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# ASSESSMENT OF CRUDE OIL SPILLAGE ON PHYSICAL AND CHEMICAL PROPERTIES OF SOIL IN UKWA WEST LOCAL GOVERNMENT AREA OF ABIA STATE. NIGERIA.

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***ASTRACT***

*This study assesses the effect of oil spillage on Physical and Chemical properties of soil in Ukwa West Local Government Area, Abia State, Nigeria. Objectives were to, determine the physical and chemical properties of soil and to evaluate the suitability of soil for agricultural use Sequential design was employed for collection and analysis of soil properties to generate data. A total of twenty (20) soil samples were collected in polyethylene bags using auger at depth of 0-15 cm for the top-soil and 15-30 cm for the sub-surface soil and labeled. Two kilogram (2kg) of soil samples were collected at five (5) different oil spill points and five control points in five wards.. The mean concentrations of pH in soil were within acidic threshold for dry seasons; top and sub soils were 6.4 and 5.54, EC in top and sub soils were 127.60µS/cm and 122.60 µS/cm, THC were high, 1342.60 mg/kg and 1275.20 mg/kg.The concentrations of heavy metals were high in dry season examples; Fe was (8.31 and 8.23) mg/kg in top and sub-surface. Zinc was 0.54 mg/kg and 0.40 mg/kg in top and sub soils of dry season Lead was 0.31 mg/kg and 0.21 mg/kg in top and sub soils of dry season. Cadmium was 0.66 mg/kg and 0.49 mg/kg in top and sub soils of dry Thus, Oil spill have negatively affected the physical and chemical properties of soil in Ukwa West Local Government Area. However, a high concentration of macro-nutrients in dry season is inferred to have resulted from zero water infiltration and percolation. Oil companies are expected to be more environmentally*

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*conscious and adhere strictly to the provisions of the law and standards set for mitigation and remediation by regulatory bodies or agencies. more so, Cooperate Social Responsibility CSR should focus on adequate Irrigation farming projects to support food production and livelihood as soil properties showed minimal pollution in rainy season.*

**KEY WORDS;** ***Assessment, chemical properties, crude oil spill, Physical properties, soil Parameters.***

## Introduction

The study area is Ukwa West Local Government Area, Abia State, Nigeria (Figure 1). It lies approximately within Latitudes 4° 52′ 30″and 5° 50′ 0″ North of the Equator and Longitudes 6° 95′ 0″ and 7° 20′ 0″ East of the Greenwich meridian. It has a total land area of about 271 km$^2$ and is bounded to the east by Ugwunagbo LGA and by Ukwa East LGA to the south-east. It is also bounded to the north and north east by Aba North and Aba South LGAs respectively.

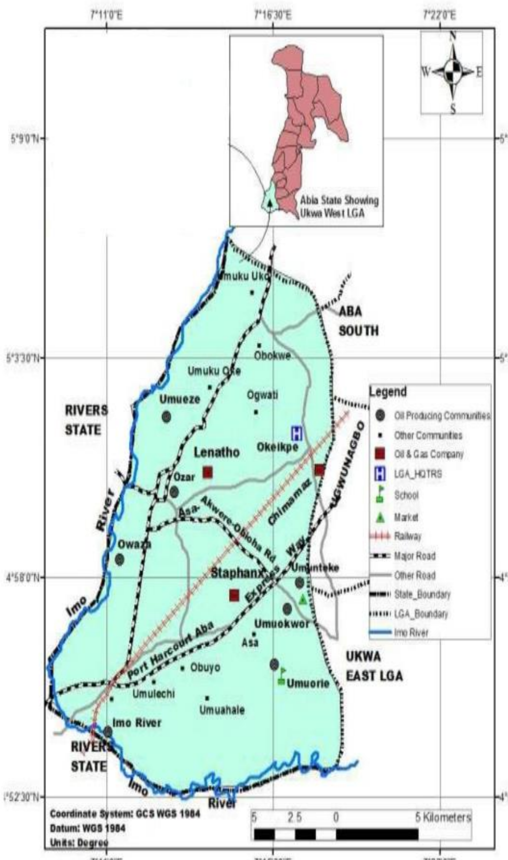


Figure 1: The Study Area Ukwa West LGA Of Abia State

On a global perspective, Nigeria records a maximum crude oil production capacity of 2.5 million barrels per day, which places her as Africa's largest producer of oil and the sixth largest oil producing country in the world, even though, significant drop to about 1.92 million barrel per day have been recorded due to effect of Post internal factors such as youth restiveness and agitations for resource control by host commnities in the Niger Delta region, (NNPC, 2018). Currently challenged by global pandemic, (Covid 19) production had dropped drastically to 181,435 barrels per day (NNPC 2020) . In Nigeria, discovery of commercial

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crude oil was initially in Oloibiri, Bayelsa State, by Shell Petroleum Development Company (SPDC) in the year 1956 and subsequent expansion of oil production in the Niger Delta region, in no doubt have uplifted Nigeria economically. However, oil exploration and production have continually led to environmental degradation (Adelana and Adeosun, 2011). The occurrence of oil spillage incidents in Nigeria is as old as the industry itself (Kadafa, 2012).

Prior to the discovery of oil in Ukwa West Local Government Area of Abia State, the people made their living from exploitation of the resources of the land, water and forest as farmers, fishermen and hunters who had these standing history of livelihood sustenance from generation to generation. However, the discovery of oil understandably changed their orientation and raised false hopes for accelerated development by the Nigerian State and the oil companies who unknown to them, were equally interested and committed to their own gains and development. They later realized that, the two shared a common interest in the maximization of profit and the accumulation of capital at any cost, (Owugah, 2000 cited in Itoro, 2016). Thus, unsustainable oil exploitation and production in the Niger Delta and its consequences such as pollution of water, soil, air, depletion of forest, and wild life with their corresponding impact on socioeconomic activities have frustrated the Niger Delta people who resort to campaign against the operation of companies in the region. Their cry has actually attracted the attention of researchers, Government and Non-Governmental Organizations (Itoro, 2016), to intervene and mitigate against Causes of oil spillage (Essien, O. E. & John, I. A. 2010): which includes: Pipeline leakage, vandalization, tanker accidents, oil production operations, industrial plants and machineries (Uquetan *et al*., 2017). The causes of oil spill have been attributed to poorly maintained pipelines and ‘ blow-outs’ of poorly maintained oil well (Okoye, and Okunrobo, 2014, Nkereuwem and Udeme, 2015).

The Niger Delta region has been reported to be one of the worst oil-impacted locations in the world due to regular oil spills, many of which go unreported thus, not catered for (Ndifon, 1998). In a report by United Nations Development Program (UNDP), more than 400,000 tons of crude oil was spilled to Niger Delta soil, water and farmland within the last three decades (World Bank, 2005, UNDP, 2006). A recent report by NNPC put the total occurrences of oil spills in the Niger Delta between 2011 and 2017 at 1,830 tons (Vanguard News, March 23, 2018). Although governments have established intervention institutions to curtail the menace of oil spill, which as well have adopted several control measures to curb this ugly situation, there is still outstanding environmental degradation going on in the area. The Director-General of National Oil Spill Dictation and Response Agency (NOSDRA), Sir Peter Idabor, during the National Oil Spill Contingency Plan and Drills on Monday 02 July, 2018 in Port Harcourt, Rivers State, lamented that Nigeria lags behind in response to oil spill. In his words “ due to overwhelming challenges, Nigeria still has a long way to go, to be able to proactively regulate oil spill response and keep the operating environment safe” (Egufe in Vanguard News Monday 02 July, 2018).

Discussions on oil spillage in the Niger Delta would be incomplete without a mention of Abia State as one of the affected or impacted states. It was a year after the discovery of Oil in Olobiri which history placed as the first area to locate oil in the Niger Delta in 1956, that a huge deposit of Oil and Gas were discovered at multiple areas in Abia State. The inability of the stakeholders to curb oil spill to keep the operating environment safe have continued to manifest in environmental pollution in the Niger Delta. Environmental pollution arising from spilled crude oil is capable of degrading, altering or

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forming part of a process of degradation of the quality of any part of the environment. " Such degradation is usually detrimental to the use of that part of the environment by man, animal, fish or plant that is useful to man" (Nkereuwem and Udeme, 2015). Over the years, oil spill have impacted disastrously on the soil and waters of the oil-bearing communities in particular with resultant effects on the livelihoods of the communities. (Ifeanyichukwu 2017)

Hydrocarbon contamination exerts adverse effect on soil condition such as higher acidity, reduced C, N, P and exchangeable cations availability, and depressed microbial activity (Elenwo and Anyawu 2017 & Adesodun and Mbagwu, 2007), it totally leads to decreased production of food crops. For instance, Abii and Nwosu (2009) studied two oil spill affected areas (Ogali and Agonchia) while an unaffected area (Aleto) all in Eleme LGA, Rivers State was used as control. The results showed that there was a significant decrease in the Ca, K, P, as well as a significant increase in the sand fraction and Na content of the oil spill affected soils when compared with the non -affected soil. The results further showed that oil spill had adversely affected the nutrient level and fertility states of Eleme soil. Joseph and Salau (2015) explained, that crude oil prevents proper soil aeration and affects soil temperature, structure, nutrient status and pH.

Crude oil can cause the reduction of the available nutrients in the soil and add some toxic elements, with a resultant death of the plants and diminished soil fertility ( Oyem and Oyem 2013.. Barua, *et al.*, 2011).

Abia state is one of the nine oil-producing states of the Niger Delta Namely: Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo and Rivers. These states have been faced with environmental challenges due to oil production and oil spillage. The discussion of oil spill in Niger Delta would be incomplete without Abia state as one of the affected states. It was a year after the discovery of Oil in Olobiri which history placed as the first area to locate oil in the Niger Delta in 1956, that a huge deposit of Oil and Gas were discovered at multiple areas in Abia State. The areas notable till date are: Ukwa West, Ukwa East and Ugwunagbo Local Government Areas (Foundation for Environmental Rights Advocacy, 2016).

## Literature Review

### Conceptual Framework

Concepts and model relevant to this study are concept of sustainable development, sustainable livelihood, environmental justice, resource utilization, and human -environment interaction model.

### The Concept of Sustainable Development

In 1987 the United Nation's World Commission on Environment and Development (the Brundtland Commission), in its report *Our Common Future* suggested that development was acceptable, but it must be sustainable development that would meet the needs of the poor while not increasing environmental problems. Brundtland commission, which coined what has become the most often, quoted definition of sustainable development and I quote " This is a development that meets the need of the present without compromising the ability of the future generations to meet their own needs" . Sustainable development refers to a mode of human development in which resources usage aims to meet human need while ensuring the sustainability of Natural systems and the environment, so that these needs can be met not only in the present, but also for generations to come. Foundation for Environmental Right Advocacy 20016 holds that " Sustainable development envisions a symbiotic balance among three pursuits that are often portrayed as mutually exclusive: maintenance of a sound environment, economic and social development" (Claire and Ashfaq, 2004 ).

It advocates for the adoption of developmental policies that protect the environment from

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degradation. It also emphasizes a comprehensive and integrated approach to economic and social development processes through judicious and thoughtful use of the environment such that, it will be maintained for coming generations (Christian and Voigt, 2008).

The need to reconcile economic development activities like crude oil production with protection of the environment is aptly expressed in the concept of sustainable development. It advocates that our usage of the environment today must not diminish its usefulness for future generations.

The major sectors for assessing sustainability are economic, social and environmental. To achieve sustainable oil exploration, these three considerations must be balanced in a way that minimizes trade-offs. Various criteria for measuring sustainability in oil production has been discussed by Claire and Ashfaq (2004) as follows:

**Sustainable Development Goals (SDGs) and Crude Oil spillage**

The seventeen (17) SDGs as listed in UN (2015) are as follows:

**Goal 1: No Poverty** - End poverty in all its forms everywhere

**Goal 2: Zero Hunger** - End hunger, achieve food security and improved nutrition and promote sustainable agriculture

**Goal 3: Good Health and Well-being-** Ensure healthy lives and promote well-being for all at all ages.

**Goal 4: Quality Education-** Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

**Goal 5: Gender Equality-** Achieve gender equality and empower all women and girls

**Goal 6: Clean Water and Sanitation-**Clean Water and Sanitation - Ensure availability and sustainable management of water and sanitation for all.

**Goal 7: Affordable and Clean Energy-** Ensure access to affordable, reliable, sustainable and modern energy for all.**Goal 8: Decent Work and Economic Growth** - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

**Goal 9: Industry, Innovation and Infrastructure-** Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.

**Goal 10: Reduced Inequalities-** Reduce income inequality within and among countries.

**Goal 11: Sustainable Cities and Communities-** Make cities and human settlements inclusive, safe, resilient and sustainable.

**Goal 12: Responsible Consumption and Production-** Ensure sustainable consumption and production patterns.**Goal 13: Climate Action** - Take urgent action to combat climate change and its impacts by regulating emissions and promoting developments in renewable energy.

**Goal 14: Life Below Water-** Conserve and sustainably use the oceans, seas and marine resources for sustainable development.

**Goal 15: Life on Land-** Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.

**Goal 16: Peace, Justice and Strong Institutions** - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all level.

**Goal 17: Partnerships for the Goals-** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

Out of these seventeen (17) goals, eight (8) are of paramount to this study. They are goal (1, 2,3,6,13,14,15 and 16). Sustainability of oil production lies on its ability to promote the achievement of these and others. However, oil spill usually counter the targets of these goal

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especially in the host communities.

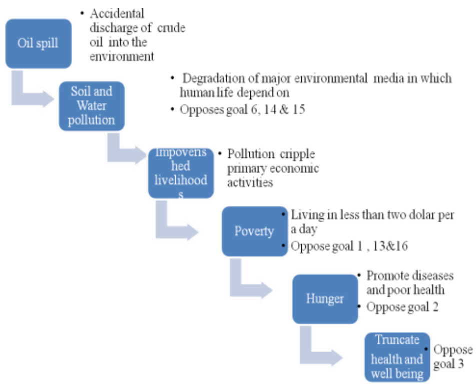


**Figure 1: The Relationship between Oil spill and SDGs 2018**

## METHODOLOGY

### Procedure for soil sample Collection

The samples were collected in January – February, 2019 for dry season samples and Hand Auger was used for boring holes to collect soil samples at depth of 0-15 cm for the top-soil and 15-30 cm for the sub-surface soil. Two kilogram (2Kg) each of soil samples collected at three (3) different points in the five wards (Owaza, Ozar West, Asa South, Asa North, Ipu West) covered by this study. Each sampling point was geo-referenced using Global Positioning System GPS , two samples and a control were collected (top and subsurface soil) . Samples were collected in polyethylene bags and wrapped with a foil to ensure samples collected on the field were not exposed before laboratory analysis. while proper labeling was ensured, indicating location name and GPS point, sample depth, sample texture/type for easy identification and handling in the laboratory.

### Reduction of sample bulk

This was done by quartering the soil sample collected to about 500g. Quartering was done by dividing the mixed soil in four equal parts then discarding two parts. The two quarters were remixed and again divided into four parts discarding two then process was repeated until the required small portion was obtained.

### Drying

Drying was done under moderate temperatures under shade where air circulation was possible.

### Soil Laboratory Analysis

The basic soil parameters analyzed were: Total hydrocarbon (THC), pH, soil nutrients (Nitrate, Sulphate, Potassium, Phosphate, Nitrogen (N), Magnesium (Mg), Calcium (Ca), Sodium (Na) and Chloride), soil Organic Matter Content and heavy metals:

### Analytical Technique

Samples were taken to the laboratory for analyses. Physicochemical parameters were determined using procedures described by Association Of Analytical Chemists AOAC (2005). Heavy metals such as zinc, manganese, copper, nickel, cadmium, chromium and lead, were determined using Atomic Absorption Spectrophotometer (AAS) as described by Miroslav and Vladimir, (1999).
Energy Dispersive X-ray Fluorescence (ED-XRF) was employed for the analysis of the various soil samples.

A finely ground 20.00g of the samples that have pass through a 200-250 mesh sieve were dried in an oven at $105^0$ for 1 hour and allowed to cool. After which, the samples were completely mixed with a binder, in the ratio of 5.0g samples to 1.0g cellulose flakes binder and pelletized at a pressure of 10-15 tons/inch in a pelletizing machine and samples were stored in a desiccator for analysis. The pelletized samples were analysed using a MiniPal 4 ED-XRF Model. The appropriate programs for the various

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elements of choice were employed to analyse the soil samples for their presence or absence, the result is reported in percentage (%) for major elements and in mg/kg.

## RESULTS

**Table 1: Physical Properties of Soil in the Study Area in Dry Season**

| Parameters | Unit | Depth | Sample Location | | | | | | SD | COV | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Owaza | Ozar West | Asa South | Asa North | Ipu West | Mean | | | Control |
| Texture | | | | | | | | | | | |
| Sand | % | 0-15 | 76.8 | 78.8 | 74.8 | 76.8 | 78.8 | 77.20 | 1.50 | 0.35 | 62 |
| | | 15-30 | 74.8 | 78.8 | 76.8 | 74.8 | 76.8 | 76.40 | 1.50 | 0 | 60 |
| Silt | % | 0-15 | 5.4 | 5.4 | 5.4 | 7.4 | 5.4 | 5.80 | 0.80 | 0.1 | 8 |
| | | 15-30 | 5.4 | 7.4 | 5.4 | 7.4 | 5.4 | 6.20 | 0.98 | 0.38 | 9 |
| Clay | % | 0-15 | 16.8 | 11.8 | 17.8 | 13.8 | 13.8 | 14.80 | 2.19 | 3.98 | 30 |
| Texture Class | | 15-30 | 17.8 | 13.8 | 15.8 | 15.8 | 15.8 | 15.80 | 1.26 | 6.06 | 32 |
| Total Porosity | % | 0-15 | 27.74 | 27.94 | 25.85 | 28.11 | 27.14 | 27.36 | 0.82 | 4.23 | 45.51 |
| | | 15-30 | 29.98 | 29.36 | 28.49 | 30.49 | 29.38 | 29.54 | 0.67 | 4.14 | 34.58 |
| Bulk Density | g/mL | 0-15 | 2.65 | 2.15 | 3.72 | 1.64 | 2.75 | 2.58 | 0.69 | 0.89 | 3.21 |
| | | 15-30 | 1.47 | 1.56 | 1.63 | 1.37 | 1.53 | 1.51 | 0.09 | 0.83 | 3.73 |

**Table 2: Chemical Properties of Soil in the Study Area in Dry Season**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | | 0-15 | 5.68 | 4.32 | 5.22 | 4.12 | 4.06 | 4.68 | 0.65 | 0.34 | 7.12 |
| | | 15-30 | 6.12 | 6.18 | 4.23 | 5.46 | 5.7 | 5.54 | 0.71 | 0.45 | 7.01 |
| EC | µS/cm | 0-15 | 120 | 132 | 131 | 127 | 128 | 127.60 | 4.22 | 37.06 | 139 |
| | | 15-30 | 129 | 115 | 110 | 125 | 134 | 122.60 | 8.87 | 56.06 | 132 |
| THC | mg/kg | 0-15 | 1358 | 1242 | 1259 | 1354 | 1500 | 1342.60 | 91.93 | 97.65 | 1.01 |
| | | 15-30 | 1235 | 1210 | 1209 | 1237 | 1423 | 1262.80 | 80.98 | 98.78 | 0.89 |
| O.C | % | 0-15 | 3.2 | 3.2 | 3.5 | 3.3 | 2.1 | 3.06 | 0.85 | 0.32 | 7.23 |
| | | 15-30 | 2.7 | 2.8 | 2.5 | 2.44 | 1.9 | 2.45 | 0.36 | 0.17 | 545 |
| N | mg/kg | 0-15 | 0.35 | 0.28 | 0.49 | 0.42 | 0.35 | 0.38 | 0.07 | 1.02 | 2.6 |
| | | 15-30 | 0.35 | 0.21 | 0.49 | 0.42 | 0.35 | 0.36 | 0.09 | 0.48 | 2.03 |

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| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **P** | **mg/kg** | **0-15** | **3.86** | **3.74** | **4.26** | **3.89** | **3.88** | **3.93** | **0.18** | **3.92** | **4.45** |
| | | **15-30** | **3.71** | **3.56** | **4.11** | **3.82** | **3.7** | **3.78** | **0.18** | **0.77** | **5.43** |
| **K** | **mg/kg** | **0-15** | **0.38** | **0.58** | **0.52** | **0.48** | **0.46** | **0.48** | **0.07** | **0.43** | **4.96** |
| | | **15-30** | **0.3** | **0.59** | **0.57** | **0.37** | **0.34** | **0.43** | **0.12** | **0.23** | **4.43** |
| **Ca** | **mg/kg** | **0-15** | **3.78** | **3.28** | **4.56** | **4.08** | **3.82** | **3.90** | **0.42** | **5.4** | **6.27** |
| | | **15-30** | **3.26** | **2.68** | **4.21** | **3.78** | **3.21** | **3.43** | **0.52** | **4.23** | **4.53** |
| **Mg** | **mg/kg** | **0-15** | **3.45** | **3.01** | **3** | **3.67** | **3.94** | **3.41** | **0.37** | **5.2** | **6.87** |
| | | **15-30** | **3.31** | **2.98** | **3.05** | **3.16** | **3.96** | **3.29** | **0.35** | **0.16** | **6.89** |
| **Na** | **mg/kg** | **0-15** | **0.58** | **0.31** | **0.68** | **0.38** | **0.39** | **0.47** | **0.14** | **3.96** | **0.35** |
| | | **15-30** | **0.26** | **0.28** | **0.53** | **0.36** | **0.3** | **0.35** | **0.10** | **5.74** | **0.28** |
| **CEC** | **meq/100g** | **0-15** | **2.05** | **2.23** | **2.44** | **3.16** | **2.45** | **2.47** | **0.38** | **0.46** | **3.86** |
| | | **15-30** | **2.1** | **2.77** | **3.81** | **3.86** | **2.23** | **3.14** | **0.74** | **0.59** | **3.93** |

**Table 4: Chemical Properties, Heavy Metals (Fe, F, Zn, Pb, Cr and Cd) in Soils of the Study Area in Dry Season**

| **Parameter** | **Unit** | **Depth** | **Sample Location** | | | | | **Mean** | **SD** | **CO** | **Control** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | **Owaza** | **Ozar West** | **Asa South** | **Asa North** | **Ipu West** | | | | |
| **Fe** | **mg/kg** | **0-15** | **6.13** | **8.01** | **8.13** | **9.06** | **10.2** | **8.31** | **1.34** | **1.56** | **7.75** |
| | | **15-30** | **5.86** | **7.78** | **9.85** | **7.78** | **9.86** | **8.23** | **1.50** | **8.01** | **4.05** |
| **Cu** | **mg/kg** | **0-15** | **2.82** | **2.78** | **2.82** | **2.78** | **2.86** | **2.81** | **0.03** | **7.78** | **0.09** |
| | | **15-30** | **1.86** | **2.16** | **2.1** | **2.17** | **1.81** | **2.02** | **0.15** | **2.78** | **0.06** |
| **Zn** | **mg/kg** | **0-15** | **0.42** | **0.55** | **0.55** | **0.62** | **0.54** | **0.54** | **0.06** | **2.16** | **Na** |
| | | **15-30** | **0.42** | **0.35** | **0.45** | **0.42** | **0.35** | **0.40** | **0.04** | **3.21** | **Na** |
| **Lead** | **mg/kg** | **0-15** | **0.27** | **0.33** | **0.37** | **0.37** | **0.23** | **0.31** | **0.06** | **3.94** | **0.002** |
| | | **15-30** | **0.17** | **0.27** | **0.27** | **0.23** | **0.13** | **0.21** | **0.06** | **3.96** | **0.001** |
| **Cr** | **mg/kg** | **0-15** | **0.49** | **0.59** | **0.48** | **0.51** | **0.68** | **0.55** | **0.08** | **0.39** | **0.001** |
| | | **15-30** | **0.4** | **0.48** | **0.36** | **0.38** | **0.53** | **0.43** | **0.06** | **0.3** | **0.0002** |
| **Cd** | **mg/kg** | **0-15** | **0.87** | **0.58** | **0.61** | **0.56** | **0.69** | **0.66** | **0.11** | **2.45** | **0.003** |
| | | **15-30** | **0.56** | **0.38** | **0.58** | **0.34** | **0.61** | **0.49** | **0.11** | **2.78** | **0.0002** |

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**Table 4.22: The Concentrations of Physical and chemical Properties of Soil and FAO**

| Parameters | Unit | Range | Mean | FAO Limit for Agriculture | DPR (INLAND) |
|---|---|---|---|---|---|
| pH | | 4.65-7.21 | 5.93 | 6-9 | 5.50-6.50 |
| EC | μS/cm$^3$ | 112-142.5 | 133.9 | - | |
| THC | mg/kg | 1186.5-1406 | 1317.5 | 10mg/kg | |
| O.C | % | 6.38-8.30 | 7.21 | - | |
| N mg/kg | | 0.22-0.40 | 0.3 | 20 | |
| P mg/kg | | 3.12-3.49 | 3.26 | 5 | |
| K mg/kg | | 0.29-0.54 | 0.41 | 50 | |
| Ca mg/kg | | 2.93-4.39 | 3.365 | 150 | |
| Mg mg/kg | | 3.24-3.95 | 3.42 | 50 | |
| Na mg/kg | | 0.27-0.61 | 0.37 | 200 | |
| CEC mg/kg | | 1.81-2.26 | 1.99 | - | |
| T exture | | | | - | |
| Sand % | | 65.5-76.4 | 68.82 | | |
| Silt % | | 5.40-6.40 | 6.18 | - | |
| Clay % | | 16.3-26.80 | 23.1 | - | |
| Porosity % | | 25.43-27.21 | 26.18 | - | |
| BD % | | 1.51-2.68 | 1.84 | G | |
| Fe mg/kg | | 3.16-4.62 | 3.87 | 1.5 | 1.0 |
| Zn mg/kg | | 0.35-0.42 | 0.3 | 3-5 | 1.0 |
| Pb mg/kg | | 0.17-0.33 | 0.23 | 0.05 | 0.05 |
| Cu mg/kg | | 0.29-0.61 | 0.41 | 0.01 | 1.5 |
| Cd mg/kg | | 0.11-0.87 | 0.49 | | 0.80 |

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| | | | | |
|---|---|---|---|---|
| **Cr** | **mg/kg** | **0.06-0.87** | **0.37** | **0.03** |

**DISCUSSIONS**

The mean concentration of pH in the oil spill site is quit lower than the control site and thus crude oil polluted sites are more acidic, acidity is probably posed by major resistance to leaching of basic salts or presence of residual hydrocarbon spill on Soil. pH was lower and consequently more acidic in dry season; the mean concentrations of pH in top and sub soils were 7.21 and 4.64 in dry season's control sites and oil spill soils respectfully. There is higher electrical conductivity, CEC in the control site was higher than the oil spill site, probably due to the inability of crude oil to conduct electric current for lack of free ions. The mean concentration of soil CEC in oil spilled site is 2.47 mg/kg and 3.14 mg/kg for top and sub soils respectively but the control point has a value of 3.86 mg/kg and 3.93 mg/kg in the top and subsoil respectively. THC was also quit higher at the oil spill affected area than control site. Oil spill site have higher organic carbon than the control site. The concentrations of macro nutrients (N, P, K, Ca, Mg and Na) are lower at the oil spill site than the control site except for Sodium (Na). Most of the macro nutrients are also higher in top than sub soils in oil spill site and control site probably due to Zero or no water peculation in dry season . Heavy metals (Fe, Cu, Zn, Pb, Cr and Cd) concentrations in soil were higher in the oil spill area than the control site,

O.C was lower in dry as the mean concentrations of O.C in top and sub soils were 7.21% and 5.45% in dry season control sites, and 3.06% and 2.45% in oil spill site, probably due to scanty agronomic practices in the polluted site, however, low frequency and amount of organic matter returned to soil in the control sites are inferred to have contributed to less values obtained, more so, profitable organic inputs may be less utilized by famers who mostly adopts the synthetic inputs.

**CONCLUSION**

Oil spill have negatively affected the physical and chemical properties of soil in Ukwa West, as results show that the oil spill sites are more acidic than the control sites. There is higher EC and CEC in the control sites than the oil spill sites. THC was also quit higher at the oil spill sites than control sites. The concentrations of macro nutrients (N, P, K, Ca, Mg and Na) are lower at the oil spill sites than the control sites while heavy metals (Fe, Cu, Zn, Pb, Cr and Cd) concentrations in soil were higher in the oil spill areas than the control sites. however, their concentrations are within the DPR threshold and , eg Cadmium is 0.80 mg/kg, The soil fall short of the FAO standard for agricultural purpose and therefore, needs slight liming and or / Bio-remediation for improved soil fertility of usage for agricultural purposes.

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**References**

Abii, T.A. and P.C. Nwosu (2009): The effect of oil – spillage on the soil of Eleme in Rivers State of the Niger – Delta area of Nigeria. Research Journal of Environmental Sciences, vol. 3, pp. 316 – 320.

Adelana, S.O, Adeosun, T.A, and Adesina, A.O (2011): Environmental pollution and remediation: challenges and management of oil Spillage in the Nigerian coastal areas. American Journal of sciences Vol 2 (6).

Adesodun, K. J. and Mbagwu, S.C. (2007): " Distribution of heavy metals and hydrocarbon contents," Bioresour. Technol.,Advances in Management &Applied Economics, 2, 211-228. Retrieved from http://sciencepress.com.

Association Of Analytical Chemists AOAC (2005).

Christian, B. H. and Voigt, C. (2008): Sustainable Development in International and National Law. Europa Law Publishing.

Claire, C. S. and Ashfaq K. (2004): Sustainable Development Law. Oxford University Press.

DPR (2002); Environmental Guidelines and Standards for the Petroleum Industries in Nigeria, Department of Petroleum Resources of Nigeria, Ministry of Petroluem National resources, Abuja. Nigeria, p 171.

Elenwo, E. I. and Anyanwu, C. A. (2017): Effect of Oil Pollution on Soil Properties along Pipeline Right of Way at Osisioma Ngwa, Abia State, Nigeria. Journal of Applied Science and Technology 22(6): 1-12.

Essien, O. E. and John, I. A. (2010): Impact of Crude-Oil Spillage Pollution and Chemical Remediation on Agricultural Soil Properties and Crop Growth. J. Appl. Sci. Environ.

Fayaz, A.W. (2013):Accumulation of heavy metals on soil and vegetable crops grown on sewage and tube well water irrigation, " vol.8,pp.2187-2193.

.Ifeanyichukwu, K. I. (2017): Evaluation of the Impacts of Oil Spillage on Soil fertility and Sustainable Livelihoods in Oil bearing communities of Abia State, Nigeria. Global Scientific journal: Volume 5, Issue 8, Online: Www.Globalscientificjournal.Com.

Joseph, A. and Salau, S. (2015): Oil pollution and agricultural productivity in the Niger Delta of Nigeria. Journal of Environmental Economics Vol.6 (4).

Kadafa, A. A. (2012): Oil exploration and spillage in the Niger Delta of Nigeria. Civil and Environmental Research, 2(3), 38-51.

Ndifon, (1998): An Assessment of the Physical Impact of Oil Spillage. Using GIS and Remote Sensing Technologies.

Nkereuwem, S. E. and Udeme, S. U. (2015): Oil Pollution and Its Impact on Water Quality in Ibeno Community Studies in Sociology of Science Vol. 6, No. 2, 2015, pp. 8-12.

NNPC Annual Bulletin, 2018.

NNPC Monthly Report , 2020.

Nwilo, P. C., and Olusegun, T. B. (2007): Impacts and Management of Oil Spill Pollution along the Nigerian Coastal Areas International Federation of Surveyors. Retrieved May 20,2017..

Okoye, C. O. and Okunrobo, L. A. (2014): Impact of Oil Spill on Land and Water and its Health Implications in Odu-Gboro Community, Sagamu, Ogun State, Nigeria. World Journal of Environmental Sciences and Engineering Vol. 1, No. 1, PP:1-21 Available online at http://scenrp.com/Journals

Owugah (2000): Big Oil, Rural Poverty, and Environmental Perspective. Oxford English Dictionary online edition, entry "petroleum".

Oyem, I. L, R. and Oyem, I. L. (2013): Effects of Crude Oil Spillage on Soil Physico-Chemical Properties in Ugborodo Community. International Journal of Modern Engineering Research (IJMER)

.UNDP (2006): Niger Delta Human Development Report. p. 76. Retrieved 19 June 2011.

GSJ: Volume 9, Issue 11, November 2021
ISSN 2320-9186

United Nations (2010): Our Common Future, From One Earth to One World. Retrieved 2011-04-02.

United Nations (2009): The Millennium Development Goals Report. Retrieved 2011-04-02.

Uquetan, U., Osang, J. E., Egor ,A. O., Essoka, P. A., Alozie, S. and Bawan, A. M. (2017): A Case Study of the Effects of Oil Pollution on Soil Properties and Growth of Tree Crops in Cross River State, Nigeria. International Research Journal of Pure and Applied Physics Vol.5, No.2, pp.19-28, www.eajournals.org.

Uzoije, A.P. and Agunwamba, J.C. (2011): Physiochemical Properties of Soil in Relation to Varying Rates of Crude Oil Pollution. Journal of Environmental Science and Technology, 4: 313-323.

Vanguard News, March 23, 2018.



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