MINI REVIEW

# An environmental scientific report into the crude oil spillage incidence in Tein community, Biseni, Bayelsa state Nigeria

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**ABSTRACT**

The disease burden associated with oil spill exposure is significant and rising, particularly in the Tein community. The impact of oil activities in the Niger Delta region has become a major source of concern for all, prompting a scientific report on their impact on health, the environment, agriculture, and people's lives in general. As a result, this paper investigates the Tein community and how the oil company's operations impacted the environment and the lives of the residents in general. To assess the various concentrations of contaminants in the environmental media studied with the Intervention values prescribed, various approaches were used. Standard criteria and procedures were used to collect and analyze samples. According the study site poses an unacceptable risk to human health and requires immediate intervention. It is recommended that the Nigerian Agip Oil Company (NAOC) manage their operations and relationships with the community in a sensitive and professional manner in order to avoid conflicts and losses, as this will reduce the negative effects of oil operations in Tein Community. Furthermore, NAOC should deal directly with landowners whose parcels of land are directly affected, rather than through chiefs or Community Based Organizations (CBOs). This report supports the contention that it provides a valuable source of data for developing effective, forward-thinking solutions that are clear and equitable, analyzing differential impacts, and thinking hard about policy and decision-makers coherence, particularly as it relates to everyone when dealing with oil spills, and can help support action toward further oil spills and environmental improvement.

**Key Words:** *OBD-PLUS Microbial Consortium, Petroleum; Polycyclic aromatic hydrocarbons; Exploitation ;Pollution, Oil exploration; Extractive industries ;Environmental challenges ;Bayelsa state.*

## INTRODUCTION

Human exposure to heavy metals and occupational hazards increases as a result of industrial activities. Innumerable Niger Delta researchers have reported adverse effects on human health as a result of exposure to some of these oil spill concentrations in drinking water and food. Even though these concentrations are toxic to humans, heavy metal contamination of raw foods has become an unavoidable problem in recent years [1-3]. While increased industrial activity continues to be a major source of heavy metal exposure in humans. When heavy metals such as Lead (Pb), Cadmium (Cd), Mercury (Hg), Arsenic (As), Chromium (Cr), and Manganese (Mn) are exposed to them, they have serious effects on various human organs and tissues. Human exposure to heavy metals causes a variety of disease disorders, including nervous system disorders, skin lesions, kidney dysfunction, vascular damage, birth defects, immune system dysfunction, cancer disease, gastric irritation, hypothyroidism, and other disease conditions. Heavy metals are widely used in a variety of industries, and humans are exposed to them through industrial activities, air, water, and the consumption of contaminated food, particularly in developing countries. Heavy metal pollution is caused by both natural and anthropogenic activities. Anthropogenic activity exposure includes mining, metal extraction through heating, industrial production processes, and the use of heavy metals products in industries. Oil spills, which can occur as a result of operational incidents, poor maintenance, or equipment corrosion, can have severe and widespread environmental, social, health, and economic consequences. Spills can also have long-term negative effects on a company's reputation. Some pollutants (or hazardous substances) produced by physical-chemical interactions are associated with the health risks and impacts of the oil and gas industry caused by soil and groundwater pollution. Pollutants can travel through the air, soil, and water in general. Pollution and continuous gas flaring from oil prospecting and production have created health risks and made fishing and farming nearly impossible. Occasional large oil spills kill fish, destroy agricultural crops, and pollute the environment, wreaking havoc on families and communities. Following a request made by representatives of Semowari, Ebiwari and Kiriokum Family through their solicitor because of the massive oil spillage from the Asamabiri, Biseni Idu 14 inches delivery line in Yenagoa to the study, LGA of Bayelsa State, belonging to the Nigerian Agip Oil Company Limited. An Environmental Consulting Group was commissioned to carry out a detailed scientific and environmental investigation with the following objectives:

- To describe the existing water quality in the area in comparison with recommended standard.
- To determine the impact of the enmasse destruction of land resources and marine/fresh brackish/aquatic life in the impacted areas.
- To determine the overall effect in this damage on the health and socio-economic life of the plaintiff.
- To use results (1) and (2) above to predict the potential as well as recovery rate of the ecosystem.

In pursuance of this request a team of specialist scientists from the consulting group was dispatched to the affected area in the month of July, 2021 with a view to achieving these objectives.

### Background information on affected areas

The area where the Agip Oil company is situated is a freshwater swamp area of the Niger Delta. There are numerous creek lets, channels and man-made creeklets which traverse the main land. The creek stretches into Gbaran in Yenagoa local government area of Bayelsa State in the Niger Delta (see Figure 1 below).

## GOALS AND OBJECTIVES

### Occupation

Residents of the affected area work primarily in fishing, farming, logging, and hunting. Palmwine is harvested depending on the season, and palm fruits are harvested for palm oil production. The kernels are also cracked and sold. Other ancillary trades are also involved in the aforementioned main economic activities. Various fishing techniques are used, the most common

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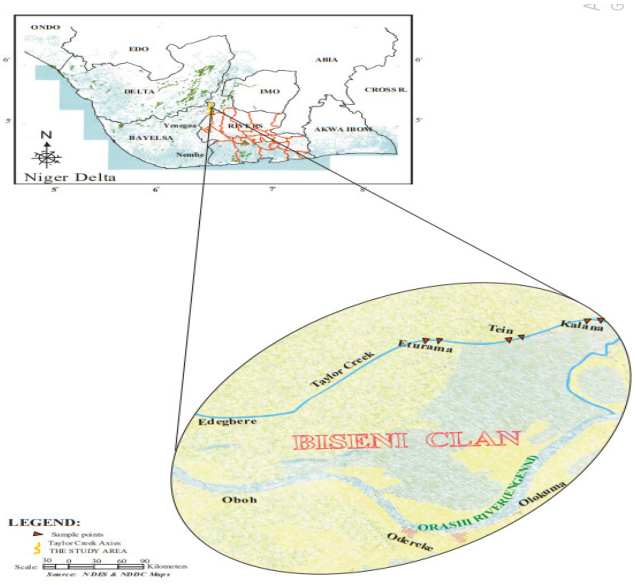


**Figure 1)** *Shows the study area*

of which are netting, traps, and pond aquaculture. These techniques are also responsible for the majority of the fish caught in the area. The river, creeks, creeklets, channels, and ponds support both deep sea and shallow water species, on which people rely for a living and education for their children [4-15].

**Field sampling and observation**

Large bodies of oil spill were seen on the surface of the water and on soil, some are anchored on the adventitious roots of the mangrove trees and swamps. Crude oil was seen on the nets and fish traps. Sampling of water within the impacted area lasted for a day the inspection was done. Standard analytical techniques were employed in the investigation. The analysis was conducted on both soil and groundwater samples obtained from oil spill site at Tein community. All sampling, conservation, transportation and analysis followed standard procedures described in APHA. All the collected samples were transported to the laboratory keeping in an icebox to prevent degradation of the organic substances. For soil samples were collected aseptically using soil auger to a depth of 30 cm in sterile sample plates and transported to the laboratory (Dexcom Solution Limited at 458, Ikwerre Road, Block 2, Flat 1, Woherem Estate, Rumuokwuta, Port Harcourt) in a cooling chest within 48hours of collection to ascertain the level of pollution on the site. Thus, the objective was to characterize the heavy metal of both ground water and soil and to determine the level of Total Petroleum Hydrocarbon (TPH) [16-22].

**Laboratory Investigation**

The objective of the laboratory investigations was to characterize the quality of water and soil. Samples were obtained to measure the Total Petroleum Hydrocarbon (TPH), Polycyclic Aromatic Hydrocarbon (PAH), Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Phenanthene, Fluoranthene, Pyrene, Benzo(a) anthracene, Chrysene, Benzo (b) fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibene(a,b) anthracene, Indeno(1,2,3,cd) pyrene, Benzo(g,h,i)pyrene, Benzene, Toluene, Ethyl Benzene and Xylene (BTEX), Arsenic, Iron, Cadmium, Chromium, Vanadium, Barium, Lead, Mercury as well as Total Heterotrophic Bacterial (THB), Total Heterotrophic Fungal (THF) Total Hydrocarbon Utilizing Bacterial (THUB) and Total Hydrocarbon Utilizing Fungal (THUF) counts in the soil and water. Internationally recommended accepted methods (Standard Methods for Examination of water and Wastewater-APHA, 2012) were used for all analysis. Appropriate quality control measures were adopted to ensure accuracy and precision of the results.

## RESULTS AND DISCUSSION

The consequences of oil spills in the Niger Delta can have an impact on the physical and social environment; these are examples of a high-risk industry that has the potential to cause significant damage to the environment, personnel, and property. Furthermore, innocent people are frequently victims of human rights violations caused by extractive companies. Recognizing and controlling these impacts is critical for preventing human rights violations and environmental damage. If there are governance and capacity gaps, this can be a serious challenge. Thus, the ecological devastation caused by oil exploration has rendered farming and fishing, the primary occupations of the indigenous Tein community in the core Niger Delta, obsolete. Results of Total Petroleum Hydrocarbon (TPH), Polycyclic Aromatic Hydrocarbon (PAH), Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Anthracene, Phenanthene, Fluoranthene, Pyrene, Benzo(a) anthracene, Chrysene, Benzo (b) fluoranthene, Benzo(k)fluoranthene, Benzo(a)pyrene, Dibene(a,b) anthracene, Indeno(1,2,3,cd) pyrene, Benzo(g,h,i)pyrene, Benzene, Toluene, Ethyl Benzene and Xylene (BTEX), Arsenic, Iron, Cadmium, Chromium, Vanadium, Barium, Lead, Mercury as well as Total Heterotrophic Bacterial (THB), Total Heterotrophic Fungal (THF) Total Hydrocarbon Utilizing Bacterial (THUB) and Total Hydrocarbon Utilizing Fungal (THUF) counts in the soil and water etc (see Table 1 and Table 2 below), demonstrate low concentration and where not significant from the recommended standards. However, the Total Petroleum Hydrocarbon (TPH) concentration, iron and lead were above NAFDAC/WHO recommended standards, thus this value is high enough to exert adverse effects on ecosystem services and human health. Below, is the flow chart (Figure 2) of the study, which shows the link between the environmental pollutants from the soil and groundwater pollution and public health impacts on the indigenous Tein communities. This flow chart is characteristic for any similar analysis and describes the conceptual framework between health and groundwater pollution. The oil spill disposed at soil and groundwater is one of the most important factors that determine its health risks [23-30].

**TABLE 1**

**Surface water parameters in the study area with that of the DPR target and intervention value.**

| Field Id | Test method | SS1 | DPR target value | DPR intervention value |
|---|---|---|---|---|
| DEPTH (m) | Instrumental | N/A | DPR Target Value | DPR Intervention Value |
| Sample Coordinates | | N/A | | |
| TPH, mg/kg ABOVE | USEPA 8015 | 31.97 | 50 | 5000 |
| PAH, mg/kg | | <0.01 | 1 | 40 |
| Naphtalene | USEPA 8270 | <0.01 | N/A | N/A |
| Acenaphthylene | | <0.01 | | |
| Acenaphthene | | <0.01 | | |
| Flourene | | <0.01 | | |
| Anthracene | | <0.01 | | |
| Phenanthene | | <0.01 | | |
| Flouranthene | | <0.01 | | |
| Pyrene | | <0.01 | | |
| Benzo (a) anthracene | | <0.01 | | |
| Chrysene | | <0.01 | | |
| Benzo (b) flouranthene | | <0.01 | | |
| Benzo (k) flouranthene | | <0.01 | | |
| Benzo (a) pyrene | | <0.01 | | |
| Dibenz (a, h) anthracene | | <0.01 | | |
| Indeno (1,2,3. cd) pyrene | | <0.01 | | |
| Benzo (g,h,i) pyrene | | <0.01 | | |
| BTEX, mg/kg | | <0.01 | 0.8 | 1250 |
| Benzene | | <0.01 | 0.2 | 30 |
| Toluene | USEPA 8260 | <0.01 | 0.2 | 1000 |
| Ethylbenzene | | <0.01 | 0.2 | 150 |
| Xylene | | <0.01 | 0.2 | 70 |
| Metal, mg/kg | | | | |
| Arsenic WS | | <0.01 | 10 | 60 |
| Iron Above | | 4.12 | N/A | N/A |
| Cadmium | | <0.01 | 0.4 | 6 |
| Chromium WS | APHA 3111C | <0.01 | | 30 |
| Vanadium | | <0.01 | N/A | N/A |
| Barium BS | | <0.01 | 50 | 625 |
| Lead BS | | 0 | 15 | 75 |

| | | | | |
|---|---|---|---|---|
| Mercury | | <0.01 | 0.05 | 0.3 |
| Microbial Analysis CFUg-1 | | | | |
| Total Heterotropic Bacteria (THB) | APHA 9221D | $3.0 \times 10^6$ | | |
| Hydrocarbon Utilizing Bacteria (HBU) | | $<1.0 \times 10^2$ | | |
| Total Heterotropic Fungi (THF) | | $6.5 \times 10^3$ | | |
| Hydrocarbon Utilizing Fungi (HBF) | | $<1.0 \times 10^2$ | | |
| Field id | Depth (m) | Analyte | Expected Concentration | Obtained Concentration |
| Method blank 1 (methanol) | N/A | TPH | N/A | N/A |
| Method blank 1 (dcm:acetone) (1:1) | N/A | PAH | N/A | N/A |

PQL: (TPH)- SOIL 0.1 mg/kg, (BTEX)- SOIL 0.01mg/kg, (PAH)- SOIL 0.1 mg/kg

Not Detected: N.D Not Applicable N/A

**TABLE 2**

**Soil samples parameters in the study area with that of the DPR target and intervention value.**

| Field Id | Test method | SS1 | DPR target value | DPR intervention value |
|---|---|---|---|---|
| Depth (m) | Instrumental | N/A | DPR Target Value | DPR Intervention Value |
| Sample coordinates | | N/A | | |
| Sample coordinates | | N/A | | |
| PAH, mg/kg | | <0.01 | 1 | 40 |
| Naphtalene | | <0.01 | | |
| Acenaphthylene | | <0.01 | | |
| Acenaphthene | | <0.01 | | |
| Flourene | | <0.01 | | |
| Anthracene | | <0.01 | | |
| Phenanthene | | <0.01 | | |
| Flouranthene | | <0.01 | | |
| Pyrene | | <0.01 | | |
| Benzo (a) anthracene | | <0.01 | | |
| Chrysene | USEPA 8270 | <0.01 | N/A | N/A |
| Benzo (b) flouranthene | | <0.01 | | |
| Benzo (k) flouranthene | | <0.01 | | |
| Benzo (a) pyrene | | <0.01 | | |
| Dibenz (a, h) anthracene | | <0.01 | | |
| Indeno (1,2,3. cd) pyrene | | <0.01 | | |
| Benzo (g,h,i) pyrene | | <0.01 | | |
| BTEX, mg/kg | | <0.01 | 0.2 | 206 |
| Benzene | | <0.01 | 0.05 | 1 |
| Toluene | USEPA 8260 | <0.01 | 0.05 | 130 |
| Ethylbenzene | | <0.01 | 0.05 | 50 |
| Xylene | | <0.01 | 0.05 | 25 |
| Metal, mg/kg | | | | |
| Arsenic | | <0.01 | 29 | 55 |
| Iron | APHA 3111C | 314.45 | N/A | N/A |
| Cadmium | | <0.01 | 0.8 | 12 |
| Chromium | | 0 | 100 | 380 |
| Vanadium | | <0.01 | N/A | N/A |
| Barium | | <0.01 | 200 | 625 |
| Lead | | 0.11 | 85 | 530 |
| Mercury | | <0.01 | 0.3 | 10 |
| Microbial analysis CFUg-1 | | | | |
| Total Heterotropic Bacteria (THB) | | $6.2 \times 10^7$ | | |
| Hydrocarbon Utilizing Bacteria (HBU) | | $<1.0 \times 10^2$ | | |
| Total Heterotropic Fungi (THF) | APHA 9221D | $4.0 \times 10^4$ | N/A | N/A |
| Hydrocarbon Utilizing Fungi (HBF) | | $<1.0 \times 10^2$ | | |
| Field id | Depth (m) | Analyte | Expected concentration | Obtained concentration |
| Method blank 1 (methanol) | N/A | BTEX | <0.01 | <0.01 |
| Method blank 1 (dcm:acetone) (1:1) | N/A | TPH/ PAH | <0.01 | <0.01 |
| SS1 | N/A | TPH | N/A | N/A |
| | N/A | PAH | N/A | N/A |

PQL: (TPH)- SOIL 0.1 mg/kg, (BTEX)- SOIL 0.01mg/kg, (PAH)- SOIL 0.1 mg/kg

Since the result of Total Petroleum Hydrocarbon (TPH) concentration, iron and lead show values considerably higher especially for soil and groundwater for samples collected on 13th August 2021. The results suggest that soil and groundwater quality at the time of sampling could adversely affect human health, ecosystem services, destroyed farmlands, fishponds, water wells, deprived farming families of vital income.

All of these have the tendency of causing neurological impairments, anemia, kidney failure, immunosuppression, gastrointestinal and respiratory irritation, abnormalities of skeletal system, inflammation of liver, cancer of the liver, cardiovascular diseases after chronic exposure [29]. Furthermore, the effects of heavy metals on humans are affected by concentration, route of exposure, and duration of exposure. Heavy metals such as Lead (Pb), Cadmium (Cd), Arsenic (As), Manganese (Mn), and Mercury (Hg) have been linked to Parkinson's disease-like neurological disorders. Inhaling Pb or Hg from an industrial setting has the potential to accumulate in brain cells and cause brain damage. Pb or Cd affects human behavior, cognitive deficits, and Intelligence Quotient (IQ). Heavy metal exposure may result in endocrine disruption and hormone-dependent human cancers (breast, prostate, and testicular cancers), abnormal sexual development, pituitary and thyroid function changes, and immune suppression. Epidemiological studies link chronic As exposure to an increase in the incidence of tumors such as neoplasms of the lungs, liver, and skin, coronary artery disease, infertility, and dementia. Pregnant women who have been exposed to Pb may experience preterm labor, stillbirth, dysplasia, upper and lower respiratory disease, and hypothyroidism. While there is also concern about the long time required for total biodegradation of various pollutant concentrations with their highly toxic low boiling point of aromatic hydrocarbons. High boiling point saturated aromatic hydrocarbons have the potential to interfere with aquatic organisms' responses to chemical stimuli, such as sex attractants, with equally serious consequences. Similarly, the most dangerous aspect of this pollution and indeed all pollution is the problem of toxicant amplification since many of the components of crude oil are chemically stable and not readily metabolized or excreted once absorbed and are thus available at all times in the food chain. The high values of Total Petroleum Hydrocarbon (TPH), iron and lead concentration are a warning sign that all is not well and it's an indication of the widespread nature of the problem and because some of these sites may have been polluted more than once, while filter feeders are widely eaten by the fishermen and also collected and sold in areas as far away as Yenagoa and nearby places. Thus, crude oil pollution kill fish, their food sources and fish larvae and damages the ability of fish to reproduce, causing both immediate damage and long-term cumulative harm to fish stocks. In addition to its lethal effects, oil may cause death by inducing a state of narcosis in which animals become dislodged from substrate. In other organisms, oil coating may cause death by asphyxiation. The consequences of the various pollutants (TPH, BTEX,heavy metals, polychlorinated biphenyls and Microbials).

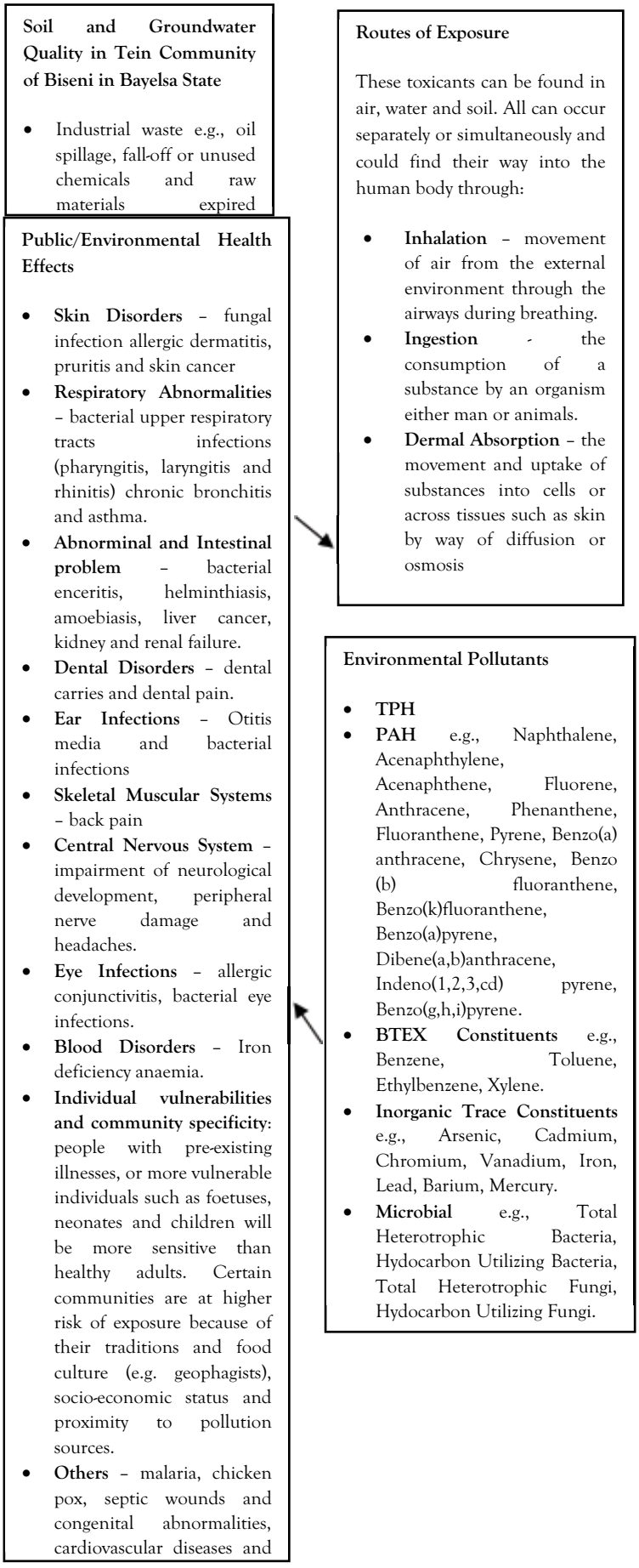


**Figure 2)** *The flow chart of the Soil and Groundwater Quality in Tein Community in Biseni Bayelsa State showing exposure to oil spillage pollution and health.*

causes untoward influences and its effect are very lasting. Not forgetting that the overall impact of pollution of this nature and magnitude incident on our ecosystem and human health is far more difficult to predict. Consequently, the complete recovery of the ecosystem may be prolonged for up to 20 years or more if immediate action is not taken. Meanwhile, if OBD-PLUS Microbial Consortium is used to bioremediate the hydrocarbon polluted soil, it could take less than 20 years. Under the Nigerian oil industry regulations, oil spill sites should be rehabilitated. This means that the soil and water at those sites should be treated to deal with the impacts of pollution and restore them as far as possible to their normal state [31-40].

## CONCLUSION

Oil spillage in Nigeria's Niger Delta region knows no bounds. Contaminants can be found on every continent, even in the most remote areas, and they are easily transported from one country to the next. As a result of the oil company's activities, thousands of different synthetic chemical compounds and naturally occurring elements with potential toxicity have been released into the Tein community environment. These contaminants can have residence times in the environment ranging from hundreds to thousands of years and are found all over the world. As a result, soil and surface water pollution has become one of the most serious threats to human health, but its consequences extend far beyond the dimensions and contaminants, as it can have irreversible consequences for human and ecosystem health, as well as severe economic losses, social inequities and jeopardize the achievement of the 2030 Agenda on Sustainable Development. Thus, in addition to the risk of disease and illness to the indigenous population living in the Tein Community, the impact of the oil spill has local, national, and global implications. As a result, proper compensation should be provided to the affected victims as a result of Agip oil company negligence. The claimants' means of subsistence have been destroyed as a result of the Agip Oil spill. Furthermore, their health is jeopardized. They should be paid for their claim because some aspects of it are unquantifiable. As a result, there is a need to strengthen new protection pathways to address the growing needs of the Tein community in ways that are sustainable, politically viable, and resilient, as well as develop effective approaches to curb oil spills at a time when people have become more complex and the interplay of public health requires greater coordination and collaboration. Strengthening social cohesion and community resilience in increasingly diverse societies to adapt to rapid social change, including community crises; developing innovative, evidence-based, and politically feasible solutions to cross-cutting extractive industries policy challenges around the world; and expanding on its efforts to develop cutting-edge policy approaches that recognize specific contexts, position systems for the future, and assist other oil spill affected communities. The following are some highlights:

- The relevant oil company have an urgent task ahead in closing down wells in the Tein community, for the sake of population that will be affected by oil spillage, because they live in oil spillage sites and make use of polluted groundwater, also because the indigenous population breath in toxins released from gas flaring. Unless the oil company act now, the growth of soil and surface water pollution is inevitable.
- In addition, Clear channels of communication are required between the oil company and the community stakeholders to ensure that timely, science-based information on the potential threats posed by oil spill contaminants is available to community and other stakeholders.
- Eventually, awareness on soil and groundwater quality and its proper management should be created amongst public and school children at the community levels by conducting several seminars, short films, etc.
- Identification and assessment of risk at potentially polluted sites is the essential first step in soil and water pollution management. If contamination at a given site is at levels that can cause harm to humans, information about such site should be collected at the appropriate governmental level and made available to the public, and remediation or risk minimization actions taken accordingly, especially if the site is used for food production or as a water reservoir for human consumption.
- Oil company domicile at Biseni in Bayelsa State should as a matter of urgency begin the changing of all pipes in their oil fields and should with other agencies carry out a comprehensive Joint Investigation Visit (JIV) report.
- In addition, proper compensations should be given to the affected victims due to the oil company negligence.

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