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Annals of Biological Research, 2011, 2 (2) : 72-78
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library

ISSN 0976-1233
CODEN (USA): ABRNBW

Post-Impact Assessment of Crude Oil Spilled Site: Four Years After Recorded Incidence

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ABSTRACT

This study assessed the impact of crude oil spill in Obie, Niger Delta of Nigeria, after four years of recorded incidence. Field reconnaissance and physiochemical parameters (pH, total organic carbon and total organic matter) were used to assess the adverse effects of the spill on the soil. Field reconnaissance studies carried out prior to sample collection revealed lower number of flora (Elaeis guineensis and Andropogon gayanus), flora with stunted growth and chlorosis of leaves (Zea mays and Manihot esculenta) and lower number of fauna (Lumbricus terrestris). The pH values ranged between 6.47 – 7.96, while the total organic carbon (TOC) and total organic matter (TOM) ranged between 1.25 – 3.27% and 2.15 – 5.26% respectively. The lower presence of flora and fauna, with acidic levels of pH and increased levels of total organic carbon and total organic matter of the crude oil spilled site show that the detrimental effects of crude oil pollution on soils can linger for years.

Key words: Field reconnaissance, pH, Total organic carbon, Total organic matter.

INRODUCTION

The world today is experiencing a rapid change with varying social, economic and political impacts on the environment: the totality of the surrounding including substances such as air, land and water [1]. Oil exploration and production have the potential for a variety of impacts on the environment. These impacts depend upon the stage of process, size and complexity of the project, nature of sensitivity of the surrounding environment and the effectiveness of planning, pollution, mitigation and control techniques [2].

The Niger Delta of Nigeria which covers a land mass of over 70,000km with about 800 oil – producing communities [3], has become vulnerable to massive oil spillages. Some of these spil-

lages occur as a result of equipment failure, operational mishap or intentional damage to facilities [4].

Post impact assessment (P.I.A) which is a major component of environmental impact assessment (E.I.A), is a systematic auditing or monitoring of the environmental impact of a project that has already been executed, with that of an unimpacted geographically similar site as reference or control [5]. The increasing occurrence of oil spillage in the Niger Delta has made post impact assessment a valuable tool in assessing damages done to the environment by such processes. It is on this premise that field reconnaissance studies and physiochemical parameters (pH, total organic carbon and total organic matter) were used to determine the impact of oil spillage on a site along an oil pipeline in Obie, a community in Niger Delta, Nigeria.

MATERIALS AND METHODS

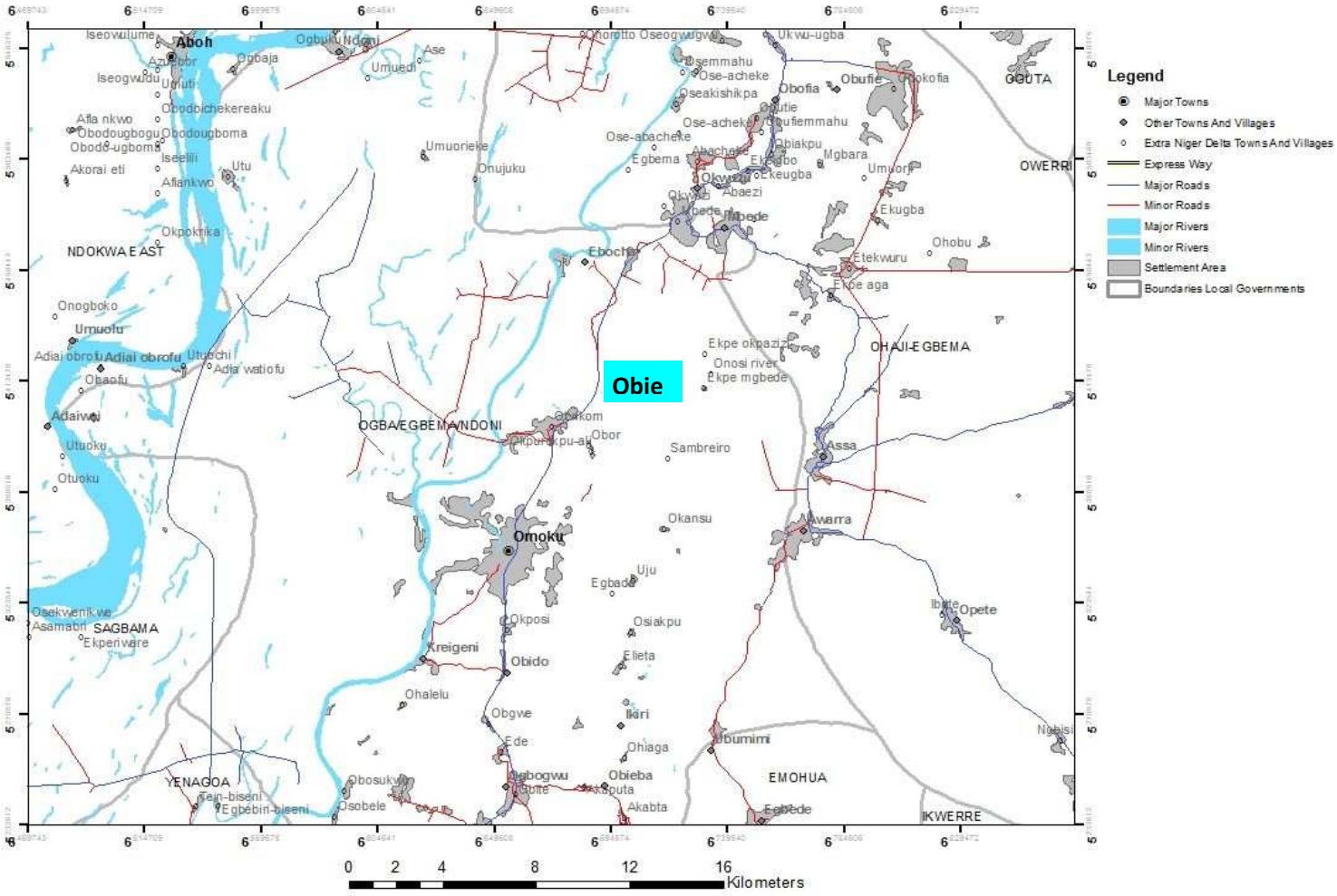

Figure i: A section of the map of Rivers State showing study site, Obie

Figure ii: A section of site after crude oil spillage

Study sites description

The study area is a crude oil spilled site at Obie in Ogba/Egbema/Ndoni Local Government Area of Rivers state in the Niger Delta region of Nigeria (figure i). The area is a complete dry land with absence of water bodies. The oil spillage was as a result of leakage from a high pressure pipe line which occurred in the year 2002. An uncontaminated site, about 110km from the spilled site was used as the control. The control site had no record of crude oil spillage prior to sampling. Crops cultivated in both spilled and control sites include maize (*Zea mays*), cassava *(Manihot esculenta*), oil palm (*Elaeis guineensis*), plantain (*Musa spp*.), and banana (*Musa paradisiaca*).

Field Reconnaissance

Field reconnaissance studies were carried to estimate the extent of pollution on soil, using the presence and absence of some flora and fauna, and developmental defects on some flora.

Sampling Design and Techniques

The grid system was used for the sampling of the site. A sampling area of 100m × 50m was delimited around the epicenter (being the point of crude oil leakage at the oil impacted site). The area was divided into 20 grid plots (quadrats), each quadrat measuring 20m × 12.5m as shown in figure iii. Forty percent(40%) of the entire quadrats (i.e. 8 quadrats), epicenter inclusive were randomly selected. Soil samples were collected from each quadrat at surface (0 – 15cm) and sub-

surface (15 – 30cm) levels. Samples were also collected from the control site at both surface and subsurface. All samples were air dried, sieved with 2mm sieve, labeled and forwarded to the laboratory for analysis.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20

Epicenter ■

Length= 100 meters Width= 50 meters

Figure iii : A schematic representation of sampling design of the polluted site.

Physiochemical Analyses

pH was determined using standard methods as reported by Onojake [6]. Total organic carbon and total organic matter were estimated using the Rapid (Chromic acid) titrimetric method of Walkey and Blacky [7].

RESULTS AND DISCUSSION

Data obtained from the field reconnaissance and physiochemical analyses of the soil samples for the pH, total organic carbon and total organic matter contents are shown in tables i and ii. pH values of 6.47 – 7.10 were observed for the oil impacted site while 7.91 – 7.96 were observed for the control as shown in table ii. Most of the quadrats′ pH fell within the acidic zone, though within the standards of 5.5 – 6.5 [8]. Acidic pH values have been reported in oil producing communities of Niger Delta with oil spillages that led to hydrocarbon pollution [9]. The amount of acid/alkaline in the soil determines the availability many nutrients for plant growth and maintenance, making pH a key player in soil microbial reactions [10].

Observed values of total organic carbon ranged between 1.38 – 3.27%, while that of total organic matter were 2.37 – 5.63% for the oil impacted site as shown in table ii. The control had 1.25 – 1.44% and 2.15 – 2.48% for total organic carbon and total organic matter respectively (table ii). The increase in total organic carbon/matter in oil impacted site concurred with increase of total organic matter that follows addition of carbonaceous substances arising from spilled crude oil [10].

Results of field reconnaissance survey are shown in table i. Low population of oil palm (*Elaeis guineensis*) and the grass, *Andropogon gayanus* was observed. Also observed were crops (*Zea mays* and *Manihot esculenta*) with stunted growth and chlorosis of leaves. The Niger Delta Environmental Survey affirmed that the flora as a whole was perhaps the most sensitive indicator of habitat change [9]. Low presence of earthworm (*Lumbricus terrestris*) was also noted which is also an evidence that oiling might have discouraged soil fauna through direct toxicity of the petroleum hydrocarbon.

Table i : Field Reconnaissance Studies of Crude Oil Polluted and Unpolluted (Control) Sites.

Quadrats	FC	OC	NC	NC / OC	*Andropogon gayanus*	Crops with chlorosis	Stunted crops	Normal crops	Oil palm	Earthworm
1	*					*		*		*
2	*									
3	*					*		*		*
4	*									
5	*						*			*
6			*							
7			*							
8			*							
9			*		*				*	
10			*							
11				*	*					
12				*	*					
13				*	*		*			
14				*	*					
15				*	*		*			
16		*			**					
17		*			**		*			*
18		*			**					
19		*			**		*			*
20		*			**					
Epicentre					*					
Control	*	*		*	**			*	*	**

* *Present* ** *Heavy presence*

FC- Fresh cultivation OC- Old cultivation NC- No cultivation

This has earlier been demonstrated by Osuji *et al* [11] through quantal response of *Lumbricus terretris* to varying concentrations of Bonny light brand of Nigerian crude oil.

Table ii: pH, Total Organic Carbon (TOC) and Total Organic Matter(TOM) contents of soil samples.

Sample Location	Soil Depth(cm)	pH	TOC(%)	TOM(%)
Control	0 – 15	7.96 ± 0.02	1.44 ± 0.02	2.46 ± 0.03
Control	15 – 30	7.91 ± 0.02	1.25 ± 0.01	2.15 ± 0.02
Quadrat 1	0 – 15	7.59 ± 0.00	2.40 ± 0.08	4.13 ± 1.21
Quadrat 1	15 – 30	7.48 ± 0.05	1.68 ± 0.03	2.89 ± 0.06
Quadrat 3	0 – 15	7.10 ± 0.05	1.98 ± 0.08	3.41 ± 0.14
Quadrat 3	15 – 30	7.03 ± 0.03	2.56 ± 0.07	4.40 ± 0.11
Quadrat 5	0 – 15	6.93 ± 0.05	2.25 ± 0.03	3.87 ± 0.05
Quadrat 5	15 – 30	7.00 ± 0.01	1.56 ± 0.07	2.68 ± 0.11
Epicentre	0 – 15	6.92 ± 0.06	1.56 ± 0.03	2.69 ± 0.06
Epicentre	15 – 30	6.57 ± 0.06	2.34 ± 0.03	4.03 ± 0.06
Quadrat 11	0 – 15	6.66 ± 0.07	2.46 ± 0.11	4.23 ± 0.12
Quadrat 11	15 – 30	6.69 ± 0.05	2.67 ± 0.03	4.59 ± 0.05
Quadrat 15	0 – 15	6.47 ± 0.06	1.80 ± 0.01	3.10 ± 0.02
Quadrat 15	15 – 30	6.55 ± 0.03	2.21 ± 0.02	3.80 ± 0.03
Quadrat 17	0 – 15	6.61 ± 0.03	3.27 ± 0.03	5.62 ± 0.06
Quadrat 17	15 – 30	6.51 ± 0.03	2.52 ± 0.03	4.33 ± 0.03
Quadrat 19	0 – 15	6.57 ± 0.07	2.01 ± 0.05	3.46 ± 0.11
Quadrat 19	15 – 30	6.51 ± 0.03	1.65 ± 0.03	2.84 ± 0.05

CONCLUSION

Increased levels of total organic carbon/matter and acidic pH values of the oil impacted site in Obie have shown that oiling was responsible, at least in part for the reduction of number of sampled species. These include *Elaeis guineensis*, *Andropogon gayanus*, and *Lumbricus terrestris*. Growth retardation and chlorosis of *Zea mays* and *Manihot esculenta* crops within the vicinity of oiling are also the after effect of oil spill. Post impact assessment of an oil spill impacted site, four years after the recorded incidence of spill, indicates that the detrimental effects of oil spillage can linger for years.

REFERENCES

[1] C.A. Chukuigwe, Environmental Risk Management: A Global Consciousness.1st ed. Osia International Publishers, Port Harcourt, Nigeria, **2000**, 1.
[2] E & P Forum/UNEP 'Environmental Management in Oil and Gas Exploration and Production. An Overview of issues and Management Approaches. **1997**, 4-7, 11-15.
[3] L. C. Osuji, E. J. Ogbuson, C. M. Ojinnaka, *Chemistry and Ecology*, **2005**, 21 (1)3-10.
[4] L. C. Osuji, *Journal of Applied Science and Environmental Management*, **2001**, 5 (2) 35-38.
[5] L. C. Osuji, S. O. Adesiyan, G. C. Obute,. *Chemistry and Bio-Diversity*, **2004**, 1, 1569-1577.
[6] L. C. Osuji, C. M. Onojake, *Chemistry and Biodiversity*, **2004**, 1, 1708-1715.
[7] A. Walkey, Soil Sci. **1934**, 17, 29.

[8] DPR, 'Environmental Guidelines and Standards for the Petroleum Industry in Nigeria', Department of Petroleum Resources, Ministry of Petroleum and Mineral Resources, Lagos, Nigeria, **1991**, 30-45.
[9] NDES, Environmental and Socio-Economic Characteristics (Revised Ed). Phase 1 Report, Vol.1, Envi- ronmental Resource Managers Limited, Lagos, **1999**, 22-24, 101-116.
[10] L. C. Osuji, S. O. Adesiyan, *Chemistry and Biodiversity*, **2005**, 2, 1079-1085.
[11] L. C. Osuji, S. O. Adesiyan, M. O. Wegwu, *Glob. J. Environ. Sci*. **2002,** 1, 59.