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Environmental And Socio-Economic Effects of Timber Exploitation In Imo River Estuary, Eastern Obolo, Akwa Ibom State, Nigeria

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Abstract: This study evaluated the environmental and socio-economic effects of timber harvesting and identified the drivers increasing the rate of timber exploitation in the Imo River Estuary, Eastern Obolo Local Government Area, Akwa Ibom State, Nigeria. Conducted across five LGAs, a random sampling technique selected 300 respondents, with 60 from each LGA. Data collection involved structured questionnaires, and analysis included percentages, frequencies, Likert scale rating, exploratory factor analysis, and Chi-square tests. Key findings indicated that the primary drivers of timber exploitation were unemployment, lack of forest regulations, unstable government policies, lack of trained officials, and high timber product costs. Factor analysis revealed that loss of biodiversity, disappearance of forest cover, and damage to immature trees and non-wood forest products are the most significant environmental effects, with scores far exceeding the 0.3 decision threshold. The most severe social effect identified was the high cost of farm labor, while the increased cost of wood and forest products and high living costs ranked highest among economic effects. This study is significant for environmental policymakers, conservationists, researchers, and geographers in Nigeria, contributing to the understanding of forest conservation in Southern Nigeria. Unlike the common issues of militancy and pollution in the Niger Delta, this study focuses on the specific drivers of forest depletion, adding valuable insights to the limited literature on this topic. The study concludes that timber harvesting significantly impacts the environmental, economic, and social well-being of the area's inhabitants. Factors such as unemployment, high timber costs, unstable policies, lack of trained officials, poverty, and hunger drive timber exploitation. Effective resource management and sustainable practices are crucial to maintaining a balanced ecosystem and ensuring the long-term availability of natural resources for future generations.

Keywords: Socio-Economic, Imo River Estuary, Environment, Harvesting, Social, Timber

1. Introduction

Forests cover almost 25% of the world's land and are critical in meeting human needs for water, food, shelter, medicine, fuelwood, fodder, and timber. They also provide a wide range of environmental services, including biodiversity conservation, watershed protection, soil protection, and the mitigation of global climate change (Hirakuri, 2013; Landell-Mills & Porras, 2012). Although other natural resources have been exploited, the rate of timber harvesting has accelerated significantly since the turn of the century. In recent decades, deforestation and biodiversity loss have become common occurrences globally, especially in developing countries like Nigeria. According to the FAO (2012), the world has just under 4 billion hectares of forest, covering about 20% of the world's land area, with a large portion of land converted from its original vegetation cover to cropping. Alarming, the net forest loss remains at 7.3 million hectares per year, or 20,000 hectares per day (Ajake & Enang, 2012). This issue is most severe in the tropics, where over 2.5 billion people depend on natural forest resources for a variety of services (Butler, 2012). Putz (2011) asserts that the major causes of timber exploitation include increasing demand for housing and infrastructural facilities, timber export, poor agricultural practices, cutting of fuelwood for urban areas, head loading (cutting of fuelwood for sale), forest fires, logging, and overharvesting.

One challenging task faced by both developed and developing countries is how to ensure the sustainable utilization of natural resources, especially timber, at the lowest possible environmental cost while still promoting economic and social development (Klawitter, 2014). Recently, as a signatory to various regional and international conventions, treaties, and protocols, the government has taken several initiatives to address this issue and to conserve the remaining floral and faunal diversity (Brown & Durst, 2013). This study aims to investigate the environmental, economic, and social effects of timber exploitation in Akwa Ibom State, using the Imo River estuary as a case study. A proper understanding of the resources-environment linkage is essential for developing effective public policy to address the numerous harms inflicted on diminishing timber resources, while still observing environmental sustainability. Thus, the objectives of this study are: (i) To identify and classify the

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forms of vegetation exploited for timber in the study area, (ii) To identify the major drivers of timber exploitation in the area, and (iii) To identify the major environmental, economic, and social effects of timber exploitation in the study area.

2. Literature Review

2.1. Drivers of Timber Exploitation

Throughout history, the fate of the world's forests has strongly reflected the patterns and intensity of land use by societies. The demand for agricultural land, timber, and other forest products, as well as technological changes in agriculture, significantly impact the mode and rate of transformation of forested areas. According to the World Resources Institute (WRI), the world has lost about half of its forest cover, decreasing from 62 million km² to 33 million km² (Summerlin et al., 2015). The magnitude of the global biodiversity situation is undoubtedly threatened at levels much higher than at any time in history. Over 15 million hectares of natural forest are lost in the tropics every year, an area larger than Nepal or Arkansas in the United States (FAO, 2009). Additionally, the current rate of species extinction is estimated to be between 1,000 and 10,000 times higher than the historical (pre-10,000 years BP) rate (Belcher, Achdiawan, & Dewi, 2015; Wilson, 2008). Consequently, the struggle to save the forests continues, and there is growing worldwide concern about deforestation.

The proximate or direct drivers of forest exploitation/deforestation and forest degradation are human activities and actions that directly impact forest cover and result in the loss of carbon stocks. The direct drivers of biodiversity loss, especially forest resources, include agriculture (food crops and livestock), which remains the largest direct human-induced driver of biodiversity degradation, species loss, and conversion of natural habitats (Díaz, Fargione, Chapin III, & Tilman, 2006). Other drivers include mining, population growth/urban expansion, infrastructural development, and overexploitation of forest resources. Underlying drivers consist of an interplay of economic, technological, institutional, and sociocultural factors (Geist & Lambin, 2012). Many well-known indirect drivers of forest exploitation exist, causing the subsequent loss of forests over time. These underlying factors include governance of land use change, poverty, illiteracy, and land tenure security.

2.2. Implications of Timber Exploitation

Drivers of change in biodiversity may be natural or human-induced. Many human interventions in ecosystems generate abrupt and large-scale changes that trigger a loss of biodiversity and make it more difficult for ecosystems to recover from the negative impacts associated with these human interventions. Ecosystem recovery from such human-induced changes is not only slow and costly in some cases, but the ecosystem may also be irreversible (Díaz et al., 2006). This study focuses on human-induced changes in forest biomes. Since these may differ according to geographical location and the factors involved, it is impossible to discuss all possible variations. Thus, forest exploitation in the study area has significantly threatened biodiversity in the forest ecosystem, having negative ecological, genetic, and socio-economic effects on the environment. Its implications, therefore, include:

Atmospheric Pollution: Forest exploitation in developing countries accounts for about 18% to 30% of increased emissions of greenhouse gases (GHG), which are responsible for global warming and climate change (Owusu, Nketiah, & Aggrey, 2011). Trees serve as a carbon sink by absorbing carbon dioxide (CO₂). During photosynthesis, trees and other plants remove carbon dioxide from the atmosphere. Carbon dioxide is harmful to animals, including humans. As deforestation occurs, the few remaining trees cannot absorb large amounts of carbon dioxide, leading to excess CO₂ in the atmosphere and causing global warming.

Loss of Biodiversity and Habitat Destruction: Forests house half of the world's animals, including mammals, reptiles, insects, and invertebrates. Many of these animals are rarely found on the ground because trees provide food and shelter for them. Several plants and animals have been depleted, and some are endangered, potentially being lost to future generations. For instance, many plant species with edible fruits, seeds, vegetables, roots, trees, mushrooms, culinary plants, medicinal plants, nuts, and kernels have been overexploited. Additionally, primates such as chimpanzees, gorillas, monkeys, reptiles, chameleons, amphibians, and birds are becoming endangered (Akachukwu, 2015). These lost plants and animals are of economic importance, serving as food, medicine, hides, and more. In the study area, biodiversity loss due to forest exploitation activities such as logging and unsustainable collection of non-timber forest products poses a serious threat to forest conservation. According to Valente, Spinelli, and Hillring (2011), many species in the environment are threatened due to habitat loss and fragmentation, over-exploitation, modification, and the introduction of invasive species such as the *Nypa* palm in the Imo River estuary. Some wildlife species that existed 10-20 years ago are now extinct in our forest lands; for example, it is rare to encounter animals such as elephants, chimpanzees, lions, and gorillas in Akwa Ibom State (King & Udosen, 2010). Other significant implications of timber exploitation include soil erosion, climate change, loss of forest products, and depletion of water and soil resources.

3. Method Of Data Analysis

Data for the study were collected from primary sources only. This was done using a set of structured and pre-tested questionnaires. To achieve the specific objectives of the study, relevant analytical tools were employed. Descriptive statistics such as frequency, percentage, tables, and charts were used to achieve objective (i). The Likert scale rating technique was used to achieve objective (ii), while the principal component factor analysis model was used to achieve objective (iii).

3.1. Model Specification

A five-point Likert-type rating scale was used in this work, as applied by Agbo, Onyenekwe, and Obasi (2015) based on their study on sustainable timber utilization and management, though they used a four-point Likert scale rating. This technique was used in this work to determine objective (ii), which entails the causes or drivers of timber exploitation. The scale was categorized as follows: Strongly Agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly Disagree (SD), with corresponding values of 5, 4, 3, 2, and 1, respectively.

The mean score of respondents based on a 5-point rating scale was computed as:

$$\text{Mean Score} = \frac{5+4+3+2+1}{5} = \frac{15}{5} = 3.00 \text{ (cut - off point)}$$

Using an interval scale of 0.05, the upper cut-off point was $3.00 + 0.05 = 3.05$, while the lower limit cut-off was $3.00 - 0.05 = 2.95$. Based on this, any item mean score below 2.95 was taken as Strongly Disagree or Disagree, as the case may be, while items with mean values between 2.95 and 3.05 were considered Undecided. Items with mean values above 3.05 were considered Strongly Agree or Agree, as the case may be.

$$\text{Item Mean Score: Item Mean Score} = \frac{\sum \text{Rating Score} \times \text{Number of Respondents for the Score}}{\text{Total Number of Respondents}}$$

3.2. Factor Analysis Model

This was employed to analyze the effects of timber exploitation on the natural environment and the socio-economic well-being of the people. The dependent variables here were the environmental, economic, and social effects of timber exploitation, while the causal factors were the independent variables.

The principal component factor analysis model was used to achieve objective (iii). It was stated as follows:

$$Y_1 = a_{11} x_1 + a_{12} x_2 + \dots + a_{1n} x_n$$

$$Y_2 = a_{21} x_1 + a_{22} x_2 + \dots + a_{2n} x_n$$

⋮

$$Y_n = a_{n1} x_1 + a_{n2} x_2 + \dots + a_{nn} x_n$$

Where:

- Y_1, Y_2, \dots, Y_n = Observed variable or consequences of timber harvesting;
- $a_1 - a_n$ = Factor loading or correlation coefficients, and
- X_1, x_2, \dots, x_n = unobserved underlying factors or consequences of timber harvesting.

4. Results

Table 1: Respondents' View on the Most Exploited Vegetation

Vegetation Type	Frequency	Percentage (%)
Mangrove forest	80	26.67
Freshwater swamp forest	65	21.68
Tropical rainforest	155	51.67
Total	300	100

Source: Researcher's Field Work, 2017.

Table 2: Respondents' Perception of the Drivers of Timber Exploitation.

Drivers of timber exploitation	Strongly Agree (SA)	Agree (A)	Undecided (UN)	Disagree (D)	Strongly Disagree (SD)	Total	Item Mean Score	Remark	SA	A	UN	D	SD
Poverty and hunger	10	50	30	70	140	300	2.04	SD	3.3	16.6	10.0	23.3	46.6
Absence of forest regulations	60	160	40	20	20	300	3.72	A	20.0	53.3	13.3	6.6	6.6
High cost of timber products	160	60	35	25	20	300	4.03	SA	53.3	20.0	11.6	8.3	6.6
High cost of timber products	150	55	25	70	0	300	3.94	A	50.0	18.3	8.3	23.3	0.0
Expanding agriculture	15	50	80	50	105	300	2.39	D	5.0	16.6	26.6	16.6	35.0
Inadequacy of farmland	5	25	55	95	120	300	1.99	SD	1.6	8.3	18.3	31.6	40.0
Illiteracy	10	40	35	85	130	300	2.03	SD	3.3	13.3	11.6	28.3	43.3
Corruption	40	50	110	45	55	300	2.95	UN	13.3	16.6	36.6	15.0	18.3

Expanding Population	45	65	105	55	30	300	3.12	A	15.0	21.6	35.0	18.3	10.0
Rapid urbanization	35	50	120	60	35	300	2.96	UN	11.6	16.6	40.0	20.0	11.6
Lack of trained officials	140	95	55	15	10	300	4.27	SA	46.6	31.6	18.3	5.0	3.3
Unstable government policies	155	85	40	10	10	300	4.20	SA	51.6	28.3	13.3	3.3	3.3
Livestock grazing	0	20	35	90	155	300	1.72	SD	0.0	6.6	11.6	30.0	51.6
Unemployment	195	80	15	5	5	300	4.50	SA	65.0	26.6	5.0	1.6	1.6

Source: Researcher's Field Work, 2017.

Table 3: Environmental, Economic and Social Effects of Timber Exploitation (Factor analysis table)

Variables	Factors		
	Environmental Effect (Factor one)	Social Effect (Factor two)	Economic Effect (Factor three)
Silting of rivers and lakes	.707	.129	-.245
High cost of farm labor	-.021	.697	-.159
Occurrence of dispute and crises over land & compensation	-.201	.655	-.102
Damaging of immature trees and non-wood forest products	.596	-.363	-.491
Loss of income and revenue by government	-.231	.887	-.045
Reduction in soil fertility and crop output	.817	-.139	.441
Loss of biodiversity	.956	-.044	-.694
Loss of forest land	.282	-.175	.638
Disappearance of forest cover	.193	.436	.315
Rural urban migration	.513	-.152	-.384
High cost of living	.305	-.164	.856
The increased cost of wood and timber products	.305	-.174	-.865
Climate change/global warming	.385	-.513	-.424
Soil erosion	.554	-.283	-.004

Extraction Method: Exploratory Factor Analysis. Source: Researcher's Field Work, 2017

5. Discussion

Table 1 shows that, based on the respondents' views, the rate of exploitation in the mangrove forest is 26.67%, in the freshwater swamp forest is 21.67%, and in the tropical rainforest is 51.67%. This implies that the tropical rainforest is the most exploited vegetation, and timber is threatened in this vegetation found in the study area. Other wood species are also exploited in the mangrove and freshwater swamp forests.

Table 2 summarizes the respondents' perceptions of the causes of timber exploitation. From the results, 46.6% strongly disagreed that poverty and hunger among the inhabitants of the study area were drivers of timber exploitation. Regarding the absence of forest regulations, 53.3% of respondents agreed it was a cause of timber exploitation, while about 10.0% disagreed, and about 13.3% were indecisive. The majority, 53.3% and 51.6% of respondents, strongly agreed that the high cost of timber products and unstable government policies, respectively, have been very serious drivers that have spurred timber exploitation in the study area over the years.

Additionally, the high cost of alternative wood products and the lack of trained officials in the areas of timber exploitation were admitted to be major causes of uncontrolled timber harvesting in the study area, as strongly agreed by 50.0% and 46.6% of respondents, respectively. This is comparable with the findings of Agbo et al. (2015) using Ebonyi State as a case study, which confirmed that the high cost of timber products, the absence of forest regulations, and the high cost of alternative wood products were very serious factors contributing to the excessive exploitation of timber in the study area.

Unemployment was one of the most serious driving forces of timber harvesting, with 65.0% of respondents strongly agreeing that it was a severe driver of tree felling and illegal logging. Rapid urbanization, expanding population, and corruption recorded that 40.0%, 35.0%, and 36.6% of respondents, respectively, were indecisive about these factors being causes of timber exploitation in the study area. However, 16.6%, 21.6%, and 16.6% of respondents, respectively, agreed that these were causes of timber exploitation in the study area.

Factors strongly disagreed upon by 51.6%, 35.0%, 40.0%, and 43.3% of respondents were livestock grazing, illiteracy, inadequacy of farmlands, and expanding agriculture, respectively. Additionally, 30.0%, 28.3%, 31.6%, and 26.6% of respondents, respectively, confirmed these factors as not serious causes of timber exploitation in the study area.

From Table 3, the results obtained from the exploratory factor analysis, taking 0.3 as a decision score, show that factors loading from 0.3 and above were noted to be areas of significant effects, while factors loading below 0.3 were noted to have a less significant effect and were thus ignored. Factors such as silting of rivers and lakes

(0.207), damage to immature trees and non-forest wood products (0.596), reduction in soil fertility and crop output (0.817), loss of biodiversity (0.956), disappearance of forest cover (0.913), rural-urban migration (0.512), increased cost of wood and forest products (0.305), climate change and global warming (0.385), and soil erosion (0.554) loaded above 0.3 in the first factor (environmental), implying that they have all negatively affected the environment of the study area. This shows over-dependence on timber resources and other forest resources by rural dwellers, resulting in scanty forest vegetation and poor forest sustainability. This concurs with Agbo et al. (2015), who opined that excess reliance on timber resources by locals results in a heavy decline in the functioning of the forest ecosystem.

In the same vein, considering the social effects, high cost of farm labor (0.697), occurrences of disputes and crises over land and compensation (0.655), loss of income and revenue by the government (0.387), disappearance of forest cover (0.436), and high cost of living (0.466) all have social effects in the study area. The factors that loaded high under Factor three (economic effects) are reduction in soil fertility and crop output (0.441), loss of forest land (0.638), high cost of living (0.783), and increased cost of wood and forest products (0.856). These factors significantly impact the economy of the study area. Hence, the results from the analysis have shown factors affecting the environmental, economic, and social well-being of the study area.

6. Conclusion

This study investigated the effects of timber exploitation in the Eastern Obolo LGA segment of the Imo River estuary, revealing that timber harvesting affects the environmental, economic, and social well-being of the inhabitants of the study area. These effects are caused by various human activities resulting in timber exploitation, such as unemployment, high cost of timber products, unstable government policies, lack of trained officials, poverty and hunger, absence of forest regulations, high cost of alternative wood products, rapid urbanization, expanding population, illiteracy, and corruption. Furthermore, most effects of timber exploitation are quite obvious, such as increased cost of wood and timber products, occurrences of disputes and crises over land and compensation, damage to immature trees and non-wood forest products, loss of forest land, etc. Compared to others like the much pronounced climate change/global warming and extinction of species, these effects are likely to manifest soon in the study area. Another danger posed by uncontrolled/illegal logging is that it has been used to sponsor conflicts between two or more communities, such as occurred between the villages of Amadaka and Elile. Hence, a holistic approach to resource management and sustainability is essential to ensure a balanced ecosystem and long-term availability of natural resources for present and future generations.

7. Recommendations

The Ministry of Agriculture and other related stakeholders should adequately sensitize the public on the long-term implications of illegal logging on the environment and socio-economic well-being of the inhabitants of the concerned communities. The state government and logging companies should embark on reforestation, afforestation, and regeneration programs to replace extracted tree species and regenerate extinct species. The government should ensure that all logging companies, cooperative bodies, and private individuals acquire and tender their certification and licenses before gaining access to the forest and its resources. Additionally, appropriate laws and penalties should be established to curb the incessant cutting down of trees, and erring persons should be sanctioned.

8. Future Research

Future research should focus on developing more comprehensive models to understand the intricate dynamics between timber exploitation and its socio-economic impacts. It is also essential to explore the long-term ecological consequences of deforestation and the effectiveness of reforestation efforts in different ecological zones. Additionally, further studies could investigate the role of technological advancements and sustainable practices in mitigating the adverse effects of timber exploitation. Understanding the community's perception of forest conservation initiatives and their willingness to participate in sustainable practices would provide valuable insights for policymakers. Finally, comparative studies across different regions and countries could help identify best practices and innovative solutions to address the global challenge of timber exploitation.

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