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SOIL PROPERTIES, ENVIRONMENTAL, SOCIO-ECONOMIC IMPACT OF OIL SPILL ON ONELGA, RIVERS STATE

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ABSTRACT

Study examined socio-economic and environmental impact of oil spills on residents of the study area. Experimental and cross-sectional method was adopted. Soil samples 5 top soils (0-15cm) and 5 sub soil (15-30cm) from impacted site, and 2 top soil samples (0-15cm) and sub soil (15-30cm) from un-impacted site as control. Physicochemical parameters (pH, EC, TOC and TOM), hydrocarbons (THC, TPH and PAH), and heavy metals (Pb, Cr, Cu, Zn, Ni and Fe) content of the soils were analysed. Results showed high heavy metals content on the impacted soil than the control; likewise, TOM, TOC (1.2184% and 1.324%, top soil and sub soil. TPH (36.21486ppm and 58.835ppm, top soil and sub soil, and PAH (18.498ppm and 19.935ppm, top soil and sub soil, with control value for PAH at zero. While pH (5.08 and 4.78, top soil and sub soil and EC (49.2µs/cm and 41.2µs/cm, top soil and subsoil values for impacted soil were higher than the control. Results show that oil spill has impacted on the soil and water bodies causing low crop yield and fish catch. Oil spill has affected the income and livelihood of the people exacerbating hunger and poverty. Study recommends a comprehensive environmental assessment in the area to ascertain the impact of oil spill on the environment and residents.

Keywords: Evaluation of Soil Properties, Environmental and Socio-economic impact, Oil Spill on Communities.

INTRODUCTION

Petroleum exploration and exploitation activities started first in Egbema in present day Ogba/Egbema/Ndoni local government area. It started as a series of seismic activities for the prospecting of crude oil in 1950s, although no success as the exploration efforts were declared tohave produced negative results (Alberta, et al., 2017). Agip Oil Company sought and got a concession and lease license in the same Egbema area where Shell's exploratory efforts were declared to have produced negative results and struck a great quantity of petroleum in commercial quantities. Agip Oil Company soon after Egbema, discovered and started drilling Oil in some Ogba areas like Obrikom, Iku, Obiafu and Omoku (Amugo, 1997). This not only increased Agipproduction in the area but also increased the number of communities and spread of petroleum in Ogba/Egbema/Ndoni L.G.A. Oil production have been in Ebocha and Mgbede fields owned mostly by Mgbede and other Egbema communities of Aggah and Okwuzi in Rivers State. According to UNDP, 2006 cited in Olu, Ugbomeh, Bob Manuel, & Ekweozor (2019) Ogba/Egbema/Ndoni is perhaps the area with the highest concentration of oil wells thus, the highest oil productive community in Nigeria. On the 31st of December, 2010 about 14 barrels of oil was spilled at Obiafu location junction at Omoku. There was another spill at Ebocha5T flow-line at ebocha on the 30th of October, 2011, where 30 barrels of oil were spilled. On the 22nd of March, 2013 about 15 barrels of oil was spilled at Obiafu31LS flow-line at Omoku. Another 0.31 barrel was spilled at Gas Lift-line Mgbede 28 Well Location on the 2nd day of the Month of March, 2014. At Obiafu 16S flow-line along the location access road, Obiafu field, Omoku approximately 11.33 barrels of oil were spilled on the 26th of November, 2017 (DPR, 2022). About 21 barrels of oil were spilled at Obiafu 21S flow-line near Orashi River at Obrikom while another happened at Mgbede11LS flow-line at Etekuru/Aggah on 30th January, 2021(DPR, 2022). Following series of oil spills, farming, fishing and hunting activities were drastically reducing in the oil communities in Ogba/Egbema/ Ndoni L.G.A. These activities hitherto to oil exploration and exploitation activities in the area were the major sources of income and livelihood of the people. With the soil infertility and low fish catch, many have been forced to abandon their land and seek for non-existent alternative means of livelihood (Nwilo, & Badejo, 2001). Oil spills has caused damage to farmlands and fishery resources with the destruction of the farm lands and fishing which is the means of livelihood and income earner of majority of the inhabitants of Ogba/Egbema/Ndoni L.G.A. Oil spills not only destroy the means of livelihood and deepen poverty but also brought about conflicts (Nwabuenyi, 2012). This common and recurrent condition in oil spill impacted communities of Ogba/Egbema/Ndoni L.G.A, has caused most youths to take to social vices and restiveness (Amadi & Tamuno, 2001). The hardship occasioned by oil spills has forced some young ladies into prostitution in order to feed themselves, finance their education and support their families this is the main trust of the study.

Aim of the study: The aim of this study is to evaluate the socio-economic and environmental impact of oil spill in selected communities of Ogba/Egbema/Ndoni Local government area of Rivers State.

Objectives of the study are as follows to:

1. Determine presence of contaminants in the soil, as a result of the oil spill on impacted communities of Ogba/Egbema/Ndoni L.G.A. Rivers State.
2. Determine specific soil properties affected by the oil spill and the extent the alteration has affected soil nutrients in communities of Ogba/Egbema/Ndoni LGA Rivers State.
3. Ascertain the effects of oil spill on means of livelihood (fishing) of people in oil spill impacted communities of Ogba/ Egbema/Ndoni L.G.A., Rivers State.
4. Determine the impact of oil spill on crop yield on impacted communities of Ogba/ Egbema/Ndoni L.G.A., Rivers State.
5. Ascertain the effects of oil spill on socio-economic life of the impacted communities of Ogba/Egbema/Ndoni L.G.A., Rivers State.

Method of Study

A map of the site was acquired and a 50m×50m grid was mapped over the area of oil spill (impacted) site. The area was divided into 25 grid plots, with each measuring 10×10m² and 1/5 of these (i.e. 5 grid plots) were sampled. The south-west corner (bottom left corner) of the grid was made the origin for the sampling. After the south west corner was sampled, four (4) other plots were sampled randomly in a direction north-eastward of the grid. The sampling was randomized with

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consideration of soil appearance (i.e. dark colour and slightly waterlogged). For the control sample, a sampling point was randomly selected from an un-impacted area, estimated to be more than 500m away from the oil spill site.

Sample Collection Techniques

The sample consists of twelve (12) soil samples which were randomly taken from six (6) separate points at two depths. Ten (10) of these samples were taken at the oil impacted site (top soil and sub soil), while two (2) were taken at an un-impacted site. That is, five (5) of the sampling points were selected in oil spill polluted area, while one (1) point was in an unpolluted site, serving as a control. At each of these points, samples were taken at depth of 0-15cm (top soil) and 15-30cm (sub soil). Samples were collected with a decontaminated hand held auger. The hand auger was decontaminated after each collection by washing with detergent and rinsing with tap water. In using the hand auger, a hole was drilled by turning the crossbar of the hand auger, at the same time pressing the auger into the ground. The hand auger was driven to the desired depth which was 0-15cm and 15-30cm respectively. Samples were transferred immediately after collection into respective polyethylene bags and sealed immediately and labelled with a masking tape. Samples from the oil spill site were labelled as follows: RSS1 top soil (0-15cm), RSS1 sub soil (15-30cm); RSS2 top soil (0-15cm), RSS2 sub soil (15-30cm); RSS3 top soil (0-15cm), RSS3 sub soil (15-30cm); RSS4 top soil (0-15cm), RSS4 sub soil (15-30cm); RSS5 top soil (0-15cm), RSS5 sub soil (15-30cm); and CONTROL top soil (0-15cm), CONTROL sub soil (15-30cm).After collecting all samples for the study, the samples were transported immediately to the laboratory in a cool chest. The cool chest was used to retain the physicochemical properties of the soil and slow down biological processes in soil.

Laboratory Analysis

Laboratory analysis was carried out to estimate the amount of petroleum hydrocarbon present in the soil. This was done by testing for the concentration of Total Hydrocarbon (THC), Total Petroleum Hydrocarbon (TPH) and Polycyclic Aromatic Hydrocarbon (PAH) in each sample. Physicochemical parameters such as soil pH, electrical conductivity (EC), Total Organic Carbon and Total Organic Matter; and level of heavy metals such as Chromium (Cr), Copper (Cu), Nickel (Ni), Iron (Fe), zinc (Zn) and lead (Pb) were conducted.

Sample Preparation

The samples were air dried to ensure that all water molecules which could alter the physicochemical parameters evaporate, and then the dried soil samples were sieved with a 2mm sieve to remove debris and other contaminants.

Soil pHand Electrical Conductivity

20g of the air-dried soil which was sieved (with a 2mm sieve pore) was put into a 50 ml beaker. 20ml of distilled water was added and allowed to stand for 30minutes and stirred occasionally with glass rod. A glass-electrode pH meter was inserted into the suspension and the pH measurement was taken. Also, an electrical conductivity meter was inserted and measurement taken. This process was repeated for each sample. The electrodes were rinsed with deionized water and wiped dry with a clean tissue after each reading.

Total Organic Carbon (TOC) and Total Organic Matter (TOM))

The sieved sample was weighed (1g) in duplicate with 250ml Erlenmeyer flask. 10ml of potassium dichromate ($K_2Cr_2O_7$) was added using a pipette and each flask swirled gently. 20ml concentrated tetraoxosulphate-VI acid (H_2SO_4) was added using a pipette and swirled gently until the soil and reagent were mixed. The mixture was allowed to stand for 30min, after which 100ml of freshly boiled and cooled distilled water was added. 3 drops of Barium diphenylamine sulfonate indicator was added and titrated with 0.5N ferrous ammonium sulphate ($Fe(NH_4)_2SO_4$).

A blank titration (without 1g of soil sample) was carried out in the same manner. This was to standardize the dichromate, serving as a reference. The TOC was calculated using the formula:

$$\%TOC = \frac{(\text{Blank titre} - \text{Sample titre}) \times 0.003 \times 100}{\text{Sample weight}}$$

After the value for TOC had been obtained, TOM was calculated as follows:

%TOM = %TOC × 1.724
Where: 1.724 = Conversion factor
[i.e. %TOM = %TOC × 100/58]

Total Hydrocarbon Content (THC)

$NaSO_4$ was added to 5g of the soil and stirred until it was free flowing and friable for proper homogenization. 25ml of chloroform was then added stirred for 2-3minutes. It was left for one hour before filtering through a funnel packed with $NaSO_4$ and silicate to remove any plant debris substances that may have unnecessary interferences with the equipment readings. Then the filtrate was collected in a conical flask and run with Harch DR 2900. The final results were calculated from the equipment readings.

Total Petroleum Hydrocarbon (TPH) and Polycyclic Aromatic Hydrocarbon (PAH)

About 2g of the sieved sample was weighed and put into an amber bottle. 10g of sodium sulphate was added to make a loose, friable mixture and free flowing to ensure removal of its water content. The mixture was stirred to ensure it was thoroughly mixed. 25ml of dichloromethane was added and shook, and then the mixture was passed through a funnel that had been packed with silica gel and sodium sulphate separated with cotton wool for thorough clean up. The extract was collected in a glass vial bottle that was carefully capped with Teflon rubber cap. The extract evaporated to a concentrate volume of 1ml. 1µl of the extract was injected into the injector port of the gas chromatograph (GC model Agilent Gas Chromatography-FID 6890N) with a syringe through a rubber septum into the column for the FID (Flame Ionized Detector) detector to separate it into different compounds and peak elution with different retention time.

Heavy Metals

2g of the sieved sample was weighed and put into a beaker. 9ml of HNO_3 and 3ml of $HCLO_4$ were added with 25ml of distilled water. The sample was agitated for 15min and the suspension was filtered through a funnel and a filter paper (0.55mm). The filtrate was aspirated into atomic absorption spectrophotometer (AAS) (solar S-series). A cathode lamp of desired metal was installed in the instrument lamp compartment of AAS and the wavelength dialed according to the metals of interest. The result was read from the screen and the concentration of the elements calculated in ppm as follows:

$$\frac{\text{DRV (ppm)}}{\text{Wt}}$$

Where: D= dilution factor
R= AAS reading
V= final volume
Wt= sample weight taken

Statistical Analysis

Statistical tool used in this study to describe the data obtain were mean and bar chart.

Physicochemical Properties

The physicochemical properties analysed were soil pH, electrical conductivity (EC), total organic carbon (TOC), and total organic matter (TOM).

Soil pH:- From the study analysis, the mean soil pH of the remediated soil was 5.08 for top soil and 4.78 for sub soil, while the control site had a soil pH of 5.9 and 5.7 for top soil and sub soil respectively. The pH of both the control and the remediated soil sample are lower at the

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sub soil than at the top soil. This implies that the sub soils were more acidic than the top soils. This is shown in table 1

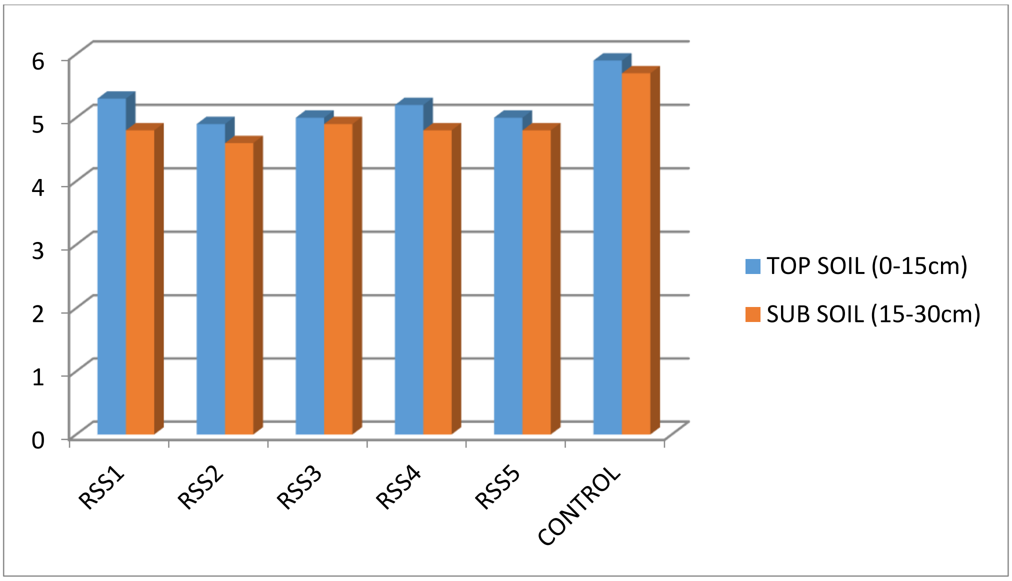

Figure 1; shows the pH value of individual soil samples from the impacted site and the control.

Table 1: Depths range and mean of the pH in the sampled soils

Depth of sample	Contaminated site (ppm)			Control (ppm)
	Mean	**Minima**	**Maxima**	
0-15cm (Top soil)	5.08	4.9	5.3	5.9
15-30cm (Sub soil)	4.78	4.6	4.9	5.7

Figure 1; shows the pH value of individual soil samples from the contaminated site and the control.

Electrical Conductivity (EC):-

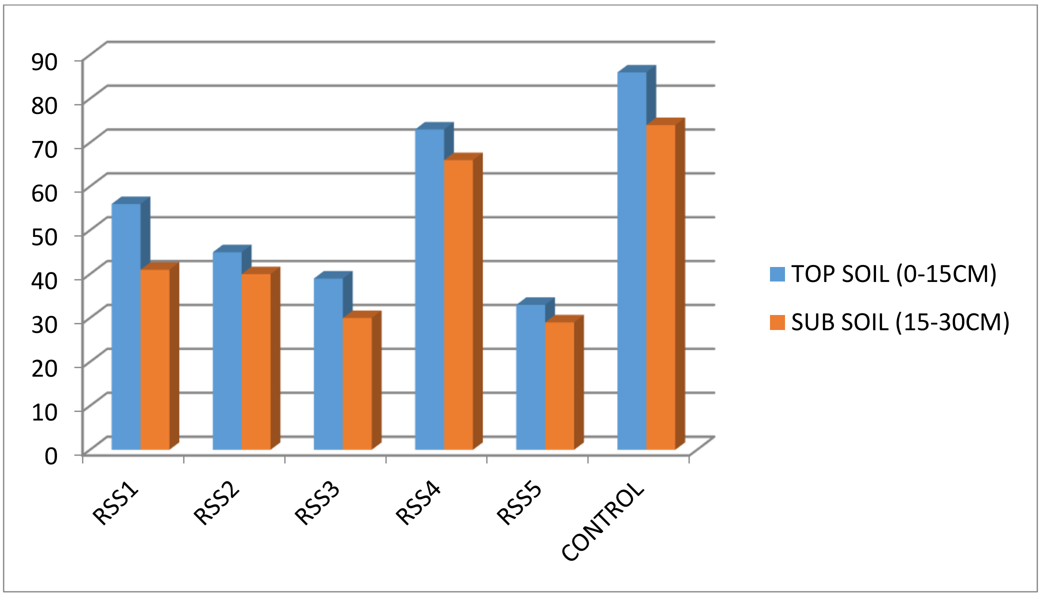

Figure 2: Electrical conductivity at various sampling points for both remediated and control site

Total Organic Carbon (TOC):-The mean total organic carbon of the contaminated site was 1.2184% and 1.3244% for top soil and sub soil respectively. While that of the control were 0.728% and 0.639% for top soil and sub soil respectively, as show in table 3 below:

Table 3: Depth range and mean of Total Organic Carbon (%) in the sampled soils

Depth of sample	Contaminated site (ppm)			Control (ppm)
	Mean	**Minima**	**Maxima**	
0-15cm(Top soil)	1.2184	0.743	1.694	0.728
15-30cm(Sub soil)	1.3244	0.869	2.043	0.639

Table 4: Depth range and mean of Total Organic Matter (%) in the sampled soils

Depth of sample	Remediated site (ppm)			Control (ppm)
	Mean	**Minima**	**Maxima**	
0-15cm(Top soil)	2.1006	1.281	2.921	1.255
15-30cm(Sub soil)	2.2874	1.498	3.522	1.102

Hydrocarbons: -The hydrocarbons analysed for this study were total hydrocarbon content (THC), total petroleum hydrocarbon (TPH) and polycyclic aromatic hydrocarbon (PAH).

Total Hydrocarbon Content (THC):-It was observed that the mean total hydrocarbon content of the contaminated site were 139.532mg/kg for top soil and 163.218mg/kg for sub soil, while the control site had 77.309mg/kg (top soil) and 86.432mg/kg (sub soil) total hydrocarbon content as shown in table 5 below.

Table 5: Depth range and mean of Total Hydrocarbon Content (mg/kg) in the sampled soils

Depth of sample	Contaminated site (ppm)			Control (ppm)
	Mean	**Minima**	**Maxima**	
0-15cm(Top soil)	139.532	91.43	230.61	77.309
15-30cm(Sub soil)	163.218	101.69	296.31	86.432

Total Petroleum Hydrocarbon (TPH):- The mean total petroleum hydrocarbon values for the contaminated site are 36.21486ppm for top soil and 58.835ppm for sub soil. While that of the control site was 1.78632ppm for top soil and 2.59860ppm for sub soil, as show in table 6 below:

Table 6: Depth range and mean of Total Petroleum Hydrocarbon (ppm) in the sampled soils

Depth of sample	Contaminated site (ppm)			Control (ppm)	DPR-EGASPIN limit (ppm)
	Mean	**Minima**	**Maxima**		
0-15cm (Top soil)	36.21486	20.0043	57.74412	1.78632	50
15-30cm (Sub soil)	58.835	33.33858	94.97706	2.59860	

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The sub soil levels were higher because crude oil settles at lower soil depth. The presence of TPH in the control site shows that the area might have been contaminated before. Though value is quite small meaning that any prior contamination was of little impact which may not necessary be an oil spill incident. The top soil mean TPH value is below EGASPIN limit while the sub soil value is above EGASPIN limit of 50mg/kg (ppm). Also, the maximum values for both top soil and sub soil are above the EGASPIN limit.

Polycyclic Aromatic Hydrocarbon (PAH):- From the table 7 below, there was absence of PAH in the control site but for the contaminated site PAH was present, with a mean value of 18.497522ppm for top soil and 19.934824ppm for sub soil, which are above EGASPIN target value of 1.0mg/kg (ppm).

Table 7: Depth range and mean of polycyclic aromatic hydrocarbon (ppm) in the sampled soils

Depth of sample	Contaminated site (ppm)			Control	DPR-EGASPIN target value(ppm)
	Mean	Minima	Maxima	(ppm)	
0-15cm (Top soil)	18.497522	16.03136	21.85719	0.00	1.0
15-30cm (Sub soil)	19.934824	14.93113	23.68275	0.00	

Heavy Metals: -The heavy metals analysed for this study were lead (Pb), chromium (Cr), copper (Cu), zinc (Zn), nickel (Ni) and iron (Fe). Of these metals, zinc, copper and iron are micro nutrients utilized by plants as such needed in little quantity.

Table 8: Depth range and mean of heavy metals {Pb, Cr, Cu, Zn, Ni, Fe} (ppm) in the sampled soil

Heavy metal	Depth of sample	Contaminated site (ppm)			Control (ppm)	Standard limit (ppm)	DPR-EGASPIN target value (ppm)
		Mean	Minima	Maxima			
Pb	0-15cm (Top soil)	0.1002	0.069	0.133	0.012	10	35
	15-30cm (Sub soil)	0.1692	0.162	0.181	0.023	10	35
Cr	0-15cm (Top soil)	0.9176	0.669	1.134	0.043	100	100
	15-30cm (Sub soil)	0.9974	0.784	1.231	0.061	100	100
Cu	0-15cm (Top soil)	3.2432	2.306	3.699	0.147	30	36
	15-30cm (Sub soil)	4.909	3.692	6.872	1.209	30	36
Zn	0-15cm (Top soil)	3.6966	1.899	4.811	1.911	90	140
	15-30cm	4.9654	3.162	6.541	2.604	90	140

	(Sub soil)						
Ni	0-15cm (Top soil)	2.0068	1.172	2.699	1.714	40	35
	15-30cm (Sub soil)	3.2038	1.702	4.714	0.361	40	35
Fe	0-15cm (Top soil)	179.3048	156.239	202.489	92.114	38,000	NA
	15-30cm (Sub soil)	198.2438	183.779	212.631	110.693	38,000	NA

Source: Researcher's Computation, 2023

Table 8 above shows level of the heavy metals in this study; both the contaminated soil site and the control (un-impacted) site. From the table, the mean level of lead is higher at the sub soil with a value of 0.1692ppm and a top soil value of 0.1002ppm while the control value is 0.012ppm for top soil and 0.023ppm for sub soil. The value for chromium is 0.9176ppm (top soil) and 0.9974ppm (sub soil) for the contaminated site; while control site values were 0.043ppm and 0.061ppm, top soil and sub soil respectively. The contaminated site had higher values than the control site. For copper, the contaminated site mean values were 3.432ppm and 4.909ppm, top soil and sub soil respectively. While the control site values were 0.147 and 1.209 top soil and sub soil respectively. The contaminated site value was three times higher than that of the control. Zinc content for the contaminated site was 3.6966ppm and 4.9654ppm, top soil and sub soil respectively. While the control site value was 1.911 and 2.604, top soil and sub soil respectively; with the contaminated site having higher values. Nickel top soil and sub soil mean values were 2.0068ppm and 3.2038ppm respectively for contaminated site while the control site values were 1.714ppm and 0.361ppm, top soil and sub soil respectively. The difference between the subsoil value of the contaminated site and that of the control site was larger compared to the differences in top soil values. The mean value for iron were 179.3048 for top soil and 198.2438ppm for sub soil of the contaminated site while the control site values were 92.114ppm for top soil and 110.693ppm for sub soil.

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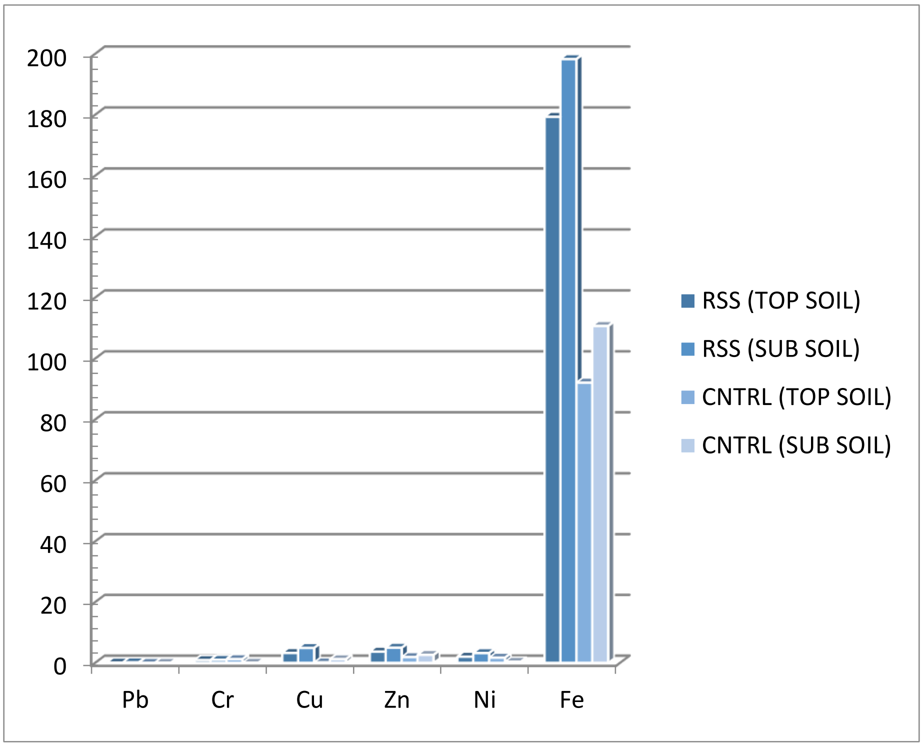

Figure 8: mean (ppm) of heavy metals of both contaminated site and control site

Figure 8 above shows the mean values of the heavy metals in this study. All the heavy metals analysed were within the standard regulatory limits as stated by Akpoveta et al., [2010], and DPR-EGASPIN target values.

Furthermore, on the socio economic aspects of analyses via the cross sectional survey, the purposively selected communities sample size was derived by use of Taro Yamane formula [1967]. The formula is stated as follow:

$$n = \frac{N}{1+N\,(e)^2}$$

Where:

n	=	Sample size
N	=	Population size
1	=	Theoretical constant
e^2	=	margin of error (0.05)

This was calculated as follow:

$$n = \frac{N}{1 + N\,(e)^2}$$

$$n = \frac{358{,}726}{1 + 358{,}726\,(0.05)^2}$$

$$n = \frac{358{,}726}{1 + 358{,}726\,(0.0025)}$$

$$n = \frac{358{,}726}{1 + 896.82}$$

$$n = \frac{113846}{897.82}$$

N =399.

In order words, the sample size for the study was 399. Proportional allocation method was used to select respondents among the communities of Obrikom, Idu, Obiafu, Omoku, Ebocha, Mgbede, Aggah and Okwuzi. To achieve this, Kumar (1976) stratum allocation formula was used. The formula used is stated as follows:

$$n? = \frac{n(NH)}{N}$$

Where

nh = stratum allocation;

n = sample size N = Overall population.

NH = stratum population;

Table 19 Sample communities and estimated Population

S/N	Communities	Estimated Population using average household sizes	Proportional Allocation using Taro Yamane formula
1.	Obrikom	19,346	22
2.	Idu	12,413	14
3.	Obiafu	14,817	16
4.	Mgbede	34,139	39
5.	Aggah	29,003	32
6.	Okwuzi	27,008	30
7.	Ebocha	22,000	24
8.	Omoku	200,000	222
	Total	**358,726**	**399**

Source: National Bureau of Statistics (NBS, 2010)

The study assessed the socio-economic and environmental impact of oil spill incidents in Ogba/Egbema/Ndoni local government area (ONE LGA) Rivers State, a total of three hundred and ninety-nine (399) copies of structured questionnaire were administered to residents of the communities where oil spill has occurred. Out of this, a total of three hundred and seventy-seven (377) copies of questionnaire were successfully retrieved and used for this study.

Table 20 Impact of Oil Spill Impact on Fishing Activities (Interrogating Question)

S/N	Question: To what extent have oil spill impacted on fishing activities?	Frequency	Percentage
1	Very high	333	88.32
2	High	37	9.81
3	Moderate	5	1.33
4	Low	2	0.53
5	Very low	-	-
	Total	**377**	**100.00**

A closer examination of table 20 shows that 88.32% of respondents indicated that oil spill have very high impact on fishing and fish catch; 9.81% respondents indicated that oil spill have high impact on fishing and fish catch; 1.33% indicated that oil spill have moderate impact on fishing and fish catch while 0.53% of respondents indicated that oil spill has low impact on fishing and fish catch.

Extent of Oil Spill Impact on Farming Activities

The section below assessed the extent of oil spill on farming activities in oil spilled communities. The result is presented as

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Table 21 Extent of oil spill impact on farming activities

S/N	Question: To what extent have oil spill impacted on farming activities in your community?	Frequency	Percentage
1	Very high	306	81.16
2	High	59	15.65
3	Moderate	9	2.39
4	Low	3	0.80
5	Very low	-	-
	Total	**377**	**100.00**

Table 21 shows that 81.18% of respondents indicated that oil spill have very high impact on farming activities; 15.65% of respondents indicated that oil spill have high impact on farming activities; 2.39% indicated that oil spill have moderate impact on farming activities while 0.80% of respondents indicated that oil spill has low impact on farming activities in their respective communities.

Extent of Oil Spills Impact on Income

To assess the extent of impact of oil spill on residents of oil spill impacted communities in Ogba/Egbema/Ndoni local government area Rivers State, respondents were asked to indicate the level of extent episodes of oil spills has impacted on their income. This is presented as follows;

Table 22 Extent of impact of oil spill on income

S/N	Question: What extent have oil spills impacted on your income?	Frequency	Percentage
1	Very high	273	72.41
2	High	69	18.30
3	Moderate	20	5.31
4	Low	15	3.98
5	Very low	-	-
	Total	**377**	**100.00**

A closer examination of table 22 shows that 72.41% of respondents indicated that oil spill have very strong impact on their income; 18.30% of respondents indicated that oil spill have high impact on their income; 5.31% indicated that oil spill have moderate impact on their income while 3.98% of respondents indicated that oil spill has low impact on their income.

DISCUSSION OF FINDINGS

The finding of the survey shows a remarkable difference in the value of soil parameters when compared with the permissible limit suggesting that oil spill has indeed impacted negatively on the soil. In other words, the result indicated that the soils of oil spill impacted communities are polluted as the soil parameters in the collected samples are above maximum limit allowed by W.H.O. The pH values show that all the soils were acidic but the contaminated soils were more acidic than the control. The total organic carbon (TOC) and total organic matter (TOM) values for the contaminated soils are higher than those of the control. This high TOC and TOM are known to affect soil mineralization. Soil mineralization is directly related to the organic carbon content of soil. This will bring about reduction in oxygen level, which in turn affect microbial metabolism (Alexander, 1961). This indicates the presence of petroleum hydrocarbon which increases concentration of hydrogen ion in the oil impacted soil, thereby reducing the pH of the soil (Oyem&Oyem, 2013). In figure 1 above, "RSS" stands for contaminated soil sample. From figure 1, it can also be seen that for all soil samples, the pH of the sub soils are lower than those of top soils. The minimum pH value of the contaminated soil ranges between 4.6 and 5.3 in both top soil and sub soil. The acidity of all the soil samples is in line with Tanee& Albert (2011) who reported similar results on the pH of polluted soil in KegbaraDere community of Gokana LGA Rivers State. Also, the pH values which were within the weak acid pH scale range are a characteristic of tropical soil (Ghigi et al., 2012). For the total organic matter, the mean values for the remediated site was 2.1006% and 2.2814% for top soil and sub soil respectively, while that of control were 1.255% for top soil and 1.102% for sub soil. The total organic carbon (TOC) and total organic matter (TOM) values for the contaminated soils are higher than those of the control. This high TOC and TOM are known to affect soil mineralization. Soil mineralization is directly related to the organic carbon content of soil. This will bring about reduction in oxygen level, which in turn affect microbial metabolism (Alexander, 1961). At the contaminated site, the top soil THC value ranged from 91.43mg/kg to 230.61mg/kg and the sub soil ranged from 101.69mg/kg to 296.31mg/kg. It was also observed as shown in figure 5 above the minimum value for the contaminated site is higher than the maximum value of the control. This shows that the THC of the contaminated soil is not in its normal state. This result conforms to the result obtained by Tanee & Albert (2011) in their study on a contaminated site in Kegbara Dere. Also, the THC observed for the contaminated site is far lower than that of Ghigi et al., (2012), in their study of an oil impacted soil of Kpean community in Rivers State. This is in consonance with the assertion of Onuoha, Bassey&Ufomba (2018) who noted that the ecological devastation in the Niger Delta region occasioned by oil exploration and production has degraded most agricultural lands in the area and has turned the hitherto productive areas into wastelands. This further means that agriculture has been negatively impacted. Majority (93.63%) of respondents indicated that there has been marked difference in crop yield before and after oil spill incidence while 92.57% of respondents indicated that crop yield has been decreasing. On the other hand, 81.18% of respondents indicated that oil spill have very high impact on agricultural activities within their community. This finding is in tandem with the findings from previous studies especially those of: Ukpatu (2001), Omoweh (2001), Omorogbe (2003) &Nwabuenyi (2012) who noted that, farm lands and fishing posts have been devastated in the affected oil producing communities through pollution by oil spillage. In a similar study Nwabuenyi (2012) maintains that the oil spillage adversely affected food crop production and productivity. He noted that crop production yields have decreased in quantity and quality following the incidence of oil spill. Farmers have been forced to abandon their farm land to seek non-existent alternative means of livelihood. This is in line with the findings of Afinotan & Ojakorotu (2009) who noted that the activity of oil exploration has contributed to the decline of food crop production in Egbema. Furthermore, from the study, majority about (88.32%) of respondents indicated that oil spill have very high impact on fishing and fish catch. This is in consonance with the study of Amadi&Tamuno (2001); Aaron (2005); Duru (2010) and Onuoha, Bassey & Ufomba (2018) who noted that aquatic lives have been destroyed with the pollution of traditional fishing grounds thereby exacerbating hunger and poverty. It is also in line with the findings of Okonkwo (2014) who noted that many Niger Deltans (Ogba/Egbema/NdoniL.G.A., Rivers State inclusive) are fishermen and farmers. With incessant oil spills cases, farming, fishing and related businesses are affected.

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CONCLUSION

Study was undertaken to assess the socio-economic and environmental impact of communities affected by oil spill in Ogba/Egbema/Ndoni L.G.A., Rivers State. Results showed that oil spillage has reduced the soil nutrients on impacted communities as shown in the analyses of some of the soil properties. Furthermore, it has also caused poor soil fertility leading to poor crop yield and low harvest leading to hunger and starvation in the affected communities. Other means of livelihood affected was the low fish population which the oil spill into the water bodies has caused. This also has affected the fish catch by fishermen which in turn affects their income and means of livelihood.

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