Perceptive assessment of oil-spill impact on the ecosystem in Asemoku, Ndokwa East L.G.A of Delta State

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Abstract

Oil explorations and syphoning has since been documented as a major source of foreign exchange earner for Nigeria. On the other hand, its (oil) exploitation has come with several environmental impacts, which mainly results from its spills. This study assessed oil-spill impact on the ecosystem in Asemoku, Ndokwa East L.G.A of Delta State, which is an area within the oil producing area of Nigeria. The cross-sectional research design was deployed and data gathering was realized using questionnaire. The Taro Yamane techniques was used to determine 400 respondents. Data analysis was done using Kruskal Wallis test and Spearman's rank correlation coefficient. The result indicated that there have been several spill incidents in the area (83%). Spill impacts were identified to affect farm lands (33%), crop yields (21%), ground and surface water quality (15%) etc. There was no significant difference in the perception of the locals in relation to oil spills impacts in the area at $p>0.05$. There was a significant relationship between crude spills and crop yields in the area at $p<0.05$. A major contribution of this study to the literature that is instructive for policy intervention, is the fact that perception showed that the community though produces oil and negatively impacted, is neglected in the provision of ameliorative and basic amenities. This study recommended among other things, that oil companies and the government agencies for spill protection, monitor spill incidents regularly, and the enforcement of compensation to the local farmers in Asemoku be done immediately after spill incidents.

Keywords: Crude-Oil, Crude-Spills, Impact-Assessment, Ecosystem-Conservation

1. Introduction

Oil spills represent one of the most severe forms of environmental pollution (Jernelöv, 2010), inflicting widespread and long-lasting damage on ecosystems around the globe (Solo-Gabriele et al., 2021, Ozabor et al., 2024). These spills occur primarily during the extraction, transportation, and storage of petroleum products (Silva et al., 2014), often due to accidents, equipment failures, or deliberate acts of sabotage (Aroh et al., 2010; Godspower et al., 2023). The resultant contamination poses significant threats to terrestrial and aquatic ecosystems, disrupting biodiversity, degrading habitats, and impairing the health of flora and fauna (Ogidi & Akpan, 2022; Ushurhe et al., 2023). Throughout history, numerous oil spills have had devastating impacts on the environment (Zhang et al., 2019). Iconic incidents, such as the Exxon Valdez spill in 1989, which released approximately 11 million gallons of crude oil into Alaska's Prince William Sound, highlighted the catastrophic potential of such events (Piatt et al., 1990). Mention can also be made of the Deepwater Horizon spill in 2010, which resulted in the discharge of around 210 million gallons of oil into the Gulf of Mexico. These spill incidences underscore the persistent risk associated with offshore drilling (Okumagba & Ozabor, 2014; Shultz et al., 2015). Also, these incidents, among many others, have driven global awareness and regulatory efforts aimed at preventing oil spills and mitigating their impacts (Ivshina et al., 2015). The questions at this juncture are, what is the awareness levels of those who dwell in the developing countries as compared with their counterparts in the developed countries? What is the level of mitigation?

The marine environments are particularly vulnerable to oil spills due to the vast spread of oil slicks and the sensitivity of marine organisms to hydrocarbons (Beyer et al., 2016; Ushurhe et al., 2024). Oil spills can

smother coral reefs, leading to coral bleaching and mortality (Saadoun, 2015). Additionally, oil spills can devastate plankton populations, which form the base of the marine food web, leading to broader ecological imbalances (Fahd et al., 2021; Ifuwe & Onosemuode, 2024). Furthermore, coastal and wetland areas are crucial buffers between terrestrial and marine environments, providing habitat for diverse species and protecting inland areas from storm surges and erosion (Ozabor & Wodu, 2016). Oil contamination in these areas can lead to the death of vegetation, such as mangroves and marsh grasses, which are essential for stabilizing shorelines and supporting wildlife (Ozabor & Obisesan, 2015; Onyena & Sam, 2020; Christabel & Christopher, 2024b). The loss of vegetation and animal life in wetlands can also reduce overall biodiversity and disrupt ecological functions.

Oil spills on land, though less common than marine spills, can have equally severe consequences (Michel & Fingas, 2016; Ushurhe et al., 2024b). Contaminated soil inhibits plant growth and reduce agricultural productivity, affecting food security and local economies (Gomiero, 2016; Nwagbara et al., 2017). Terrestrial wildlife suffers from direct exposure to oil, leading to poisoning, loss of habitat, and reduced reproduction (Kendall, 2016; Okumagba & Ozabor, 2016). Oil residues in soil can persist for years, posing long-term risks to the health of ecosystems and communities (Duan et al, 2015). In the literature, there is a serious compendium of work concentrating on the physical assessment of the impacts of oil spills on the environments (Piatt et al., 1990; Zhang et al., 2019), with very few works exploring the perceptions of affected persons. Therefore, this study is centred on assessing the perception of locals about the impacts of oil-spill on the ecosystem in Asemoku, Ndokwa East Local Government Area (L.G.A) of Delta State.

2. Materials and methods

This study was carried out in Asemoku. Asemoku is one of the Villages in Ndokwa East Local Government Area (LGA) of Delta State, situated on the Eastern fringes of the state. It is bordered to the North by Aniocha south and Oshimili South LGAs respectively. The area is bordered in the East by River Niger and to the South by Isoko south and to the West Isoko North and Ndokwa West (figure 1). The Nigeria Agip Oil Company (NAOC) pipeline passes through several communities and Asemoku is one of them. In terms of geo-referencing, the area lies on latitudes 5°.55’ and 5°.69’ North and longitudes 6°.40’ and 6°.56’ East.

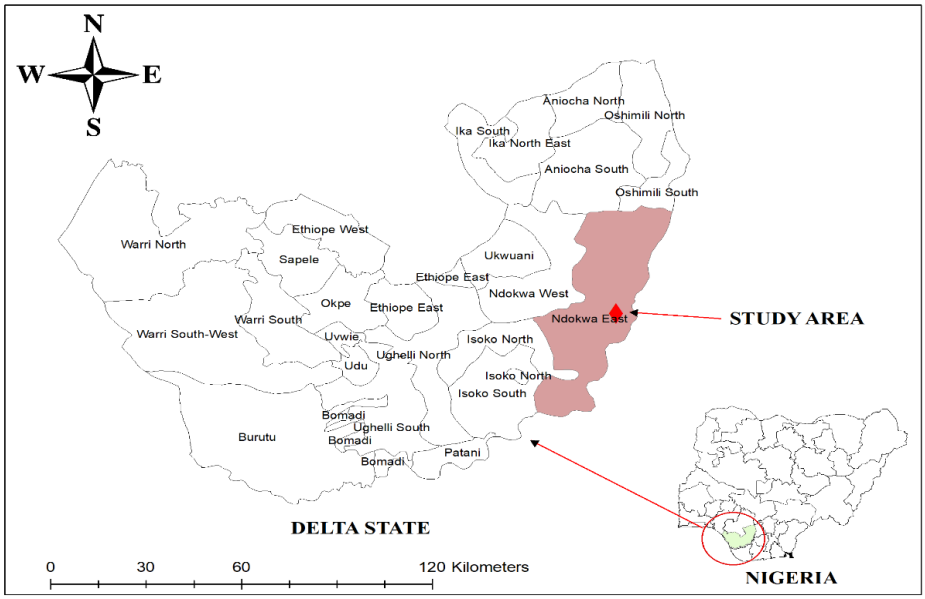

Figure 1: Map of Delta State showing Ndokwa East.
Source: Ifuwe and Onosemuode (2024)

The area is largely an agrarian society, which enjoys the tropical monsoon type of climate; with a temperature that ranges between 27-29°C annually (Ozabor & Ajukwu, 2023) and a total amount of rainfall that ranges from 2105mm to 2200mm annually (Ozabor, 2014). However, recent spill that have happened in the area have affected the productivity of lands and the yields of crops in the area (Ukhurebor et al., 2021; Ozabor & Nwagbara, 2018).

The study deployed the cross-sectional design. The area was delineated into five based on existing quarters (Famous & Adekunle, 2020). The local population was enumerated and a total of fifty thousand, two hundred and thirty four (50234) persons were determined using house hold size. After the determination of the population, the Taro Yamane formula was used to determine a sample size of 400 respondents. The designed questionnaire was distributed using the random sampling techniques. The inclusive criteria were persons of the age cohort of 30-60 years of age; locals that could communicate in English or at least "pidgin English"; and locals who are farmers and understood the trend of spills and the effects of them (the spills) on the crops in the area (Weli & Famous, 2018; Weli et al., 2017). The instrument was tested for validity using the aid of a psychometric experts. While the instrument reliability was tested using the test re test method. This was achieved when the instrument was administered on respondents in the area at two different intervals of three weeks apart. The respondent size for this reliability test was 40 (10%) of the total sample size. The results of the twin assessment were tested using the Pearson's Product Moment Correlation (PPMC) and a result of r-0.92 was realized. On the strength of this result, the instrument was administered in the area. Data analysis was done using Kruskal Wallis test and Spearman's rank correlation coefficient. There spearman's rank correlation was used to test for relationship between crude spills and crop yields in the area; while the Kruskal Wallis test checked for differences in perception of impacts across the study area as touching crude oil spills. The analyses were done in the environment of the statistical package for the social sciences (SPSS) version 25.

3. Results and Discussion

The results of the study of oil spill incidents and the environmental effects in Asemoku, are presented in Tables 1-8. Table 1 presented the demographic characteristics of the study. The inclusive criteria of respondents for the study were ages between 30 and 60 years of age. The majority of respondents fell within the 30-40 years range with 47.3% of the total respondents. The 51-60 years were the lowest of the respondents' population and represented 14.4%. The low turnout of the elderly may have been as a result of unwillingness to be interrogated and/or language barrier. The male population were more than that of the females (70.9%>29.1%). As for the education status of the respondents, the respondents were fairly educated with only 17.7% reporting not to have received any form of formal education. However, of the educated population, those with primary (26.1%) and secondary (36.2%) education dominated.

Table 1: Demography of respondents in Asemoku

Variables	Categories	Frequency	Percent (%)
Age cohorts	30-40 years	187	47.3
	41-50 years	151	38.2
	51-60 years	57	14.4
	Total	395	100.0
Gender	Male	280	70.9
	Female	115	29.1
	Total	395	100.0
Educational level	Primary	103	26.1
	Secondary	143	36.2
	Post-secondary	79	20.0
	No formal education	70	17.7
	Total	395	100.0
Occupation	Fishing	78	19.7
	Private business	111	28.1
	Farming	167	42.3
	Government employee	24	6.1
	Unemployed	15	3.8
	Total	395	100.0

The respondents were engaged in fishing (19.7%), farming (42.3%), private business (28.1%) and by government (6.1%). The unemployed among the respondents represented 3.8%. The reported data shows that majority of the inhabitants of Asemoku suffers in the event of any environmental pollution (oil spill inclusive) (Bayode & Adewunmi, 2011).

Table 2 reported the respondents' perception of the occurrence of oil spill in Asemoku and 83% of the respondents confirmed to have experienced oil spill in the area. As for the severity of oil spills, 47.9% reported that the spills were severe, while 33.9% reported that the spill were very severe spills (Table 3).

Table 2: Occurrences of oil spill incidents in Asemoku

Opinion	Frequency	Percentage (%)
Yes	328	83.0
No	67	17.0
Total	395	100.0

Table 3: Severity of oil spills in Asemoku

Severity levels	Frequency	Percentage
Very severe	72	18.2
Severe	189	47.9
Not severe	134	33.9
Total	395	100

The spills were reported to have happened mostly within 1-5 years (59.2%) while 31.1% reported that the spills happened within a period of 6-10 years period (Table 4). This reported frequency is dangerous for agriculture, surface and underground water systems and even aquatic life (Okereafor et al., 2020). This is because the environment is not able to heal at this frequency reported (Teal & Howarth, 1984). This finding agrees with that of Asif et al. (2020).

Table 4: Frequency of spills in Asemoku

Times	Frequency	Percentage
One spill in ≤ 1 year or less	38	9.6
One spill in 1-5 years	234	59.2
One spill in 6-10 years	123	31.1
Total	395	100

The effects of oil spills in the area have been reported in table 5. From the responses, 75.9% of the respondents agreed that oil spills affected the farm lands and the weighted average (3) showed that the majority of the respondents were of this opinion. Majority (74.7%; WM 3) also affirmed that the oil spills that have occurred in the area were also responsible for the poor yield of crops. Same could be said about oil spill effects on biodiversity (71.6% agree; WM 2.9) and fishing (62.8% agreed, WM-2.7). However, the respondents disagreed (72.9% disagree; WM 2) that oil spill have effects on the traditional culture and values. The respondents also revealed that the events of oil spills in the area have affected land surfaces (80.8% agree; WM 3.1); Surface and underground water (90.4% agree; WM-3.5) and Social Economic activities (90.6% agree; WM-3.3).

Table 5: Effect of oil spills on the environment of Asemoku

Effects	SA(%)	A(%)	SD(%)	D(%)	Total (%)	WM
Impacts of spills on farm lands	144(36.5)	156(39.5)	44(11.1)	51(12.9)	395(100)	3.0
Effects of spills on crop yields	148(37.5)	147(37.2)	42(10.6)	58(14.7)	395(100)	3.0
Effects on Biodiversity	126(31.9)	157(39.7)	66(16.7)	46(11.6)	395(100)	2.9
Effects on fishing	109(27.6)	139(35.2)	76(19.2)	71(18)	395(100)	2.7
Effects on Traditional culture and values	46(11.6)	61(15.4)	154(39)	134(33.9)	395(100)	2.0
Effects on land surfaces	164(41.5)	155(39.2)	41(10.4)	35(8.9)	395(100)	3.1
Surface and underground water	234(59.2)	123(31.1)	25(6.3)	13(3.3)	395(100)	3.5
Effects on Social Economic activities	159(40.3)	199(50.4)	23(5.8)	14(3.5)	395(100)	3.3

These findings agree with that of Ivshina et al. (2015) who suggested that the occurrence of oil spill not only affect the environments by destroying the flora and fauna in the ecosystem, but also spill incidents affects humans and their very means of survival. This is because farms are affected, yields are distorted and then food insecurity pervades as a result of spills.

Table 6: Compensation and cooperate social services rendered by the oil companies to the community

Options	Frequency	Percentage (%)
Yes	17	4.3
No	378	95.7
Total	395	100.0

There have been no compensation for spill incidents in the study area. This is as suggested by 95.7% of the respondents. This suggests that the locals are faced with the double tragedy of coping with loss of livelihood and prevalence of hunger and diseases as corroborated by Ocholi (2022). The impacts as perceived by the locals (Table 7) is not significantly different spatially at $p>0.05$ (X^2 .259, Asymp .968). This simply implied that the locals have similar experience in terms of crude oil pollution.

Table 7: Test for the significant difference in the perception of the locals in relation to oil spills impacts on the environment

	Effects of oil spills on the environment
Chi-Square	.259
df	3
Asymp. Sig.	.968

a. Kruskal Wallis Test
b. Grouping Variable: Identifiers

Table 8: Spearmans rank correlation for relationship between crude spills and crop yields in the area

			Crude_Spills	Crop_yield
Spearman's rho	Crude Spills	Correlation Coefficient	1.000	.697**
		Sig. (2-tailed)	.	.000
		N	395	395
	Crop yield	Correlation Coefficient	.697**	1.000
		Sig. (2-tailed)	.000	.
		N	395	395

****. Correlation is significant at the 0.01 level (2-tailed).**

In table 8, there was a significant relationship between crop yields (poor yields) and crude oil spills in the area at P<0.05 (r-.697, sig .000). This means as spills increased so was the incidences of poor crop yields in the area. Also, the model explained that 48.6% of poor crop yields significantly depended on the cases of crude oil spills in Asemoku.

4. Conclusion and Recommendations

This study assessed the incidences of crude oil spills and its impacts on the environment in the vicinity of Asemoku, in Delta State. The thrust of the study was to unravel the effects of the oil spills on sources of livelihoods and environment of Asemoku. The study progressed by adopting the cross-sectional research design and questionnaire was deployed to gather information on the subject matter in the study area. The Kruskal Wallis and Spearmans Rank correlations tests were deployed to test the posited hypotheses. The study found that there have been cases of spill in the area but was mostly observes around 1-5 yearly. The spills were also reported to be affecting the farm lands and the aquatic environments, with surface water being the most affected. The study concluded that the cases of crude oil spills, if not checked, could instigate serious food crisis and health issues. Consequently, routine checks of the pipe line traversing the Asemoku area should be check regularly and where there are defects, such defects should be repaired before it results in leaks unto the environment. Additionally, remediation of the existing spills should be carried out by the oil companies that exploit oil in the area. And where they fail punishments and fines should be imposed on them by the relevant authorities of Government. Finally, compensations and poverty alleviation programs should be initiated by both the government, Oil Company (owners of the pipeline) and relevant Non-Governmental Agencies (NGOs).

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