

# Effects of Oil Spillage on Agricultural Productivity in Niger Delta Using Imiringi as a Case Study

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**ABSTRACT:** The project accessed the effects of oil spillage on agricultural productivity in Niger Delta using Imiringi as a case study. The physico-chemical properties of the soil samples of both the affected region and a control region were analysed. The PH, electrical conductivity, temperature, Total Dissolved Solids (TDS), Nitrate, Nitrite, Phosphorus, Total organic matter, Total petroleum hydrocarbon was analysed. Conductively, the results showed that the concentration of the soil properties mentioned above was quite different from the result of the control sample. The result obtained revealed a significant decrease in temperature with 28.6°C, decrease in PH of 4.26, increase in electrical conductivity of 290mg/kg, increase in total dissolved solids of 145mg/kg, decrease in Nitrate of 0.894mg/kg, decrease in Nitrite of 0.007mg/kg, decrease in Phosphorus of 1.68mg/kg, decrease in total organic matter of 20,245mg/kg, and an increase in total petroleum hydrocarbon of 30,000mg/kg. It was concluded that the soil in the study area is polluted and not fit for agricultural production. It is recommended that companies should take necessary steps to prevent occurrence of oil spillage.

**KEYWORDS:** Physico-chemical, PH, Electrical Conductivity, Total Dissolved Solids (TDS), Temperature, Oil spillage, Agricultural Production.

## I. INTRODUCTION

Crude Oil is naturally occurring complex mixture of liquid and gasses, mainly of hydrocarbon contents, found thousands of meters below the earth crust and brought to the surface by drilling. Crude oil is accompanied by varying quantities of volatile and extraneous materials such as water, organic matters and gases. Crude oil was discovered in commercial quantity in the region especially in the present Bayelsa State in 1986. Since the discovery of oil in 1956, the country has been suffering the negative environmental consequences of oil

spillage. An oil spillage is the release of liquid petroleum hydrocarbon into the environment due to human activities. It is a form of pollution. Oil exploration and spillage has continued in the area resulting into what is termed environmental degradation due to neglect and negative attitude of the multinational companies. The growth of the country oil industry, combined with the population explosion and the lack of enforcement of environmental regulations has led to substantial damage to Nigeria's environment, especially in the Niger Delta region. The oil companies have become the greatest contributor to the environment degradation. The first major oil spillage occurred in 1970 in the South East of Nigeria. The most damaged region was Ogoni-land. The Nigerian Agip Oil Company (NAOC) about the 13<sup>th</sup> of August 1983 reported major crude oil spillage along the Ogada – Brass 24 pipelines in the then Ahoada Local Government Area of Rivers State. The amount of oil spilled was estimated to about 10,000 barrels by the Department of Petroleum Resource (DPR). The Niger Delta region is Nigeria's only productive region for petroleum. The Niger Delta region is linked to the South-South Geo-Political Zone of Nigeria. It is the most endowed delta in terms of both human and material resources. Before the finding of crude oil, agriculture was the dominant occupation of the people. The region consists entirely of nine states of Rivers, Bayelsa, Cross River, Akwa Ibom, Delta, Edo, Ondo, Abia and Imo State.

[6].As the case with many oil rich developing countries, oil reserves has proved a mixed blessing for Nigeria. This is so because of the environmental and social impacts exploration and exploitation of this important natural resources. Rural communities dominate the Niger Delta region that depend solely on the natural environment for sustenance living and non-living livelihood.

[10]. Productivity losses due to environmental degradation are of topical concern to communities in the Niger Delta region.

[17]. Oil production has worsened environmental disaster in the Niger Delta region.



**Fig-1-** Oil spill in Kolo Creek Fields, Bayelsa State, Niger Delta [8]



**Fig-2-** Oil spill site at Owaza, Niger Delta, Nigeria [13]

Ironically, 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. The exploration and exploitation of crude oil have been in Nigeria for many years ago and their on the oil producing communities have been quite problematic. These activities through development, have elicited all kinds of impacts, ranging from barely tolerable ones to utterly disastrous effects. Also these activities are known to have decimated terrestrial and aquatic biotas, which constitute the peoples major source of

livelihood. Soil fertility remains one of the inevitable effects that have received insufficient attention. Soil fertility maybe defined as the ability of soil to sustain plant growth on basis under given conditions of climate and other relevant properties of land.

Loss of soil fertility through loss of soil organic matter, leaching out of nutrients, loss of nutrient laden top soil, change in soil pH, and reduction in carbon exchange capacity, salinization, water logging and other form of soil degradation are major problems associated with agricultural production in the oil producing areas of Nigeria.

[12]. Oil is known to excrete adverse effects on the soil properties and plant communities beyond 3% concentration, oil has been reported to be increasingly deleterious to soil biota and crop growth.

[5].Crude oil spillage on soil makes it inadequate for plant growth.

[14].This is due to the insufficient aeration of the soil because of displacement of air from the spaces between the soil particles by crude oil.

[1]. In Nigeria substantial amount of crude oil is spilled annually. In Nigeria, between 1976 and 2000, about 20,106 barrels of oil were discharged into the environment (especially farmlands), and the fact that the inhabitants of the areas are subsistent farmers, there is urgent need for the various agencies connected with oil productions in Nigeria to pay more attentions to the problems of oil spillage. Oil pollution also comes from oil well blowouts seepage and ballasting operations, sale and use of petroleum products, pipeline overflow and breakage and storage tank spills.

[7].States that mineral ions absorbed initially by the roots are finally received by mesophyll cells of the leaves. The growth of plants growing in oil polluted soil was generally decelerated and chlorosis of leaves results together with the dehydration of the plants indicating water deficiency. Crude oil spillage has a major impact on the ecosystem into which it is been released. An estimated 5% to 10% of Nigeria mangrove ecosystem have been wiped out either by settlement or by oil spillage. Crude oil spills in populated areas often spread out over a wide area, destroying crops and aquacultures through contaminations of the ground water and soils. The toxicity of crude oil or petroleum product varies widely depending on their composition and concentration, environmental factors and on the biological state of the organisms at the time of the contamination.

[16]. In highly contaminated areas, there are immediate detrimental effects on plants and animal life, including agriculture.

[2]. In addition to its effects on visible plants and animals, petroleum contamination impacts microbial populations. The effect of oil on microbial populations depends upon the chemical composition of the oil and on the kind of microorganisms present. Populations of some microbes increase; typically, such microbes use the petroleum hydrocarbons as nutrients. The consumptions of dissolved oxygen by bacteria feeding on the spilled hydrocarbon also contribute to the death of aqua life. Human efforts to improve the standard of living of man through the control of nature and the development of new products have also resulted in the pollution or contamination of the environment. Most of the world's water and land are now partially poisoned by chemical wastes from industrial processes, including those of crude oil and gas. Many species of plants and animals are in the verge of extinction due to the effect of pollution. Consequently, the activities of these oil companies in Ogbia, Imiringi, Ogbia Local Government of Bayelsa State to be precise resulted in various kind of spill that grossly affected the environment. Hence, the research which will examine the oil spillage on Imiringi in Ogbia Local Government of Bayelsa State, Nigeria. This project work is carried out to know the adverse effects of spilled crude oil on the soil fertility and its remediation based on the sample (A, B and C) that was obtained from the different location in Imiringi community.

### **Environmental Implication of Oil Spillage on Land and Water**

#### **1. Land**

Oil spill on farms or grassy land will lead to the choking of plant life. Plant life is so detrimentally affected because the soil will lose its ability to absorb water. Light oil will seep into the top soil quickly, rapidly peculates and then contaminates ground water. On the other hand, heavier oil with a high viscosity rate penetrates slowly into the soil which will eventually contaminate ground water. Terrestrial oil spills seriously affects the fertility of soil, which will eventually contaminate ground water. Terrestrial oil spills seriously affects the fertility of soil, often making it unfit for vegetation. Vegetation cover is affected because it makes both crops and grasses turn yellow and immediately dry up. Land organisms such as insects both flying and creeping die due to contamination and inhalation of crude oil. In situation where the oil spill result to fire outbreak either due to temperature or by other means, the whole vegetation, and all other living organisms including man are burnt which may eventually lead to death, loss of soil fertility and deforestation.

When there is an oil spill on soil, the gaseous and liquid components evaporate. Some experience bacterial changes and eventually sink to the bottom by gravitational action. The soil is then contaminated with a gross effect upon the terrestrial life (Plant and Animals). The mangrove was once a source of both fuel woods for the native people and a habitat for the areas biodiversity, but is now incapable of surviving the oil toxicity of its habitat.

#### **2. Water**

Aquatic wildlife and their habitats are affected by oil spills by means of physical contact ingestion and inhalation. The oil spill causes damage to the whole aquatic food chain. Suspended oil on the water contaminates plantation, algae, larvae, and fish eggs, which are consumed by small fish species. This contamination is then passed to larger fishes, bears, aquatic birds and even humans. Oil spills affect the germination and growth of marine plants. When exposed to oil spills, some species of marine algae and sea weed may even perish. Oil spills can cause marine invertebrates to choke. It can also alter their metabolic activities and shell development. The vertebrates may accumulate high level of toxins in their bodies, which get passed on their predators when they are eaten. Fish tend to ingest large amount of oil through their gills, which seriously affects the health of their eggs, oil spills can even destroy the insulation capacity of a marine bird's feathers or a mammal's fur, which leads to death by hypothermia. When oil is ingested by these species, it also leads to the damage of their lungs, liver and kidneys, followed by death. The growth of algae in polluted water cause numerous health problems including nausea, infectious disease and allergic reactions and odours to those living near algae covered water ways.

#### **Remediation of Crude Oil Polluted Sites**

Owing to the problems associated with physical, chemical and mechanical methods, there is a need for a safer and less expensive approach to remediation of polluted environments.

[4]. Bioremediation is a means of cleaning up contaminated environments by exploiting the diverse metabolic abilities of microorganisms to covert contaminants to harmless products by mineralization or by conversion into microbial biomass. Microbial degradation has emerged as the most important natural mechanism for the removal of non-volatile hydrocarbon pollutants from the environment. Although biodegradation occurs at an alarmingly slow rate, it can be enhanced by inoculation with microbial species that will degrade the oil waste more efficiently, and or by introducing air and nutrients into the environment.

[9]. Oil degrading micro-organisms are abundant and are not limited to oil producing areas, but are present in any conceivable environments.

[14]. Filamentous, fungi and bacteria all have the ability to utilize hydrocarbon substrates through their ability to do so vary among individual strains and in some cases, depends on hydrocarbon chain length. For example, bacteria and yeasts revealed decreasing abilities to degrade alkanes with increasing chain length. Filamentous fungi did not exhibit preferential degradation for particular chain lengths.

### General Description of the Area of Study

The Kolo Creek Area is made up of several communities and is located within 4.55 55.25N and 4 55 31.92N and latitudes 6 20 11.94E and 6 24 50 70 E including the towns of Imiringi, Otuasega, Elebele, Orom and Ayon. The Kolo Creek oil and gas field is found within Imiringi town area and situated about 10km east of Yenagoa, the capital city of Bayelsa State. The 2012 anticipated population of the community is 8,351. The main economic activity in the area is slinked to the oil industry business which is operated by SPDC. Kolo Creek flow station is the major oil and gas facility in Bayelsa State, which uses about 30% of its associated gas to generate electricity in the state. The Kolo Creek field hosts some oil surface production facilities including 46 oil wells, one flow station, one manifold and one SPDC Camp Site. The other economic activities include subsistence agriculture, artisanal fishing, palm wine tapping and processing and basic commerce.

## II. STATEMENT OF THE PROBLEM/OBJECTIVES

It is supposed that the socio-economic well-being of the people of the Niger Delta has been affected as a result of the negative effect of oil spillage and gas flaring in their communities. This led to youth restiveness in many crude oil producing areas.

[3]. The effect of these phenomena has in the last decade had negative impact on national economic development. There is high rate of oil spillage and gas flaring in the Niger Delta region resulting to a loss of revenue by both the oil and gas prospecting Companies and the Government in the Niger Delta.

[15]. This led to a total loss cost of US# 175, 795, 811 equivalent to N20,671,321,766.00 derived from a combine total oil spilled of 4, 220, 803 barrels of crude oil and total gas flared of 112, 408, 693 million thousand standard cubic feet of gas over the past 30 years in the Niger Delta region. The Imiringi Community of Ogbia Local Government Area of

Bayelsa State is blessed with abundant natural resources, major ones being crude oil and gas. She is one of the hearts of the hydrocarbon industry in Bayelsa State. Ever since the commencement of oil and gas exploration and exploitations activities in the Niger Delta Region, there has been social, economic, health and ecological destabilizations in the terrestrial and aquatic life. Oil spillage is one of the problems in the area, also gas leaks, blow out canalizations and discharge of wastes and influents from oil and gas operation directly into surface water bodies and land surface. Oil spills in Nigeria occur due to a number of causes that include corrosion of pipelines, sabotage and accidents in the oil production operations. The activities of this multi-national oil company operating in Imiringi Area has disrupted the balance of the environment and thereby creating some environmental pollution problems as a result of oil spillage. The Area is experiencing a wanton destruction of her wetland ecosystem due to the carelessness of the oil industry. Corrosion of pipelines account for high percentage of oil spills in the area. These pipelines which were laid about 50years ago with expectation of having a life span of 15 years are old and susceptible to corrosion. This study will help to determine the cause of oil spillage, the physico-chemical parameters of soil contaminated with crude oil spills, the extent of impact of crude oil in agricultural products, and also provide a means of improving the spill affected area.

## III. MATERIAL AND METHODS

The materials used for this work are, soil samples, PH meter, distilled water, beakers, weighing balance, filter paper, funnel, thermometer, conductivity meter, spectrometer, mechanical shaker, volumetric flask, conical flask, spectrophotometer, pipette, Erlenmeyer flask, measuring cylinder, burette

## SITE SELECTION, DESCRIPTION AND SAMPLING

### SITE SELECTION AND DESCRIPTION

The study area used for this research work is around the vicinity of Imiringi Community in Ogbia Local Government Area, Bayelsa State, Nigeria. Imiringi is a semi-urban community situated at Ogbia Local Government Area of Bayelsa State in the Niger Delta region of Southern Nigeria. Imiringi was chosen for the study for a number of reasons including location in the fresh water, swamp zone, easy accessibility by road from Yenagoa, the Bayelsa State Capital, which lies only about 10km away, a favourable security report – Imiringi community had a reputation for peace and

stability and therefore offered an opportunity for meaningful social, health and biophysical investigations; and it is a community located within a relatively old oil spill zone – The Kolo Creek Area.

#### TEMPERATURE AND RAINFALL

The area lies within the rain forest belt of the Eastern Niger Delta of Nigeria. It is within the tropical wet climate classification of Koppen. The area is characterized by continued high temperatures and rainfall. Average temperature are usually greater than 18 degrees Celsius while annual precipitation is greater than 1,500mm. Precipitation takes place all year long although, there is a slight reduction in precipitation in months of August each year and between the months of December and February.

#### SOILS, VEGETATION, RELIEF AND DRAINAGE

The Kolo Creek is characterized by tropical rainfall and fresh water swamps that are usually flooded in most parts of the year, especially between May and November. The area is characterized by seasonal flooding and marsh flooded vegetation permanently swampy and mostly flooded by fresh water. The primary vegetation in the study area is the rattle-dominated fresh water swamp vegetation while the major soil types in the area are young shallow, poorly drained soils. The soils here may have been created by the meandering of the Kolo Creek and Elebele systems which have created silted river belt soils characterized by peaty clay water bogged soils inundated by water for most of the year. The study area is a low-lying flood plain environment with heights not more than 7 meters above sea level.

#### Sampling Design And Soil Collection

Soil samples were taken from three oil impacted areas and a non – impacted (control area). The contaminated areas considered are around the well head, 5meters, 100meters, and 500meters and very far from the well head 100meters (control area) soil samples were collected at surface (or 15cm) depths. The soil samples were placed in aluminum foil paper bags, labeled and taken to the laboratory.

#### LABORATORY ANALYSIS

##### PH

PH: The fundamental electrometric principle method of electrometric PH measurement is determination of the activity of the hydrogen ions by potentiometric measurement using a standard glass electrode and a reference electrode.

Apparatus: PH meter consisting of potentiometer, a glass electrode, a reference electrode and a temperature compensating device, beakers, weighing balance, filter paper and funnel.

##### Procedure:

- ❖ Weight 20g of dry soil (passed through 2mm sieve) into a 50ml beaker.
- ❖ Add 20ml to distilled water.
- ❖ Allow to stand for 30 minutes and stirring occasionally with a glass rod.
- ❖ Rinse the electrode of the PH meter into the partly settled suspension and measure the PH. Do not stir the suspension during measurement.
- ❖ When the reading is stable, record the sample PH.

#### ELECTRICAL CONDUCTIVITY & TOTAL DISSOLVED SOLID

##### Laboratory method / Filterable method

EC/TDS: Conductivity is the measure of the ability of an aqueous solution to carry electric current. This ability depends on the presence of ions. On their total concentration, mobility and valence and on the temperature of measurement.

Apparatus: self-contained conductivity meter capable of measuring conductivity with error not exceeding 1% or 11s/cm. Whichever is greater, thermometer, capable of being read to the nearest, 0.1oc and covering the range 23 to 27o<sup>c</sup>, weighing balance, filter paper, funnel procedure.

- ❖ Weigh 20g of air dry soil (passed through 2m sieve) into a 50ml beaker.
- ❖ Add 20ml of distilled water.
- ❖ Allow to stand for 30mins and stirring occasionally with a glass road.
- ❖ Rinse the electrode with distilled water.
- ❖ Insert the electrode of the EC meter into the partly settled suspension and measure the EC.
- ❖ Do not stir the suspension all through the measurement.
- ❖ When reading is stable, record the sample EC.

#### CADMIUM – REDUCTION METHOD

Nitrate: Nitrate is reduced almost quantitatively to nitrite in the presence of cadmium. The nitrate is the diazotized with sulfanilamide and coupled with N – (1-naphthyl) ethylene diamine hydrochloride to form a highly colored azo dye that is measured colorimetrically. The method is recommended particularly for  $\text{NO}_3^-$  levels below 0.1mg N/L where other methods lack adequate sensitivity.

Apparatus: Spectrophotometer to use at 543nm, reduction column, conical flask, 250ml or 500ml, measuring cylinder, 100ml and 50ml, volumetric flask, 25ml mechanical shaker, weighing balance, filter paper, funnel.

### Extraction of Soil Sample

- ❖ Weigh 5g of air – dried, grounded and sieved (2mm) soil into a 125ml Erlenmeyer flask.
- ❖ Add 50ml of the 2m KCL
- ❖ Shake for 30 minutes on a mechanical shaker.
- ❖ Filter the soil suspension using any medium grade filter paper that will provide a clear filtrate without contributing measurable amount of  $\text{NO}_3 - \text{N} - \text{Co}$  the filtrate.

### SAMPLE ANALYSIS

- ❖ Measure 10ml of sample into your conical flask.
- ❖ Add one sachet of nitra-ver 5 powder pellow.
- ❖ Shake thoroughly for 1min and allow to stand for 10mins.
- ❖ An amber colour would develop.
- ❖ Read absorbance of 410nm wave length using UV spectrophotometer.

### COLOMETRIC METHOD

**Nitrite:** Nitrite is determined through formation of a reddish purple azo dye produced at PH 2.0 to 2.5 by coupling diazotized sulfanilamide with N-(1-naphthyl) – ethylene diamine dihydrochloride (NED dihydrochloride). The application range of this method for spectrophotometer measurement is 0.01 to 1.0mg  $\text{NO}_2 - \text{N/L}$ . Higher concentration can be determined by diluting the sample.

**Apparatus:** Spectrophotometer for use at 410nm, conical flask, 250ml measuring cylinder, 100ml & 50ml, mechanical shaker, weighing balance, filter paper, funnel.

### PROCEDURES

#### Extraction of Soil Sample

- ❖ Weigh 5g of air – dried, grounded and sieved (2mm) soil into a 125ml Erlenmeyer flask.
- ❖ Add 50ml of the 2m KCL
- ❖ Shake for 30 minutes on a mechanical shaker.
- ❖ Filter the soil suspension using any medium grade filter paper that will provide a clear filtrate without contributing measurable amount of  $\text{NO}_3 - \text{N} - \text{Co}$  the filtrate.

### SAMPLE ANALYSIS

- ❖ Measure 25ml of sample in a conical flask.
- ❖ Add 1ml of color reagent and mix.
- ❖ Allow to stand for 10mins for proper color development.
- ❖ Read absorbance at 543nm wave length using UV spectrophotometer.

### ASCORBIC ACID METHOD

Phosphorus: Ammonium molybdate and antimony potassium tartrate react in acid medium with orthophosphate to form a heteropoly acid

(phosphomolybdic acid) that is reduced to intensely colored molybdenum blue by ascorbic acid.

The intensity of the blue colour is proportional to the concentration of phosphate. The minimum detectable concentration by this method is 0.01mg/L.

Erlenmeyer flask 250ml spectrophotometer for use at 880nm, pipette, mechanical shaker, pipette, filter, acid washed glass wares, weighing balance, filter paper and funnel.

### PROCEDURES

- ❖ Extraction of soil samples
- ❖ Weigh 5g of soil into a 125ml Erlenmeyer flask.
- ❖ Add 25ml of the extracting solution (0.5M  $\text{NAHCO}_3$ ) to the sample.
- ❖ Stopper tightly and shake for 30 minutes with mechanical shaker.
- ❖ Filter the suspension through a filter paper.
- ❖ If filtrates are dark colored add carbon black and filter again to obtain a clear filtrate.

### SAMPLE ANALYSIS

- ❖ Pipette 5ml of the supernatant clear digest solution into a 50ml volumetric flask.
- ❖ Add about 20ml distilled water to each flask.
- ❖ Add 10ml of the ascorbic acid reducing agent to each flask.
- ❖ Make up to 50ml with distilled water.
- ❖ Stopper tightly and shake well.
- ❖ Let stand for about one hour for colour development.
- ❖ Measure the samples absorbance (blue colour) at 880nm wavelength setting in a suitable colorimeter.

### WALKELY AND BLACK METHOD

#### Total Organic Carbon

**Apparatus:** Weighing balance, Erlenmeyer flask 500ml, 10ml pipette, measuring cylinder, 50ml and 100ml, 50ml burette.

### PROCEDURES

- ❖ Weigh 1g or more of soil sample depending on the organic content of the soil.
- ❖ Pipette 10ml of 1N,  $\text{K}_2\text{Cr}_2\text{O}_7$  solution accurately into the flask and swirl gently.
- ❖ Add rapidly 20ml concentration  $\text{H}_2\text{SO}_4$  directing the stream into the suspension.
- ❖ Immediately, gently swirl the flask until sample and reagents are properly mixed.
- ❖ Place the flask on a sheet of asbestos / insulation pad and allow to stand for at least 30minutes.
- ❖ Afterward add 10ml of distilled water and swirl.
- ❖ Add 10ml of orthophosphoric acid
- ❖ Add 0.2g of sodium fluoride.

- ❖ Add 3 drops of terrain indicate and swirl gently for proper mixing. The indicator is added just prior to titration.
- ❖ Titrate immediately with 0.5M ferrous sulphate solution or 0.5M ferrous ammonium sulphate FAS.
- ❖ As the end point is approached, the solution takes on a greenish colour and then changes to dark green. At the point, the green colour changes to brownish red and maroon colour.

#### TOTAL PETROLEUM HYDROCARBON

##### Extraction for Soil Sediment Samples

- ❖ 10g of sample is weighed into an acid, washed and acetone rinsed beaker.
- ❖ 25ml of 1+1 DCM and acetone are added. Sample is placed in a sonicator to sonicate for 20mins. (A sonicator is an apparatus used to subject a sample to ultrasonic vibration so as to cause fragmentation of molecules.
- ❖ Extract with centrifuge for 10mins and solvent phase is carefully extracted through a filter paper containing 5g of anhydrous sodium sulphate and preconditioned with 1+1 DCM and acetone.
- ❖ 50ml 1+1 DCM and acetone is added to the separating funnel and extraction procedure is repeated.
- ❖ The extracts are combined in the Erlenmeyer flask and concentrated into 5ml syringe using rotary evaporator.
- ❖ The extracts are then fractionated into aliphatic and aromatic using column with hexane.

**For Aliphatic:** 2ml of concentrate is introduced into the column and eluted with 10ml of hexane. The eluted solvent is concentrated into final 2ml vial which is run with the gas chromatography machine.

**For Aromatic:** 2ml of concentrate is added into the column and eluted with 10ml DCM. The eluted solvent is concentrated into 2ml final vial which is run into the gas chromatography machine.

#### IV. RESULTS AND DISCUSSIONS

Results of the soil properties analyses at the crude oil contaminated area. (5 metres from well head).

##### A. PH

The values of the PH of the oil contaminated area were gotten from analyses for three trials.

The PH at the first trail was gotten as 4.10, the second trail 4.25 and the third trail 4.50.

##### B. TEMPERATURE

The values of the temperature of the oil contaminated area were gotten from analyses of the three trails.

The temperature of the first trail was gotten as 27.7, the second trail 29.5 and the third trail 28.6.

##### C. ELECTRICAL CONDUCTIVITY

The conductivity of the soil at the well head was gotten from the analyses for the three trails. The conductivity at the first trail was gotten as 284 $\mu$ s/cm, at the second trail, the result was 292 $\mu$ s/cm, while the result at the third trail was 294 $\mu$ s/cm.

##### D. TOTAL DISSOLVED SOLID

The values of the total dissolved solid of the oil contaminated area was gotten from analyses of three trials. The total dissolved solid at the first trial was gotten as 142mg/kg, at the second trails the result was 146mg/kg, while the result at the third trail was 147mg/kg.

##### E. NITRATE

The concentrations of extractable nitrate in the soil far from the wellhead was from the analyses of three trials. The first result of the amount of nitrate at the first trail was gotten as 0.890mg/kg, at the second trail, the result was 0.895mg/kg while the result at the third trail was 0.897mg/kg.

##### F. NITRITE

The concentrations of extractable nitrate in the soil far from the well head was gotten from the analyses of three trails.

The result of the amount of nitrite at the first trail was gotten as 0.017mg/kg, at the second trail, the result was 0.008mg/kg while the result of the third trail was 0.005mg/kg.

##### G. PHOSPHORUS

The concentrations of phosphorus and compounds of phosphorous in the soil far from the well head were gotten from the analyses for the three trails. The result of amount of phosphorus at the first trail was gotten as 1.60mg/kg, at the second trail, the result was 1.70mg/kg, while the result at the third trail was 1.74mg/kg.

##### H. TOTAL ORGANIC MATTER

Total organic matters in the soil at the well head were gotten from analyses for the three trails. The result of the amount of organic matter at the first trail was gotten as 39,680mg/kg, at the second trial the result was 39,691mg/kg while the result at the third trail was 39,690mg/kg.

##### I. Total Petroleum Hydrocarbon

The concentrations of hydrocarbon compounds in the soil far from the well head were gotten from the analyses for the three trails.

The result of volumes at the first trail was gotten as 29,990mg/kg, at the second trail, the result was 30,000mg/kg, while the result at the third trail was 30,010mg/kg.

#### RESULTS OF THE SOIL PROPERTIES ANALYSES AT THE CRUDE OIL

**CONTAMINATED AREA. (100 METRES FROM WELL HEAD).**

**A. PH**

The values of the PH of the oil contaminated area were gotten from analyses for three trials.

The PH at the first trail was gotten as 5.10, the second trail 5.01 and the third trail 5.19.

**B. TEMPERATURE**

The values of the temperature of the oil contaminated area were gotten from analyses of the three trails. The temperature of the first trail was gotten as 28.9, the second trail 28.6 and the third trail 28.0.

**C. ELECTRICAL CONDUCTIVITY**

The conductivity of the soil at the well head was gotten from the analyses for the three trails. The conductivity at the first trail was gotten as 261 $\mu$ s/cm, at the second trail, the result was 268 $\mu$ s/cm, while the result at the third trail was 269 $\mu$ s/cm.

**D. TOTAL DISSOLVED SOLID**

The values of the total dissolved solid of the oil contaminated area was gotten from analyses of three trials. The total dissolved solid at the first trial was gotten as 133mg/kg, at the second trails the result was 132mg/kg, while the result at the third trail was 134mg/kg.

**E. NITRATE**

The concentrations of extractable nitrate in the soil far from the wellhead was from the analyses of three trials. The first result of the amount of nitrate at the first trail was gotten as 3.51mg/kg, at the second trail, the result was 4.31mg/kg while the result at the third trail was 4.51mg/kg.

**F. NITRITE**

The concentrations of extractable nitrate in the soil far from the well head was gotten from the analyses of three trails.

The result of the amount of nitrite at the first trail was gotten as 0.067mg/kg, at the second trail, the result was 0.068mg/kg while the result of the third trail was 0.072mg/kg.

**G. PHOSPHORUS**

The concentrations of phosphorus and compounds of phosphorous in the soil far from the well head were gotten from the analyses for the three trails. The result of amount of phosphorus at the first trail was gotten as 91.3mg/kg, at the second trail, the result was 92.3mg/kg, while the result at the third trail was 92.4mg/kg.

**H. TOTAL ORGANIC MATTER**

Total organic matters in the soil at the well head were gotten from analyses for the three trails. The result of the amount of organic matter at the first trail was gotten as 36,359mg/kg, at the second trial

the result was 36,363mg/kg while the result at the third trail was 36,364mg/kg.

**I. Total Petroleum Hydrocarbon**

The concentrations of hydrocarbon compounds in the soil far from the well head were gotten from the analyses for the three trails.

The result of volumes at the first trail was gotten as 11,994mg/kg, at the second trail, the result was 12,003mg/kg, while the result at the third trail was 12,003mg/kg.

**Results Of The Soil Properties Analyses At The Crude Oil Contaminated Area. (500 Metres From Well Head).**

**A. PH**

The values of the PH of the oil contaminated area were gotten from analyses for three trials.

The PH at the first trail was gotten as 7.62, the second trail 7.64 and the third trail 7.74.

**B. TEMPERATURE**

The values of the temperature of the oil contaminated area were gotten from analyses of the three trails. The temperature of the first trail was gotten as 27.7, the second trail 29.5 and the third trail 28.6.

**C. ELECTRICAL CONDUCTIVITY**

The conductivity of the soil at the well head was gotten from the analyses for the three trails. The conductivity at the first trail was gotten as 240 $\mu$ s/cm, at the second trail, the result was 245 $\mu$ s/cm, while the result at the third trail was 247 $\mu$ s/cm.

**D. TOTAL DISSOLVED SOLID**

The values of the total dissolved solid of the oil contaminated area was gotten from analyses of three trials. The total dissolved solid at the first trial was gotten as 122mg/kg, at the second trails the result was 124mg/kg, while the result at the third trail was 120mg/kg.

**E. NITRATE**

The concentrations of extractable nitrate in the soil far from the wellhead was from the analyses of three trials. The first result of the amount of nitrate at the first trail was gotten as 6.70mg/kg, at the second trail, the result was 6.81mg/kg while the result at the third trail was 6.83mg/kg.

**F. NITRITE**

The concentrations of extractable nitrate in the soil far from the well head was gotten from the analyses of three trails.

The result of the amount of nitrite at the first trail was gotten as 0.134mg/kg, at the second trail, the result was 0.124mg/kg while the result of the third trail was 0.144mg/kg.



### G. PHOSPHORUS

The concentrations of phosphorus and compounds of phosphorous in the soil far from the well head were gotten from the analyses for the three trails. The result of amount of phosphorus at the first trail was gotten as 181mg/kg, at the second trail, the result was 182mg/kg, while the result at the third trail was 183mg/kg.

### H. TOTAL ORGANIC MATTER

Total organic matters in the soil at the well head were gotten from analyses for the three trails. The result of the amount of organic matter at the first trail was gotten as 26,136mg/kg, at the second trial the result was 26,143mg/kg while the result at the third trail was 26,144mg/kg.

### I. TOTAL PETROLEUM HYDROCARBON

The concentrations of hydrocarbon compounds in the soil far from the well head were gotten from the analyses for the three trails.

The result of volumes at the first trail was gotten as 2,997mg/kg, at the second trail, the result was 3,001mg/kg, while the result at the third trail was 3,002mg/kg.

## RESULTS OF THE SOIL PROPERTIES ANALYSES AT THE CONTROL AREA. (1000 METRES FROM WELL HEAD).

### A. PH

The values of the PH of the control area were gotten from analyses for three trials.

The PH at the first trail was gotten as 7.97, the second trail 8.05 and the third trail 7.98.

### B. TEMPERATURE

The values of the temperature of the control area were gotten from analyses of the three trails. The temperature of the first trail was gotten as 28.5, the second trail 28.4 and the third trail 29.2.

### C. ELECTRICAL CONDUCTIVITY

The conductivity of the soil at control area was gotten from the analyses for the three trails. The conductivity at the first trail was gotten as 169.0 $\mu$ s/cm, at the second trail, the result was 172.5 $\mu$ s/cm, while the result at the third trail was 173.0 $\mu$ s/cm.

### D. TOTAL DISSOLVED SOLID

The values of the total dissolved solid of the control area was gotten from analyses of three trials. The total dissolved solid at the first trial was gotten as 85.0mg/kg, at the second trails the result was 85.8mg/kg, while the result at the third trail was 86.6mg/kg.

### E. NITRATE

The concentrations of extractable nitrate in the soil at the control area was gotten from the analyses of

three trials. The first result of the amount of nitrate at the first trail was gotten as 9.09mg/kg, at the second trail, the result was 9.03mg/kg while the result at the third trail was 9.00mg/kg.

### F. NITRITE

The concentrations of extractable nitrate in the control area was gotten from the analyses of three trails.

The result of the amount of nitrite at the first trail was gotten as 1.61mg/kg, at the second trail, the result was 1.71mg/kg while the result of the third trail was 1.81mg/kg.

### G. PHOSPHORUS

The concentrations of phosphorus and compounds of phosphorous in the control area were gotten from the analyses for the three trails. The result of amount of phosphorus at the first trail was gotten as 206.1mg/kg, at the second trail, the result was 261.4mg/kg, while the result at the third trail was 261.5mg/kg.

### H. TOTAL ORGANIC MATTER

Total organic matters in the control area were gotten from analyses for the three trails. The result of the amount of organic matter at the first trail was gotten as 20,238mg/kg, at the second trial the result was 20,249mg/kg while the result at the third trail was 20,248mg/kg.

### I. Total Petroleum Hydrocarbon

The concentrations of hydrocarbon compounds in the control area were gotten from the analyses for the three trails.

The result of volumes at the first trail was gotten as 1.10mg/kg, at the second trail, the result was 1.60mg/kg, while the result at the third trail was 1.80mg/kg.

## EVALUATION OF THE MEAN VALUES OF THE SOIL PARAMETERS AND THEIR CONTROL AREA MEAN VALUES.

The mean values of the soil parameters refer to the average values of the soil parameter gotten in the three trials for the cases of soil collected 5 meters, 100 meters, 500 meters from the well head and soil collected at the un-implemented or control area (1000 meters).

### CASE 1: (5 METERS) FROM THE WELL HEAD

The mean values of the various parameters are presented in the table below:

Mean values of soil parameters around the well head.

Parameters	Well Head (5meters)	Control Area (100 meters)
PH	4.26	8.0
Temperature °c	28.6	28.7
Electrical Conductivity	290	171.5
Total Dissolved Solids	145	85.8
Nitrate	0.894	9.04
Nitrite	0.007	1.71
Phosphorus	1.68	261
Total Organic Matter	39,687	20,245
Total Petroleum Hydrocarbon	30,000	1.50

**CASE 2: (100 METERS) FROM THE WELL HEAD**

The mean values of the various parameter are presented in the table below:

**Mean values of soil parameters around the well head**

Parameters	Well Head (100 meters)	Control Area (1000 meters)
PH	5.10	8.0
Temperature °c	28.5	28.7
Electrical Conductivity	266	171.5
Total Dissolved Solids	133	85.8
Nitrate	4.11	9.04
Nitrite	0.069	1.71
Phosphorus	92.0	261
Total Organic Matter	36,362	20,245
Total Petroleum Hydrocarbon	12,000	1.50

**CASE 3: (500 METERS) FROM THE WELL HEAD**

The mean values of the various parameters are presented in the table below:

**Mean values of soil parameters around the well head.**

Parameters	Well Head 500 (meters)	Control Area (1000 meters)
PH	7.66	8.0
Temperature °c	28.6	28.7

Electrical Conductivity	244	171.5
Total Dissolved Solids	122	85.8
Nitrate	6.78	9.04
Nitrite	0.134	1.71
Phosphorus	182	261
Total Organic Matter	26,141	20,245
Total Petroleum Hydrocarbon	12,000	1.50

## V. CONCLUSION

In this paper, the concentration of the following soil properties (PH, Electrical conductivity, total dissolved solids), Temperature, Nitrate, Nitrite, Total Organic Carbon, Phosphorus and Total Petroleum Hydrocarbon) were determined and was quite different from the result of the control soil sample. When compared with the concentration of the soil properties of the control area (non-oil impacted area) it shows that the level of oil spillage is high and which really affect the environment of the community. Therefore, it is clearly seen from the result obtained that high level of oil spill really pollutes our environment and causes so many harms to the life of the people residing in the community, terrestrial animals and aquatic habitat. This also causes reduction in the concentration of the soil properties which leads to poor plants growth.

### Nitrate, Nitrite & Phosphorus

From the analyses, it can be seen that the amount of Nitrate, Nitrite and Phosphorus in the soil reduced in the contaminated soil. The Highest reduction of Nitrate, Nitrite and Phosphorus were noticed at 5 meters from the well-head. The approximate amount of Nitrate, Nitrite and Phosphorus that would have been present in the soil had the soil not been affected by spillage are 9.04mg/kg, 1.71mg/kg and 261mg/kg respectively measured at the control area.

However, the volumes of Nitrate, Nitrite and Phosphorus in the soil can be improved by the application of additional inorganic NPK fertilizers.

### Total Petroleum Hydrocarbon

From the analyses, it can be seen that the total petroleum Hydrocarbon in the soil increased contaminated soils.

The polluted soils have much higher hydrocarbon content than the control area as the points representing the contaminated soils are very far from the point representing the control area.

[11], such high hydrocarbon levels affect both above-ground and subterranean flora and fauna, which are essential adjuncts in the biogeochemical cycle that affects availability of

plant nutrients. The results of this is noticed as the amount of nitrite, nitrate and phosphorus contents of the soil reduced for the contaminated soils.

Electrical conductivity, PH, Temp. & Total dissolved Solids & the temperature

The PH of the contaminated soils and control area was really not affected.

Electrical conductivity is a measure of ionic concentration in the soils and is therefore related to dissolved solids electrical conductivity was significantly lower in the control area than in the contaminated area.

Therefore the total dissolved solids will also be lower at the control area since it is related to the electrical conductivity. Total organic matter contents were slightly lower for the contaminated soils than that for the control area. Organic matter content should normally increase following the addition of such levels of carbonaceous substances but results obtained herein show that there is rather a reduction in organic matter contents of the polluted soils. The best connection perhaps might be that the spilled oil impaired the metabolic process that could have facilitate the agronomic addition of organic capacity of the Microflora.

### RECOMMENDATION

1. Company should take necessary steps to prevent occurrence of oil spillage.
2. When there is oil spillage, there should be pollution control and bio mediation method to clean up the environment.
3. Improvement of the soil properties should also be carried on the affected soil area which could be used for farming activities. Hence following can be done to achieve this task.
  - a. Application of organic manures and chemical fertilizers.
  - b. Water management practices (irrigation and Drainage)
  - c. Prevention and elimination of inorganic chemical contamination of the soil.
  - d. stabilization of the soil PH.

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