

Natural Resources Exploitation and Utilization in Imo State, Nigeria: The Economic and Environmental Perspective

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Authors' contributions

This work was carried out in collaboration between both authors. Authors CCN and OTN designed, wrote and analyzed this original manuscript. Both authors read and approved the final manuscript.

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ABSTRACT

This research was carried out in six Local Government Areas of Imo state, Nigeria. Natural resources endowment of any area in the world when properly harnessed can act as a catalyst to the economic life of the area. In an effort to harness these resources, the environment of the area is also affected especially when harnessed without due consideration for the effect on the environment. This research examines various resources exploited, harnessed and utilized from various locations within the study area of Imo state, Nigeria. The methods of exploitation are also examined with the view of ascertaining how they impact on economic life of the people living within these areas, as well as the environment where exploitation takes place. Both primary and secondary data were employed for this research. Questionnaires and oral interview were instruments used for primary data generation. Five hundred and fifty six copies of the questionnaire were distributed to communities systematically sampled from 6 local government areas out of the 27 local government areas of Imo state. Data generated were presented in frequency tables and as percentages. Two hypotheses were tested. Inferential statistics of correlation analysis and Chi

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Square were used to test the hypotheses. One of the hypotheses sought to know if there is a relationship between methods of natural resources exploitation and environmental deterioration in the state. The result obtained showed that natural resources in the study area have contributed positively to the economic life of the people. It was also observed that various resources exploitation methods have created a lot of problems, ranging from environmental, economic, health to socio-cultural. Most of these resources are exploited largely using rudimentary methods without any recourse to its impact on the environment. There are no environmental impact assessments (EIA) to determine positive and adverse environmental and socio-economic impacts, and where mitigation is possible, before these resources are harnessed. The research thereby recommends among others, controlled resource exploitation and environmental impact assessment before these resources are harnessed.

Keywords: Imo state; EIA; environment; natural resource; Nigeria.

1. INTRODUCTION

The role of any natural resources endowment of an area can only be optimized for economic development when the resources are harnessed and managed in a sustainable manner [1]. Natural resources are naturally occurring products and features which support human needs on planet earth. The implication is that they occur freely in the wild and constitute vital elements in the development process of any nation. Some natural resources are renewable (e.g., fish, timber, wildlife) and others are non-renewable (e.g., petroleum, minerals).

According to [2], one of the nature's most obvious service to humanity is the development and production of commodities vital to human wellbeing. Therefore, the natural resources of any nation be they renewable or non renewable, enhance the wellbeing of an individual, leading to the development of the nation if properly harnessed and managed. The recent rapid and environmentally unsustainable pace of natural resources exploitation in Imo state Nigeria is one of the most visible consequences of environmental degradation experienced in the area.

This activity (natural resource exploitation) is also a key factor in economic development and growth of the state, but also one that can have serious negative environmental and socioeconomic impact. These impacts can be seen in destruction and degradation of the forest, the depletion and pollution of land and water resources, the pollution of the atmosphere, the decimation of fisheries and wildlife, and the despoliation of land in order to extract mineral resources.

Many natural resources play an invaluable role in both local and international trade, as well as

industry and maintenance of food security. The major resources currently being exploited in Imo state for socioeconomic development include solid minerals (limestone, clay deposits, crushed rocks), and liquid minerals (Crude oil and its associated gas). These two categories fall into non renewable-resources. Renewable resources exploited in the state include agricultural products, water resources, wildlife resources, fishery products and other sea foods. The manner in which these resources are being exploited has a localized effect on the livelihood and human security. The environmentally unsustainable exploitation of natural resources can have significant trans-boundary impact that pose threats to peace and stability. This paper addresses the economic and environmental consequences arising from unsustainable exploitation of natural resources in Imo state.

1.1 Statement of Research Problem

The exploitation and utilization of natural resources be it renewable or non-renewable is associated with different degrees of environmental and ecological problems. This is despite the fact that natural resources exploitation improves the economic status of the location area in particular and the society at large in general. However, resource exploitation if undertaken in an unsustainable manner, while providing short-term economic benefits, may be over-shadowed by adverse long-term impacts on man, the economy and the environment. The seriousness of the spread of these associated problems is dependent on the environment that is affected. For instance, an oil spill in an aquatic environment, as experienced in Oguta area of the state, rapidly spread adversely impacting aquatic life over a much larger area than the initial spill. The degree and extent of problems are also associated with the manner in which

these resources are harnessed, most often undertaken in an unsustainable and environmentally unfriendly manner such that the environment, including life, is imperiled. include the rising The driving forces behind this resource exploitation include the rising demand for raw materials, for industrial inputs, and for energy, nutrition (e.g. bushmeat, honey and fish), cultural (e.g. hunting), poverty, and for quest to improve standards of living and pressures to improve the economic base of the state. To meet these and other demands, resources are often over exploited in an unsustainable manner without considering that future generations may well depend upon these natural resources for both their survival (e.g., food) and economic well being. Improper management can result in resource depletion, habitat degradation and a major loss of biodiversity necessary for the survival and economic well being of the people living in the area of exploitation. Various degrees of environmental problems include gully erosion with its attendant consequences, pollution of air and water bodies, deforestation and even threat to human life.

In Imo state, recently it can be adduced that two additional factors have also driven the over-exploitation of natural resources, especially renewable ones. This includes the fall in oil prices since late 2014 which reduces the Federal Government allocations of funds to state and local governments. This reduces cash earning of individuals working for the state, thereby forcing people to resort to alternative means of sustenance. The implication is that natural resource exploitation is still being undertaken without considering long-term impacts. In Imo state, some agricultural and forestry practices are still undertaken in a traditional and rudimentary manner that adversely impacts the overall condition of the soil. For instance, slash and burn agriculture in the study area, since undertaken without appropriate fallow periods, increases the quantity of carbon in the atmosphere and kills the soil microorganism that converts plants and animal matter into fertile humus, and in so doing reduce the soil fertility.

Quarrying activities expose the soil to possible attack by erosion through deforestation and devegetation of the area. This singular activity also destabilizes the iso-static equilibrium, distorting the cohesiveness and compactions, in which different rock layers are laid under the soil. This makes the soil vulnerable to various degrees of soil erosions and their attendant

problems. Finally, what needs to be determined is whether any if at all, the extent to which natural resources exploitation and utilization in the area has adversely impacted the environment and related biodiversity in the areas where these activities area taking place.

1.2 Aim and Objectives

The research aim is to access the economic and environmental impact of natural resources exploitations and to investigate its role in the environmental condition of Imo state.

The following specific objectives will be pursued;

1. To determine different natural resources and their locations in Imo state
2. To examine the economic benefits of the available resources to the people of Imo state
3. The identify the major environmental problems arising from natural resources exploitation
4. To investigate the methods, states and stages of resources exploitations.

1.3 Working Hypotheses

1. The negative effects of natural resources exploitation in Imo state do not result from the rudimentary methods of exploitation
2. The identified natural resources have not been fully utilized for economic development of Imo state.

1.4 Research Questions

To address the issues posed in the research, the following questions was used as guide to data collection

1. What are the natural resources available in your area
2. What are the major economic benefits derivable from the resources
3. What are the environmental and other problems associated with natural resources exploitations
4. What are the various methods of natural resources exploitations

2. LITERATURE REVIEW

The literature for this study is reviewed under the following headings: Concept of

resources/environmental resources; classification and types of resources; economic benefits of natural resources exploitation; and environmental effects of natural resources exploitation.

2.1 Concepts of Resources: Environmental and Natural

A resource is any physical or virtual entity that needs to be consumed to obtain benefit from it. The dictionary of Geography [3] defined a resource as anything that provides support for a state. [4] sees resources as any possession of a country in the form of wealth and goods that helps one get what he wants. They are human appraisals and they vary from place to place and from time to time. It could be any form of human and natural appraisal which varies over time and space. Resources refer to the sum total wealth or sources of wealth of a person or country [5]. A critical overview of the above definitions shows that resources have three main characteristics: utility, quantity (often in terms of availability) and consumption. Environmental resources are those resources that have intrinsic value of their own or of value for longer term sustainability and use by man [6]. They are to a large extent tangible. Social and human resources are defined in terms of density of population, groups, their occupational activities, their land rights, their sources of income, and their standard of living.

2.2 Types of Resources

Resources can be grouped into many types using different criteria. They can be natural and man-made (human); tangible and intangible; renewable and non-renewable. According to [7], many of natural resources are essential for human survival, while others are used for satisfying human want. Natural resources may be classified in many forms;

1. On the basis of origin, resources may be divided into biotic and abiotic resources
2. On the basis of state of development, natural resources may be called potential resource, reserve and actual resources
3. On the basis of renewability, natural resources can be categorized into renewable and non-renewable resources

Natural resources can be regrouped again following how the resources are being used. They are resources which are available for immediate consumption after harvesting, and resources available after development. [1] highlighted that the major natural resources

exploited in Nigeria for supposedly meeting the demand for socioeconomic development include

1. Solid minerals such as iron ore, coal limestone, bitumen, crushed rocks
2. Liquid minerals such as crude oil with its associated gas
3. Agricultural products
4. Forest products and non timber forest products (NTFPs)
5. Water resources
6. Fishery products and other sea foods
7. Wildlife etc.

2.3 Economic Benefits of Natural Resources Exploitation

The physical environmental characteristics of a region have both positive and negative implication for its development [8]. In the case of Niger Delta region, where the major export resource in Nigeria is located, according to [8], a review of the list of physical attributes could lead to the conclusion that all the elements constitute a constraint to sustainable development in all its facets. However, the resource base of any area could be turned to advantage for the development of the area. The biological diversity of an area provides access to diversity of animals and plants, resources, both marine and terrestrial, - for food, fuel, medical care, housing construction materials and economic security, especially at the grassroots level. This has the potential for increasing the economic base of the area by creating jobs and reducing poverty.

According to [9], oil products have had a positive robust effect on economic growth in Russia over period 1990 – 2006. [10], provides evidence that Russian regions well endowed in oil grew faster than resource poor regions, at least during the first few years of transition. Empirical studies by [11] find that the share of exported primary products accounts among the top 20 variables that explain GDP (Gross Domestic Product) growth. [12], showed that the growth rate is reduced by one point per year when the share of natural capital on natural wealth increased by 10 points.

In Nigeria, while there are been many positive impacts of oil to the economy such as, provision of infrastructures, basic amenities and corporate social responsibilities, the adverse consequences (to be discussed in the next section) currently greatly outweigh the beneficial ones. As of the year 2000, oil and gas export accounts for more than 38 percent of the export earnings and about 83 percent of the federal revenue as well as generating more than 14

percent of its GDP. It provides 95 percent of foreign exchange earnings, and about 65 percent of government budgetary revenues [13]. Nigeria's proven oil reserve according to US EIA 2000 is between 16 and 22 billion barrels ($3.5 \times 10^9 \text{m}^3$), though other sources claim it is more than, as much as 35.5 billion barrels ($5.61 \times 10^9 \text{m}^3$). Nigeria crude oil production as of 2004 was averaging 2.2 million barrels ($350,000 \text{m}^3$) per day [8]. It is expected that oil industry will generate a huge sum of money which will be used for national development, based on an average bench of oil which stood at \$85 - \$90 in 2004. Recently, Nigeria oil product stood at about 1.7 million barrel per day, with oil selling at below \$50 per barrel. Nigeria's rank in the world's oil production is 13th and 1st in Africa. Despite the huge revenue generated from this resource, it was observed that currently, it is estimated that 90 percent of the national wealth is in the hands of 10 percent of the population, thereby impoverishing 90 percent of the population. Nigeria owes about US\$29 billion on foreign creditors, many loans that they deliberately gave to a corrupt government. [14], observed that despite this huge revenue from oil that amounts to billions of dollars over the past 3 decades, 70 percent of the nation's population lives on less than US\$2 per day. Nigeria's oil industry employs more than 100,000 people out of a population of over 200 million.

2.4 Environmental Effects of Natural Resources Exploitation

The production and utilization of every natural resource, from clearing of forest and tillage of fields to mining of metals and burning of fossil fuel causes changes that may be large or small, local or global, pleasant or unpleasant. They may be given such names as pollution or environmental degradation, but they are all consequences of natural resources exploitation [15]. According to [1], the natural resources endowment of the Niger Delta region, especially crude oil and gas, has inadvertently transformed it into a region of captivity in which aggressive exploitation of the resources, dominates over sustainable development. The region is in captivity because it has witnessed decades of hi-tech resource exploitation that amounts to billions of United States dollars annually, and whose exploitation has caused harm to the environment.

As a result of oil exploration in the Niger Delta, there is a visible record of environmental

destruction and human right violation. This gross level of environmental degradation is caused by oil exploration and extraction, and this has been on for over 3 decades. It has been validated that as a result of oil generated environmental pollution visible throughout Niger Delta, it has become extremely difficult or impossible for fishing and farming. This has adversely affected the local economy and society, including loss of life. Gas that is flared could be a source of energy for local communities, but is dumping climate-impacting CO_2 into the air, resulting in acid rain. In addition it is causing respiratory problems, and skin rashes among other ailments [14].

It has been estimated by Bird [16] that between 9 and 13 million barrels of oil has spilled since oil drilling started in 1958. The spill contaminated the environment, including land, air and water. The federal government estimated that about 7000 spills occurred between the years 1970 – 2000 [16]. The major effect of the spills on the ecosystem is destruction of the mangrove forest and associated fisheries. The Niger Delta has the third largest mangrove forest in the world and the largest in Africa. Mangrove forests are important for sustaining local communities because of the ecological functions they perform and the essential resources they provide, including soil stability, medicines, healthy fisheries, wood for fuel and shelter, tannins and dyes and critical wildlife habitat. Endangered species-including the Delta elephant, the white-crested monkey, the river hippopotamus and crocodiles-are increasingly threatened by oil exploitation [14].

An estimated 5-10 percent of the country's mangrove ecosystem has been destroyed either by settlement or by oil spill. Spills affected crops and aquaculture through contamination of ground water and soils. Contaminated drinking water is very dangerous because of numerous hydrocarbons and other chemicals which represent carcinogenic risk.

Perman et al. [15] observed that mining and quarrying disrupts the land suitable for agricultural, urban or recreational use, the deterioration of the immediate environment through noise, and airborne dust, as well as causes deforestation and different degrees of soil erosion. In the case of petroleum exploitation, [17], observed that petroleum exploitation, exploration and refining as well as transportation, storage, marketing and use of the products have all created pollution problems in various parts of

the environment. During exploration and exploitation, drill cutting, drilling mud and especially accidental discharge of crude petroleum constitutes serious water pollutant in the Niger Delta. The refining of the resource produce refinery effluents which includes oil and grease, phenol, cyanide, sulphide, suspended solid, chromium, and biological oxygen demanding organic matter which may pollute water body. During transportation, storage and marketing and use of the products, petroleum, lubricating oil, as well as sludge from tank cleaning operations are commonly discharged on to the landscape.

3. METHODOLOGY

3.1 The Study Area

Imo state, Nigeria is the study area. According to Federal Office of Statistics, Imo state covers a land area of 5,530 km². It lies between latitudes 5°23'N – 6°00'N and longitudes 6°40'S – 7°23'S. It is bounded on the south by Rivers state, west by Delta, north by Anambra and east by Abia state (Fig. 1 and 2). It has a relatively low terrain averaging 130 – 200 meters above sea level. The state is made up of 27 local government areas distributed to three senatorial zones of Okigwe, Owerri and Orlu at the rate of 6:9:12

respectively. The 2006 national population census of the study area is 3,927,563 persons comprising of 1,976,471 males and 1,951,092 females. However with the projected growth rate of 2.8%, the population is projected to be 5,035,716 by 2015, comprising 2,534,198 males and 2,501,588 female.

3.2 Research Design

The research systematically sampled 6 local government areas (LGA) at the rate of 1:2:3 from the three zones. Here 1 LGA is sampled from Okigwe Zone, 2 from Owerri zone and 3 from Orlu zone. The sampled local government area (LGA) for the pilot survey are shown in Table 1.

3.3 Areas of Data Need

Two types of data were used for the study. They are primary and secondary. These data types are presented in quantitative, qualitative, cartographic and pictorial format. Secondary data were generated from library, basic statistics, and internets, published and unpublished materials, from ministries, departments and agencies of Imo state government. Primary data were generated through sampling, field observations and measurements, interviews and questionnaire.

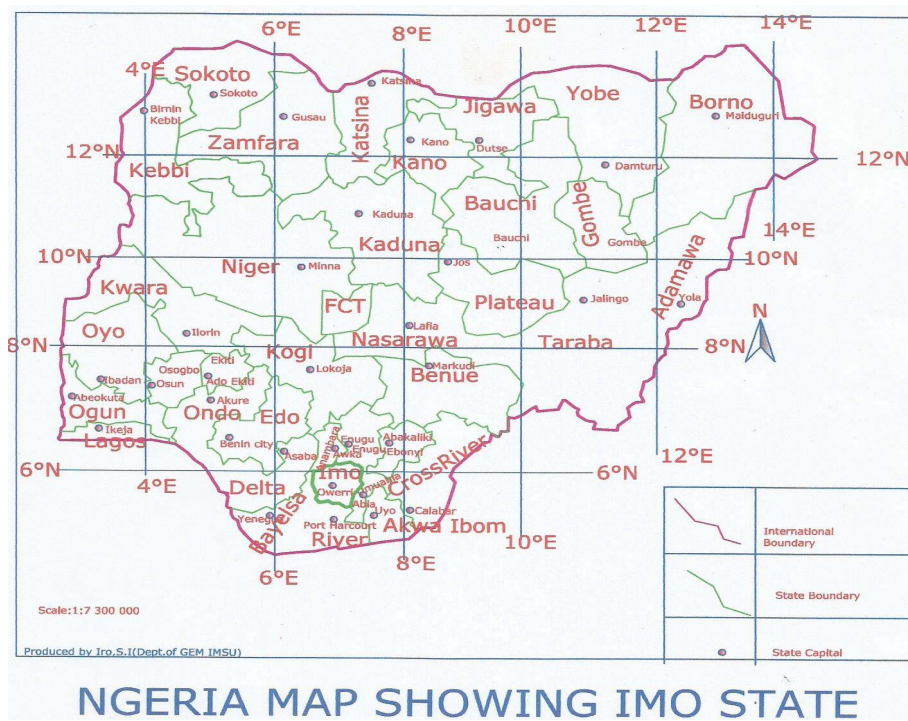


Fig. 1. Nigeria map showing the states

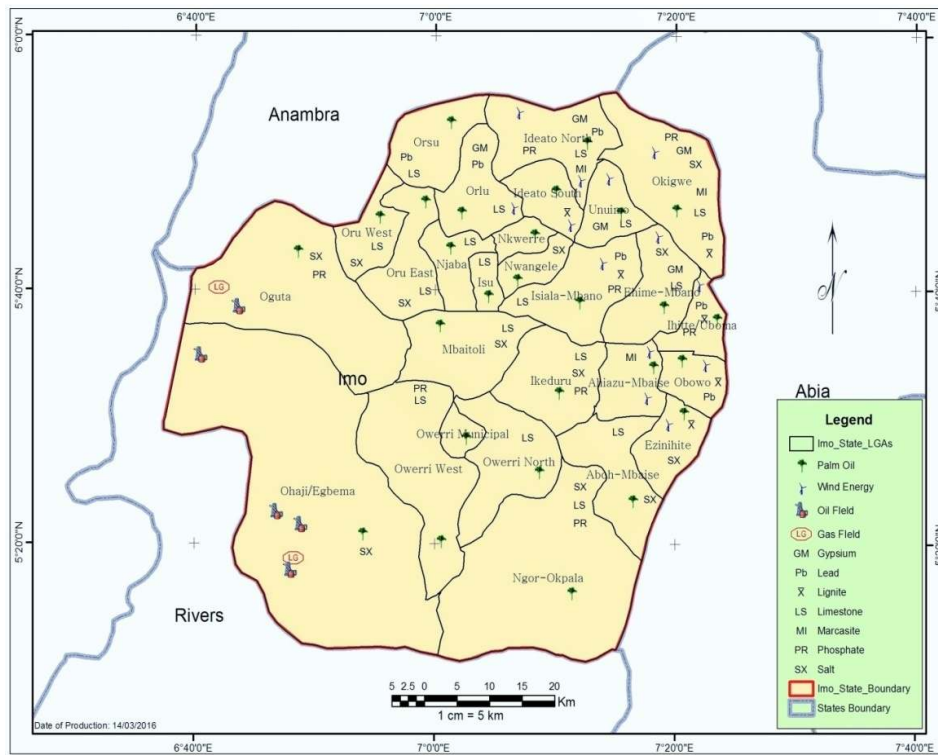


Fig. 2. Natural resources map of Imo state

Table 1. Sampled L.G.A for the pilot survey

Zones	LGA	Population (2006)	Population (2015) **
Okigwe	Okigwe	132,701	170,142
Owerri	Ikeduru	147,937	189,655
	Ngor Okpala	157,858	202,373
Orlu	Oguta	142,340	182,480
	Orlu	142,792	183,059
	Ideato North	156,161	200,198
Total		879,789	1,127,907

Source: NPC, 2006, ** Projected

Table 2. Questionnaire administration

L.G.A	2015 population	% sampled	No. distributed	% Distributed	No. retrieved	% retrieved
Okigwe	170,142	0.05	85	15.1	84	14.9
Ikeduru	189,655	0.05	94	16.7	92	16.3
Ngor Okpala	202,373	0.05	101	17.9	100	17.8
Oguta	182,480	0.05	91	16.2	90	16
Orlu	183,059	0.05	92	16.3	90	16
Ideato north	200,198	0.05	100	17.8	100	17.8
Total	1,127,907	0.05	563	100	556	98.8

Source: Author's fieldwork, 2016

3.4 Questionnaire Administration

Taking a sample of 0.05% of the 2015 population, resulting in a sample size of 563, to whom the questionnaire was administered. The quantity distributed and retrieved for the study is presented in Table 2.

3.5 Presentation and Discussion of Results/Findings

Data generated through from primary data are presented under: Questionnaire administration; location and types of natural resources; economic benefits of natural resources, methods of natural resources exploitation; state of exploitation of different resources; and environmental problems of natural resources exploitation.

3.6 Examination of Locations and Estimates of Major Natural Resources in Imo State

Imo state is sectioned into three senatorial zones. Information obtained through questionnaire and field measurement indicates that each of these senatorial zones has peculiar types of natural resources while some of these resources are common in all the zones. The major resources and their locations within the state are presented in Table 3.

Analysis of the data in Table 3 shows the locations and different types of natural resources within the three zones of Imo state. The data reveals that 75.5% of the natural resources locations in Imo state belong to the renewable group, while the non renewable ones constitutes 24.5% of all locations, of which 7.7% consist of petroleum and natural gas, 7.7% of clay deposits and associated minerals such as lead, and 9% of sand and crush rocks. Information in the Table and from the field indicated that the greater quantities of non-renewable resources (petroleum and natural gas) are located within Orlu zone in Oguta and its sister local government Ohaji Egbema. Of the renewable resources, Timber (e.g. iroko (*Milicia excelsa*), Mahogany (*Swietenia mahagoni*), Gmelina (*Gmelina arborea*), Obeche (*Triplochiton scleroxylon*) etc.) and Non-Timber Forest Products (NTFPs) (e.g. *Gonronema latifolia*, *Gnetum Africana*, *Tetracarpidum conophorum*, *Piper guineensis*) and agricultural resources location constitutes 36% (timber/NTFPS) and 29.5% (agriculture) respectively, of the natural

resources in the study area. Majority of the timber trees identified have been endangered as a result of over-exploitation. Quarry (crushed) stones/ sand mines constitute 9% of natural resources locations, while water resources accounted for 9.7% of the natural resources locations in Imo state. Summarily it was observed that Okigwe zone state is richly with sand mines/ quarry stones and clay deposits with a lesser quantity of Timber and Non Timber Forest Products and water resources; Orlu zone is endowed with both petroleum and natural gas and agricultural resources while Owerri Zone has agricultural and Timber and NTFPs with little crush stones and sand mines. These resources since they are renewable if properly harnessed will contribute significantly to socioeconomic development of the state.

3.7 Economic Benefits of Natural Resources Exploitation in Imo State

Natural resources if sustainably exploited have derivable economic benefit to the localities and individuals both presently and for future generations. Data on economic benefits of natural resources in Imo state is presented in Table 4.

Provision of wild food and agricultural products collectively constitutes the greatest benefit of natural resources exploitation in Imo state. Some of the wild food includes honey, wildlife, fish and wild vegetables, while agricultural products includes crops like yams, tuber, maize, cassava, pineapples, bananas and plantain. This accounts for 31.7% (wild food, 10.1% and agricultural products, 20.6%) of economic benefit of natural resources in the state. This figure is in agreement with that in Table 3 where agricultural resources and NTFPs locations make up the greatest percentage of natural resources exploited in Imo state: 29.5% and 36.0%, respectively. Some of the excess foods produced are sold, to generate revenue. This among others might be the reason why revenue generation constitutes about 16.4% of the economic benefits of natural resources as seen in the Tale 4. The revenue generation could also come from sales of timber and NTFPs (e.g. bush-meats), petroleum and natural gas.

Employment generation and industrial provision constitute 19.6% and 4.5% respectively of the economic benefits of natural resources exploitations. Industrial provisions as it relates to this work are those industries cited in the

locations as a result of the presence of the natural resources, which the industries extracts as raw materials and/or undertake some level of transformation, and in so doing add value to the resources. This employment may be direct where the local communities are involved in the extraction, and transformation of the resources (e.g., oil and natural gas), and/or selling of raw materials to industries (e.g., sand, stone and clay) constituting 12.9% responses and/or to consumers (e.g., bushmeat, wild medicines, fish). The sale of raw products to industries is common in Okigwe zone where the youths engage in sand mining and stone quarrying in order to make a living. Industries involved in extraction and transformation of natural resources can be found in Oguta and Ohaji/Egbema (Orlu zone), preferring to locate nearer their source of raw materials. Through the establishment of these industries, employment opportunities are generated for the host communities. A good example is the location of Adax Oil Company in Ohaji egbema area. Other industries located in Imo state (though most area moribund) include, Clay Products Limited and Topaza Company Limited in Amuro, both in Okigwe Local government area. The reason for the moribund state of these two industries is attributable to the management of these industries. These industries utilize huge clay deposits in the region to produce burnt bricks, tiles and other products. Provision of infrastructures (constituting 9.0% of the responses in Table 4), such as roads, good water supplies, hospitals, electricity, schools etc, are other economic benefits emanating from natural resources. This infrastructure is either provided by the government in these areas, or by companies as part of corporate social responsibilities to the host communities.

3.8 Environmental Effects of Natural Resources Exploitation

Negative impacts from unsustainable and/or unmitigated exploitation of natural resources, as observed in the literature include soil erosion, deforestation, pollution of the atmosphere, lithosphere and hydrosphere, and even social conflicts (e.g., as observed in the Niger Delta). To indicate the actual environmental problems arising as a result of natural resources exploitation in Imo state, the data is presented in Table 5.

Based upon responses to the questionnaire (Table 5), the greatest environmental problem

arising from natural resources exploitation in Imo state is soil erosion; 30.2% of responses. This is followed by deforestation which constituted 20.3% of responses. Other environmental problems associated with natural resources exploitation in the state and percentage responses are air pollution (15.5%), biodiversity loss (16.4%), water pollution (13.3%), and landslides (4.3%).

To examine the percentage contributions of these resources to degradation of the environment of Imo state, information from Table 5, shows that exploitation of agricultural resources degrades the environment of Imo state by 21.9%. This is closely followed by petroleum exploration, exploitation, transportation and product usage which degrade the environment by 18.3%. The contribution to degradation of environment of Imo state by other resources are sand mining/crush rock (17.3%), timber and NTFPs (12.6%), clay deposits (12.1%), natural gas (8.8%) and water resources (9%).

3.9 Methods of Natural Resources Exploitation

To investigate the methods used by inhabitants and companies in the extraction of natural resources, the data obtained is presented in Table 6.

The information in Table 6 shows that methods of natural resources exploitation in Imo state are extensively rudimentary. These rudimentary methods can be attributed to the main reasons for extensive environmental degradation of the area. It was observed that use of machines and seismic drilling which are advanced method of natural resources exploitation accounts for only 24.2% of resource exploitation methods. This means that the remaining 75.8% of the methods are traditional and rudimentary manner. The poison Gamalin 20 is still used for fishing in some of the rivers, despite its health hazard and high pollution capacity [8]. Slash and burn methods releases carbon into the atmosphere, in addition to carbon released from firewood in rural areas and charcoal in urban areas. Slash and burn, if improperly undertaken, can cause irreversible soil erosion from wind and rain, as well as kill soil micro organism. Based upon responses, this constitutes 9% of resources exploitation methods in Imo state. Sand mining and rock crushing are undertaken using hammers and shovels, constituting 7.6% of the responses.

Table 3. Locations and estimates of major natural resources in Imo state

Zones	Locations	Types of natural resources								
		Renewable resources				Non renewable resources				
		Water res.	Timber/NTFPs	Agric products	Total Ren.	Petroleum	Sand mines/ Crush stones	Natural gas	Clay deposit	Total Non ren
Okigwe	Okigwe	15	17	10	42	-	22	-	20	42
Owerri	Ikeduru	8	31	52	91	-	1	-	-	1
	Ngor	5	37	46	88	-	5	-	5	10
Orlu	Okpala									
	Oguta	12	28	9	49	25	-	18	-	43
	Orlu	6	46	20	72	-	10	-	8	18
	Ideato North	8	41	29	78	-	12	-	10	22
Total	556	54	200	164	420	25	50	18	43	136
Percent of 556 locations	100	9.7%	36.0%	29.5%	75.5%	4.5%	9.0%	3.2%	7.7%	24.5%

Source; Authors Fieldwork, 2016

Note: NTFPs (Non Timber Forest Products); Ren. (Renewable Resources); Non REN (Non renewable Resources)

Table 4. Economic benefits of natural resources exploitation

Economic benefits	No. of respondents	Percentage response
Employment	109	19.6
Revenue generation	91	16.4
Source of wild food	56	10.1
Provision of agricultural food	120	21.6
Provision of infrastructure	50	9.0
Provision on raw material for industries	72	12.9
Provision of industries	25	4.5
Provision of wild medicinal herbs	33	5.9
Total	556	100

Source: Author's Fieldwork, 2016

Table 5. Responses raising environmental problems of natural resources exploitation in Imo State

Environmental resource	Responses raising environmental problems												Total	%
	Soil erosion	%	Water pollution	%	Air pollution	%	Deforest	%	Land Slide	%	Biodiv Loss	%		
Water Resources	-	-	20	3.6	-	-	-	-	-	-	30	5.4	50	9
Timber/NTFPs	-	-	-	-	-	-	49	8.8	-	-	21	3.8	70	12.6
Sand/rock mining	48	8.6	-	-	3	0.5	21	3.8	9	1.6	15	2.7	96	17.3
Agric products	70	12.6	5	0.9	-	-	30	5.4	-	-	17	3.1	122	21.9
Petroleum	10	1.8	49	8.8	41	7.4	-	-	-	-	2	0.4	102	18.3
Natural gas	-	-	-	-	42	7.6	3	0.5	-	-	4	0.7	49	8.8
Clay deposit	40	7.2	-	-	-	-	10	1.8	15	2.7	2	0.4	67	12.1
Total	168		74		86		113		24		91		556	
Percentage		30.2		13.3		15.5		20.3		4.3		16.4		100

Source: Author's Fieldwork, 2016

Table 6. Methods of natural resources exploitation

Natural resources	Responses to the methods of exploitation											Total
	Use of machine	Slash/burn	Use of poison	Use of nets	Seismic drilling	Tillage	Use of shovels/hammer	Gas flaring	Gas capture	Blasting	Use of machete	
Timber	80	-	-	-	-	-	-	-	-	-	111	191
Sand/stone	8	-	-	-	-	-	42	-	-	-	--	50
Agric Res.	9	50	-	-	-	80	-	-	-	-	35	174
Petroleum	3	-	-	-	23	-	-	-	-	-	-	26
Natural gas	5	-	-	-	-	-	-	13	-	-	-	18
Clay	7	-	-	-	-	36	-	-	-	-	-	43
Water Res.	-	-	15	39	-	-	-	-	-	-	-	54
Total	112	50	15	39	23	116	42	13	0	0	146	556
Percentage	20.1	9.0	2.7	7.0	4.1	20.9	7.6	2.3	0.0	0.0	26.3	100

Source: Author's Fieldwork, 2016

Table 7. State of resources exploitations in Imo state

Renewable		Non renewable	
Resources	Quantity exploited	Resources	Quantity exploited
Water resources (Sea food)	5 tons *	Petroleum	N/A
Timber	38 tons *	Sand	150 tipper loads **
NTFPs	10 tons *	Crush rocks	6 tipper loads **
Agricultural resources (crops)	100 tons *	Natural gas	N/A
Agricultural resources (fruits)	20 tons *	Lead	0
Wildlife	15 tons *	Limestone	0
Wind energy	0	phosphate	0
Solar energy	0	Salt	0
Total	188	Total	156

Source: **Author's Fieldwork, 2016 from the site of exploitation * Imo state ministry of Agriculture and Natural Resources, N/A (not available)

3.10 State / Quantity of Resources Exploited in the Study Area

Natural resources are exploited for socioeconomic development of any area where they are located. To develop, a nation has to convert its potential resources into actual resources. To be sustainable, this has to be done in a manner that will take care of both the present and future generations. To investigate the state of exploitation of each resource in Imo state and to know the quantity extracted on a daily basis, the data obtained is presented in Table 7.

Information in Table 7 shows that while some renewable resources have been utilized to a greater extent, most of their non renewable counterparts are yet to be touched. The agricultural resources and timber have been overexploited. The reason for this may be due to non existence of laws that protects both plants and animals in the area. This has lead to over-exploitation, leading to extinction of many species of wild plants and animals. The must hunted animals that provide the protein need of the people include, antelope (*duiker/cephalope*), porcupine (*hystricidae*), grasscutter (*thryonomys swinderianus*), squirrels (*sciuridae*), pouched rat (*cricketomys*), monkeys (*macaca facsicularis*), and deer (*cervidae*) [14]. Some of these bushmeats are endangered, while few of them have gone extinct. This might be the reason for various degrees of environmental degradations witnessed in Imo state. As a result of inadequate availability of timber products resulting from over-

exploitation, in the past, most of the timber products used in the state was brought from outside the state by timber dealers. Some of the non-timber forest products which include plants like *Gonronema, latifolia, Gnetum Africana, Tetracarpidum conophorum Piper guineensis* are in a serious state of over exploitation, which can result in extinction if care is not taken. These plants serve as local herbs and are also used as food. The water resources in the form of sea-food have not been fully utilized as indicated by only 5 tons per day. This is in spite of abundant water bodies in the state which include Imo, Otammiri, Nworie Rivers, etc and the Oguta lake etc. Abundant wind and solar energy in the state has not been tapped.

For non-renewable resources, the figure for crude oil and natural gas in barrels per day is not available. Apart from these two resources, only sand and rocks are being exploited currently, mostly by local communities. It was indicated that they exploit 100 tippers and 6 tippers per day for sand and rocks respectively. Other minerals in the state which include lead, limestone, salt and phosphate have not been touched. In summary, while it is true to say that some renewable resources in the state have been exploited to extent of over-exploitation; some of the non renewable ones are yet to be tapped.

3.10.1 Hypothesis 1

The negative impact of natural resource exploitation in Imo state is not as a result of rudimentary methods of resources exploitation

Correlation analysis table

Correlation r	r ²	% contribution	Residual	Calculated t	Tabulated t	Degree of freedom
0.7452	0.5553	55.5%	45.5%	2.449	2.57	5

Explanation: Correlation the information in Table 5 with that in Table 6, the Pearson's r is 0.7452. This shows that there is a strong positive relationship between environmental problems and methods of natural resources exploitation. The coefficient of determination (r^2) is 0.5553. This shows that the methods of natural resources exploitation contribute about 55.5% of environmental problems in Imo state. The unexplained variations are 44.5%. The calculated t value is 2.449. The critical value of t @ 5 degrees of freedom value is 2.57.

Since $t_c < t_{(v)}$, H_0 is accepted.

3.10.2 Hypothesis 2

H_0 : The identified natural resources in Imo State have been fully exploited for economic development Chi Square Table.

Observed and expected Chi Square table

Renewable resources			Non-renewable resources			Total
Resources	Observed	Expected	Resources	Observed	Expected	Total
Water resources (Sea food)	5	2.6	Petroleum	0	2.4	5
Timber	38	97.5	Sand	150	90.5	188
NTFPs	10	8.3	Crush rocks	6	7.7	16
Agricultural Resources (crops)	100	51.9	Natural gas	0	41.8	100
Agricultural Resources (fruits)	20	10.4	Lead	0	20	20
Wildlife	15	7.8	Limestone	0	7.2	15
Wind energy	0	0	Phosphate	0	0	0
Solar energy	0	0	Salt	0	0	0
Total	188		Total	156		344

$$X^2_c = \sum (O - E)^2 / E = 106.4 + 117.2 = 223.6$$

$$D.F = (R-1)(C-1) = 7 * 1 = 7$$

$$X^2(0.05)_7 = 14.07$$

Since $X^2_c > X^2 (@V)^7$, we reject the null hypothesis and affirm that natural resources in Imo state have not been fully exploited for economic development of the state

4. CONCLUSION AND RECOMMENDATION

The development of an area correlates with the type of the available resources and also how these resources are effectively harnessed and utilized for socioeconomic development. Imo state is blessed with abundant resources as identified in Table 3 and Fig. 1 of this study. Some of these resources especially the renewable group have been properly harnessed and utilized, thereby contributing to the socioeconomic development of the state. Non-renewable resources, including crushed stones, sand, petroleum and natural gas, have been harnessed to some extent. The presence of these resources, especially oil and natural gas

has made the state a member of the Niger Delta Development Commission and this is responsible for extra amount of money the state receives from the federation account. However, it is unfortunate that the exploitation of these latter two resources has resulted in a number of negative social and environmental impacts categorized by scholars as a "Resource Curse" where the negatives out-weigh the positives for both the local population and nature. Adverse environmental impacts include soil erosion, air, water and soil pollution, destruction of agricultural land, social conflicts and sometimes wildfires due to oil spills. Other manifestations of resource curse includes, lung problems from natural gas flaring, increased malnutrition from the destruction of mangrove swamps and related

fisheries and from the loss of agricultural production due to soil pollution from petroleum [14]. Despite these observed problems, the availability of any resource in an area will enhance socio-economic development of an area if the resources area exploited in a manner that are both environmentally and economically sustainable.

Finally, the research recommends the following

1. Environmental assessments need to be undertaken for each major resource being exploited. Both beneficial and adverse environmental and socio-economic impacts need to be identified. Mitigation of adverse impacts should be raised and calculated as a cost of doing business. Where adverse impacts are serious, long-term and cannot be mitigated with the technique of exploitation being used, that form of exploitation must be banned. Such assessments must be made by impartial observers and not the resource exploiters/industries. Monitoring of environmental impacts (e.g., water and quality, trends in catch per unit effort and/or size/age for fish and bushmeat species) must be built into the cost of doing business.
2. Unexploited resources such as solar and wind power, and abandoned resources, such as lead, clay, etc. should be harnessed, to improve the income generation capacity of the state.
3. The resources should be harnessed in a manner that will not imperil the environment. This is because improper resource exploitation leads to environmental degradation.
4. Gas flaring, which represent flaring of wealth and creates major health problems, should be stopped and the gasses captured and utilized effectively for socio-economic development.
5. Funds realized from these resources should be effectively channeled for socio-economic development of the host communities, as this will reduce social conflicts between the host communities and prospecting companies.
6. Unsustainable methods of natural resources exploitation need to be identified and discouraged especially those methods that causes serious environmental degradation.
7. Imo state government should look inwards in the harnessing of these resources, as it

will help to increase the economic base of the state.

8. The knowledge of traditional natural resource users (e.g., fishers, sawyers, hunters, wild medicine and food collectors, etc.) needs to be captured and integrated into modern concepts of sustainable use/conservation that both involves them in the sustainable harvest of these renewable natural resources, but also assures the availability of these critical natural resources for future generation [14].

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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