserves at 1991and through to 2019 were obtained from the records of the Forestry Management Department of the Ministry of Environment, Osun State, Nigeria and the trend was estimated using Ordinary Least Squares (OLS) regression.

$$Y = a + bX + \mu \quad \text{.....Equation i}$$

Objective (ii) determined the climate change effects of deforestation and the Willingness to Pay (WTP) for greenhouse gases regulation and maintaining the carbon balance. The WTP questionnaire is administered and the socioeconomic data (independent variables) and the Willingness to Pay for GHG regulation and CO_2 balance (Dependent variables) and the significance is determined at 95% confidence level or 5% level of significance using LOGIT Regression Model. The dichotomous choice of respondents was subjected to LOGIT analysis as shown in equation ii,

$$L\frac{Pi}{1-Pi} = \frac{f(X1+x2+x3+\cdots+Xn)}{fi} \quad \text{.....Equation ii}$$

Where: X_1 = Gender; X_2 = Marital Status; X_3 = State of origin; X_4 = Education; X_s = Size of farm; X_6 = Annual Income; X_7 = Age; X_8 = Size of family; X_9 = Distance from Forest Reserves; and, Fi comprised of F_1,or MCB= Maintaining of Carbon Balance; and, F_2, or GHG= Absorption of Green House Gases.

Objective (iii) estimated the costs to reflect in the accounts of the state in respect of the climate change liabilities of deforestation by interpolating the amount of WTP over the population to obtain the mean cost and the annualized cost of depreciation of service value of disappearing forests. The mean WTP representing the per capita value of Forest Environmental Service (FES) is computed as shown in equation iii,

$$\text{Mean } WTP_i = \text{Intercept/Bidcoeff(i)} \quad \text{……Equation iii}$$

Extrapolation of Mean WTP to obtain the Total Value of Climate Services of Forests (V_{CS}) as shown as:

$$V_{CS} = \text{Mean WTP} * POP_{OSUN} \quad \text{……..Equation iv}$$

i.e. $V_{CS} = \sum (\text{Mean } WTP_{MCB + GHG}) * POP_{OSUN}$

Annual Cost of Climate Change Liability Due to Deforestation = $V_{CS} * R_{DEFORESTATION}$…Equ. v

Results

Data on Forest Reserves of Osun State, Nigeria: At inception of the Osun State in 1991, she had a total of eleven (11) forest reserves as shown in Table 2. Ago-Owu forest reserve located in Ayedaade local Government Area was the largest with a land mass of 31,744 ha, dominated by natural forests interspersed with plantations. The second largest, Shasha, and the third, Ife F3 Forest Reserves are both located in Ife South Local Government Area and were 31,232 ha & 8,383 ha respectively. These three reserves constitute the bulk of the forest cover in the state. Others include Oba Hills forest reserve in Ejigbo local Government Area, 6,773ha, fourth largest was mostly natural forest with plantations at the fringes. Oni & Ikeji-Ipetu forest reserves both in Oriade Local Government Area were fifth and sixth largest, 5,632ha & 4,349 ha respectively. They were both dominated by natural forests with plantation only at Ikeji/ipetu forest. Ede forest reserve in Ede South local Government Area was totally plantation, 1,344ha was seventh largest, similar to Osogbo forest reserve in Osogbo local Government Area, 594ha, eighth. Ejigbo and Olla forest reserves in Ejigbo Local Government Area, 314ha & 107ha respectively were mostly plantations ranked ninth and eleventh respectively. Ila forest reserve measuring 256 hectares was plantation. It ranked tenth.

Over the years however, several changes have occurred to alter the above stated data and had led to deforestation in some way. Thus, table 2 shows the current state of the forests as well as the changes therein.

Table 2: A Comparative View of Forest Reserves of Osun State

S/N		*Size (Ha) 2000*	*Size (Ha) 2019*	*DIFFERENCE*	*Reasons for Difference*
1.	**Ago- Owu**	31,744	19,847	-11,897Ha	Agriculture + excessive logging
2	**Ede**	1,344	1,044	-300Ha	Excessive Logging/Housing
3	**Ejigbo**	314	214	-100Ha	Excessive + illegal logging
4	**Ife F3**	8,383	7,168	-1,215Ha	Excessive logging.
5	**Olla**	107	0	-107 Ha	Fully exploited
6	**Ikeji-Ipetu**	4,349	2,849	-1,500Ha	Excessive logging
7	**Ila**	256	230	-26Ha	Plantation heavily exploited
8	**Oba Hills**	6,773	4,225	-2,548Ha	Excessive logging/ Encroachment by farmers
9.	**Oni**	5,632	0	-5632Ha	Disputed
10.	**Osogbo**	594	0	-594Ha	De- reserved for LAUTECH
11.	**Shasha**	31,232	23,064	-8,168Ha	Excessive logging/farming
	TOTAL	90,728	58,641	-32,087Ha	Unsustainable practices

Source: Forest Management Department, Osun State Ministry of Environment

The trend of forest holding in Forest Reserves of Osun State, Nigeria 1991-2019 was shown in Figure 2. The sharp decline from eleven (11) legacy forest reserves to eight and, a continuous conversion activity had

left the forests largely shrunk to about half the original size at inception in 1991. The data on trend of deforestation comprised of forest land cover over the 29-year period that Osun state has existed. The trend was subjected to time series analysis through a 5-year moving averages (autocorrelation). The results were indicative of the rate of forest cover loss over the years, with an average rate of decline at 0.383 forest depreciation with an annual rate of (120.873/16 = 5.7558; 5.7558/120.873 = 0.0476). All the years show p-values that were significant at 1%, 5% and 10% levels of significance indicating that deforestation is prevalent in Osun state and at the present stands at 38.3% of the legacy forest reserves with annual growth rate of 4.76%.

Analysis of Trends and Rates of Deforestation in Osun State, Nigeria: The data available in respect of forest cover of Osun State, Nigeria from 1991 - 2019 and subsequent years to 2014 showed the status of the forest reserves from year to year giving effect to the various changes occurring over the years. These were plotted in Figure 4 with a trend line showing the linearity of the phenomenon of deforestation. The principal forest conversions were reflected alongside the cumulative effects of unsustainable logging.

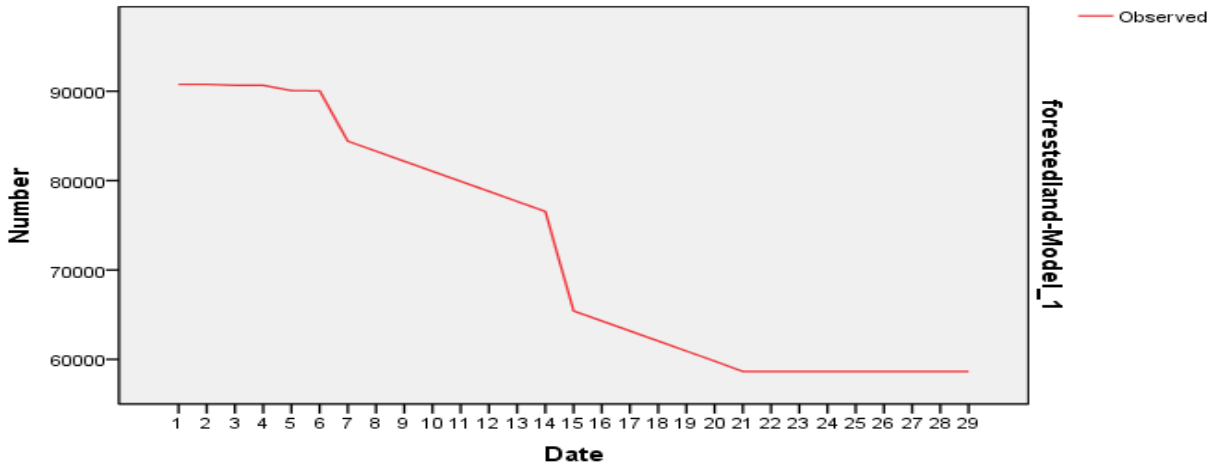

Figure 1. Trend of forested land in Osun State, Nigeria

Fitting a line of good fit, the trend of deforestation can be estimated using the data as shown in figure 3

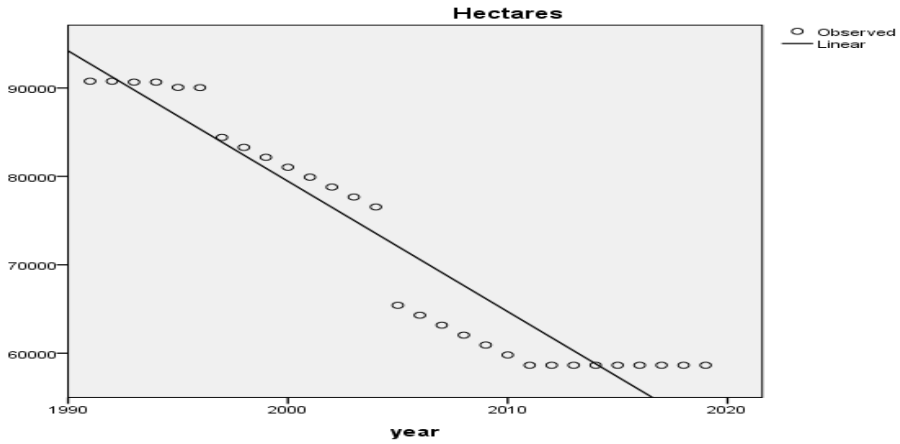

Figure 2. The line of good fit depicting the rate of deforestation in the study area

The Socioeconomic Characteristics of Respondents: The socioeconomic characteristics of the respondents is depicted in Figure 4 featuring age, gender, education, citizenship, income level, size of farm, distance of dwelling place from forest reserves.

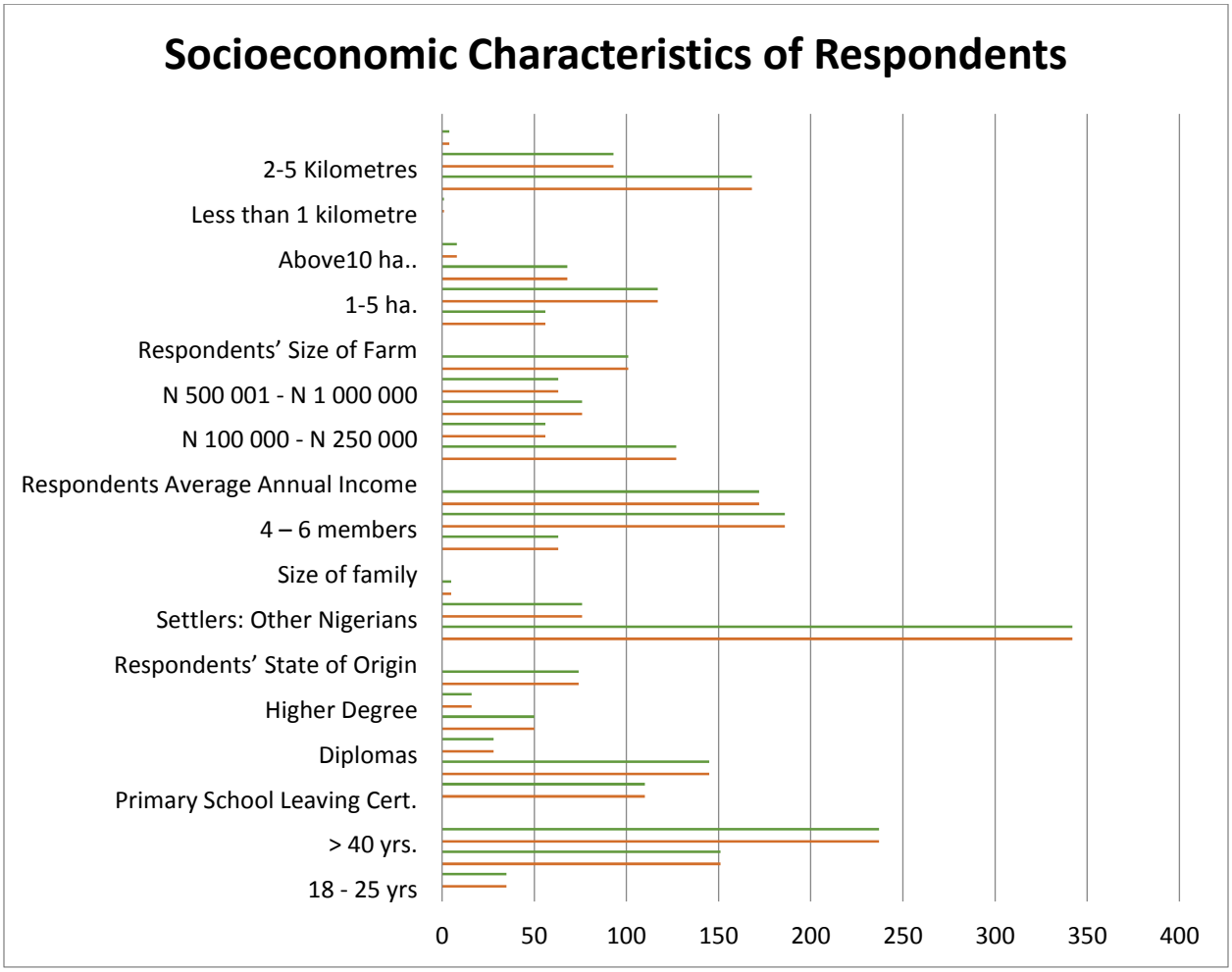

Figure 3: Socioeconomic characteristics of respondents
Source: Researcher's computations

Discussion

Butler (2010) in a study with mongabay.com, hinted that Nigeria has the highest deforestation rate in the world. Although Brazil has the largest area of deforested land and Congo has the heaviest consumption of bush-meat, threatening wildlife, Nigeria's rate is much higher than any other country. The finding of this study showed that whereas the rate of national deforestation in Nigeria was reported as 1.8% per annum (Salami, 2009), through remote sensing and the Nig-Sat1, a study on Osun state forests showed an average rate of deforestation of 3.1% per annum (Olatunji, 2005). The implications of deforestation are divers but its prevalence is equally worrisome. Among the most threatened tropical rain forest are those in Africa, with Togo, Congo and Nigeria being at worst risk. It would seem that the Kuznet's hypothesis is playing out because most of the regions at risks are developing countries. It should be recalled that the Kuznet's hypothesis argues that environmental concerns only become dominant after basic economic growth is resolved (Pasternak & Schlissel, 2001).

It was reported that Nigeria loses about $6 billion annually to deforestation by 2006 estimate by Buttler on mongabay.com, 2006. Odigha (2011) was more direct when he declared that at the present rate of

deforestation there would be nothing left in the next six to ten years. FAO, reports Nigeria as having the world's highest deforestation rate of primary forests. She has lost more than half of its primary forest in the last five years. Causes cited are logging, subsistence agriculture, and the collection of fuel wood. Almost 90% of West Africa's rainforest has been destroyed (Csupomonahttp://www.csupomona.edu/ ~admckettrick/projects/ag101_project/html/ size.html). Schmidt (2012) observed that the global cost of deforestation transcends the costs of financial system collapse and these costs were calculated from the perceived costs of losing the services that forests provide. Yet it is impossible to accrue such costs without initially ascertaining the level and rate of deforestation.

Assessment of the Climate Change Implications of Deforestation: Results of the survey which sought to assess the perception of the costs of deforestation in Osun state forest reserves is presented here. Mean response analysis and the Analysis of Variance (ANOVA) were employed for the analysis of data collected. The research hypothesis was tested at 5% level of significance.

To investigate stakeholders' value of the climate change implications of deforestation. The questionnaires were totally self-administered to the 500 potential respondents. A total of 423 duly completed responses were received, representing 84.6%. The data obtained was employed in carrying out one-way. The questionnaire elicited information regarding the respondent's age, levels of education, nativity, size of family, average annual income, size of farm and distance from forest reserves.

Table 3: *Willingness to Pay for Forest Environmental Services*

	Willingness to Pay					
Forests Environmental Services	Yes	%	No	%	Total	%
Maintaining of Carbon Balance	194	72.9	72	27.1	266	100
Absorption of Greenhouse gases	184	69.2	82	30.8	266	100

Source: Research Survey

LOGIT Results

The data in respect of the dichotomous responses on environmental services were analyzed with the use of LOGIT Regression Model. However, to overcome the problems of crowding out of important details in the analysis, each response was subjected to the evaluation, using the model as follows:

$$L\frac{Pi}{1-Pi} = \frac{\mathrm{f}(X1 + x2 + x3 + \cdots + Xn)}{fi}$$

Where: X_1 = Gender; X_2 = Marital Status; X_3 = State of origin; X_4 = Education; X_s = Size of farm; X_6 = Annual Income; X_7 = Age; X_8 = Size of family; X_9 = Distance from Forest Reserves; and,

Fi could be: F_1,or MCB= Maintaining of Carbon Balance; F_2, or GHG= Absorption of Green House Gases.

Carbon Balance: The roles of forests in maintaining carbon balance was examined and the WTP for carbon balance evaluated. The dichotomous question was analysed using the LOGIT regression model. The results showed that the combined p-value was 0.0017. This is significant being less than 0.05. Five variables also showed significance in the course of the study. These were education, annual income, size of family, gender and size of farm.

f (-1.71X_1 +1.58X_2 -0.51X_3 –3.16X_4 +1.78X_5 +2.27X_6 - 1.13X_7 -2.10X_8 +0.69X_9 +2.02)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Combined
Pvalues	0.088	0.115	0.613	0.002	0.076	0.023	0.258	0.036	0.487	0.0017

The combined influence of the nine variables to determine the willingness to pay for maintaining carbon balance was significant at p= 0.0017 which is less than 0.05, or 0.10 significance levels. Five variables

exerted significant influence on the respondents' choice, namely, X_4, Education; X_6, Annual Income; X_8, Size of family (at 5% level of significance) and, X_1, Gender; and X_5, Size of Farm (at 10% level of significance).

Greenhouse Gases Absorption: The role of the forest to absorb greenhouse gases was examined and stakeholders WTP was captured through the dichotomous questions raised. 69% of respondents indicated a WTP for Greenhouse Gases Absorption by forests in Osun State. The LOGIT regression model for analysis of the WTP survey showed that the combined influence of the nine variables to determine willingness to pay for absorption of greenhouse gases was significant at p= 0.0001 which is less than 0.05, or 0.10 significance levels. Five variables exerted significant influence on the respondents' choice, namely, X_2, i.e. Marital Status; X_5, Size of Farm; X_7, Age; and, X_8, Size of family; and X_9, Distance from Forest Reserves (at 5% level of significance).

$$f(-0.45X_1 + 2.31X_2 + 1.09X_3 - 2.32X_4 + 0.96X_5 + 2.70X_6 - 2.33X_7 - 2.09X_8 + 0.78X_9 + 1.60)$$

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	Combined
p-values	0.649	0.021	0.613	0.276	0.020	0.337	0.007	0.020	0.037	0.0001

Amounts of Willingness to Pay: Data in respect of amounts that respondents are willing to pay for maintenance of carbon balance and absorbing greenhouse gases were captured and shown on Table, the average WTP for Maintenance of Carbon Balance was N3,682.74; and Prevention of Greenhouse Gases Emission, N3,573.68. These are per capita values of the forest services. To set the framework for the determination of environmental costs of deforestation in Osun State, Nigeria.

Table 6: *Amounts of WTP*

	Mid point	*CCB*		*GHG*	
Amount N	*X*	Freq	Fx	Freq	Fx
< #1000	500	128	63,000	126	63,000
#1000 – 10000	5500	45	247,500	42	231,000
#10001 - #20000	15,000	13	195,000	11	165,000
Above #20000	20,000	11	220,000	11	220,000
Total		197	725,500	190	679,000
Mean: $\sum Fx/\sum f$			3682.74		3573.68

Source: Research Survey

The value that stakeholders place on the forest services are captured in terms of the average WTP which is capable of being extrapolated over the population of the state and revised according to price levels from year to year.

Conclusion

It was concluded that that deforestation is a continuing phenomenon in Osun state forest reserves as a result of forest conversions for other uses. It was also concluded that deforestation has significant effect on climate mitigation services of forests and the willingness to pay for these forest environmental services in Osun

state Nigeria. Even though opinions may vary in some respect regarding some environmental services as a consequence of some socioeconomic variables, the overall willingness to pay is positive in all respects. There was a convergence of opinion as to the hypothetical values for environmental services of forests. The value of the forest environmental services can be modelled for accounting purposes.

Recommendations

This research on the environmental costs of deforestation on climate change services has shown the need for collaboration between environmental accounting and resource managers. It has also shown the need for comprehensive cost-benefit analysis to determine if it is worthwhile to convert forests to other uses. Besides, the carbon sequestration capacity of the state forests is lost to deforestation and this hinders the state from claiming for carbon credits. Thirdly, the cost of deforestation could also be seen to include loss of income under REDD initiative which could assist the state in no small measure.

The environmental management of the state is vested in the Ministry of Environment, which supervises the Forestry Management and Forest Regeneration Departments. There is significant inadequacy in the statistics of both departments to cater for accounting needs. This is largely due to the fact that they were not designed for accounting purposes. Thus, if the records will be of any accounting relevance, they need to be redesigned.

The use of remote sensing can help greatly in determining the state of the forests. Replanting old and cut-over forests are essential to gain on the advantages of afforestation.

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