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Land Resource Inventory and Ecological Vulnerability: Assessment of Onne Area in Rivers State, Nigeria

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Abstract: Key enviromental issues in the Niger Delta of Nigeria relate to its oil industry. The Delta covers 20,000 km^2 within wetlands of 70,000 km^2 formed predominently by sediment deposition.Home to 20 million people and 40 different ethnic groups,this floodplain makes up 7.5% of Nigeria's total land mass. It is the largest wetland and maintains the third-largest drainage area in Africa. The Delta's environment can be broken down into four ecological zones: coastal barrier islands; mangrove swamp forests; freshwaterswamps and lowland rainforest.This incredibly well endowed ecosystem,which contains one of the highest concentrations of biodiversity on the planet,in addition to supporting the abundant flora and fauna,arable terrain that can sustain a wide variety of crops,economic trees and more species of freshwater fish, than any ecosystem in West Africa.

Key words: Enviroment, ecosystem, land degradation

INTRODUCTION

Onne is part of the Odido and Nchia clan in Eleme Local Govertment Area of Rivers State,in Nigeria, which is situated on atitude 4.72 N and longtitude 7.15 E (at an altitude of 1440 feet) to Bonny River.The closest ethnic group to which the Onne people have been associated with are the Ogonis. With an approximate population of 733,522 persons on a land area of over 5,000 km^2, the area is described as amongst one of the many large wetlands in Africa as well as a beehive of oil and gas activities. The area consists of rivers, creeks and estuaries while, stagnant swamp covers about 600 km^2 with the area dotted, with mangrove swamps Zabbey *et al*. (2004). The ecosystem of the area is highly diverse and supports numerous species of terrestrial and aquatic flora and fauna including human life. As opined by Iyayi (2004), it is amongst one of the richest in the world. The region could be said to be an ecologically sensitive region. Large resources of oil and gas are extracted from the region (which are the main source of revenue for the Nigerian state, accounting for about 97% of the country's total export), has dominated the Nigeria's economy. The study area is highly susceptible to adverse environmental changes caused by climate change because it is located within the coastal region of the world. Coastal regions of the world are already experiencing flooding due to rise in sea level. Besides the impact of climatic change, the region is also faced with a myriad of environmental problems resulting from oil exploration and exploitation activities. Reports on the environmental state of the study area are conclusive that the area has almost become an ecological wasteland due to often uncontrolled use of the natural resoures of the area. Therefore, the objectives of the paper are to highlight the land resource inventory and ecological vulnerability of the study area.

MATERIALS AND METHODS

Aerial data: This study was conducted in Onne area,in Eleme Local Govertment area of Rivers state IN 2008. Aerial photographs of 1st October 2008 were used. Visual interpretation was applied in discerning land features, water features, canals and creeks, built up areas and landfills (Fig. 1-5). The pressure on the few available land in the study area was seen from the thickly clustered pattern of houses as is evident from the aerial photograph over the central area of the study area. Over-population and overcrowding is imminent. This is believed to be due to the presence of large numbers of multinational companies, promising jobs for millions of unemployed people. Canals and creeks, dotted with thick mangroove vegetation can be seen criss-crossing all sides of the study areas and dredging activities can be spotted on the southern side of the aerial photograp.

Vegetation: Investigation into the floristic composition, physiognomy and health status of vegetation of the study area was also carried out. Sampling stations were chosen after an initial reconnaissance survey was conducted to assess the vegetation variations and their orientations to

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Fig. 1: Canals and creeks in study area

Fig. 2: Bush clearing activities in study area

facilitate vegetation monitoring and assess the magnitude of change due to deforestation and oil exploitation activities. Efforts were made to locate some transects depending on the variations noted. The segmented belt transect sampling technique was adopted to provide maximum observation. In this process, continuous blocks of three belt quadrants (measuring 5x5 m^2 in size) were laid on a randomly choosen side of the transect and one random quadrant per block was chosen and studied in detail. Such alternately spaced observation points, which covered the entire study as demarcated by the transect was generally more efficient statistically. The pathological conditions of plants in the samples transects were assessed by estimating the frequency of occurrence.

Collection of water samples: Subsurface (10-20 cm) water samples were collected from selected sites. These samples were also preserved according to standard laboratory/field analytical methods.

Physicochemical: Five sampling sites and two soil samples of each of the sites at randomly selected positions and sampling commenced at a depth of 1-15 and 15-30 cm. This gave a total number of 10 samples for the study area.

Socio-economic survey: This aspect of the study assessed the impacts of the activities of extractive industries on the study area and on human settlements. The aims and objectives of the socio-economic studies included the following: identification and description of human settlements within the communities.

Survey methods: A cross-sectional design that enabled information to be gathered was used to aquire primary data. One-on-one interviews were conducted with individuals who were quite knowledgeable of the environment and have lived in the study area all their life.

Fig. 3: Sand filled areas of study area

Fig. 4: Dredging activities in the study area

The questionnaire was principally used for gathering of information on the study area. The survey included 25 leaders of households from 10 selected zones in the study area.

RESULTS

Soils of Onne: The native soils of the Onne area were, generally, young soils derived from recently deposited materials. The depositional medium varied from freshwater swamps, saltwater swamps and beach ridges. The freshwater swamp soils were developed from alluvial sediments laid down in the extensive floodplains of major River systems. The textures ranged from sand to clay but, predominantly, loamy. The surface layer is humus and the soils were, generally, poorly drained. The dark grey mangrove soils occupy a large proportion of the soils around the estuary. The young soils are acid silty clay loams while; the more extensive older soils were covered with a thick layer of organic matter derived mainly from undecomposed mangrove roots. The beach ridge soils or abandoned river channel soils are extensively drained and consist of deep brownish yellow coarse sand with a slightly humus topsoil (FPDD, Federal Ministry of Agriculture and Natural Resources, 1990). Ayolagha (2003) explained the Onne soils under his description of the Ogoni coastal plain. According to the above author, the deposits were generally sandy and laid down at, or

Fig. 5: Sand filled areas in the study area

near, sea level in Oligocene to Pleistocene times. These soils are very uniform in composition but varied due to differences in drainage into:

- Well drained slight slope
- Well drained steep slope
- Low-lying, liable to short-term flooding
- Sands in swamps, with Raphia hookeri

Well-drained, slight slope: This is the main well-drained part of the soil and the most useful for agriculture. The soil at the surface is usually sandy or loamy sand. The average clay content being about 10% with a range of 5 to 17%. There is little silt and the sand content of the surface horizon is 80 to 90%. The ratio of course to fine sand varied between 22% coarse to 61% fine and 64% coarse to 29% fine; on the average fine sand slightly exceeds coarse. The clay content increases with increasing depth to about 30% at 2 ft depth and seems to be fairly constant below. In terms of color, the topsoil is varied from dark grey-brown to very dark brown (Munsell 10 Yr 3/2 to 2/2, moist). At 45 cm, the color passes through dark brown to, typically, strong brown (7.5Yr 5/6, moist) at about 30% at 2 ft. There may be mottles in the lower part of the profile, at a depth of 4 ft, but above this there is no evidence of poor drainage.

Well drained steep slope: These soils are very similar to those just described above and they have only been distinguished in order to draw attention to their vulnerability to erosion The degree of slope may be only 4 or 5% although, often it is much greater, but even those lesser slopes suffer seriously from erosion once cultivated.

Low-lying, liable to short term flooding: These soils are found in depressions and dry valleys where there is often stagnant or flowing water for some hours after heavy rainfall but not long periods of flooding. They also occur on low-lying land fringing the permanent swamps. Their parent material is the coastal plains sands formation, which is the same as that of the well-drained soils already described above. These soils are very similar to the well-drained Ogoni sands but are more highly leached. The colour of the soil ranges from dark brown to dark grey (Munsell 10 Yr 4/3 to 5/2, moist). Their texture is within the range of the well-drained sands.

General features of the original mangrove soils: The soils are, generally, water saturated or daily inundated soils. The dominant properties of the soils are:

- Thick layer of poorly consolidated organic soil that shows no evidence of soil structure and coarse soil particles.
- A thick layer or massive fibrous sediment of organic matter consisting dominantly of roots of mangrove at various stages of decomposition popularly referred to as chikoko.
- High composition of shells and holes and biotic activities of marine and mangrove organisms on to top 15 cm of the soil.
- Gleying: Grey colour of the sub-surface (>60 cm) soil, which is a reflection of the permanent water regime of the deeper layers due to the dominance of anaerobic conditions.

However, these mangrove soils only occur now in pockets and marginal areas. This soil could be described

Tables 1: Physico-chemical characteristics of soil samples for study area

Sample identity	Sample type	Analysis date	Copper (Cu) mg/L	Barium (Ba) mg/L	Sodium (Na) mg/L	Vanadium (V) mg/L	Mercury (Hg) mg/L	Arsenic (As) mg/L	Potassium (K) mg/L	Iron (Fe) mg/L	Nickel (Ni) mg/L	Chromium (Cr) mg/L	Manganese (Mn) mg/L	Zinc (Zn) mg/L
SS 1 (0-15 cm)	SOIL	23 /06/08	6.00	0.008	68.70	<0.001	<0.001	<0.001	27.00	682	<0.001	3.680	0.025	20.41
SS 1 (15-30 cm)	"	"	<0.001	0.002	71.20	<0.001	<0.001	<0.001	33.41	741	<0.001	1.210	0.013	11.92
SS 2 (0-15 cm)	"	"	6.40	0.009	90.90	<0.001	<0.001	<0.001	36.80	613	1.160	0.300	0.047	21.97
SS 2 (15-30 cm)	"	"	2.00	0.002	97.70	<0.001	<0.001	<0.001	28.4	597	<0.001	<0.001	0.021	9.93
SS 3 (0-15 cm)	"	"	6.00	0.011	72.00	<0.001	<0.001	<0.001	39.8	747	1.000	4.22	0.110	22.41
SS 3 (15-30 cm)	"	"	3.40	0.003	66.55	<0.001	<0.001	<0.001	21.5	599	0.762	1.40	0.056	12.93
SS 4 (0-15cm)	"	"	6.40	0.008	56.44	<0.001	<0.001	<0.001	33.19	710	0.905	2.320	0.132	25.13
SS 4 (15-30 cm)	"	"	<0.001	0.001	36.32	<0.001	<0.001	<0.001	27.82	623	<0.001	3.140	0.051	13.12
SS 5 (0-15 cm)	"	"	6.80	0.010	93.57	<0.001	<0.001	<0.001	36.71	821	0.667	5.240	0.049	20.19
SS 5 (15-30 cm)	"	"	<0.001	0.004	77.17	<0.001	<0.001	<0.001	23.4	694	<0.001	4.810	0.051	8.41

as unconsolidated sand deposited on, recently, as reclaimed area. The pedogenic features of the original soils are completely lacking.

Physicochemistry of soils in the study area: The laboratory results of some pertinent parameters of the soils are presented in Table 1. Some scientists refer to the soils as Ogoni sands of southeastern Nigeria. These soils, with the exception of some localized variations are characterized by the following:

- Very good physical features
- Poor inherent fertility status
- High degree of acidity
- Low cation exchange capacity
- Predominant sandy texture, etc.

The soils are very slightly acidic to near neutral with pH ranging from 6.02 to 6.94. There was minimal variation with depth and location. These pH values are within the ranges reported by Odiete (1999) in the humid soils of the Niger Delta area of Nigeria. The ranges of PO_4^{-3}, SO_4^{-2} and NO_3^{-1} for the wet season were 0.26-2.73, 1.0-13.8 and 0.4-5.5 mg/kg, respectively. There was no definite trend in the nutrients between the top soils (0-15 cm) and sub-soils (15-30 cm). The content of Total Hydrocarbon (THC) and oil and grease in the soils were below the detection limit of 0.001 mg/kg. The level of THC in these soils was reflective of a pollution-free environment as they were, generally, within biogenic levels (i.e., below 100 mg/kg).

Heavy metals in the soils: From the results of the soil analysis, it was observed that vanadium (V), mercury (Hg), and arsenic (As) were not detected. Iron (Fe), sodium (Na) and potassium (K) were more abundant than others and ranged in concentration from 597 to 821 mg/kg (mean = 682.7 mg/kg), 36.32 to 97.70 mg/kg (mean = 76.06 mg/kg) and 21.5 to 39.8 mg/kg (mean = 30.80 mg/kg), respectively. Similarly, copper (Cu), barium (Ba), nickel (Ni), chromium (Cr), manganese (Mn) and zinc (Zn) ranged in concentration from < 0.001 to 6.80 mg/kg (mean = 3.7 mg/kg), 0.001 to 0.011 mg/kg (mean = 0.006 mg/kg), <0.001 to 1.160 mg/kg (mean = 0.45 mg/kg), <0.001 to 5.240 mg/kg (mean = 2.632 mg/kg), 0.013 to 0.132 mg/kg (mean = 0.056 mg/kg) and 8.41 to 25.13 mg/kg (mean = 14.13 mg/kg), respectively.

The baseline data for the area showed that there was no seasonal variation in the heavy metals concentration of the soils. From previous studies in the area, the concentration of the heavy metals was relatively higher in the topsoil and lower in the subsoil except for lead and zinc. Some heavy metals As, Hg and Se had concentrations below equipment detectable limit in both seasons while, Ni and V were not detected in the wet season. The concentrations of the other heavy metals were similar to values reported in the coastal areas of Nigeria and natural occurrence levels in soils, Odiete (1999).

Landuse and agriculture: Onne is an Oil and Gas Free Zone and host to several multinational companies. The many land use features are a reflection of this. The most outstanding land users are the Federal Ocean Terminal and the Lighter Ocean Terminal both of which have attracted companies whose operations need movement of materials through the seaport. Very large transport and logistic companies are also among the most prominent features. The area has, rapidly, grown to an urban status with its attendant pressure on land resources. This makes settlement and space for factories and development less available in the area. More than 60-65% of the land harbours factories, institutions, and human settlement, 20 to 25% for bush and forest, and 10-15% is used for agriculture. The land is either owned communally, by households or individuals. Key features of the land use in the area are the presence of the following companies:

- The National Fertilizer Company of Nigeria (presently, called Notore)
- The Naval College
- The International Institute of Tropical Agriculture (IITA), Sub-station, Onne

DISCUSSION

Biological resources: A resource must be physically and technically accessible to man with attendant uses. This implies that naturally endowed resources, be it renewable and non-renewable are destined to be used by man.The

study area, is endowed with abundant natural resources. It is mangrove, and is one of the most productive ecosystems in the world with a rich community of fauna and flora. These include oil and natural gas, sand and gravel and rich biological diversity among others. This has made the study site fragile as it is has become the hub of extractive and related industries. There are two types of resources; renewable and non-renewable. Renewable resources include living resources such as phytoplankton and higher plants with animal life sustained by these Aigbedion (2005). The non-renewable resources include crude oil and gas, solid minerals, salts, sand and gravel etc. the most important natural resources of the study site, are its deposits of crude oil and gas on which the whole country depends for its energy sources and foreign exchange Ajakaiye (1985).

Biological diversity: Okiwelu and Anyanwu (2003) defined biological diversity (biodiversity) as the variation among living organisms, which encompasses species diversity (the number of different species) genetic diversity (genetic variety within species) and ecosystem diversity (the variety of interactions among living things in natural communities). The term is also used to describe the number, variety and variability of living organisms. In a broad sense, it is essentially "life on earth". The study site has been described as an interesting zone for the conservation of extraordinary biodiversity. In addition, Global Biodiversity Assessment (GBA), in a massive review of our current knowledge on the broad field of biological diversity commissioned by United Nations Environment Programme (UNEP), considers humans as an integral and critical important part of biodiversity (UNEP, 1999). It is estimated that in the study area there are more than 4,600 plant species of which about 205 are endemic (i.e cannot be found elsewhere). Of these, about 484 plants in 112 families are threatened with extinction. Many animals and birds are also threatened with extinction (Salau, 1993).

Importance of biological diversity to the study area: Describing the value of biodiversity is the same as describing the benefits and functions of nature and natural biological resources. Biodiversity or biological diversity, which is the sum of all the different species of animals, plants, fungi, and microbial organisms living on earth and the variety of habitats where they are found. Biodiversity encompasses everything from food production to medical research. Humans, the world over, use at least 40,000 species of plants and animals on a daily basis. Many people around the world still depend on wild species for some or all of their food supplies, shelter, and clothing. All of our domesticated plants and animals came from wild-living ancestral species. The array of living organisms found in the study environment together with the physical and environmental factors are vital to the existence of life in the study site. They regulate many of the chemical and climatic systems that make available clean air and water and plentiful oxygen. Forests, for example, regulate the amount of carbon dioxide in the air and produce oxygen as a byproduct of photosynthesis. The intricate network of ecological diversity of different species in the study area presents a local ecosystem and a deep dynamic interplay between them. The ecosystem in the study area consists of organisms from different species living together in the region and is connected through the flow of energy, nutrients, and matter that occurs as the organisms of different species interact with one another. The freshwater system in the study area is important for agriculture, industry, urban development and inland fisheries while, the nearby mangrove forests, which are thickly and densely grown, are sources of timber and firewood that play important roles in biogeochemical cycling. Species and genetic diversity in the study area are important for the following reasons; (a) they are used as food; (b) most of the biological species aid in the control of pest and help crop improvement, and (c) medicinal drugs derived from natural sources, a small fraction of mainly marine animal species make an important global contribution to health.

Human resources (Developmental activities) in the study area: Onne, a community located in the Niger Delta region of Nigeria, produces a high percentage of the oil wealth that accounts for over 90% of the nation's foreign exchange earnings. Paradoxically, these vast revenues from the rich industry have barely touched the lives of the local populace. This has spurred formidable challenges to sustainable human development in the region, particularly, as conflicts over resources tighten their often-vicious grip. The physical environment has been deteriorating at an alarming rate, which hinders economic prospects and harms human well-being. Local people in the area are, acutely, aware of how much wealth oil can produce. Oil and gas alone have generated 40% of Nigeria's national Gross Domestic Product (GDP) over the recent decades. Between 2000 and 2004, oil revenues alone accounted for about 79.5% of total government revenues and about 97% of foreign exchange earnings. Within the study area, a few oil companies and individuals appear to be flooded with cash but, for most people, progress and hope, much less prosperity, still remain an illusion. Rather, misdirected resources, inappropriate policy frameworks and a poor leadership vision of what development should look like have destabilized their societies, and stoked deep and proliferating concerns.

The difficult topography prevents people from cohabiting in very large settlements but encourages in the prevalence of small rural communities, which offers very limited economic opportunities. Infrastructure and social services are generally deplorable, and vastly inadequate.

While many development agencies and private sector organizations, including oil companies, have sought to transform the area socially and economically, analyses of poverty and human development paint a dismal picture. According to UNDP (2005), the area's Human Development Index (HDI) score, which is a measure of well-being encompassing the longevity of life, knowledge and a decent standard of living, remains at a low HDI value of 0.564 (making it a medium human development area) compared to the lower HDI value of 0.470 for Nigeria (making the country to be rated as a low human development area). The disparity in HDI values recorded for the Niger delta region and the country at large show clear evidence of inequalities in human development in the study area despite efforts by oil companies to enhance the well-being of the communities, through several development initiatives, particularly, in social infrastructure. The study area's appalling human development situation cannot be, completely, captured by the HDI, as some essential issues in the region are not reflected in the computation of the index, such as the dire state of infrastructure. The lack of reliable data also distorts the computation of the index, to some extent.

Nevertheless, available data point to the fact that the area is not faring well. Behind the study area's poor performance on human development, is a complex brew of economic, social, political and environmental factors. Others are social instability, poor local governance, competition for economic resources and environmental degradation that have all taken their tolls as well. The generally deplorable state of infrastructure, often rationalized by the difficulty of the terrain, has worsened people's access to fundamental services such as electricity, safe drinking water, roads and health facilities that are taken for granted in many other parts of Nigeria. Other elements include the negative impacts of the oil industry, a constricted land area, a delicately balanced environment and extreme economic deprivation. The area today, is a place of frustrated expectations and deep-rooted mistrust. Unprecedented restiveness at times erupts in violence. Long years of neglect and conflict have fostered a siege mentality, especially among youths who feel they are condemned to a future without hope, and see conflict as a strategy to escape deprivation. Persistent conflict, a response to poor human development, has also entrenched it, serving as a consistent drag on the area's economic performance and expectations for advancement. The sabotage of oil production hurts the economy through the loss of sorely needed foreign exchange to finance national development. Blown pipelines interrupt the supply of crude oil to existing refineries and produce shortages that cause sudden hikes in oil prices.

Hostage-taking is not only a stress on foreign captives, their families and the companies they work for but, the disruption also has adverse effects on the local people, as ensuing violence threatens individuals and communities alike. Lives are lost, and investments drop along with the attendant unavailability or loss of jobs. The human development implications extend to the harm done to the life chances of children unable to go to school and the further constraints on human and social capital. The turmoil, that occurs at times in the study area can be attributed to some of the following factors; (a) declining economic performance leading to rising unemployment or underemployment; (b) the lack of access to basic necessities of life such as water, shelter, food and clothing; (c) discriminatory policies that deny access to positions of authority and prevent people from participating in shaping the rules that govern their lives. These all indicate that governance over time has fallen short of its fundamental responsibilities and obligations to her citizenry. Wide-ranging and usually destructive environmental changes have stemmed from oil and gas extraction, industrialization and urbanization. Since oil and gas exploration is the mainstay activity in the study area, it has had deleterious effects on the ecosystem as well as the local biodiversity. Oil spills and gas flares, in particular, have destroyed natural resources central to local livelihoods. Economically, the study area is heavily invested in the oil and gas industry, but despite the fact that this is a nonrenewable resource, economic diversification has been limited.

Local people often cannot tap directly into oil industry benefits, including employment, because they lack skills or capital resources or both. Oil exploration by seismic companies involves surveying, clearing of seismic lines and massive dynamiting for geological excavation (Seismic testing). The explosion of dynamite in aquatic environment produces narcotic effect and mortality of fish and other faunal organisms thereby leading to loss of biodiversity, gradually. Destabilization of sedimentary materials associated with dynamite shooting cause's increment in turbidity, blockage of filter feeding apparatuses in benthic fauna, reduction of photosynthetic activity due to reduced light penetration, and so on. Burying of oil and gas pipelines in the study area has led to a fragmentation of the rich biodiversity ecosystem like rainforest, and mangroves. Natural populations have also been distorted, due to pipeline tracks. The overall effects of oil on ecosystem health and biota are very numerous. For example, oil interferes with the functioning of various organs and systems of plants and animals by creating environmental conditions unfavourable for life Adekoya (1995). Gas flaring, which is a major activity in the study area, is associated with oil production and is very unfriendly to its natural ecosystems and biodiversity. Gas flares contain over 250 toxins. Environmental Rights Action (ERA), Nigeria and The Climate Justice Programme, UK, (2005), have carefully documented the environmental and economic implications of gas flaring in Nigeria.

Perhaps more important is the finding from a study on the impact of gas flaring on the environment, which revealed that there was about 100% loss in yield in all crops cultivated about 200 m away from the Izombe oil flow station, 45% loss of those about 600 m away and about 10% loss in yield for crops about one kilometer away from the flare (Okezie and Okeke, 1987). Leakages and fire incidents are also associated with gas production and transportation. Local plants and animals inhabiting the affected areas are killed and this has resulted in the elimination of a whole population of endangered species with restricted distribution. In the study area, sand dredging is another extracting industry that is having negative environmental toll on biodiversity. Sand and gravel are a good resource for housing and road construction.

Sand dredging has affected the biodiversity, of the study area in many ways. (a) it has caused settled sedimentary particles to enter into suspension, leading to high turbidity of water and reduced photosynthetic activity, (b) many fauna that inhabit sandy sediments are "sucked" and pumped onto land, leading to their deaths, (c) sedimentary plumes are carried by tidal currents inland and become deposited in nursery grounds. When this happens, reproduction success is hampered, (d) in most of the shallow inland area of the study area where sand dredging takes place, erosion occurs, due to weakening of the shorelines, and the entire biodiversity is destroyed, completely. The effects of human developtment activities from extractive industry on the biodiversity in the study area are negative, Adepelumi *et al*. (2006). This ranges from subtle sub-lethal impairment to outright mortality of plants and animals. Undoubtedly, development, environmental degradation and pollution are like twin brothers, but the extractive companies must adopt technologies and "best practices" that will forestall or lessen impacts on biological diversity for the ecological well-being and revival of the study area.

Landuse/Land cover analysis: In the study area, human population growth and associated demands are exerting an accelerated pressure on soil and water sources Akamigbo (1999). Over the past century, the area of agricultural lands has reduced in the study area. Almost, all of the researchers believe that land use is one of the most important factors in some of the hazards such as flood Adeniyi (1986), soil erosion and sediment yield ecological and environmental dynamics and soil properties changes. Decreasing of forest area in the study area is one of the critical problems, in recent years. In spite of scientists' and governmental agencies' constant warnings, the accurate information and maps from the area of forests in the study area is yet not available. Rapid reduction of agricultural lands derived from forest transformation was dominated by land use dynamics, especially, in the last decades, in the study area. People live in areas where they find their means of subsistence and shun those areas that present difficulties to them. The ecology and physiographic nature of the terrain and the customs and traditions of the people living in the study area have to a great extent dictated the land use pattern of the area.

Agriculture in the study area is almost absent because participation in homestead farming is very neglible while, fishing is important in the study area. It is, primarily, undertaken using drift and set nets from dugout canoes. Cast nets, hook lines, fish fences and traps are also used. Traditional uses of forest in this area include timber, trees for dug-out canoes, climbers for ropes and rattans, tree-crops such as raffia palm, oil palm, mango, banana, plantain, citrus fruit, coconut, bread fruit and kola nuts. Bush meat is very important in the forest of the study area. Raffia palms are used in the preparation of thatches for roofing of houses. It is also a source of fibre from which brooms and brushes are made. Palm produce is collected from wild palms in the area. The study area is host to a leading seaport in the country, and a major industrial center. Its exports include palm oil, petroleum, coal, tin, columbite, cocoa, and peanuts. The study area has prospered as the regional headquarters for the petroleum industry. It is also a host to several multinational companies, and the 90% of the land use area are a reflection of this.

The most outstanding land users are the Federal Ocean Terminal and the Lighter Ocean Terminal both of which have attracted companies whose operations need movement of materials through the seaport. Very large transport and logistic companies are also among the most prominent features. The area has rapidly grown to an urban status with its attendant pressure on land resources. This makes settlement and space for factories and development less available in the area. More than 60 to 65% of the land harbours factories, institutions, and human settlements, 20 to 25% for bush and forest, and 10 to 15% for agriculture. The land is either owned communally, by households or individuals.

Commercial, Recreational, Religious, and Other Contending Land Uses: Commercial (retail) activities account for a substantial land use category within the area. These retail outlets in the form of kiosks, grocery stores, periodic traditional market, etc constitute a major land use category (20%) as they pivot the local economy of the host community. As stated earlier, goods traded are mainly food items and some durable household items such as cooking pots, stores, cutlasses, clothes, etc. Other contending land uses are recreational facilities (10%), religious (5%), educational (30%), and institutional facilities (15%), amongst others.

CONCLUSION

The extraction of oil is responsible for the deforestation, degradation, and destruction of lands across

the study area. The oil extraction process has resulted in the spilling of toxic drilling by-products into local and international water bodies surrounding the study area. Broken pipelines and leakages have resulted in persistent oil spillage. Also, the construction of roads for accessing remote oil sites opens wild lands to land developers and destroys the ecosystem also. Some of the most promising oil and gas deposits of the study area lie deep in its tropical rainforests. While these fossil fuels can be extracted in an environmentally-friendly way, (protecting the ecology of the area), oil companies usually opt for expediency over consideration for the environment/ ecology or the interests of local people most affected by production. The activities of the oil multinationals have seriously, degraded the ecosystem and reduced the biodiversity of the study area, continuosly, for over a generation, thereby affecting the general ecology of the area. This has affected the lives of thousands of indigenous peoples and settlers. Over the past three decades, the study area has suffered serious degradation and deforestation. Oil spills and clearing for access roads, exploration, and production activities have damaged the surrounding rainforest and adversely affected the lives of local people. As at the mid-1990, lands once used for farming, lay bare and hundreds of waste pits remained. Pipeline ruptures; have blackened the water bodies of the study area. All these activities go hand in hand with insufficient clean-up methods along with widespread environmental degradation and serious health problems among local peoples. The exploitation of oil in the study area serves as a, particularly, negative example of oil development projects in the rainforest. Typically, oil companies cut roads through the forest in order to carry out operations. These roads are followed by transient settlers who colonize and damage the surrounding forest through slash-and-burn agriculture, the introduction of domestic animals, hunting, the collection of fuelwood, and often the introduction of foreign diseases to local dwellers. Besides the opening of oil roads, oil companies burn off by-products of natural gas in the open air, a process known as flaring. The flames, besides adding pollutants to the atmosphere, have caused fires that have destroyed many hectares of forest, threaten the lives of locals as well as having increased the spate of climate change and global warming. Oil extraction processes are relatively messy and destructive. Spills resulting from burst pipelines and toxic drilling by-products have been dumped directly into local creeks and rivers killing and disrupting aquatic life. From the human health point of view, eating fishes caught in these waterways have led to the outbreak of many health disorders amongst the indigenes of the study area. Some of the more toxic chemicals are often stored in open waste pits and have led to the pollution of surrounding lands and waterways. Indigenous and local peoples of the study area have often gained the least from oil extraction. For the impact on their homes, culture, environment, and health, these people generally see little in the form of compensation from the government or oil companies. A case in point is the Ogoni tribesmen in Nigeria who have seen little revenue from Shell's activities in the Niger River delta and have mostly relied on sabotage of oil installations to collect oil-spill compensation from Shell. Acid rain and the dry deposition of acidic particles, are also some of the problems in the study area, damaged buildings, automobiles, and other structures made of stone, metal, or any other material exposed to weather for long periods. The corrosive damage has been very expensive. Also, toxic substances leached from soils have polluted large volumes of local water in the study area. In the air, acids react with other chemicals and have produced urban smog, which have led to lung disorders among the populace, especially for people who already have asthma, bronchitis, or other respiratory diseases. Government and regulatory bodies have a potent role to play in maintaining and protecting the ecology and biodiversity of the fragile area, and at the same time protecting the area from the activities of multinationals. This should include enacting and enforcing pragmatic ecological laws that will protect biodiversity and enhance strict monitoring of industrial activities.

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