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Assessment of the Impact of Crude Oil Spillage on Surface Water and Aquatic life in some Selected Oil Producing Communities in Delta State, Nigeria

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ABSTRACT: *The study assessed the impact of oil spill on surface and aquatic life in some selected oil producing communities of Delta state. A survey and experimental design was adopted for the study. The data for the study were derived from surface water samples, as well as questionnaire responses. samples were collected from six (6) oil producing communities of Tebu, Tisun, Okpail, Emedadja, Ote-Do, and Okpare respectively and taken to the laboratory for analysis. Samples were collected using purposive and systematic techniques. Total of (200) copies of questionnaire were administered to the selected communities and analyzed using simple percentages and presented in charts and tables. The study find out that the major causes of oil spillage package are: pipeline linkages, well blow out, accidents during and after drilling operation, sabotage, explosions of oil terminals and wells, spills from vandalized oil pipelines and linkages, spill from loading oil vessels. It is concluded that the significant deterioration in both surface and aquatic life due to oil extraction. Therefore, the use of such waters for drinking and domestic purposes may pose a threat to the health of the users. Thus, there is need for the intervention by government agencies while simple physical treatment of pollutants is recommended.*

KEYWORDS: crude oil spills; surface water, aquatic life; pipeline vandalization; hydrocarbon content; biological oxygen demand and total suspended solids.

INTRODUCTION

Oil spillage is a major environmental problem associated with oil exploration activities in most countries where oil is a major source of income like Nigeria. As a result, has led to very serious pollution and destruction of flora and fauna (Worgu, 2000, Mogborukor, 2014). It has also

resulted in the pollution of water, either for domestic, industrial and agricultural purposes. Not only that, it has also led to destruction of lives and properties along the Nigerian coast (Ayaweip, 2000, ITOPF 20218). Issues arising from oil exploitation activities have caused communal crisis within the Niger Delta region. Niger Delta region is rated as the most oil impacted environment and polluted area in the world most especially by environmental experts from the UK, the USA Atubi, (2015).

The Niger Delta basin is considered the mainstay of the Nigerian economy for its significantly high level of oil reserves. The region is also naturally endowed with viable deposits of hydrocarbon and gas reserves. Petroleum and the derivatives dominate the Nigerian economy making up about 98 percent of exports, over 80 percent of government's annual revenue and 70 percent of budgetary expenditure (Ohwofasa & Aiyedogbon, 2012).

Delta State is the largest crude oil producing state in Nigeria located in the Niger Delta region, the base of the Nigerian oil and gas industry which generates over 90 percent of the nation's foreign exchange earnings. Paradoxically, in spite of the increasing revenue from crude oil exploitation, the communities from which this resource flows in the Niger Delta continue to live in conditions of social deprivation and abject poverty. All stages of oil exploitation impact negatively on the environment, and the greatest single intractable environmental problem caused by crude oil exploration in the Niger Delta region is oil spillage (Worgu, 2000, Mogborukor, 2014).

According to Akinpelu, 2021 there has been major environmental deserter in the oil sector due mainly to technological and human errors these has led to challenges and impact on the human populations. Akinpelu, 2021 opined that over the years, incident of oil spillage have become very rampart in Delta state with little or no action taken by stakeholders to bring succor to the inhabitant of the impacted areas.

Spills may take months or even years to clean up. Oil also enters the marine environment from natural oil seeps. Most human-made oil pollution comes from land-based activity, but public attention and regulation has tended to focus most sharply on seagoing oil tankers (Nwilo & Badejo, 2005, Akinpelu 2021). A study carried out by Osueke and Emeka-Opara (2014) found out that every settlement in the Niger Delta area has experienced this ugly incident. This incident occurs frequently within the area, it was related that incident has occurred at least ten times between 2005 till date in the study area. Pipeline leakage is the most experienced cause of this incident. The aquatic ecosystem; rivers fish ponds and mangrove vegetation are facing degradation as a result of the incident. The rivers and creeks of the area are no longer good and fit for domestic activities due to the constant pollution of oil spillage. It has become unfit for the survival of aquatic life as a result of the incident in the area which has also brought about a reduction of fish and other seafood to human in the area and also retardation of crops and total productivity of the areas.

Consequently, residents of oil producing communities in Delta State are affected by oil spillage from oil exploration and exploitation activities because it has led to adverse environmental effects. The most profound and adverse impact of oil spills in the area with far reaching implications on all other aspects of our traditional lifestyles and livelihoods had been the total loss of biodiversity. It has also led to loss of biodiversity of plants and animal species, it has led to loss of soil fertility which affects agricultural produce and this pose serious threat to man's meaningful living and destruction of habitats largely due to soil degradation, it has resulted in environmental degradation; destruction of vegetation, livestock, ecosystems and ecological habitats. However, according to Ofomota (1997 and Amusa, Mejeha, and Azubuike. (2021), the human environment is the basis for economic, social and cultural development and it is important that the quality of our environment be maintained in a good state so as to ensure a high level of societal performance. Therefore, for the purpose of conservation and protection of the environment, the causes and measures to mitigate or prevent such environmental problem must be identified. It is based on this premise that this research was focused on assessing the impact of crude oil spill on surface and aquatic life in selected oil producing communities in Delta State.

MATERIALS AND METHOD

Study area

Delta State lies approximately between Latitudes s°00'N and 6º30'N, & Longitudes 5''00'E & 645'E. (see fig. 1.1) below.

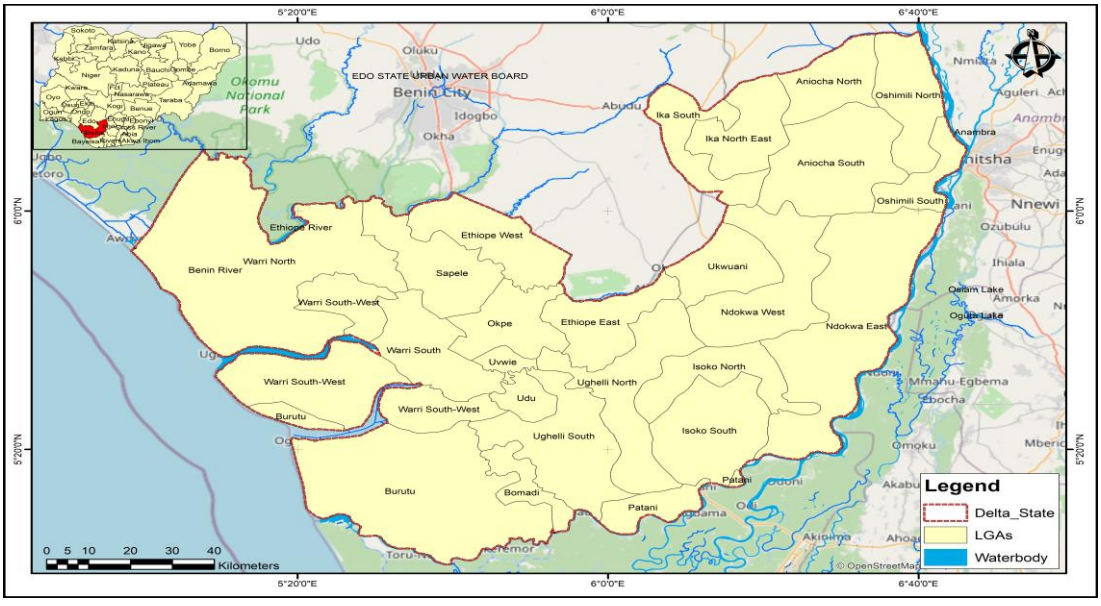

Fig 1.1 Delta state map showing Local Government Area.
Source: Field work, 2021

The area of study lies in a low relief region topographically without remarkable hills, and has a landmass of about 18,050km of about 60% constitute land area (NPC, 2006). The area has a wide range of coastal belt inter-spaced with inlet of rivulets and streams, which makeup the Niger-Delta. It is one of Nigeria's extremely southern states, and covers an area of 17,001 km (DSEPA, 2010). The area is low-lying with mean height of 6m above sea level. Some of the major rivers that drain the area are Ethiope, Forcados, Warri river and empty their water into the Atlantic oceans. Geologically the area can be stratified into the Akata, Agbada and Benin formation. The latter formation is the youngest and the main source of groundwater in the region. It consists of coarse grain sands, gravels, lignite streak and wood fragments with minor intercalations of shale (Kogbe, 1992; Reyment, 1965). Climatically, the area exhibits equatorial type of climate dominated by two seasons, a long wet season (April to October) and a shot dry season (November to March), in response to the interplay between the southwest and the northeast trade winds that blow over Nigeria, Annual rainfall is usually in excess of 3000mm, as no month of the year is entirely devoid of rainfall, Temperature is above 28^{oC} and humidity is about 80% (Ilocje, 1981).

The data for this study, involve the collection of surface water samples from each oil producing areas to determine the pollution status and aquatic life that was impacted. Questionnaires was distributed to residents to examine frequency of occurrence of oil spillage, the causes of the oil spillages, ascertain the amount of oil spills on water bodies, as well as its effects on community development and on the health status of the inhabitants. Water quality was also measured through the collection of water samples from these communities: (Tebu, Tisun, Okpaile, Emedadja, Ote-Do, Okpare, Benikrukru and Kokodiagbene) for laboratory analysis.

Out of Eight (8) Oil Producing communities, only six (6) local government areas were selected for this study which is home to several oil producing communities in the area of study; these are Tebu (Warri South), Tisun (Warri North), kokodiagbene (Warri South West), Benikrukru (Warri South North), Okpaile (soko North), Emedadja (Udu), Okpare (Udu), Ote-Do (Udu) (See Fig. 1.2).

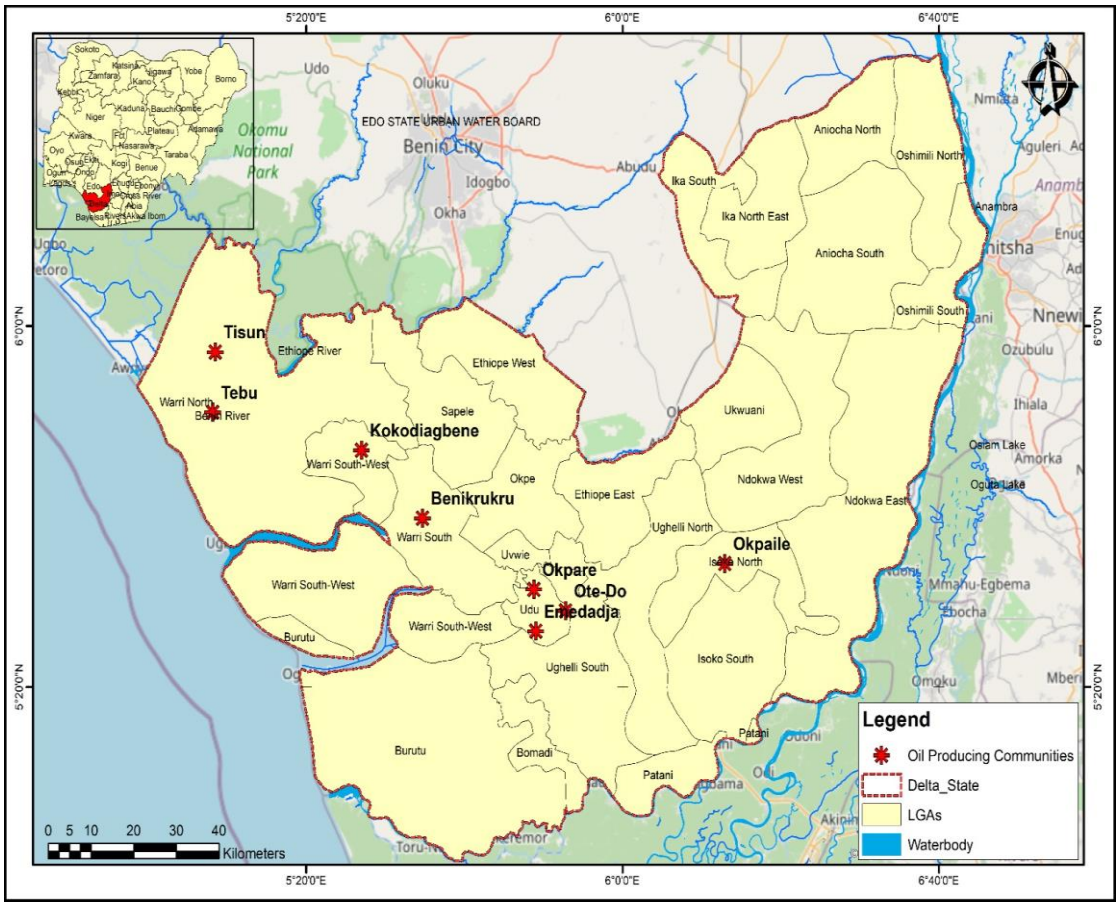

Fig. 1.2: Map showing selected Oil producing communities
Source: fieldwork, 2021

A purposive sampling technique was employed to select Eight (8) Oil Producing Communities in the six (6) LGAs selected. In order to get equal representation, 25 respondents were selected randomly from each of the selected oil producing communities to make a total sample size of 200 respondents used for the study. Also, six sampling points were selected and identified for water quality status using the purposive sampling technique and systematic technique. These six (6) sampling points include; Tedu (Warri South), Tisun (Warri North), Benikrukru (Warri South North), Okpaile (Isoko North), Okpare and Ote-Do (Udu) along with random sampling technique which was employed in the administration of questionnaire. Twenty five (25) structured questionnaires were administered to each of the selected communities. In all, two hundred (200) copies of questionnaires were administered to the eight oil producing communities selected from the state respectively.

The questionnaires were administered to household heads and that where literate enough to answer questions on the questionnaires. However if household is not literate enough interpreters were employed to use vernacular. To ensure an even distribution of the questionnaire a systematic sampling technique of an interval of every seven (7) houses in each street to one respondent was used. The collection of surface water sample was done using the grab sampling method. The samples were collected using 5 liter plastic containers, which were rinsed with distilled water before collection. The water were put in a container and titled sample A-F after which it was taken directly to the laboratory for water analysis. The measurements were taken for a period of one week considering transport cost and locality of the environment. Materials used for the analysis include pipettes, diluters, burettes, flow meters, and thermometer. In order to determine the quality, surface water samples collected was sent to the laboratory for analysis. The water was put in a container/cooler and listed sample A-F before it was taken to the laboratory.

Groundwater samples were collected from boreholes from the six (6) different points in the selected communities. Samples were collected with the aid of sterile 1 liter water sampling cans. After collection, sample bottles were tightly covered and transported also to laboratory for analysis.The data were presented in tables, statistical diagrams and simple descriptive analysis of the distributions and cross tabulation of variables was carried out.

RESULTS AND DISCUSSION

Data obtained from the field was through administration of questionnaire and analysis of surface water and aquatic life impacted. These are presented and discussed below:

Demographic Characteristics of Respondents

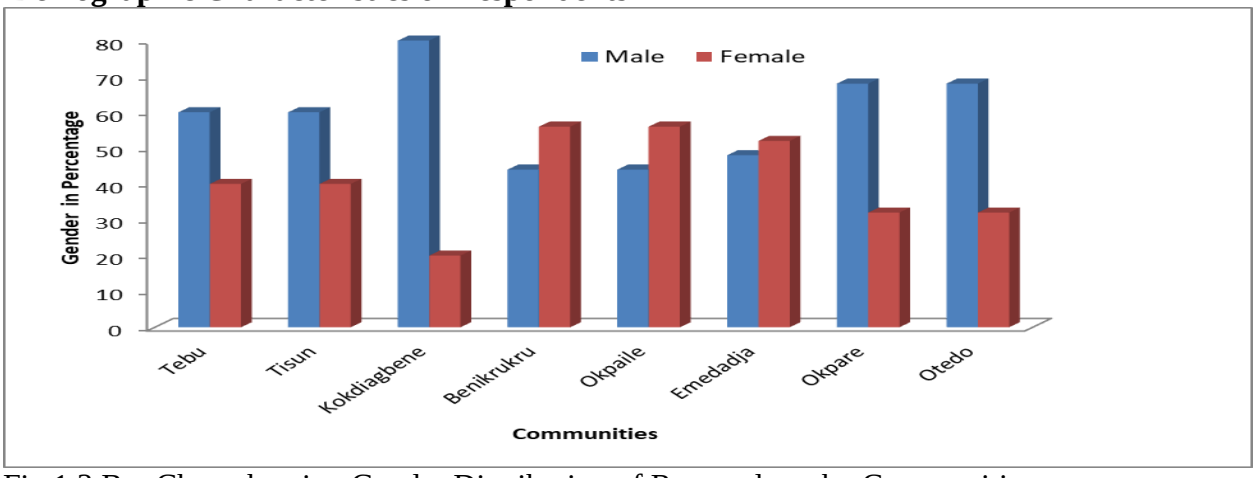

Fig 1.3 Bar Chart showing Gender Distribution of Respondents by Communities

Data presented in Fig 1.3 showed the sex distribution of the respondents in the different oil producing communities. The graph indicated that Tebu and Tisun communities comprised of 60% male respondents and 40% female respondents respectively as compared to the respondents from Kokodiagbene who comprised of 80% males and 20% females. Similarly, respondents in Benikuru and Okpaile were made up of 44% males and S6% females respectively. In the same vein, respondents from Emedadja had 48% males and 52% females as compared to respondents from Okpare and Otedo had 68% males and 32% females each. It could be observed that a total of 59% of the respondents from the various oil producing communities are males while 41% are female. It could therefore be deduced that there are more male respondents who attended to the questions raised than female and males have more knowledge about the effects of oil spill on surface water.

Occurrence of Oil Spillage in the Area

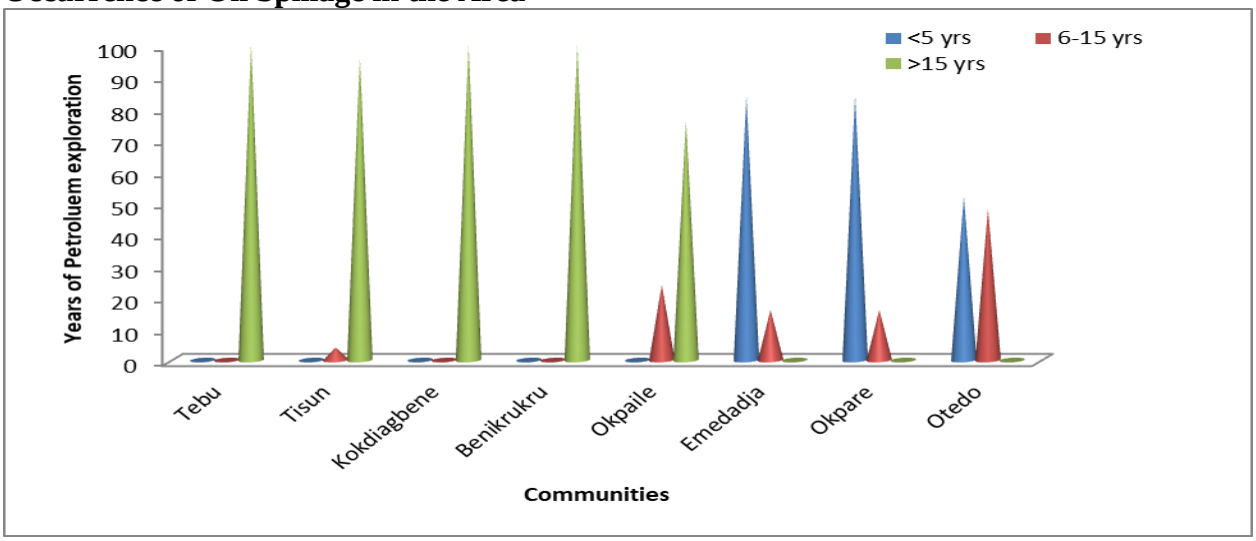

Fig 1.4 Bar Chart showing Duration of Petroleum Exploration in Communities

Data presented in Fig. 1.4 shows the duration of oil exploration and extraction in the various communities. In Tebu, Kokodiagbene and Benikrukru, all of the respondents (100%) agreed that there had been oil exploration above 15 years. For Tisun, only 4% of the respondents said it has been between 6-15 years while 96% respondents indicated above 15 years. Okpaile community had 76% respondents who agreed that it was over 15 years while 24% said it was between 6-15 years, Similarly, respondents (84%) from Emedadja and Okpare communities agreed it was less than 5 years while 16% agreed it was for between 6-15 years respectively. Ote-do community showed that 52% respondents agreed exploration has been on for less than 5 years, 48% greed it has been on for 6-15 years.

From the analysis, it was observed that, 27% believed oil exploration has been on for less than 5 years, 14% submits oil exploration has been on for about 6-15 years, while 59% believed the extraction of oil has been on for more than 15 years hence, the resultant effect of oil spill on surface water in the areas.

Vulnerability of Oil spillage

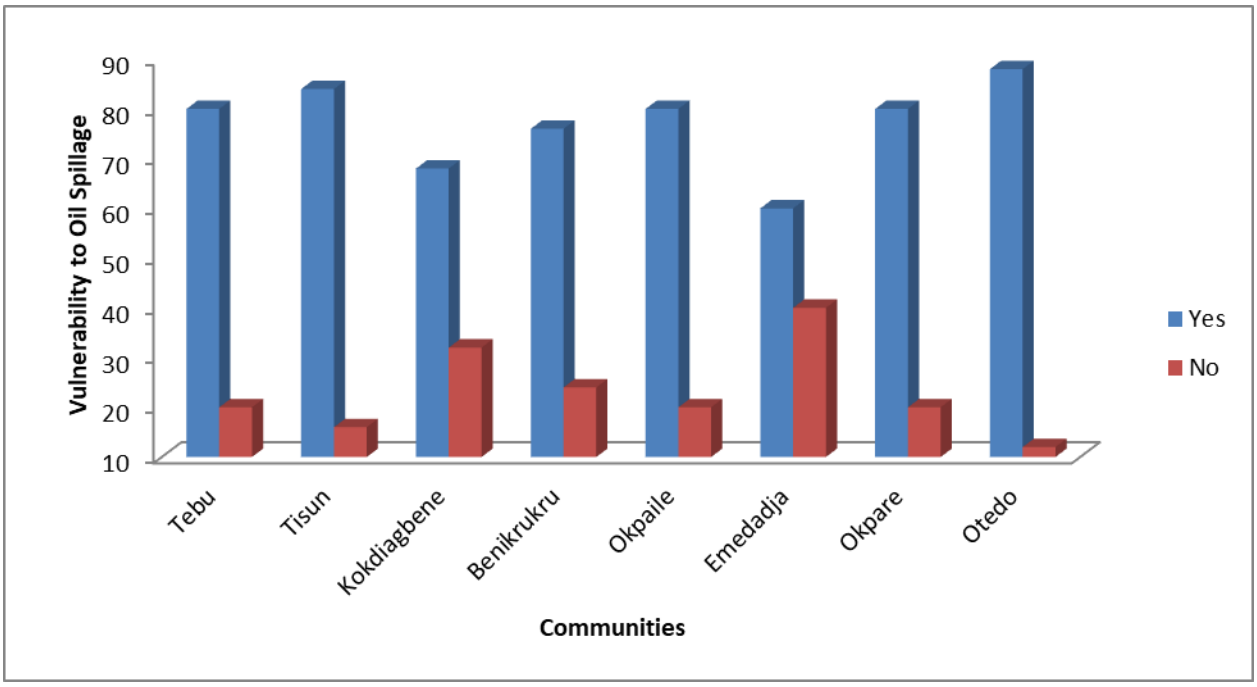

Fig 1.5 Bar Chart showing Vulnerability of Oil spillage

Data presented in Fig 1.5 shows the respondents opinion on vulnerability to spillage in the communities. It indicates that majority of the respondents in the different oil producing communities agreed that they were all vulnerable to oil spillage which devastated their natural environment and have serious effect on surface water.

Data revealed evidence based occurrence of oil spillage in these munities with a minimum of 2-3 years interval in at least three communities (Tisun kokodiagbene and Benikrukru) and in other communities having reported prevalence of monthly, quarterly and yearly oil spillage. This finding corroborates earlier reports of the World Bank (1990) on the pollution status of the Niger Delta which stated in its report that, the oil industry particularly in Rivers and Bayelsa States were oil spilled throughout the rural area. Chronic leaks resulted in widespread destruction of fishing and cultural resources, and also to the deforestation of the area. According to World Bank report there were about 784 incidents of oil pollution which completely destroyed aquatic life in

some states such as Edo, Delta, Akwa lbom, Cross Rvers, Rivers and Ondo. Pollution was also attributed to spillages, washing of tankers, sledging, moving of heavy equipment and deballasting (World Bank, 1990).

Frequency of Oil Spillage in Selected Communities

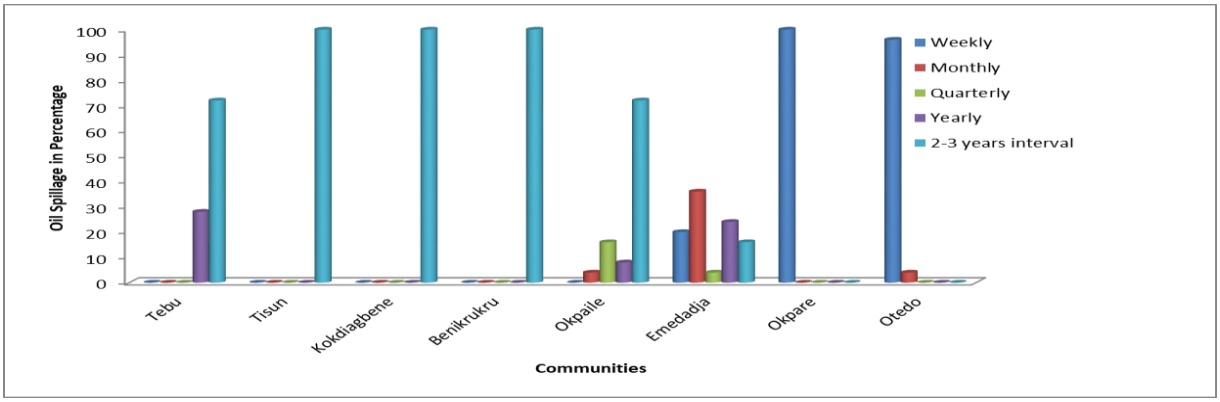

Fig 1.6 Bar Chart showing frequency of Spillage in Selected Communities

Data presented in Fig 1.6 shows the frequency of oil spillage in the selected communities. In Tebu community, 28% respondents say it occurs yearly while 72% of the respondents say it is at intervals of 2-3 years. All respondents (100%) in Tisun, Kokodiagbene and Benikrukru communities say it is at interval of 2-3 years respectively. In Okpaile community, 4% of the respondent feels it is monthly, 16% respondents quarterly, 2 yearly and 72% of the 96% in Otedo community is copies in oil spillage.

Causes of Oil Spillage in the communities

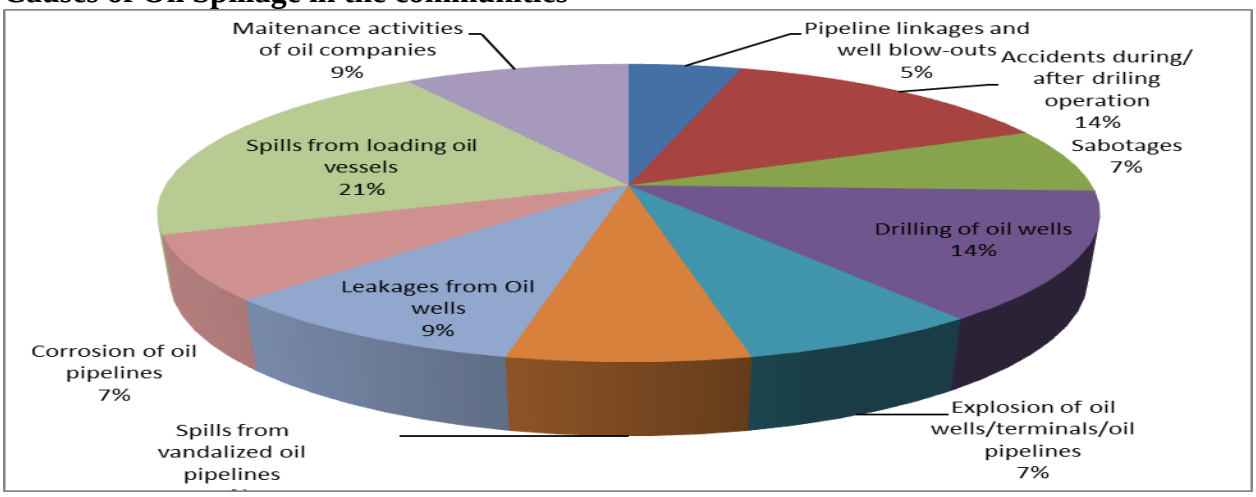

Fig 1.7 Pie Chart showing causes of Oil Spillage

Data presented in Fig 1.7 show the response on the causes oil spillage in the various communities which were identified for different reason across the communities of which about 2% of the respondents indicated that pipeline leakages and well blow out as the major causes of oil spillage in the different communities within delta state (Okpale, Tebu, Tistun, Benikruknu, Kokodiagbene, Okpare, and Otedo) Also, 6% of the respondents said accidents during and after drilling operation, 3% mentioned sabotages 6% said drilling of oil wells. 3% said explosion of oil terminals and wells, corrosion of oil pipelines, and spills from Vandalized pipes respectively are the cause oil spillages in the area, while 4% attributed leakages and maintenance by oil companies were ascribed to causes of oil spillage. 9% of the respondents also attributed spills from loading of oil vessels. 57% the analysis above, was able to deduced that the identified cases of oil spillage in these communities were not different from those that have been previously reported to be leading causes of oil spill which as contributed to issues of environmental degradations in the Niger Delta Region.

Responses of Oil Companies towards Oil Spillage

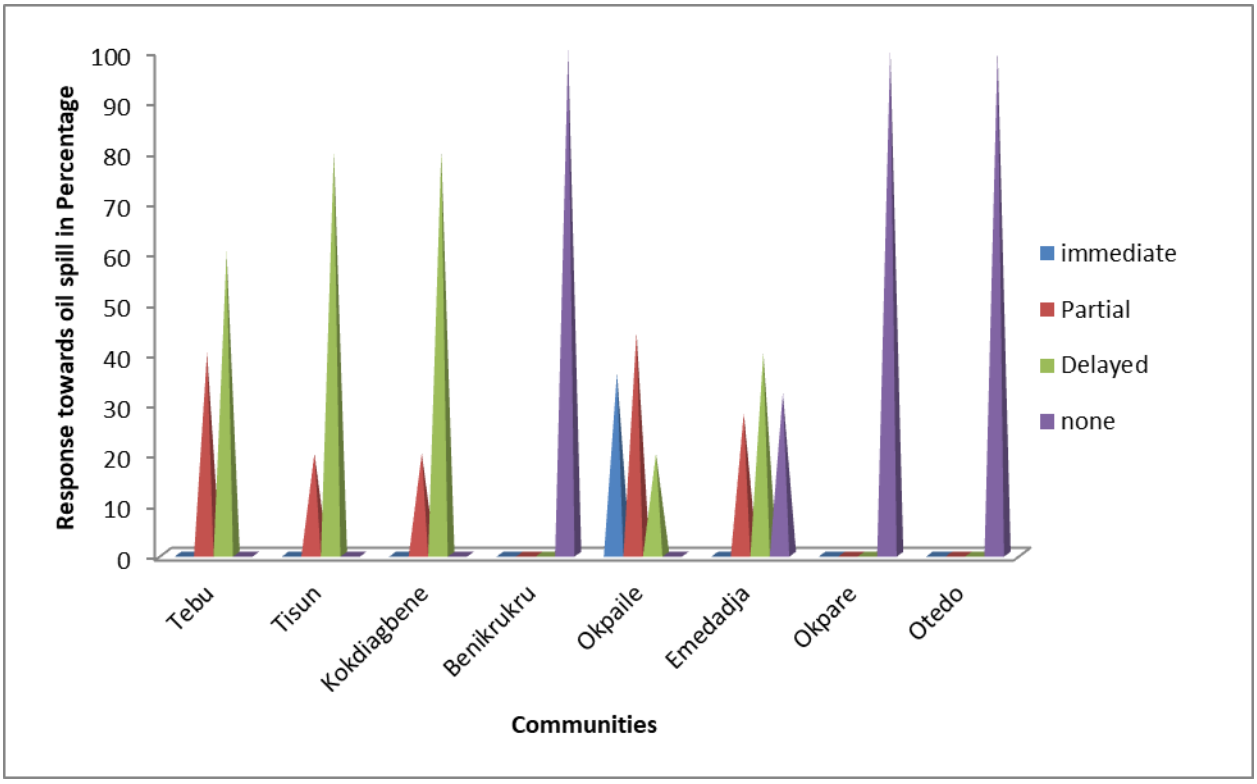

Fig 1.8: Bar Chart showing Responses of oi1 Companies towards Oil Spillage

Data presented in Fig. 1.8 reveals the reactions of oil companies towards oil spillage in communities. About 40% of the respondents in Tebu community alluded to the Occurrence of

partial cleanup while 60% said delayed cleanup occurred Tisun and Kokodiagbene had 20%. Which indicates that partial cleanup was carried out while others reported that there was delayed clean up. All Respondents (100%) in Benikrukru, (Okpare and Otedo communities noted that there were no form of clean up. Okpaile had 36% respondents reporting that there was immediate cleanup, 44% said there was oil cleanup, 20% respondents reported delayed cleanup. Emedaja community on the other Tisun had 89% respondents who said there were partial clean up, 40 % respondents delayed cleanup and 29 respondents no clean up.

The analysis above, it was reveal that there was no near non-existent of cleanup measures for several oil spills in these communities which is similar to many other oil spills occurring in other communities.

Effects of Oil Spillage on the Communities

Table 1.1: Effect of oil spillage on aquatic life in the communities

	Tebu		**Tisum**		**Kokodiagbene**		**Benikrukru**		**Opaile**		**Emedadja**		**Okpare**		**Otedo**		**Total**	
Respondents	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Yes	15	60	20	80	18	72	22	88	21	84	20	80	24	96	18	72	158	79
No	10	40	5	20	7	28	3	12	4	16	5	20	1	4	7	28	42	21
Total	25	100	25	100	25	100	25	100	25	100	25	100	25	100	25	100	25	100

Source: fieldwork, 2021

The data presented in Table 1.1 shows the effect of oil spillage on aquatic life in the sampled communities. The data revealed that majority of the respondents in Tebu. Tisun. Kokodiagbene. Benikrukru, Emedadja, Okpaile, Otedo, and Okpare affirmed the negative effects of 200 oil spill on the aquatic life with only few of them indicating that there is no negative effect. This may be due to the fact that they benefit in one way or the other from the activities of the oil companies in their communities. The reported effect of oil spillage on aquatic life has also been previously reported by Osuagwu and Olaifa (2018) who reported the grave influence of oil spillage on aquatic life in the Niger Delta region. This study corroborated several other findings in literature on the negative effect of oil spills on fish production and suggested a cautious approach to oil exploration activities in the study area for sustainable development. Akpokodje and Salau (2015)

also established enormous amount of spills and forest loss which as impacted negatively on agricultural production.

Impact of Oil spillage on Community Health

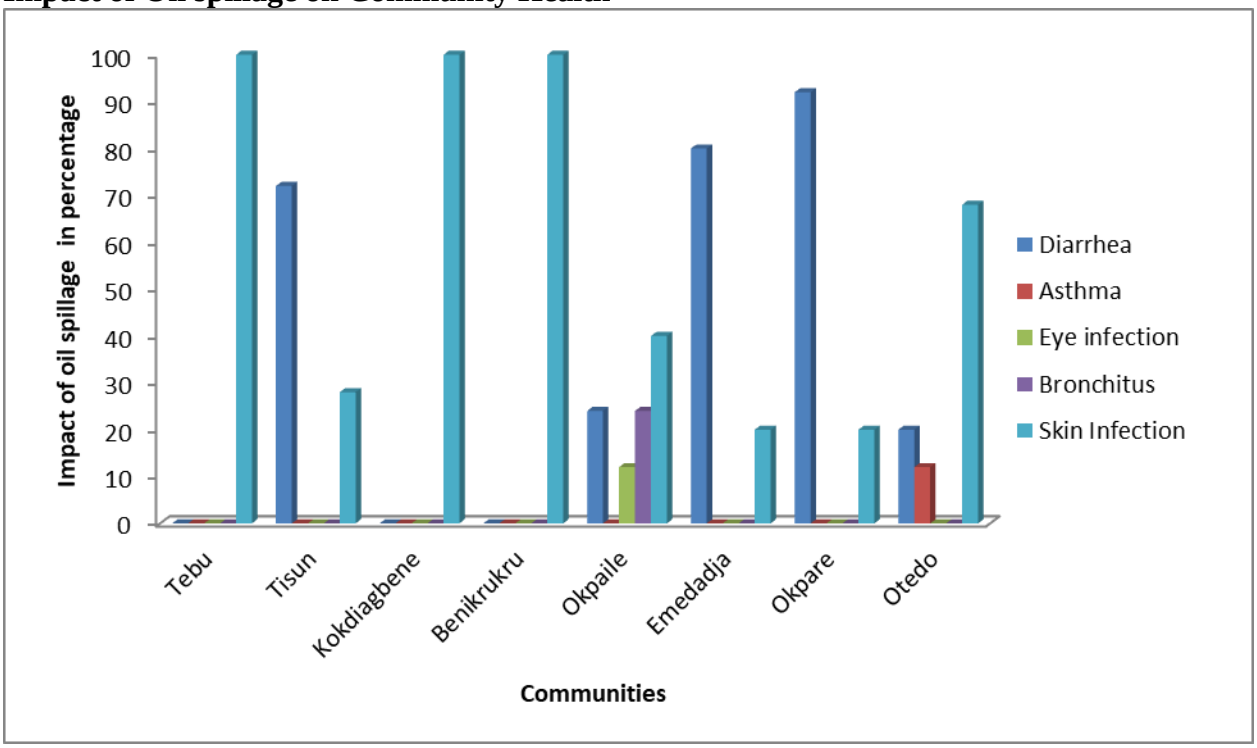

Fig 1.9 Bar Chart showing Impact of Oil spillage on Community Health

Fig. 1.9 presents the responses on the impact of oil spillage on community health. Data presented in the table and graph reveals that the most prevalent ailment or health challenge was skin infection which was 100% prevalent in Tebu, Kokodiagbene and Benikruku Communities. Also, 68% respondents of Otedo community and 28%, 20% and 28% respondents and Tisun, Okpaile, Emedadja and Okpare communities had skin infection. Diarrhea was another most prevalent ailment as 12% respondents in Tisun, 24% respondents in Okpaile, 80% respondents in diarrhea. Put together, there were 12 persons amounting to 36% of the entire population with diarrhea, 1% having asthma, 2% having eye infection and 39% with bronchitis. From the analysis above, about 58% of the respondents had skin infection while 36% had Diarrhea, 2% are Asthmatic patients and have and eye infection respectively, and 3% had Bronchitis diseases resulting from oil spillage effects. These manifestations are in tandem with the study of Sako (2017) in a community based study in Koluama reported that data provided by respondents on illness echoed the increased negative effects of oil pollution on the health which in Emedadja, has been previously reported by other studies on the acute and long-term health effects of exposure to oil-

related pollution of which Solomon and Janssen (2010) reported that common human health effects of oil spills include nausea, vomiting, dizziness, headaches, and respiratory problem

Quality of Surface Water in the study area relative to WHO and NAFDAC standard

Table 1.3: Average analytical result of Surface Water in selected oil producing communities

Sample Location	**pH**	**EC (Uscn)**	**TSS (Mg/I)**	**TS (Mg/I)**	**DO (Mg/I)**	**COD (Mg/I)**	**BOD (Mg/I)**
Okpare	7.2	34.23	23.8	93.6	6.00	20.2	17.67
Tebu	9.2	26.60	23.67	98.67	5.27	19.33	15.67
Kokodiagbene	8.9	24.23	23.25	93.6	4.00	20.2	17.67
Otedo	8.3	18.60	23.67	98.67	5.27	19.33	15.67
Tisun	8.4	14.23	19.5	93.6	6.00	20.2	17.67
WHO/NAFDAC	**6.5-8.5**		**10-15**	**45**	**>3**	**10**	**10**

Source: fieldwork, 2021

Table 1.3 shows the average analytical result of Surface Water in selected oil producing communities within Delta State. From the table and graph above, Tebu community had the highest water pH which was 9.2 while Okpre had the least pH which was 7.2. The standard water p for drinking water as recommended by WHONAFDAC ranges between 6.5-85 which indicates that Tebu community with 9.2 and Kokodiagbene community with pH of 89 surpassed the recommended safe water pH by WHO indicating that the water is highly alkaline and not safe for drinking. The implications of alkaline pH in Tebu and Kokodiagbene as compared to the Control community Okpre and the WHONAFDAC standard is that the water may not be safe for consumption which may be accountable for poor health status of the indigenes occasioned by high rate of skin infections and Diarrhea amongst the community indigenes.

From the table, surface water electrical conductivity shows that Okpare has the highest with (3423) followed by Tebu (26.23) Kokodiagbene (24.23) Otedo (I 8.6) and Tisun (14.23) compared to community had the least. Put together the electrical conductivity in the communities ranged between 14.23-3423 and was not above the WHO recommended EC of 400LS/cm.

The table reveal that total soluble solutes in the communities indicate that they were higher than the recommended 10-15mg/l recommended by WHO and DPR standard. This ranged between 19.5-23.8mg/l with the highest occurring in Otedo community (23.8) and least in Tisun (19.5mg/). This result is indicative of a highly polluted water body as Total suspended solids (TSS) are solid materials which include organic and inorganic materials that are suspended in water. TSS is a known significant factor in observing water quality. The TSS observed in this study shows that TSS for oil-impacted water was higher than that of the permissible limit of 30mg/M as stated in FEPA (1991) and this confirms the presence of pollution in oil impacted waters.

The table reveals that the total solutes of surface water in the oil communities ranged between 93.6-98.67mg/l with Otedo having the highest and Kokodiagbene having the least. Comparing it to the WHO/DPR standard, this was way higher than the recommended 45mg/l increase in TSS and TS could be attributed to the ability of oil to attract particulates. The table also shows that the total dissolved oxygen in all the communities in greater than the recommended WHO, NAFDAC of >3 which ranged between 4-6.0mg/l and is indicative of the safety of the water environment for aquatic animals. The dissolve oxygen is an indicator of the amount of carbon dioxide present in water and an increase is indicative of toxicity.

The table also indicated the biological oxygen demand in surface water samples from oil impacted communities. This ranged between 15.67-17.67mg/l in across the communities and this outscores the WHO, NAFDAC permissible limit of 10mg1. A BOD greater than 10mg/l as in this study is indicative of the presence of several effluents that needs greater time to be broken down by biological substances present in water. This high trend is justifiable because the biological organisms needed more oxygen to breakdown the crude oil pollution in the oil impacted area.

CONCLUSION AND RECOMMENDATIONS

This study has established that most oil producing communities like other communities in oil exploring region of the Niger Delta has been highly degraded and has its manifestation in form loss of water sources. This has also led to a great challenge in the health status of most people living in these areas. The study revealed that the surface water samples collected over selected oil producing communities were relatively acidic, contained acidic radicals and may be attributed to petroleum refining activities, which is common in the area. Higher concentrations of most of the measured parameters are suggestive of input of effluents into the water from industries within and around the oil producing area of Delta State. Therefore, by virtue of its present quality status it can be assumed that it is detrimental to aquatic Terrain. High contents of BOD often deplete the amounts of dissolved oxygen which is harmful to aquatic life.

In order to cushion the negative effects of environmental degradation in the Niger Delta region, the following were suggested to be done:

Government through her agencies should reduce gas flaring activities in oil producing areas of the state. This can best be achieved through enforcement of environmental laws. Planting of trees and afforestation should be encouraged so as s to replace defaced forests and natural resources which have been degraded by oil spillage and oil exploitation. Government through the Ministry of Environment should carryout immediate cleaning-up of polluted areas in the Niger Delta. Government and NGOS should organize campaign awareness programs in 0il producing areas to educate the masses on the need to safeguard and protect their environment. Indigenes of oil Producing Communities and staff of oil companies should develop inter- personal relationship so

as to avoid inter-communal clash and conflicts between communities on one hand and indigenes-oil Company staff and management on the other hand which may cause severe damage of company facilities and community infrastructure including residential buildings thereby leading to loss of lives and properties in Oil Producing Areas. There should be development of recycling plants for environmental wastes as well as improvement of community infrastructure to cushion these negative effects. Water quality in the producing communities should look into so as to ensure clean water for drinking and domestic usage. Failure to do so may pose a threat to the health of the inhabitants which will eventually calls for the intervention of government agencies at a more severe and expensive rate. It was also recommended that simple physical treatment of effluents should be effected.

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