Logan Journal of Multidisciplinary Earth Sciences, and Sustainability
Volume 1 Issue 1 February 2025
ISSN: Pending…

ENVIRONMENTAL DEGRADATION AND ITS EFFECTS ON LIVELIHOOD SUSTAINABILITY IN THE NIGER DELTA'S RURAL AREAS

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Abstract: Natural resources are vital for human survival and development, as they provide the essentials for shelter, food, transportation, and energy. However, their over-exploitation can severely impact the sustainability of ecosystems and livelihoods. This study highlights the delicate balance between utilizing natural resources for economic growth and the environmental consequences of over-exploitation. Data reveals that the global extraction of minerals has tripled from 1970 to 2017, with projections indicating a further increase by 2060. Environmental degradation resulting from excessive resource extraction includes a significant loss of biodiversity, water stress, and high levels of greenhouse gas emissions. Studies from various regions, including those by Danish and Ulucak (2020) and Bekun, Alola, and Sarkodie (2019), demonstrate that while renewable energy consumption helps reduce carbon emissions, the extraction and consumption of non-renewable resources cause lasting harm to the environment. This underscores the urgent need for policies that integrate sustainable resource management practices to mitigate environmental degradation while ensuring the continued economic benefits of resource utilization.

Keywords: Natural resources, over-exploitation, environmental sustainability, renewable energy, carbon emissions

Introduction

Natural resources constitute the bedrock of the well-being of human beings. No human can survive without clean air, plants and water. Natural resources are used for man's shelter, clothing, home heating or cooling, vehicular movements, etc. (UNEP, 2020). Though natural resources are key assets that pilot developmental activities and wealth creation, their over-exploitation eventually affects the livelihoods and sustainability of humans who depend on these resources. The annual extraction of minerals globally, has tripled between 1970 and 2017, and by projection, global material use may exceed double by 2060. On the level of environmental impact, in 2017, the world experienced 90% of biodiversity loss, 90% of water stress and 50% of greenhouse gas emissions (UNEP, 2020). Danish and Ulucak (2020) in a study of the relationship between renewable energy consumption, institutional quality, economic performance and carbon dioxide emissions in eighteen Asia-Pacific countries (APEC), confirms that while renewable energy reduces carbon emission, non-renewable energy causes severe harm to the environment. In a study conducted in eighteen EU countries, Bekun, Alola and Sarkodie (2019) found a nexus between natural resource rent and CO2 emissions over time. This means that, the over-reliance on natural resource rent affects environmental sustainability in countries where conservation and management options are not considered necessary. How the environment is sustained is intrinsically linked to human's judicious use of natural resources. Environmental degradation takes place upon the exploitation of natural resources.

Invariably, the mode of man's encroachment on the environment determines the nature of the environment. Continued negative impact on the environment ensues when humans exploit the environment without

complementarily protecting it. Humans indulge in various productive activities to enhance their standard of living. Imperatively, societies that rely solely on the environment for their livelihoods are bound to be more affected by the exploitation of the natural resources. This is common among less developed countries such as those in Africa. A typical example is the Niger Delta region of Nigeria, where oil exploration has been on for several decades. The decades of oil exploration have decremented and degraded the natural environment. The most dangerous aspect of the exploration is oil pollution, which implies the discharge of hydrocarbon into the environment (Kamalu & Wokocha, 2011). The extent of degradation affects livelihoods and environmental resources. According to Oghenetega et al. (2021), oil pollution in host communities in the Niger Delta region affects the health, basic amenities, social and economic condition and livelihood of the inhabitants adversely. Oil spills cause a 60% reduction in the food security of households, leading to the prevalence of hunger and childhood malnutrition (Ordinioha & Brisibe, 2013). Africa is known to have vast quantities of natural resources, but with a severe prevalence of poverty. Africa is endowed with enormous quantities of fossil and renewable energy resources with frequent new finds. This implies an abundance of natural resources that generates huge revenues for the government but, unfortunately, with consequences of economic stagnation. It clearly explains the negative development associated with non-renewable resources, oil and other minerals. African countries with rich natural resources, depend on such resources for exports and revenues. In countries like Nigeria, Angola, Congo, Gabon and Equatorial Guinea, oil revenue constitutes over half of their total revenues, yet with high levels of poverty and food insecurity due neglect of agriculture and high rate of corruption. Pervasive environmental degradation through oil pollution is a major problem in oil-producing countries in Africa.

The main challenges of oil and gas in Africa are in the areas of geographic distribution of the resources, environmental problems, little knowledge of the resources, limited human capital, contracting procedures limitation, weak institutions, etc. (African Development Bank & African Union, 2009). According to Arthur and Amo~Fasu (2020), oil and gas production in towns such as Takoradi, New Town and Shama in Ghana has effects on fishing, the predominant livelihood of the local people. The people experience low fish catch, livelihood loss and environmental pollution and degradation.

A major problem of oil production in the Niger Delta is oil spillage that contaminates the environment because the growth of oil production increases the incidence of spillage (Eleke et al., 2019). Onuoha et al. (2018) in a study conducted in six communities in Akwa Ibom state, revealed that the end effect of oil spillage is basically the destruction of crops and fishes due to the pollution of rivers and soil that destroys livelihoods. Ojimba (2012) in a study conducted in Rivers State, examined the effects of oil pollution on crop production. The findings showed that oil pollution reduced the size of farmlands significantly by 1%. According to Odubo (2022), oil pollution causes low crop yield and a shortage of fish. Zhang et al. (2019) identified the severe impact of oil spills on mangroves. According to Akpoghelie et al. (2021), ground and surface water pollution due to the emission of hydrocarbon into the environment leads to food insecurity and health problems among humans. In addition, Oghenetega et al. (2021) identified oil pollution as a major source of health challenges due to the adverse effects of hydrocarbons on the environment. Bello and Amadi (2019) in a study on conservatism in the Niger Delta region, identified the lack of credible conservation practices as a cause of the intense degradation of the environment. This, they propose triggers the depletion of food resources and health challenges. Usman Yusuf (2021) blamed the operating oil companies for neglecting their responsibilities of remediation and compensation by taking advantage of the institutionalized corrupt system despite the statutory regulating laws. The study thus, concluded that companies should stop corrupt practices and do the needful. Ogbeibu et al. (2020) in a study on

groundwater quality conducted in the Sapele area of Delta State, identified severe metal contamination of surface water due to oil pollution.

Generally, the outcome of oil spills is environmental degradation and loss of income. The destructive impact of oil pollution on crops and fish affects the income of farmers and fishers. Farmers' income in oil-polluted areas is significantly lower than in areas that are not polluted by oil (Elum et al., 2016; Emmanuel et al., 2006). Ogunkeyede et al. (2022) found out that despite remediation, the petroleum hydrocarbons resulting from the oil spill at the Emede community in Delta caused soil contamination and are not good for crop planting. Ipingbemi (2009) while explaining the socio-economic and environmental effects of oil spillage in the Niger Delta region, averred that while fishing and farming accounted for 70% of the people's employment, the monthly income of 75% of fishers and farmers was less than N15,000 per month. Osuagwu and Olaifa (2018) opined that an increase in oil spills affects fish production negatively and that the prolonged impact of heightened oil spills reduces crop yield and fish. They also explained that since most of the rural households are peasants, polluting the source of fish catch deprives them of their inherent productive capacity.

Alvernia et al. (2021) asserted that fishermen experience a decline in income after oil spills compared to before the oil spills. Some farmers and fishers were thus, compelled to diversify their livelihoods to survive oil pollution. Odubo (2021) identified a positive relationship between livelihood diversification and income level among farmers and fishers in the Niger Delta. The higher the level of livelihood diversification, the higher the income.

A critical aspect of sabotage and pipeline vandalism, which escalated oil pollution in the Niger Delta region, is oil theft and bunkering. Oil theft and bunkering through the vandalising of oil pipelines caused several cases of oil spills in the Niger Delta communities (Nwilo & Badejo, 2008). Such activities resulted in the introduction of artisanal crude oil refining in the oil pollution narrative. Artisanal crude oil refining became a coping strategy adopted by farmers and fishers to cope with environmental degradation in the region (Odubo & Odubo, 2022). Artisanal crude oil refining is not a sustainable livelihood because its activities are a major source of ecological devastation in the Niger Delta, leading to the loss in both livelihood and national income. Mohammed et al. (2021) assert that a livelihood can be regarded as sustainable if it does not destroy the environment and livelihood sources. Though they recognized the fact that artisanal crude oil refining comes with some economic gains, they were emphatic that the gains cannot be compared with the economic loss to the nation. On the economic gains of the crude oil refining activity, Umukoro (2018) was of the view that, artisanal crude oil refining improves the living conditions of several people in the Niger Delta communities because it offers employment opportunities such as the sale of artisanal refined petroleum products etc.

Another major aspect of sabotage is pipeline vandalism, leading to crude oil supply to artisanal crude oil refineries and other destinations. Thus, heightened oil pollution in the Niger Delta region was due to the devastating impact of artisanal crude oil refining. According to Gundlach (2018), oil pollution is compounded by the activities of artisanal crude oil refiners, who are major causes of oil pollution. Artisanal crude oil refining generates waste that far surpasses the waste produced by mainstream regulated refineries (Naanen & Tolani, 2014).

According to the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services ((IPBES) Global Assessment Report of 2019, the world requires transformative change to protect the natural resources meant for the sustenance of humanity. This will require some fundamental shifts in production and consumption patterns, involving proper governance and management by governments. These objectives are enshrined in the 2030 Agenda for Sustainable Development by the United Nations, with governments aspiring to achieve sustainable management and efficient use of natural resources.

Though the implementation has not been speedy, various means have been deployed to enact the same by various governments. There is an increased attention to ensuring standards on resource exploitation and reducing environmental impacts (IPBES, 2019). Amer et al. (2024) stated that, the outcome of 27 empirical studies on various countries showed a positive correlation between natural resources and ecological footprint, implying that the upsurge in the exploitation and use of natural resources increases ecological footprint. However, they also revealed that some other studies showed conflicting results. In China, the upsurge in the use of natural resources

is more than the replenishments, leading to rapid exhaustion of resources, including the reduction of environmental quality. The ecological deficit of China shows that demand is more than the capacity of the ecosystem, leading to over-exploitation of natural resources, thus disturbing the equilibrium of the ecological environment (Ahmed et al., 2020)). Ehiomogue et al. (2022) drew a nexus between oil pollution and global food security due to a reduction in food and fibre production worldwide. Thus, Khan et al. (2020) encouraged policymakers in the United States of America to control the excessive use of natural resources and promote sustainable lifestyles, such as using renewable energy through relevant policies for a sustainable future for the country. Kattumuri (2019) established that good management of natural resources and collaborations among various sectors is capable of causing more plausible generation and transfer of knowledge that will enable decision-making to achieve sustainable development.

The COP28 UN Climate change conference held in Dubai in December 2023 identified the slow pace of efforts to address climate change under the Paris Agreement by nations of the world. Thus, countries responded with a decision to Fastrack actions on the issue. A key element of the decision was for governments to expedite actions on the transition away from fossil fuels to wind and solar power, which are renewables to preserve and protect the environment. The agreement signed at the closing of the conference marks the beginning of the end of the fossil oil era.

Theoretical Framework

The theoretical frameworks adopted in this work are the sustainable livelihood framework (Carney, 1998) and the resource curse theory. The sustainable livelihood framework explains that social, human, natural, financial and physical capitals are the key to other forms of assets. In this wise, households will need to create choices or opportunities to use these assets to create livelihood strategies to survive vulnerabilities. For example, households may get involved in multiple livelihood activities based on their choices and opportunities. These livelihood activities will, in turn, generate income for sustenance.

The assets are seen as building blocks of livelihoods and livelihood outcomes. In this study, human, social, natural, physical and financial capitals are identified, and how the combination of these assets is used to achieve better livelihood outcomes in view of the identified vulnerability was analysed. This is achieved by information gathering on the assets of households in the study area and the identification of problems and opportunities in their livelihood activities. Their major livelihood activities are farming and fishing. The oil spills have environmental, social and economic effects. The spills contain hydrocarbons that are harmful to livelihoods. This also affects the capital assets of households and opportunities for adaptation, leading to low income and a reduction in the number of farmers and fishers, which, in turn, engender food insecurity, poverty and several other social problems.

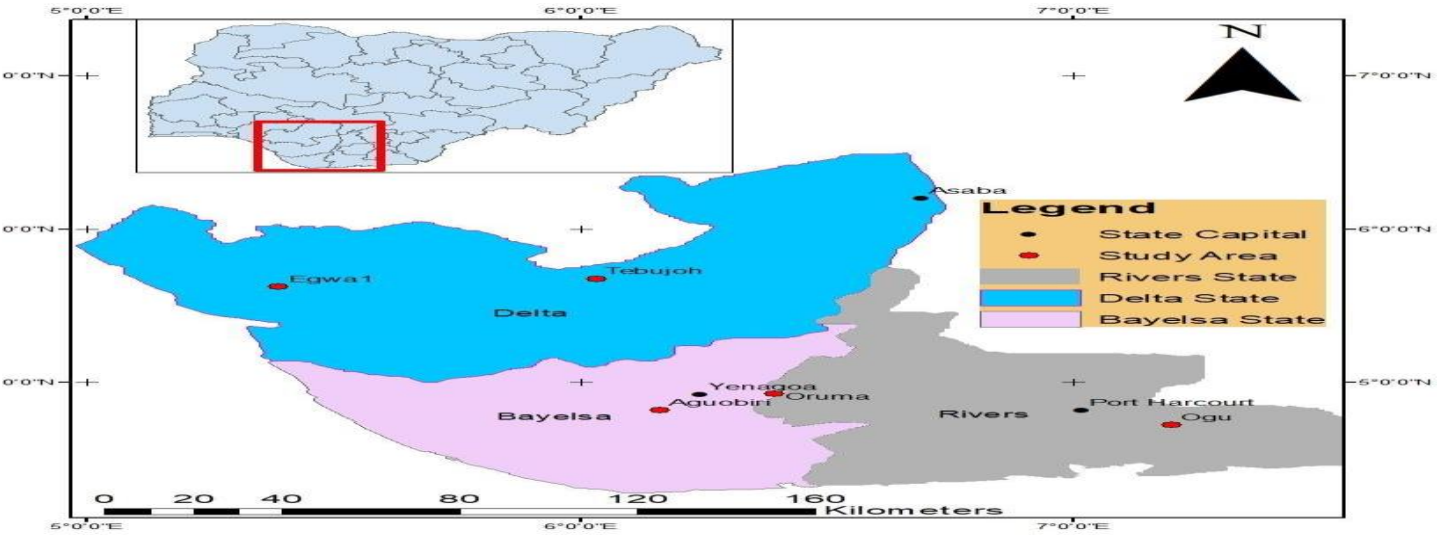

Figure 1: Map of selected Niger Delta states showing sample locations Rivers, Bayelsa and Delta States, Nigeria.
Source: Bayelsa State Geographic Information System Agency, Nigeria, 2015

The Niger Delta region is located in the South of Southern Nigeria. The region is rich in petroleum resources with several oil exploration and production companies operating therein. The region has both tropical and mangrove forests. While the tropical forest is made up of basically freshwater rivers, the mangrove forests and swamps contain salt water. Those in the freshwater area are predominantly farmers and fishers, while those in the mangrove and swamp areas are mainly fishers. Other traditional occupations in the region are palm wine tapping, oil milling, lumbering, local gin making, canoe carving, etc. The major language of the people is Ijaw. A crosssectional research design was adopted in this study. The study was conducted in Oruma and Aguobiri communities in Bayelsa State, Ido and Bille communities in Rivers State, and Egwa 1 and Tebujoh communities in Delta State. Figure 1 shows the selected states and communities. The three states and six communities were purposively selected due to the predominance of artisanal crude oil refining and oil pollution. Data for the study were obtained from primary and secondary sources. A simple random sampling technique was used to select households for the work. While data collection instruments were focus group discussions and structured interview schedules, the Taro Yamane formula was used to determine a sample size of 400, though 314 respondents actively participated in the research. Wilcoxon Signed Ranks Test was used to test if artisanal crude oil refining has a significant impact on income. The Statistical Package for Social Sciences (SPSS, version 22.0) was used for the data analysis.

Results and Discussion

Impact of Oil Pollution on Forests and Biodiversity

Forests form an integral source of livelihood in the rural communities of the Niger Delta region. Examples of such livelihoods are lumbering, palm wine tapping, canoe carving, hunting, periwinkle/crab picking and palm oil production. The degradation of the forests by oil pollution economically affects the said livelihood activities. The destruction of mangrove forests by oil pollution has led to the near depletion of economic trees, periwinkles, crabs, etc. FGD participants adduced that:

"*Oil pollution affects our forests severely. We now hardly do palm wine tapping, canoe carving, hunting, palm oil production, local gin production, etc. The effect on the mangroves has led to the depletion of periwinkles, crabs and edible worms. Generally, all these affect us so much and have led to low income among the rural dwellers.*" (FGD/Oruma).

"*Our environment is polluted heavily by oil. For example, the rivers and other waters in our communities are covered with much oil from oil pollution. The pollution is getting worse by the day due to the increase in oil spills. The spills are increasing because of the activities of oil bunkering and artisanal refining in our area. The face of our waters has changed more and become a source of destruction to animals that live in the waters. A good example are fishes and water snails*" (FGD/Egwa 1).

From the above, the oil pollution on forests and biodiversity affects livelihood in the Niger Delta region. The pollution involves air, water and land. The local people are severely affected by the pollution because of their dependence on the natural environment for livelihood. The mangroves are major sources of sustenance in terms of aquatic animals such as crabs, crayfish, water snails, fish etc. The respondents are having agonizing experiences due to adverse changes in the ecosystem caused by severe oil pollution. Crops such as yam, plantain, corn, etc., are affected by oil pollution, resulting in low harvest, food insecurity, low income and poverty. Rivers, creeks and underground water are also polluted, thus affecting the major sources of fish catch and other water animals.

Fishing and farming are the major occupations of people in the communities. Air pollution emanating from carbon emissions from artisanal refineries and gas flaring by oil companies are key elements that degrade the environment of Niger Delta communities. The destruction of economic trees such as palm trees and timbers by oil pollution is a major livelihood blow to palm wine tappers, palm oil producers and lumbers. The drastic pollution of livelihood activities has led to dwindling funds and number of traditional livelihood practitioners. The environmental and livelihood problems of the respondents are an outcome of unsustainable oil extraction activities that degraded the ecosystem and livelihood assets of the local people, causing households to adopt strategies to survive. A typical example of such a strategy is a change from traditional livelihoods, i.e. farming and fishing, to other livelihoods. This explains the reduction in the number of farmers and fishers. The impact of oil pollution leads to the loss of assets, which worsens the environmental, social and economic conditions of households. Incidentally, vulnerabilities that affect the natural, physical, human, financial and social capitals of people in the Niger Delta region are self-inflicted because the gains from the natural resources do not translate to societal development and growth. Such natural resources are considered to be a curse rather than a blessing.

Figure 2: Destruction of Forest and Vegetation caused by oil pollution at Oruma, Bayelsa State
Source: Field Work, 2019.

Impact of Oil Pollution on Financial Capacity

Respondents made vivid complaints about the destruction of their household items such as lamps, stoves, generators, etc. They lamented that the increased spending on repairs of these items was due to adulterated petroleum products from artisanal crude oil refining. They mentioned that apart from health problems associated with oil pollution, air pollution constitutes a major source of filth that defaces household items such as chairs, tables, floors, clothes, etc, due to soot. Soot also keeps the human feet extremely black, either indoors or outdoors. FGD participants averred that:

"*We suffer a regular breakdown of our generators, boat engines, stoves, and lamps these days because of low-quality petroleum products by people who refine these products themselves. We spend money to effect repairs or replace the items. Also, the soot from air pollution defaces our floors, chairs, tables, stools etc. The soot is very dark in colour. We often clean them. Soot also defaces ceilings and makes feet and clothes dirty*" (FGD/ Oruma).

"*The destruction of household items often occasions replacements that cost money, leading to more economic hardship for farmers and fishers. The increase in oil pollution often affects household items also. For example, we suffer the effect of soot even inside our houses. The soot often blackens our various household items. We often spend time to always wash to preserve them. Based on this, they often do not last. We use the money we need for other things to replace such items. This is even worsened by the massive pollution from the activities of artisanal refining. Another source of the soot is from the gas flaring activities of multinational oil companies*." (FGD//Egwa 1).

The above is indicative of the fact that the impact of oil pollution on financial capacity has to do with the effects of oil pollution on household items in relation to artisanal crude oil refining on one hand and the operations of multinational oil companies on the other. As earlier stated, artisanal refining worsened oil pollution in the Niger Delta region. The refining process is crude and dangerous. It involves the setting up of open fires to boil crude oil to distil petroleum products. The massive smoke that emanates from this act worsens air pollution through the production of soot, which affects household items such as chairs, tables, clothes, etc. Another dimension of the impact is the explosion of kerosene lamps and cooking stoves and the destruction of electricity generators due to low-quality kerosene and fuel from artisanal refineries. Lamps and electricity generators are commonly used as sources of power due to poor or lack of electricity from the national grid. The energy situation is very poor. The destruction of household items creates financial losses for community members. The patronage of low-quality kerosene and fuel is a result of lower prices and availability. Gas flaring by oil companies also generates soot that affects household items. Another dimension to the problem of gas flaring is acid rain, which affects roofing sheets. The replacement of roofing sheets requires considerable funds due to high cost. The problem of financial capacity is an outcome of unsustainable oil extraction activities that pollute the environment and livelihood assets of the local people, thus, causing households to lose funds and resources unduly. The unfortunate impact of oil pollution on natural, physical, human, financial and social capital in the communities is a pathway to poverty among traditional livelihood practitioners. Unfortunately, the social and economic circumstances suffered by households in the region are an offshoot of bad and corrupt governance that cannot convert the abundant natural resources to societal development and growth. The resources are, thus, referred to as a curse rather than a blessing, as already stated.

Impact of Oil Pollution on Occupational Tools

Occupational tools are often destroyed by oil pollution. The research interviewees maintained that fishers often have their equipment destroyed by the polluted waters. Tools like fishing nets are often smeared in oil in the polluted waters. Canoes and boats that are often smeared require frequent repairs. FGD participants pointed out that:

"*The oil that floats on the water due to pollution destroys our fishing tools. We often replace them because fishes avoid such pollution-ridden tools, e.g. fishing nets. Good fishing nets and other items do not last due to the effects of oil pollution*" (FGD/Aguirre).

"*Life is difficult with the problem of oil pollution in the environment. The pollution is also affecting our work tools, which are quite expensive. Usually, our tools, like fishing nets and twines, were meant to last long. But these days, the nets do not last that long. This results in unnecessary spending of scarce funds to effect replacements regularly. We cannot do our work without our tools. For example, we save to buy canoes. These canoes are made of wood. Since we paddle our canoes in these highly polluted waters, it affects the life span of the wood. Over time, canoes have become so expensive to buy*." (FGD/Tebujoh).

From the above, the occupational tools used for farming and fishing in the Niger Delta region are rudimentary tools such as hoes, cutlasses, knives, fishing nets, hooks & lines, canoes etc. These tools are usually replaced whenever they are damaged. The replacement of these tools requires funds. Since the demand for labour is high because of the use of rudimentary tools, the cost of procuring tools has become a burden to households.

The impact of oil pollution on work tools is quite expensive. Tools such as fishing nets, canoes, hooks, twines, etc, do not last long enough due to oil pollution. Replacement of these occupational assets triggers the spending of funds meant for other uses. Since canoes are made of wood and are the major means for farming and fishing

activities to be carried out, they are, thus, subject to the vagaries of polluted waters. Affected canoes do not stand the test of time. Occupational tools are quite expensive based on the prevailing circumstances. Unfortunately, the tools are indispensable and must be bought. Occupational tools are, thus, very significant in the daily lives of the local people, even though the effects of spending on such tools are enormous economically. While the impact of oil pollution on farm tools contributes to shortage and high cost of food, the impact on fishing tools contributes to fish shortage and high cost of fish. With vast quantities of natural resources, Africa is still considered to be a poor continent due to the high presence of poverty. The tremendous amount of fossil and renewable energy resources is mismanaged by a select few. This implies an abundance of natural resources with the ultimate consequences of economic woes. That explains the government's inability to manage the environment in terms of oil exploration and production. The main challenges are in the areas of resource distribution, environmental degradation, low human capital, weak institutions, etc (African Development Bank & African Union, 2009). The discovery of oil and other natural resources that would have brought about fortune has rather heightened corruption, insecurity, poverty and diseases.

Figure 3: Emissions from Artisanal crude oil refining camp at Gbaramatu community River Escravos River, Delta State, Nigeria

Source: Odubo & Onyige, (2019)

Impact of Oil Pollution on Human Health

Several health challenges have been experienced due to oil pollution. Deaths occur through water borne diseases and other sources due to oil pollution. Moreover, people get involved in the refining of crude oil due to the fact that oil-polluted waters and land have ruined their traditional livelihoods. Figures 2 and 3 show evidence of unsafe emissions and water pollution, respectively, in the study area. These artisanal crude oil refining activities are very dangerous to the environment and human health. Those involved in the refining are exposed to very high temperatures. They get very close to the burning fire used for refining without any form of protective equipment. This can affect their eyes, skin and other body organs, sometimes leading to untimely deaths when accidents occur. Deaths also occur through kerosene lamps and cooking stove explosions due to the low quality of these locally refined petroleum products. FGD respondents averred that:

"*People suffer health problems due to oil-polluted waters, land and air. Some have lost their lives. Even the crude oil refining process by the local people is very dangerous. Explosions occur in some camps, leading to deformities and deaths. The disasters are always very severe because the entire environment is filled with inflammable*

materials. For example, a very severe fire incident occurred in the Ibelebiri community in December 2017. The entire camp caught fire. Several persons lost their lives." (FGD/Oruma).

"*Due to the effect of increasing oil pollution in our community, people are becoming more careful in the use of water, considered to be contaminated by oil. We have the perception that more deaths are recorded now due to the effects of pollution. We believe that there could be severe health issues associated with oil pollution in the environment because of the level of pollution. Waterborne diseases are common in the community. We do not have good pipe-borne water. We rely solely on the river water for bathing, washing clothes and household utensils, as well as cooking. The companies and the government often neglect the environment. Most times, the clean-ups are not properly done*" (FGD/ Aguobiri).

The above quotations are indicative of the fact that oil spillage emanating from the activities of oil companies and artisanal oil refining degrades the rivers, creeks and underground waters, leading to diseases in communities in the Niger Delta region. These oil exploration and production activities, worsened by artisanal oil refining, caused severe pollution due to the dumping of wastes and spills into the rivers and creeks. Water pollution is harmful to humans, fish and other water animals such as periwinkle, crabs, crayfish, etc. The infected fish and other water animals are also a source of health concern to humans upon consumption. Air pollution also degrades the environment of the Niger Delta. Apart from the activities of artisanal refining, the burning of artisanal refining camps and products by security operatives is also a source of air pollution. One noticeable problem with air pollution is the change in air quality. The air gets warmer, particularly in gas-flaring and artisanal crude oil refining communities. It is common to see soot all around. Another dimension of the dangers of air pollution in this regard is the presence of acid rain. Such rains have severe environmental and health impacts on humans. The thick black smoke emanating from artisanal refining sites is very dangerous to human health. The existing air pollution can cause respiratory and skin infections, tuberculosis, etc. Rainwater collected from the roofs for drinking and other domestic use is dangerous to human health just as it affects or corrodes the roofing sheets. In summary, oil spillage emanating from activities of oil companies and artisanal oil refining degrades the rivers, creeks and underground waters and can lead to diseases in communities in the Niger Delta region. Incidentally, most community members rely mainly on river water for drinking and other domestic use because of the nonavailability of pipe-borne or clean water in several communities.

Impact of artisanal crude oil refining on income and occupation

Table 1: Cross tabulation analysis of occupation and monthly average income before artisanal crude oil refining.

Occupation	<$27.50	$27.50-$82.50	$85.40-$137.70	$140.50 above	and Total
Farming	10(12.2)	26(31.7)	30(39.5)	28(37.8)	94(29.9)
Fishing	62(75.6)	38(46.3)	34(44.7)	38(51.4)	172(54.8)
Trading	8(9.8)	10(12.2)	2(2.6)	2(2.7)	20(6.4)
Civil service	0(0.0)	2(2.4)	8(10.5)	6(8.1)	16(5.1)
Artisan	2(2.4)	6(7.3)	0(0.0)	0(0.0)	8(2.5)
Canoe carving	0(0.0)	2(2.4)	2(2.6)	0(0.0)	4(1.3)
Total	82(100.0)	82(100.0)	76(100.0)	74(100.0)	314(100.0)

(percentage in parenthesis)

Table 1 shows a cross-tabulation analysis of occupation and monthly average income before the advent of artisanal crude oil refining in the study locale. The analysis revealed that 12.2 percent of farmers earned less than

twentyseven fifty cents ($27.50). 31.7 percent were in the income bracket of between $27.50 and $82.50. 39.5 percent were in the income bracket of $85.40 to $137.70, while 37.8 percent fell within the income bracket of $140.50 and above. In addition, 75.6 percent of the respondents who are fishers earned less than twenty-seven fifty cents ($27.50). It is also shown that 46.3 percent were in the income bracket of between $27.50 and $82.50. 44.7 percent were in the income bracket of $85.40 to $137.70, while 51.4 percent fell within the income bracket of $140.50 and above.

Furthermore, 9.8 percent of traders earned below twenty-seven fifty cents ($27.50). 12.2 percent were in the income bracket of between $27.50 and $82.50. 2.6 percent were in the income bracket of $85.40 to $137.70, while 2.7 percent fell within the income bracket of $140.50 and above. Also, 0.0 percent of civil servants were in the income bracket of under twenty-seven fifty cents ($27.50), while 2.4 percent were in the income bracket of between $27.50 and $82.50. 10.5 percent were in the income bracket of $85.40 to $137.70, and 8.1 percent fell within the income bracket of $140.50 and above. Further analysis showed that 2.4 percent of artisans were in the income bracket of under twenty-seven fifty cents ($27.50). 7.3 percent were in the income bracket of between $27.50 and $82.50. 0.0 percent were in the income bracket of $85.40 to $137.70, while 0.0 percent fell within the income bracket of $140.50 and above. The analysis also showed that 0.0 percent of canoe carvers were in the income bracket of under twenty-seven fifty cents ($27.50).

2.4 percent were in the income bracket of between $27.50 and $82.50. 2.6 percent were in the income bracket of $85.40 to $137.70, while 0.0 percent fell within the income bracket of $140.50 and above.

Table 2: Cross tabulation analysis of occupation and monthly average income during artisanal crude oil refining

Occupation	<$27.50	$27.50-$82.50	$85.40-$137.70	$140.50 and above	Total
Farming	12(50.0)	22(33.3)	34(29.3)	24(22.2)	92(29.3)
Fishing	10(41.7)	30(45.5)	36(31.0)	34(31.5)	110(35.0)
Trading	2(8.3)	2(3.0)	6(5.2)	10(9.3)	20(6.4)
Civil service	0(0.0)	0(0.0)	8(6.9)	8(7.4)	16(5.1)
Artisan	0(0.0)	2(3.0)	6(5.2)	0(0.0)	8(2.5)
Canoe carving	0(0.0)	0(0.0)	4(3.4)	0(0.0)	4(1.3)
Sale of petroleum products	0(0.0)	10(15.2)	22(19.0)	32(29.6)	64(20.4)
Total	24(100.0)	66(100.0)	116(100.0)	108(100.0)	314(100.0)

(percentage in parenthesis)

Table 2 shows a cross-tabulation analysis of occupation and monthly average income with the advent of artisanal crude oil refining in the study locale. The data presented show that 50.0 percent of farmers are in the income bracket of under twenty-seven fifty cents ($27.50). 33.3 percent are in the income bracket of between $27.50 and $82.50. 29.3 percent are in the income bracket of $ 85.40 to $137.70 while 22.2 percent fell within the income bracket of $140.50 and above. Also, 41.7 percent of fishers are in the income bracket of under twenty-seven fifty

cents ($27.50). In all, 45.5 percent are in the income bracket of between $27.50 and $82.50. 31.0 percent are in the income bracket of $85.40 to $137.70, while 31.5 percent fell within the income bracket of $140.50 and above. Furthermore, 8.3 percent of traders are in the income bracket of under twentyseven fifty cents ($27.50). 3.0 percent are in the income bracket of between $27.50 and $82.50. 5.2 percent are in the income bracket of $85.40 to $137.70, while 9.3 percent fell within the income bracket of $140.50 and above. The analysis also showed that 0.0 percent of civil servants are in the income bracket of under twenty-seven fifty cents ($27.50). 0.0 percent are in the income bracket of between $27.50 and $82.50. 6.9 percent are in the income bracket of $85.40 to $137.70, while 7.4 percent fell within the income bracket of $137.70 and above. Also, 0.0 percent of artisans are in the income bracket of under twenty-seven fifty cents ($27.50). 3.0 percent are in the income bracket of between $27.50 and $82.50. 5.2 percent are in the income bracket of $85.40 to $137.70, while 0.0 percent fell within the income bracket of $140.50 and above.

Regarding canoe carvers, 0.0 percent of canoe carvers are in the income bracket of under twenty-seven fifty cents ($27.50). 0.0 percent are in the income bracket of between $27.50 and $82.50. 3.4 percent are in the income bracket of $85.40 to $137.70, while 0.0 percent fell within the income bracket of $140.50 and above. Finally, 0.0 percent of sellers of petroleum products are in the income bracket of under twenty-seven fifty cents ($27.50). 15.2 percent are in the income bracket of between $27.50 and $82.50. 19.0 percent are in the income bracket of $85.40 to $137.70, while 29.6 percent fell within the income bracket of $140.50 and above.

Table 3: Descriptive statistics on changes in income

	N	Mean	Std. Deviation	Mini-mum	Maximum	Percentiles 50th 25th	(Median)	75th
Income pre-artisanal refining	314	2.4522	1.11594	1.00	4.00	1.000 2.0000	0	3.0000
Income	314	2.98	0.929	1	4	2.00 3.00		4.00

Table 3 shows descriptive statistics on changes in income before and during the artisanal crude oil refining era. The mean rank of income is higher during this era of artisanal crude oil refining (2.98) than before the commencement (2.45). The median rank of income is also higher within this period of artisanal crude oil refining (3.0) than before the commencement (2.0).

Table 4 shows the rank analysis on changes in income. The analysis reveals that 68 (21.7%) respondents earn less income after the advent of artisanal crude oil refining. 158 (50.3%) respondents earned more income after the advent of artisanal crude oil refining, while the income of 88 (28.0%) respondents did not change after the advent of artisanal crude oil refining.

Table 4: Ranks Analysis on Changes in Income

		N	Mean Rank	Sum of Ranks
Post-Income - pre-artisanal income	Negative Ranks	68[a]	101.09	6874.00
	Positive Ranks	158[b]	118.84	18777.00
	Ties	88[c]		
	Total	314		

a. Present-Income < pre-artisanal income

b. Present -Income > pre-artisanal income
c. Present -Income = pre-artisanal income

Hypothesis Testing

Ho: Artisanal crude oil refining has no significant impact on income.

Table 5: Results of Wilcoxon Signed Ranks Test

Test Statistics[a]	Post-Income - pre-artisanal Income
Z	-6.196[b]
Asymp. Sig. (2-tailed)	0.000

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

Table 5 shows the results of Wilcoxon signed ranks test for the impact of artisanal crude oil refining on income. The analysis reveals that artisanal crude oil refining has a statistically significant impact (Z= -6.196, p=0.000) on income. The results of the Wilcoxon signed ranks test reveal that artisanal crude oil refining has a statistically significant impact on income (Z= -6.196, p=0.000). The null hypothesis was rejected.

Discussion of Findings

The study shows that exploiting the natural environment through oil exploration and production activities without complementarily replenishing it led to oil pollution in the Niger Delta Region of Nigeria. This affected forests and biodiversity, occupational tools, household items and livelihoods of rural communities in the region. Several persons in rural communities in the region rely on the natural environment for their livelihoods. The predominant livelihoods of the people are fishing and farming. These have been altered by oil pollution. The negative impact of oil pollution on the environment, which has escalated with the advent of artisanal crude oil refining, has resulted in the loss of income of fishers and farmers. The UNDP report of 2006 warned that the continuous activities of oil refining would lead to the eradication of mangrove habitat in the affected areas. Artisanal crude oil refining in the region worsened the oil pollution problem because it added to the pollution emanating from the activities of the oil companies. From the UNEP report of 2011, artisanal crude oil refining is also a main source of oil pollution in the Niger Delta region.

According to the study, artisanal crude oil refining has a statistically significant impact on income. This is in line with the findings of Osuagwu and Olaifa (2018), who revealed that an increase in oil spills negatively affects fish production and crop yield. While non-traditional livelihood practitioners, such as sellers of artisanal petroleum products, make more income, those who engage in traditional livelihoods, such as farming and fishing, earn less income due to the devastating effect of oil pollution on livelihoods that traditionally rely on the environment for sustenance. This accounts for the dwindling number of farmers and fishers, thus, aggravating the traditional livelihood sustainability problem in the region. The decline in the number of farmers and fishers due to low income, results in food insecurity as a result of less quantity of food supply. Oil spills cause a 60% reduction in the food security of households, leading to the prevalence of hunger and childhood malnutrition (Ordinioha & Brisibe, 2013). Ground and surface water pollution can cause health challenges among humans due to the emission of hydrocarbon into the environment (Akpoghelie et al., 2021). Oghenetega et al. (2021) also identified oil pollution as a major source of health challenges due to the adverse effects of hydrocarbons. These health issues are severe because of the neglect by the government, which fails to take adequate measures to control oil

production as well as remediate the polluted environment. For example, some of the consequences of oil production in South Sudan include pollution, bad governance, health hazards due to contamination of water, and pollution of land and air (Fallet, 2010). The same scenario plays out in Nigeria and other oil-producing African countries where the impacts of vulnerabilities on the natural, physical, human, financial and social capital of people in the communities are considered to be self-inflicted. Rather than attaining development and growth with the abundance of natural resources, societies are without meaningful progress.

Mittelman (2014), like other scholars, is also of the view that in less developed countries such as Africa, the discovery of oil or other natural resources that would seem to bring about fortune instead leads to corruption, insecurity and poverty. The resources are mismanaged and stolen by government officials and foreign companies. This automatically affects other segments of the economy, leading to a high cost of goods and services. Local populations are neglected with little show for their resources. Incidentally, most of the local population relies on the natural environment for their sustenance. Therefore, livelihood sustenance becomes a problem.

This occurrence is despite the fact that the United Nations is projected to eradicate hunger by 2030 under the Sustainable Development Goals Objectives. In 2015, the United Nations adopted the 2030 Agenda for Sustainable Development as a road map to transform the world by enhancing the well-being of humanity. Imperatively, the effect of fossil fuel on agriculture is a drawback to achieving the milestone of eradicating hunger, particularly, in developing countries.

In the Niger Delta region, more than 60 percent of the people are dependent on the natural environment for their sustenance and livelihood. Oil pollution contaminates the soil and affects agriculture severely, leading to low yield, low income and food insecurity (Amnesty International, 2009). In these communities, low income, as shown in the tested hypothesis, was not unexpected based on the intense level of environmental exploitation and degradation and reduced quantity of food production, worsened by the dwindling number of farmers and fishers. Studies have shown that for agriculture to be productive, the soil must be adequately fertile. Sims et al. (2015) identified pollution as one of the causes of food insecurity in Africa. But in low-income countries of Asia, despite the pollution, the major problem of food insecurity is more of high global energy prices.

So far, land and crop production contamination are not limited to Africa and Asia. It also features in other parts of the world where oil production occurs, such as the United States of America, Gulf countries and South American Countries (Song & Davis-Kollman, 2019; Asem et al., 2016; Espana et al., 2018).

The impact of oil pollution seems worse in Africa due to the source and rapidity of oil pollution. In Africa, unsustainable oil extraction activities have immensely degraded the ecosystem and livelihood assets of local people. Households, therefore, needed to adopt strategies to survive. One such strategy is to change livelihood, which explains the migration from traditional livelihoods. The impact of the vulnerabilities led to further loss in assets, worsening the precarious environmental, social and economic conditions of households. In Africa, the impacts of vulnerabilities that affect the natural, physical, human, financial and social capital of people are self-inflicted because natural resources do not translate to the development and growth of the society. Such resources are considered to be a curse rather than a blessing because they become a source of backwardness. Most of the oil pollution is caused by the lack of enforcement of environmental laws by the government against the operating oil companies due to corrupt practices and sabotage. A critical aspect is sabotage and pipeline vandalism, which escalated oil pollution in the Niger Delta region. Sabotage and vandalising of pipelines and corroded networks of oil pipelines account for most of the cases of oil spills in the Niger Delta region (Nwilo & Badejo, 2006). Thus, the ensuing environmental degradation negatively impacts the capital assets of the local of oil in Sudan is a curse

in the communities rather than a blessing. There are no set standards for enforcing rules on oil production. Just a small fraction of the population benefits from the oil, while a large proportion of the society suffers in poverty due to bad governance. Some of the other consequences of oil production in South Sudan include pollution, bad governance, health hazards due to contamination of water, and pollution of land and air (Fallet, 2010).

Eze and Eze (2014) stated that, unlike the situation in Nigeria, where pollution matters are not regarded as important, Canada has infrastructure and training for rapid response to oil spills. Gas flaring is prohibited in Canada. The relevant Federal Agencies responsible for ensuring that appropriate reporting, surveillance and response mechanisms in Canada are efficient and deal effectively with Environmental emergencies. There are no overlaps of functions. Eze and Eze (2014) also stated that the United Kingdom, like Canada, has well-defined environmental laws that are adhered to. The crude oil pipelines in those climes are of high quality. There are, so far, no reported cases of oil spillage caused by pipeline failure. The United Kingdom also has effective agencies that protect the environment. The United States also has the awareness that oil and gas activities are hazardous and, as such, in readiness to address the situation at all times. This is unlike in Nigeria where the preoccupation of government is to maximize oil output with little or zero attention to the damaging effects of oil production on the environment. A country like Saudi Arabia has issues similar to those of Nigeria, Angola, and Iraq in terms of low political will, lack of technical capabilities, and the lack of public participation, etc. However, Saudi Arabia has a known framework for the control of oil and gas pollution. In the United States of America, Canada, and the United Kingdom, there are no incidences of sabotage of oil facilities, as in Nigeria, where there are frequent cases of pipeline vandalism (Eze & Eze, 2014). In Africa, since the extraction of oil and other natural resources is handled without following best global practices, the impact on the physical environment becomes very severe.

Despite the economic benefits of oil production globally, the contaminants have done enormous damage to land, air and water resources. Though natural resources are key assets that pilot developmental activities and wealth creation, over-exploitation eventually affects the livelihoods and sustainability of humans (UNEP, 2020)). Over-exploitation and increased use of natural resources can result in a rapid upsurge of ecological footprint (Amer et al., 2024). At the COP28 UN Climate Change conference held in Dubai in December 2023, countries agreed to expedite actions to transition away from fossil fuels to wind and solar power, which are renewables to save the environment.

Conclusions

The study explored the impact of oil pollution on the environment and income in the Niger Delta region. It revealed that artisanal crude oil refining, in the context of the escalation of oil pollution, has a statistically significant impact on income. While non-traditional livelihood practitioners, such as sellers of artisanal petroleum products and others, make more income, those who engage in traditional livelihoods, such as farming and fishing, earn less income mainly because of the devastating effect of oil pollution on livelihoods that traditionally rely on the environment for sustenance. This accounts for the dwindling number of farmers and fishers, thus aggravating The resultant effect is a decline in the number of farmers and fishers, leading to food insecurity, poverty, etc. Oil and gas production in towns such as Takoradi, New Town and Shama in Ghana effects on fishing (Arthur & AmoFasu, 2020). Part of their recommendation was that rules regulating the operations of oil and gas companies should be enforced. Also, relevant international conventions on oil and gas production should be domesticated to ensure global best practices. In Angola, the story was not quite different. Oil exploration and production led to soil erosion and deforestation. Oil pollution also affected wide areas of the Angolan coast causing the fishers to see their catch drop due to the death of fishes or the decline of environmental conditions. A typical example is the

Bay of Luanda (Rodriguez et al., 2014). Oil pollution and gas flaring in sub-Saharan countries create health problems and environmental effects that adversely affect livelihoods where the local people depend on the natural environment, e.g. agriculture and fishing. A pertinent issue in the operations of oil companies is the inability of governments to implement enabling laws to regulate their activities. The issue, however, is not a problem of lack of laws, but the lack of will to implement them (Baumuller et al., 2011). Pervasive environmental degradation through oil pollution is a major problem in oil-producing countries in Africa. The main challenges of oil and gas in Africa are in the areas of geographic distribution of the resources, environmental problems, little knowledge of the resources, limited human capital, contracting procedures limitation, weak institutions, etc. (African Development Bank & African Union, 2009). The existence of oil contributed to the war and problems in the post-war era in Sudan. This was a result of the implications of solely relying on natural resources. The existence farmers and fishers in the region. Farming and fishing are the predominant occupations of people in the rural communities of the Niger Delta. It is recommended that the Government should promptly remediate oil-polluted sites to protect the environment from severe degradation to enhance the sustainability of traditional livelihoods. While the quality of oil pipelines and monitoring should be properly handled, modern technology should be deployed to detect pipeline vandalism or oil theft proactively. The government should provide relevant intervention policies such as the provision of infrastructure, credit facilities, modular refineries and other programmes to discourage artisanal crude oil refining and boost farming and fishing for the sustainability of traditional livelihood strategies in the region.

While operating multinational oil companies should be compelled by the government to meet sustainable environmental standards through the enforcement of existing environmental laws, rural households in the communities should be sensitized on the ills of artisanal crude oil refining to the environment and livelihoods.

Acknowledgement

This paper was made possible in part by a grant from Carnegie Corporation of New York. The statements made and views expressed are solely the responsibility of the authors. Furthermore, the authors gratefully acknowledge the support from the Future Africa Research Leader Fellowship (FAR-LeaF) Programme at the University of Pretoria.

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