



Biodiversity and Oil Activities in the Niger Delta Region of Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author OAE designed the study, performed the statistical analysis, managed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author COE managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

The variation among living organisms, encompassing species, genetic and ecosystem diversity is known as Biodiversity. It includes all species of plants, animals, and microorganisms, the ecosystems and ecological processes of which they are part, covering all forms of life on earth. Oil activities have for over fifty years, been carried out in the Niger Delta, without recourse to the environment resulting in detrimental impacts on the environment with concomitant effects of biodiversity. This study investigates the impact of oil activities on biodiversity in the Niger Delta, deploying an eclectic approach in which, structured questionnaire schedule and focus group discussion were used to obtain relevant data. It concludes that the adverse effects of oil activities on the environment have had concomitant negative impacts on biodiversity in the Niger Delta.

Keywords: Biodiversity, oil, species, microorganisms, ecosystems, environment, Niger delta.

1. INTRODUCTION

Biodiversity (biological diversity) can be defined as the variation among living organisms, encompassing 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). Biodiversity includes all species of plants, animals, and microorganisms, the ecosystems and ecological processes of which they are part [1]. It covers the variety of all forms of life on earth and provides the building blocks for our existence and ability to adapt to environmental changes in the future [2]. It is the infinite variety of life forms; genetic diversity – variation of genes within individual species; species diversity – variety of species in flora and fauna and ecosystem diversity – variety of ecosystems, such as rainforests, coral reefs and deserts that exists in the planet [3]. The United Nations Convention on Biological Diversity, defined biodiversity to include diversity of ecosystems, species and genes and the ecological processes that support them [4]. This in a broad sense, it is essentially “life on earth” [5]. Biodiversity has various benefits (food, medicinals and biological control) and functions, with social, economic, sacred (cultural, spiritual), nutritional and linguistic values. It is the key to and the most important foundation for food security [6] has shown that though there may not be death as a result of hunger, the nutritional status of the people who live in areas where biodiversity loss is prominent is far from satisfactory as a significant proportion of the dwellers may suffer from malnutrition, even though they may not actually experience food shortages.

Natural diversity in ecosystems provides essential economic benefits and services to human society—such as food, clothing, shelter, fuel and medicines—as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development. Biodiversity is under threat in many areas of the world. Concern about global biodiversity loss has emerged as a prominent and widespread public issue. The biodiversity in the Niger Delta has been severely disturbed by oil activities in various ways. These include clear cutting of mangroves forests for seismic surveys, indiscriminate cutting of navigational canals - primarily to make way for drilling activities and staff housing, construction of access roads to all drilling sites

and oil wells. All these have resulted in the intrusion of salt water into freshwater swamp forests culminating in the succession of the native mangroves with nypa palms (*Nypa fruticans*) - an exotic plant species which is a fast colonizer but provides no extensive ecological services, [7].

Over 4600 plants species exist in Nigeria, of which about 205 are endemic. About 484 plant species in 112 families are threatened with extinction. Among the animals, 25 out of 274 mammals, 10 out of 831 birds, and 2 out of 114 reptiles known to exist in Nigeria are endangered [8].

Since the genesis of life on Earth, five major mass extinctions and several minor events have led to large and sudden drops in biodiversity [9,10,11]. With the emergence of humans, there has been an ongoing biodiversity reduction and an accompanying loss of genetic diversity. This reduction is caused primarily by human impacts, particularly habitat destruction.

Crude oil activities which has been going on in the Niger Delta region for over fifty years now has been fingered as the major source of pollution in the marine environment of the region [12,13,14,15]. Oil pollution causes severe damage to the environment that adversely impacts on soil microbes and plants as well as contaminating groundwater resources [16]. Crude oil also contains toxic components, which has caused outright mortality of plants and animals as well as other sub lethal impacts. Generally, toxicity is dependent on the nature and type of crude oil, the level of oil contamination, type of environment and the selective degree of sensitivity of the individual organism. The Niger Delta is well known for the production of light (sweet crude) crude which according to Proffit et al. has more lethal effects on the environment.

The mangrove ecosystem and its biodiversity is the main source of livelihood for the people of the Niger Delta and the incessant oil spills have implication for food security in the Niger Delta [17].

This study was therefore undertaken to determine the impacts of oil activities on biodiversity in the Niger Delta and the probable effect on the livelihood of the people in the Niger Delta region.

2. MATERIALS AND METHODS

Sediment and water samples were collected from three riverine communities in the Niger Delta region. Two of these communities – Nembe, Nembe local Government Area of Bayelsa State, and Okrika, Okrika Local Government Area of Rivers State have high oil activities while the third – Okpare, Ughelli North Local Government Area of Delta State is devoid of oil activities. The water samples were collected in sterilised plastic bottles and transported in an iced chest to the laboratory. Both the sediment and the water samples were then cultured in potato dextrose agar (PDA) for their microbial population and their species richness calculated. The samples were collected in January and July, the peak of the dry and wet seasons respectively for two consecutive years.

The species richness of the micro-organisms (bacteria and fungi) was calculated using the following formula:

$$\text{Mangalef's index} = S - 1 / \ln(N)$$

Where: S = Total number of species
 N = Total number of individuals
 Ln = Napierian logarithm

Well structured questionnaire schedule were also administered to residents in the same riverine communities in the Niger delta region, where the water and sediment samples were collected from. The population of this study is the core Niger Delta of Nigeria, which is made-up of the three major oil producing states of Bayelsa, Delta and Rivers (Fig. 1). These three states cumulatively, account for over 75% of the crude oil production in Nigeria. The sampling units were the oil-host communities in these three states, out of which three were randomly selected for the study. The questionnaires were administered using the Cluster Survey method of [18] as described by [19] and were administered to respondents in households based on availability. The sampling frame is all resident indigenes, as at the time of the survey. The actual population of each community is not known. However, since they are rural communities, a sample size of two hundred, was considered adequate and this was prorated based on the population [20] of the local government areas in which the communities are located. Based on these population figures, the sample size for each community, were as follows; Nembe 39, Okpare 95 and Okrika 66.

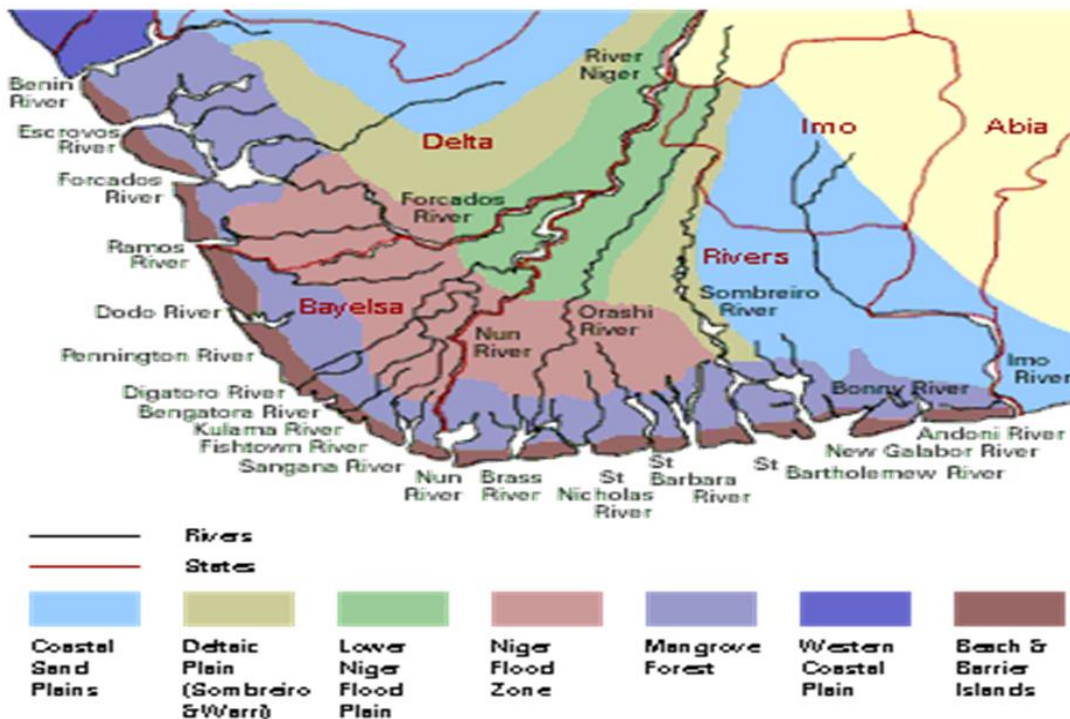


Fig. 1. Map showing the Niger Delta Region in Nigeria

There were also three focus group discussions, one at each location. Each group discussions comprised seven persons (4 women and 3 men) in each session, which lasted for a maximum of ninety minutes. The participants were merely expected to express their opinions on issues raised; hence there was no consensus on all issues. A fresh issue was raised only, after an earlier issue had been fully discussed. Due to the structure of the study, the measuring instrument was not weighted, thus, triangulation was deployed for the collection of field data. This model enables a researcher to cross-check data from multiple sources to search for regularities in data, which gives a more detailed and balanced picture of the situation being investigated [21,22].

3. RESULTS AND DISCUSSION

The Niger Delta region is rich in biodiversity as it is interwoven with fresh and salt water swamps, mangrove forests and abundance of aquatic and wild life, making it is a hot spot for biodiversity [23]. This biodiversity is however being threatened by the oil activities which has caused the spilling of millions of barrels of crude oil into the environment, most of which were never recovered [24,25,26] persistent gas flaring and dredging / canalization of old and new waterways respectively.

A study of the bacterial and fungal biodiversity index of the sediments and water samples collected from the region showed that with the exception of sediments from Okpare, the species richness were all below 0.5 (Tables 1 & 2) and even as low as 0.02 in Nembe and Okrika (Table 2).

Species richness indicates the variety of the particular fauna or flora in the region. The closer the index is to one (1) the more diverse the biodiversity and vice versa. This study shows that the bacteria and fungi were low in diversity as their species richness was nearer to zero than to 1. Previous studies [27,28,29,30] have shown that oil spills often kill or inhibit large sectors of microbial population, whereas soils devoid of pollution show greater numbers and diversity of microorganisms. Thus, the low biodiversity index

obtained in the region could be attributed to the incessant oil pollution experienced in the region. [31] in a study also observed that crude oil pollution has also resulted in the proliferation of some microbes and limiting the growth of other microbes. Bacterial community biodiversity in oil polluted sediments is often reduced despite increase in percentage, as oil pollution leads to selective enrichment of hydrocarbon utilising bacteria at the detriment of biodiversity [29,32,33,34,35,36,37,38,39,40]. Microbes play a very a very important role in the food chain as they form its foundation and without these organisms, there will be no putrefaction of dead flora and fauna.

An analysis of the questionnaires administered showed that there is a prevalence of oil pollution in the region as there has been incidences of oil pollution in all three communities visited (Fig. 2). It is noteworthy that communities without oil activities have also experienced oil pollution. This is an indication that the pollution is not restricted to only oil producing communities. Oil pollution has also been blamed for the reduction in fish catch and farm produce in the region as about 71% of the respondents riposted that oil pollution has resulted in a decrease in farm produce (Fig. 3), while 75% say that the oil pollution has caused a reduction in fish catch (Fig. 4). A reduction in the fish catch and farm produce is an indication that the biodiversity in the region is gradually being affected. About 81% of the respondents rely on the floral and faunal biodiversity in the environment (fishing, farming and hunting) for their survival (Fig. 5). This is an indication that the negative effect of the oil activities on biodiversity also negatively affects the livelihood of the residents in these communities. Some of the participants in the focused group discussion commented on the virtual disappearance of some fauna and flora in the region, corroborating the responses from the questionnaires. These views can also be supported by [41] on the disappearance of manatee and electric fish; [42] on the disappearance of edible frog (okhere), small red crayfish (iku-ewhewhe) epepete, iguana (ogbrigbo) and cocoyam (idu).

Table 1. Species richness in the sediments from the studied sites

	Bacteria			Fungi		
	Nembe	Okrika	Okpare	Nembe	Okrika	Okpare
Mangalef's index	0.36	0.37	0.64	0.40	0.31	0.63

Table 2. Species richness and pH of the water from the studied sites

	Bacteria			Fungi		
	Nembe	Okrika	Okpare	Nembe	Okrika	Okpare
Mangalef's index	0.36	0.36	0.48	0.02	0.02	0.03
pH	5.03±0.13	5.23±0.10	5.60±0.14	5.03±0.13	5.23±0.10	5.60±0.14

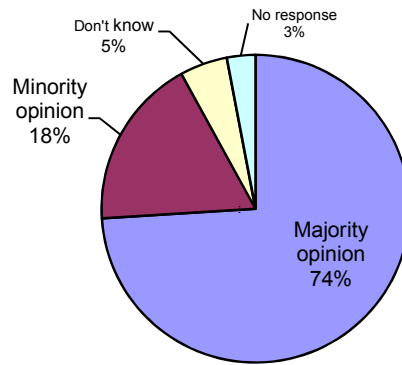


Fig. 2. Incidence of oil spills in the locality

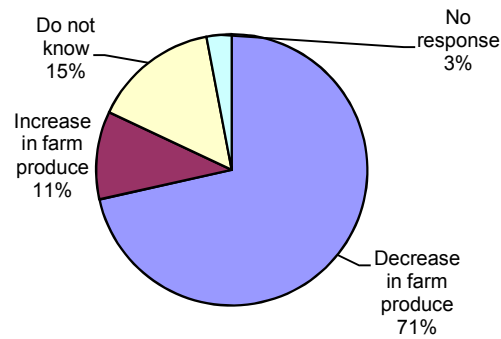


Fig. 3. Effects of oil pollution on farm produce

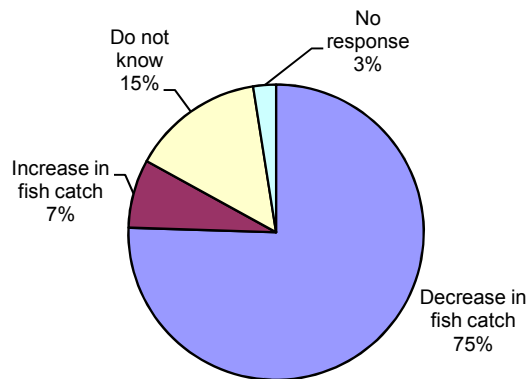


Fig. 4. Impacts of crude oil on fish catch

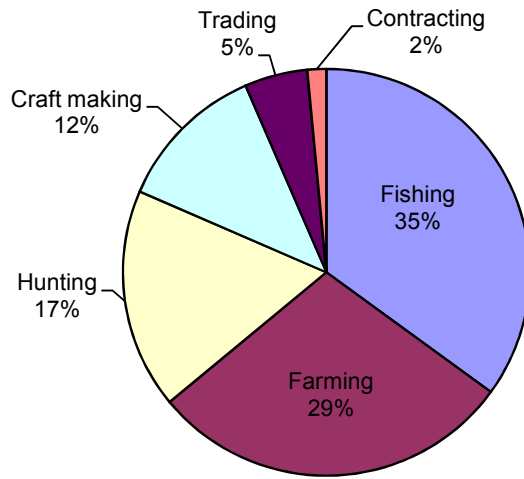


Fig. 5. Means of livelihood in the Niger delta

4. CONCLUSION

That there oil pollution in the oil producing communities in the Niger Delta region is no more in doubt. What is however worrisome is that this pollution has spread to non-oil producing communities in the region. This was observed in this study. The study also showed that the microbial species richness in the region is very low. These microbes are the basic units of life. Also observed in this study is the reduction in farm produce and fish catch, a situation which does not augur well for the region because their livelihood is being affected. The government is therefore advised to stem the tide of oil pollution in order to reduce or out rightly stop the depletion of the biodiversity and mitigate the suffering of the people of the region.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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