Sokoto Journal of Geographical Studies (SJGS)

Volume 2, Issue 1, July, 2025 Edition

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Sokoto Journal of Geographical Studies (SJGS) is a double-blind peer reviewed journal that is being published in **July** and **December** annually, by the Department of Geography Sokoto State University, Sokoto-Nigeria. The Journal provides a platform for researchers and academicians around the world in order to promote healthy intellectual discourse concerning research, preservation and dissemination of academic knowledge. The journal adopts a multidisciplinary approach to scholarship in all areas of Geographical Studies.

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All correspondence shall be addressed to**:**

Secretary Editorial Board,
Sokoto Journal of Geographical Studies
Department of Geography
Faculty of Social and Management Sciences
Sokoto State University, Sokoto
P.M.B 2134, Along Birnin Kebbi Road, SokotoState-Nigeria

Tel: 080-6950-1786 (Secretary Editorial Board)
Email: sjgs@ssu.edu.ng
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THE IMPACT OF FUELWOOD HARVESTING ON BIODIVERSITY LOSS: THE IMPLICATIONS FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY OF BENIN ENVIRONS

Emily Osa Iduseri

Department of Environmental Science, National Open University of Nigeria, Jabi, Abuja

Corresponding Author's Email: iemily@noun.edu.ng

Abstract

The fragile forest ecosystem has suffered serious degradation due to the continuous dependence of man on wood. This study was carried out to examine and evaluate the impacts of fuel wood harvesting activities on biodiversity loss in Benin environs. Images from Landsat 4 Thematic Mapper (TM), Landsat7 Enhanced Thematic Mapper (EMT), and Landsat 8 Operational Land Imagery (OLI) were used. Equally close ended questionnaire was employed. A total of 600 questionnaires were distributed and retrieved as the purposive and snowball sampling method were employed to the 12 communities making up the environs of Benin. The Shannon- wiener diversity index on the average was 1.9 with a nonlinear response to harvesting intensity, indicating high species diversity. In general, fuel wood consumption was an average of 1,452 kg/person/year of tree biomass. However, poorer communities, consume 35,976 kg/person/year. Harvesting is concentrated to a few early successional species with the most common species being Hymenostegia afzelii with recorded 65 (16%), Afzelia Africana 58(14%) Khaya senegalensis had 54(13%) while Alstonia boonei 12 had the least percentage of 2.9%. Fuel wood harvesting which is a profitable business cannot be ignored as a major source of forest degradation and its impact on the environment on the source regions is biodiversity loss and environmental degradation. The study recommended the introduction of fuel-efficient cooking device and afforestation programme as a means of conciliating biodiversity conservation with poverty amelioration is an urgent task.

Keywords: *Fuel Wood, Wood Harvesting, Biodiversity, Environmental Degradation and Sustainability*.

Introduction

Wood is the most versatile raw material the world has ever known. Throughout history, people relied on wood for needs varying from farming tools to building materials, from fuel to weapons of hunting and warfare (Douglas, 1995). According to Fuwape, (2000), the ubiquitous nature and versatile nature of wood has endeared it to multiple forms of domestic and industrial uses and has made it a valuable material in every stage of human development. At early age, the baby rests in wooden court, plays with wooden toys, and learns to write on wooden slate and paper when he is of school age. On graduating from school, he receives a paper certificate. If he is lucky to secure employment his salary is paid in paper currency. When he is old, he uses a wooden walking stick, sleeps on wooden bed and when the body dies are laid in wooden coffin. Thus, man depends on wood right from the cradle to the grave. (Fuwape,2000). In Africa, forests cover about 520 million hectares and constitute a reservoir of biodiversity on which about 90% of African countries dwell directly or indirectly on agriculture and forest products for employment and food security (Nielsen and Reenberg, 2010). Among all forest products, fire-wood remains the most used domestic fuel in Africa. Forests can thus be said to be the major source of livelihood for many especially those in Africa and Nigeria in particular. Nigeria ranks 9th among countries with the largest forest cover however the economic crisis that has bedeviled the nation, Covid-19 Pandemic and the global recession has led to a pauperization of populations marked by a significant drop in the purchasing power of the population. This has resulted in the emergence of new income-generating activities. Thus, the exploitation of wood other times intended to satisfy the strict domestic needs of those who took it has become today a commercial activity, to meet the strong demand of the urban populations (Madi, 1996).

The significance of forestry ecosystems and their management is enormous to any society and at any scale. They provide non-timber forest products from a wide range of species, both flora and fauna, which are very useful to the human (Cavendish, 2001). Tropical forests are incredibly biodiverse; they support at least two-thirds of the world's biodiversity (Raven,2009) despite covering less than 10% of Earth's land surface (Bradshaw et al, 2009). Unfortunately, prospects for tropical forests and the biodiversity therein are becoming increasingly bleak owing to unabated deforestation and forest alteration (Hansen et al 2013) that stem from human activities such as logging, hunting, agricultural expansion, and human settlement (Wilcove et al 2013, D´avalos,2016). The UN in its report states that human activity has altered almost 75 per cent of the earth's surface, squeezing wildlife and nature into an ever-smaller corner of the planet and increasing risks of zoonotic diseases like COVID-19. These human actions on the environment lead to the degradation process of the ecological system (Maharana et al., 2018). Unsustainable forest resource exploitation, especially in developing countries for economic growth, has contributed to global warming, climate change, health issues, poor yield and extinction of certain plant and animals' species (Maroto et al, 2013). The synergism between wood consumption and biodiversity maintenance is actually poorly understood and given the difficult economic situation in Sub-Saharan Africa. Equally due to the linkages between socio-economic systems and ecological systems, issues such as development, poverty eradication, and biodiversity conservation need to be addressed not as individual phenomena but rather as complex dynamic systems (Ares et al,2010). One of the central questions is, in the context of a rapidly increasing population, limited resources and infrastructural problems, how does a country achieve both economic growth and reduced environmental degradation and biodiversity loss against this backdrop the need for an interdisciplinary approach to science has become obvious in recent years and is perhaps most pertinent in the fields of conservation and sustainable development in order to respond to the need to address the extent of biodiversity change, the drivers of this change and its functional consequences.

The United Nations' Sustainable Development Goals 12 encourages sustainable consumption and production patterns with the goal of reducing environmental impact and promoting sustainable practices. SDG 12 is crucial for achieving the other SDGs, as it directly addresses the relationship between economic development, social well-being, and environmental sustainability. However, the current extent and future evolution of traditional wood fuel consumption are closely related to several key challenges in achieving sustainable development (Bonjour et al 2013).

The Nigerian Situation-Fuelwood Dilemma

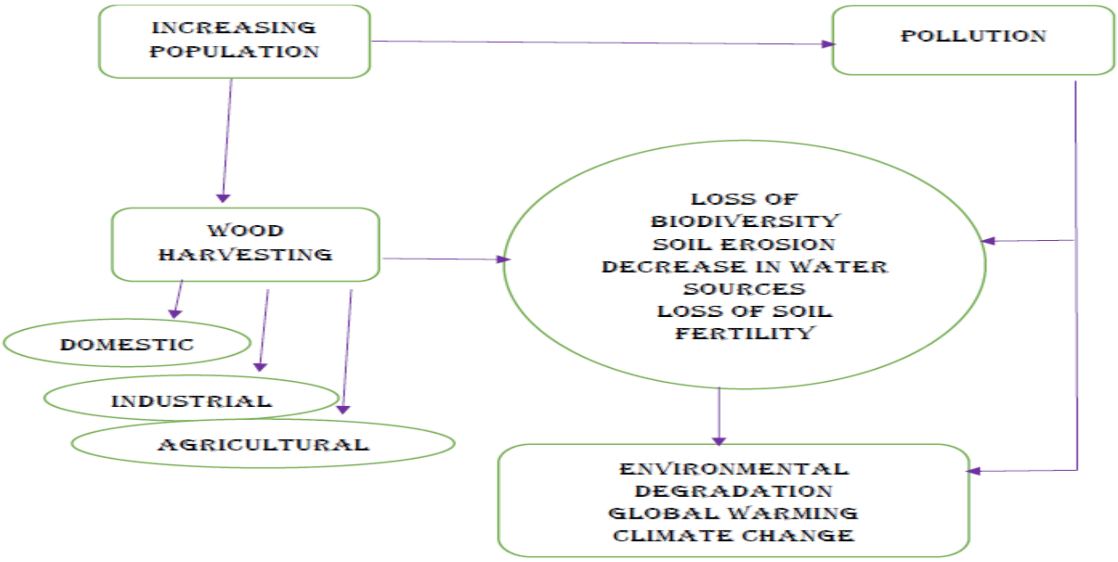
Fuel wood harvesting and consumption is a universal phenomenon in Africa and most other developing countries. It remains the major source of domestic fuel as well as the main source of energy for the micro economic enterprises (Dwaf, 2005). According to Gwandu (1991), fuel wood energy is a pivot on which the domestic and economic lives of people revolve. Over the years, the demand and consumption of fuel wood has increased with increase in human population. More importantly, wood supplies appear to be diminishing in the face of increasing demand. Nigeria, being one of the African countries with Agriculture as the economic backbone needs to tackle environmental degradation constraints rigorously by bringing on board all stakeholders who invariably contribute to sustainable environmental management (Osman,2013).

The FAO (2005) reported that Nigeria lost 55.7% of its primary forest to logging, subsistence agriculture, and firewood collection between 2000 and 2005. This rate has positioned Nigeria as one of the countries on top of the chart with the highest rate of deforestation. Fuwape, (2000) asserts that fuel wood harvesting and its economic and environmental implications are no doubt huge, and unsustainable forest management could lead to poverty, hunger, extinction of wildlife and biodiversity loss, erosion and floods. (Sylvie and Martin, 2010). Supporting this, stated opined that most towns which constitute the source regions have experienced decreases in wood population over the years and this could have serious repercussions on communities near forest zones. The fuel wood issue presents the double sides of a coin. That is to say, wood is an indispensable source of energy; it is source of income for the traders, yet intensive and indiscriminate harvest of fuel wood imposes heavy environmental burden (Iduseri and Ogedegbe,2009). Forest degradation especially cutting down of trees for different purposes is on the increase due to the increasing demand for firewood and timber by an ever-exploding population. This has resulted in threatening loss of vegetation, all due to over exploitation of wood plant resources for many domestic and industrial purposes (Chapin, 2012). Thus, the major factor for the depletion of Nigerian forests resources is the uncontrolled wood harvesting and forest fire which, according to *Hanagam (2013).* Another reason for the depletion is the people's low patronage of other sources of energy in Nigeria as stated by *Adeshina (2013)* who equally surmised this by saying that electricity generation is below 4,000MW, erratic and expensive, Kerosene kerosene which should have been a better alternative for energy generation, is also embroiled in price racketeering and scarcity in the country, leaving fuel wood as the only option for domestic cooking and energy supply to the majority of the citizens. Consequently, the forests and woodlands in the country bear the burden and are the worst for it. Indeed, the dependence on fuel wood as a source of energy reduces carbon storage and sequestration, increasing the cases of environmental degradation as consequences of the deforestation rate in Nigeria (Adewuyi& Olofin, 2014).

Conceptual Discourse

Human activity poses multiple environmental challenges for ecosystems that have intrinsic value and also support that activity. Durward, (2014), draws on complementary insights from social and biological sciences to propose a "livelisystems" framework of multiscale, dynamic change across social and biological systems which describes these processes and how they affect biodiversity loss. Fargion et al (2008) states that human-induced changes to ecosystems and the extinction of species have been more rapid in the past 50 years than at any time in human history, especially as population sizes of vertebrate species, have declined by an average of 68% over the last five decades with the key driver of the destruction of ecosystems being the demand of growing populations and new consumers for biofuels, meat, and grains.

The conceptual framework of the study tries to show the relationship between the variables in the study. It depicts the interrelationship that play out as a result of wood felling or harvesting and the exogenous factors that bring this about. It is based on the concept that, livelihood activities have trickledown effects which end up causing unsustainable forest management such as climate change, environmental degradation and global warming which will be experienced in the communities through environmental degradation. This interrelationship informs the bane of this study and is depicted in the Figure 1.



Source: Authors Deduction, 2023

Materials and Methods

Study Area

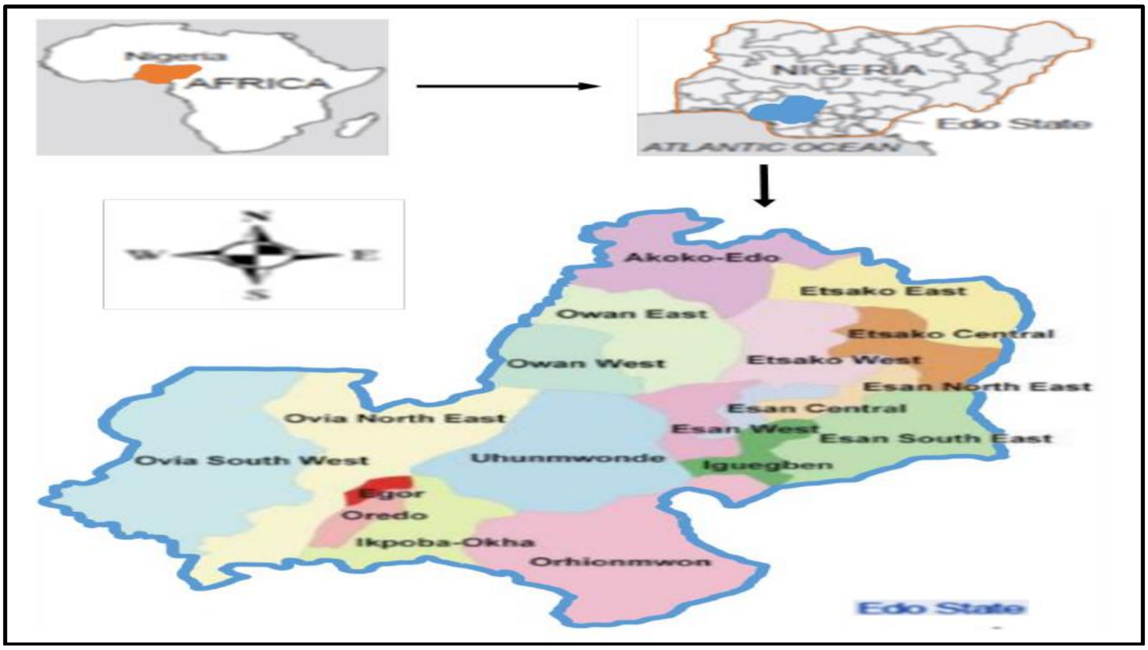


Figure 2: Map of the Study Area.

The study was conducted in Benin City. Nigeria. Benin City (60N 20' 0"N / 50 38' 0"E) is the capital of Edo State with an estimated population of about 1,495,800 (2015). It is situated 320 kilometers by road East of Lagos. The State experiences both wet and dry seasons; the wet season lasting from April to November while, the dry lasts from December to March. The state is however not homogeneous with respect to local climate. The rainfall distribution pattern ranges from 2900 mm per year in the south and as low as 350 mm per year in the north, the rainfall patterns are characterized by double maximum pattern in each given year as observed from the twenty- year data from the Benin synoptic station. The annual mean rainfall averaged over a twenty (20) year period indicated that Benin had 2,147.36 mm. The ecology and vegetation characteristics Edo State is typified by low land rain forest ecosystem. (Edo State Ministry of Budget, Planning and Economic Development and World Bank,2021).

Sampling Strategies

Descriptive Survey design involving qualitative and quantitative methods were used to gather data on respondents' demographic characteristics as well as impacts of fuel wood harvesting in the area. During the recognizance survey, household for distribution of questionnaires were selected and structured questionnaires were distributed to 12 communities that made up the study area. Based on the type of sampling strategy involved the questionnaires were distributed to those who fit the criteria selected by the researcher. The criteria used for the purposive sampling included: Geographic Proximity to Fuelwood Harvesting Areas; Occupation or Livelihood Dependence on Forest Resources; Knowledge or Experience in Biodiversity Conservation; Length of Residency in the Area; Representation of Local Authorities and Decision-Makers; Gender and Age Diversity.

Justification for Purposive Sampling

This sampling methods was employed because it:

- Targeted **s**pecific knowledge holders (e.g., environmental officers, fuelwood users, elders).
- Required diverse yet relevant viewpoints across gender, age, and role.
- Depended on contextual expertise or lived experience not uniformly present in the general population.

At the end of the exercise, a total of 600 respondents, were selected. using Purposive and Snowball sampling techniques while the Transect Sampling method was used to assess plants species diversity.

Table 1: Selection of Respondents

	Communities	***No of selected household initially selected***	***Number of households given questionnaire***
EGOR	***Egor***	***67***	***54***
	Ugbighoko	***67***	***54***
	Uwelu	***66***	***56***
IKPOBAOKAH	***Ekae***	***65***	***60***
	Idogbo	***68***	***60***
	Obayantor	***67***	***60***
OREDO	***Amagba***	***67***	***60***
	Obazagbon	***67***	***60***
	Ugbor	***66***	***61***
OVIA NORTH EAST	***Ekehuan***	***66***	***25***
	Ekiadolor	***67***	***25***
	Iguoshodin	***67***	***25***

Three cloud free satellite images from Landsat 4 (TM), Landsat 7 (ETM+), and Landsat 8 (OLI) from the USGS (United States Geological Survey) server for land cover maps were used. These images were selected on the basis of their availability and the quality of the datasets for the study area. Using satellite imagery in this study helped to visually and quantitatively track changes in forest cover over time, making it easier to identify areas most affected by fuelwood harvesting. It allowed for the detection of patterns in deforestation, habitat loss, and environmental degradation that contribute to biodiversity decline. The imagery also supported what local people reported, helping to validate their experiences with scientific data. In addition, it offered strong visual evidence that can be shared with policymakers or development agencies to promote more sustainable practices. Overall, the use of satellite imagery was to strengthen the research by combining spatial data with community insights for a more comprehensive understanding of the issue. Table 2 summarizes the details of the satellite data used in this study.

Table 2. Data Used for the Study

Year	Spacecraft	Sensor ID	Spatial resolution	Acquisition date	Band	Path/Row
1992	Landsat 4	TM	30 meters	17-01-1992	(RGB)432	Path 189, Row 056
2002	Landsat 7	ETM+	30 meters	30_13-2002	(RGB) 432	Path189, Row 056
2022	Landsat 8	OLI	30 meters	03-05-2022	(RGB) 543	Path189, Row 056

**TM: Thematic Mapper, EMT+: Enhanced Thematic Mapper plus and OLI: Operational Land Imager;*

Source: http://www.earthexplorer.usgs.gov.

Data Analysis

The frequency, percentage, mean and standard deviation distribution tables were used to analyze data on the respondents. In analysing the challenges of wood felling and its impact on biodiversity and the environment; the average mean score (AMS) technique was used. The decision value (DV) was obtained from the average of all the scale points (1–5) thus:

$$DV = \frac{5+4+3+2+1}{5} = 3$$

The computed values (CV) were also compared to the derived values (DV) of 3.0. When CV is greater than DV, then the answer was regarded as positive, but negative when CV is less than DV. The Shannon-Wiener index of diversity (H') was computed to evaluate the species diversity of the study area because it incorporates both species richness and the evenness of species abundance and is also suitable for both large and small sample sizes. It is given by the expression;

$$H' = -\sum_{i-1}^{s} pilnpi$$

Where, H' = Shannon diversity index; Pi = the proportion of individuals or the abundance of the itch species expressed as a proportion of total cover; ln = log base ten (Rad *et al*., 2009).

Table 3: Land Use/Land Cover Status of Benin City in 1992, 2002 and 2022

	1992		2002		2022	
LULC	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Built up	6493.32	12.70	14669.37	28.69	22014.09	43.06
Open space/Bare land	3256.56	6.37	2067.57	4.04	7.56	0.015
Vegetation	***23445.09***	***45.86***	***21046.77***	***41.16***	***15947.5***	***31.19***
Water body	12304.80	24.07	2368.53	4.63	1282.04	2.51
Wetland	5629.23	11.01	10976.76	21.47	11877.79	23.23
Total	51,128.99	100	51,128.99	100	51,128.99	100

Source: Author's Analysis, 2022

Table 4: Changes in Land Use-Land Cover of Benin City from 1992-2022

	1992-2002		Annual Change		2002-2022		Annual Change		1992-2022		Annual Change	
LULC	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)	Area (ha)	(%)
Built up	8176.1	125.9	817.6	12.6	7344.7	50.1	367.2	2.5	15520.8	239.0	517.4	7.9
Open space/Bare land	-1188.9	-36.5	-118.9	-3.7	-2060.1	-99.6	-103.0	-4.9	-3249.0	-99.8	-108.3	-3.3
Vegetation	*-2398.3*	*-10.2*	*-239.8*	*-1.0*	*-5099.3*	*-24.2*	*-254.9*	*-1.2*	*-7497.6*	*-31.9*	*-249.9*	*-1.1*
Water body	-9936.3	-80.8	-993.6	-8.1	-1086.5	-45.9	-54.3	-2.3	-11022.8	-89.6	-367.4	-2.9
Wetland	5347.5	99.0	534.8	9.5	901.0	8.2	45.1	0.4	6248.6	111.0	208.3	3.7

Source: Author's Analysis, 2022

Results and Discussions

Results

Table 5: Species of Trees in Study Area

EGOR LGA	***IKPOBA OKHA LG***	***OREDO LGA***	***OVIA NORTH EAST LG***
Albizia ferruginea	*Afzelia Africana*	*Albizia lebbeck*	*Antiaris welwitschia*
Canarium schweinfurthii	*Anonidium mannii*	*Albizia zygia*	*Baphia nitida*
Chrysophyllum delevoyi	*Cordia millenii*	*Angylocalyx zenkeri*	*Berlinia grandiflora*
Combretodendron macrocarpum	*Cylicodiscus gabunensis*	*Bombax brevicuspe*	*Blighia sapida*
Dacryodes edulis	*Diospyros alboflavescens*	*Celtis mildbraedii*	*Bosqueia angolensis*
Lovoa trichilioides	*Gossweilorodendron Balsaminiferum*	*Cola acuminata*	*Brachystegia nigerica*
Maesopsis eminii	*Lonchocarpus griffonianus*	*Diospyros dendo*	*Celtis zenkeri*
Rauwolfia vomitoria	*Milica excels*	*Garcinia kola*	*Cleistopholis patens*
Spathodea campanulate	*Myrianthus arboreus*	*Guibourtia sp.*	*Daniella ogea*
Sterculia oblonga	*Pachyelasma Tessmannii*	*Hevea brasiliensis*	*Distemonanthus Benthamianus*
Terminalia ivorensis	*Panda oleasa*	*Irvingia gabonensis*	*Entandrophragma angolense*
Tetrorchidium didymostemon	*Pentadesma butyracea*	*Irvingia grandifolia*	*Fagara macrophylla*
Khaya grandifoliola	*Polyalthia suaveolens*		*Funtumia elastica*
Lophira alata	*Tabernaemontana pachysiphon*		*Guarea cedrata*
Mansonia altissima	*Trichilia prieuriana*		*Hunteria umbellate*
Nauclea diderrichii	*Xylopia aethiopica*		*Memocylon blakeoides*
Pausinystalia macroceras	*Olax subscorpioidea*		*Musanga cecropioides*
			Pentaclethra macrophylla
			Pycnanthus angolensis
			Ricinodendron Heudelotti
			Rothmannia hispida
			Strombosia postulate
			Trichilia lanata
			Uvariopsis dioica

Table 6: Showing cumulative tree abundance in all sampled plots

Species	**Local name**	**No of individual spp(EGOR)**	**No of individual spp (IKPOBA-OKHA)**	**No of individual spp (OREDO)**	**No of individual spp (OVIA-NORTH-EAST)**	TOTAL	%
Antrocaryon micraster A. Chev.	Ekhuen	8	1	1	4	14	3.4
Lannea welwitschi (Hiern) Engl.	ẹ́wínwán	7	1	1	5	14	3.4
Anonidium mannii (Oliv.) Engl.and Diels	Ogedegbo/ Ebom	9	2	2	6	19	4.6
Alstonia boonei De Wild.	Úkhú/stoolwood	6	-	-	6	12	2.9
Hunteria umbellata (K. Schum) Hailier	òsù	5	-	-	8	13	3.1
Rauwolfia vomitoria Afzel.	Ákátà	6	-	-	10	16	3.9
Albizia ferruginea (Guill. and Perr.) Benth.	Albizia/	7	-	-	14	21	5.1
Albizia lebbeck (L.) Benth.	eshegeshege	10	4	4	12	30	7
Newbouldia laevis (P.Beauv.) Seeman ex Bureau	Ikhimi	9	3	3	12	27	6.6
Spathodea companulata P.Beauv	ókuèkuè, or ókwèkwè	5	8	10	8	31	8
Khaya senegalensis (Desr.) A.Juss.	Ogwango	**16**	**12**	**8**	**18**	**54**	**13**
Afzelia africana Sm.	Akpari or Akpasi	**20**	**10**	**4**	**24**	**58**	**14**
Amphimas pterocarpoides Harms	Erurumwesi	**13**	**4**	**4**	**12**	**33**	**9**
Hymenostegia afzelii (Oliv.) Harms	Ukpakenokuta	**19**	**15**	**13**	**18**	**65**	**16**
TOTAL		***140***	***60***	***50***	***157***	***407***	***100***

Table 7: Shannon- Wiener Diversity Index

	EGOR	IKPOBAOKHA	OREDO	OVIA NORTH EAST
Species	**Pi*lnPi**	**Pi*lnPi**	**Pi*lnPi**	**Pi*lnPi**
Antrocaryon micraster A. Chev.	**-0.1635**	**-0.0634**	**-0.0782**	**-0.0936**
Lannea welwitschi (Hiern) Engl.	**-0.1498**	**-0.0634**	**-0.0782**	**0.1096**
Anonidium mannii (Oliv.) Engl.and Diels	**-0.1765**	**-0.1133**	**-0.1288**	**-0.1247**
Alstonia boonei De Wild.	**-0.0363**	**0.0000**	**0.0000**	**-0.1247**
Hunteria umbellata (K. Schum) Hailier	**-0.0368**	**0.0000**	**0.0000**	**-0.1518**
Rauwolfia vomitoria Afzel.	**-0.0363**	**0.0000**	**0.0000**	**-0.1754**
Albizia ferruginea (Guill. and Perr.) Benth.	**-0.1498**	**0.0000**	**0.0000**	**-0.2156**
Albizia lebbeck (L.) Benth.	**-0.1884**	**-0.2070**	**-0.2021**	**-0.1965**
Newbouldia laevis (P.Beauv.) Seeman ex Bureau	**-0.1765**	**-0.1498**	**0.1688**	**-0.1965**
Spathodea companulata P.Beauv	**-0.0368**	**-0.2686**	**-0.3219**	**-0.1518**
Spathodea companulata P.Beauv	**-0.2479**	**-0.3219**	**-0.2932**	**-0.2482**
Afzelia africana Sm.	**-0.2781**	**-0.2986**	**-0.2021**	**-0.2872**
Amphimas pterocarpoides Harms	**-0.2208**	**-0.1498**	**-0.2021**	**-0.1965**
Hymenostegia afzelii	**-0.2710**	**-0.3466**	**-0.3502**	**-0.2482**
	-2.1703	***-1.9824***	***-2.0256***	***-1.3284***

Average Index = ***1.876675 ≃1.9***

Fuelwood Consumption Pattern

Table8: Demographic Characteristics of Respondents

S/N	Variables	Categories	Frequency	Percentage (%)
1	Age (years)	< 25	140	23
		25 – 30	180	30
		31 – 40	180	30
		41– 50	60	10
		> 50	40	7
			600	**100**
2	Marital Status	Single	120	20
		Married	220	37
		Divorced/Separated	150	25
		Widow/Widower	110	18
			600	**100**
3	Religion	Christianity	312	52
		Islam	80	13
		African Traditional Religion	150	25
		Others	58	10
			600	**100**
4	Level of Education	No formal education	180	30
		FSLC (Primary School)	250	42
		SSCE (Secondary/High school)	100	17
		Tertiary Education	70	12
			600	**100**
5	Occupation	Farming	150	25
		Wood seller	193	32
		Trading	100	17
		Civil servant	130	22
		Student	27	5
			600	**100**

Table 9: Socioeconomic Status

	Communities	Number of households interviewed	Mean number of people per household	Average monthly per capita income in US$
EGOR	Egor	54	7.5	193
	Ugbighoko	54	8.1	72
	Uwelu	56	9.1	434
IKPOBAOKAH	Ekae	60	6.1	72
	Idogbo	60	6.2	482
	Obayantor	60	8.3	48
OREDO	Amagba	60	6.4	145
	Obazagbon	60	6.1	72
	Ugbor	61	4.2	120
OVIA NORTH EAST	Ekehuan	25	9.2	241
	Ekiadolor	25	5.6	482
	Iguoshodin	25	4.4	783

Values in parentheses refer to standard deviation and US$ 1.00 equals ₦415.12 in 2022 values

Table 10: "Average A Day" Fuelwood Consumption

	Communities	Number of days per week each household used fuelwood									Origin of fuelwood consumed		
		1	2	3	4	5	6	7	Total		Self-harvested	Bought	Total
EGOR	Egor	2	4	6	5	5	9	10	41		33	21	54
	Ugbighoko	3	4	6	6	6	7	12	44		40	14	54
	Uwelu	3	6	5	7	4	7	7	39		20	36	56
IKPOBAOKAH	Ekae	2	6	6	8	4	9	9	44		41	19	60
	Idogbo	10	6	5	3	3	2	4	33		10	50	60
	Obayantor	3	3	3	6	7	8	20	50		41	19	60
OREDO	Amagba	7	7	4	4	10	5	15	52		39	21	60
	Obazagbon	5	6	5	5	6	7	18	52		45	15	60
	Ugbor	16	11	6	4	3	4	2	46		8	53	61
OVIA NORTH EAST	Ekehuan	1	2	2	2	2	3	5	17		18	7	25
	Ekiadolor	1	1	1	2	2	5	6	18		13	12	25
	Iguoshodin	7	2	2	2	2	1	1	17		6	19	25
											347	286	600

Table 11: Fuelwood Consumption

	Communities	*Mean number of people per household*	*Wwb*	*Wwc*	*Wwl*	$\frac{(Wwb + Wwc) - Wwl}{Npp}$	*Mean biomass (kg) of fuelwood consumed monthly*
EGOR	*Egor*	*7.5*	*21000*	*10000*	*10000*	*21000/7.5*	*2800*
	Ugbighoko	*8.1*	*24000*	*18123*	*20796*	*111523/6.1*	*2633*
	Uwelu	*9.1*	*2450*	*300*	*1503*	*1247/9.1*	*137*
IKPOBAOKAH	*Ekae*	*6.1*	*13880*	*7240*	*9567*	*111523/6.1*	*1889*
	Idogbo	*6.2*	*2899*	*300*	*2448*	*751/6.2*	*121*
	Obayantor	*8.3*	*34331*	*11123*	*23708*	*21746/8.3*	*2620*
OREDO	*Amagba*	*6.4*	*32111*	*10009*	*26758*	*15360/6.4*	*2400*
	Obazagbon	*6.1*	*36105*	*18100*	*35917*	*18288/6.1*	*2998*
	Ugbor	*4.2*	*8009*	*3219*	*9779*	*1449/4.2*	*345*
OVIA NORTH EAST	*Ekehuan*	*9.2*	*43816*	*22199*	*56355*	*9660/9.2*	*1050*
	Ekiadolor	*5.6*	*22140*	*18145*	*23765*	*16520/5.6*	*2950*
	Iguoshodin	*4.4*	*14444*	*8888*	*18844*	*4488/4.4*	*1020*

AWARENESS OF THE IMPACT OF FUEL WOOD HARVESTING ON ENVIRONMENT

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Table 12: Awareness of the Impact of Fuel Wood Harvesting on Environment

PARAMETER	SA	A	D	SD	UD	Σfx	Σf	CV	STD EV	Remark
Felling down trees affects soil fertility	230	180	80	60	50	2300	600	3.80	3.50	CV>DV
Felling down of trees lead to loss of some species.	80	134	186	140	60	1834	600	3.06	2.77	CV>DV
Felling down of trees can lead to soil erosion.	150	170	130	100	50	1970	600	3.28	3.17	CV>DV
Cutting down of trees leads to decreased of trees population.	149	199	103	69	80	2068	600	3.44	3.19	CV>DV
Cutting down of trees can cause windstorm.	141	210	118	80	51	2110	600	3.52	3.22	CV>DV
Conflict among communities do occurs as result of felling down of trees.	192	180	130	50	48	2218	600	3.69	3.39	CV>DV
Felling down of trees can affect grazing of animals.	187	174	166	48	25	1910	600	3.18	3.40	CV>DV
Increased felling down of trees affects food production.	87	60	170	263	20	1671	600	2.78	2.58	CV<DV
Sources of water such as ponds are affected by increase in cutting down of trees.	78	45	260	190	27	1757	600	2.92	2.59	CV<DV
Felling down of trees can affect the animals in the forests.	187	197	121	90	5	2271	600	3.79	3.42	CV>DV

Table 13: Control Measures Against Fuel Wood Harvesting Activities

Impact of tree felling and harvesting	SA	A	D	SD	UD	Σf	CV	STDEV
Felling down trees affects soil fertility	230	180	80	60	50	600	3.80	3.50
Felling down of trees lead to loss of some species.	80	134	186	140	60	600	3.06	2.77
Felling down of trees can lead to soil erosion.	150	170	130	100	50	600	3.45	3.17
Cutting down of trees leads to decreased of trees population.	149	199	103	69	80	600	3.45	3.19
Cutting down of trees can cause windstorm.	141	210	118	80	51	600	3.52	3.22
Conflict among communities do occurs as result of felling down of trees.	192	180	130	50	48	600	3.70	3.39
Felling down of trees can affect grazing of animals.	187	174	166	48	25	600	3.75	3.40
Increased felling down of trees affects food production.	87	60	170	263	20	600	2.89	2.58
Sources of water such as ponds are affected by increase in cutting down of trees.	78	45	260	190	27	600	2.93	2.59
Felling down of trees can affect the animals in the forests.	187	197	121	90	5	600	3.79	3.42

DISCUSSIONS

Abundance of Tree Species Used in The Study Area

Table 6 shows that the most frequently exploited species for firewood. *Amphimas pterocarpoides Harms (Ukpakenokuta) is* the most exploited tree species with it accounting for 16%, while the least exploited tree species is *Alstonia boonei* De Wild *(Úkhú/stoolwood) (2.9%.)*. Following Ukpakenokuta, in most explioted is *Afzelia africana Sm. (Akpari or Akpasi*) *(14%), Khaya senegalensis (Desr.) A.Juss. (Ogwango)(13%.), Albizia lebbeck* (L.) Benth. *(7%)* and *Newbouldia laevis (*P.Beauv.*)* Seeman ex Bureau *(6.6%)*. From table 7, it can be seen that the significant figure (H) from this calculation shows that Egor has the highest diversity index with 2.2 with Ovia North East having least diversity index of 1.32. The cumulative average diversity index of the area is 1. 9. The implication of this is that the study area generally has low diversity of tree species which could be as a result of the indiscriminate harvesting of wood for sundry purposes.

Fuelwood Consumption Pattern

Table 8 shows that 32% of the populace, engage in wood selling which they deemed a very profitable business. Tables 9 and 11 show the characteristics related to the habits of fuelwood consumption. To quantify the fuelwood consumption, the method suggested by the Food and Agriculture Organization (FAO), the ‘‘average day’’ (FAO, 2003) was applied. The ‘average day’ method involves collecting data on fuelwood consumption for a typical or average day and using that data to estimate total fuelwood consumption over a longer period, like a year or a season as indicated in table 10.

Awareness of the Impact of Fuel Wood Harvesting on Environment

Tables 12 and 13 shows the results of the knowledge and aware of the respondents on the impact that wood harvesting had on the environment. With the computed value being greater than the derived value in almost all the responses it can be said that indeed the respondents are already experiencing the negative impact that the over exploitation of their environment brings about. They also believed that serious government intervention and that diversification of the economy my help.

Conclusion and Recommendations

Conclusively, the study was able to find out that number of tree species were found to be used as fire wood in the area and the forest studied had quite a good number of these trees and was so diverse especially *Amphimas pterocarpoides Harms (Ukpakenokuta)*, which cut across all the selected communities making up the study area and was the most felled tree. Similarly, data gathered on the impacts of fuel wood harvesting in the study area were found to be so eminent and considerably high. These impacts including loss of soil fertility, windstorm, loss of biodiversity, soil erosion, decrease in tree population, loss of grazing fields and so on which even at present are taking a toll on the local communities and will certainly escalate and affect wider area if the rate of wood harvesting continued unchecked.

Consequently, eradicating fuel wood harvesting or reducing its intensity will create other socio-economic problems like loss of jobs, increase in crime and many more. Therefore, the best approach to solving this problem is to embrace afforestation and social forestry which will solve both the environmental as well as the socio-economic problems since it will generate more jobs and it will allow many to diversify their sources of income. The use of alternative cooking fuels should be encouraged to discourage people from using wood as fuel, in order to maintain the natural abundance and diversity of tree species in the area, the cutting down of trees especially those commonly used as firewood and for other purposes should be well regulated. Finally, Government at all levels, should put in place a sustainable method of harvesting, such as putting a limit to the quantity of wood harvested per time and provision of alternative supply of affordable energy to the population in order not to be left behind in the quest for the attainment of the Sustainable Development Goals.

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