Pollution Status and Effect of Crude Oil Spillage in Ughoton Stream Ecosystem in Niger Delta

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Abstract-**The present study, evaluate pollution status and the physico-chemical characteristics of Ughoton stream water as it affects the quality of water and its impact on Ughoton stream ecosystem. Surface water samples were collected at various distances, 50,100, 250, 500m downstream from an oil well. The potentially toxic elements, Fe, Mn, Zn, Ca, Cr, Cd, Ni, Pb were analyzed. Other parameters including cations, coliforms, heterotrophic bacteria and Total hydrocarbon were analyzed. The study reveals most of the parameters; pH, DO, BOD, and COD are within limits set by World Health Organization (WHO) for surface water. The heavy metal concentrations in the stream water are also below the threshold levels associated with the toxicological effects and the regulatory limits. However, the high concentration of nutrients, coliform and heterotrophic bacteria confirmed high pollution status. The coliform and heterotrophic bacteria count ranged from 96 to 520 and 48 to 284 per 100ml respectively. Pollution nature of Ughoton stream water is further confirmed by its oil films coated environment. The pollution load exceeded tolenrance limit of stream that empties into major river. Therefore, The Ughoton stream water is considered as a threat to Ughoton natural ecosystem.**

Keywords- Physico chemical parameters, coliform and heterotrophic bacteria, freshwater stream

I. INTRODUCTION

Coastal belts and in particular, Niger Delta of Nigeria are highly populated as a result of agricultural activities, mining, production and distribution of petroleum products (Eke 2002, Ijah 2003). Oil production has predominantly interfered with greater densities on recreational activities such as bathing, boating and fishing, often leading to public disquiet and disenchantment of the communities (Achudume 2009). The normal everyday routine operations are adversely affected by petroleum spills. The threats to aquatic species are persistent with physical smothering of surface water (Brassard 1996, Achudume 2009). Humans are exposed to petroleum compounds by inhalation, direct contact with the skin and /or ingestion. Heavy metal uptake occurs directly from the surrounding as a chemical compound in the atmosphere. The bioavailability of trace metals is a key factor in determining metal levels in fresh water biota. Information on the level of heavy metals pollution in freshwater environment is important as they cause serious environmental health hazard (Shukla et al. 2007; Achudume 2009). In recent past, a study was conducted on the sediment samples after flooding in the Niger Delta (Achudume 2007). The study showed that heavy metals toxicity in regular flooding of the coastal communities has similar disastrous consequences because of chemical pollution that may on the long run have adverse effects on soil and vegetations in Niger Delta.

Total suspended solids (TSS), Dissolved oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrite, Nitrate, inorganic phosphate, and Total Hydrocarbon (THC).

Achudume 2009, studied the impact of oil spill and concluded that Niger Delta are important breeding ground for marine organisms and continuous absence of fish and other aquatic organisms was a result of diminished levels of dissolved oxygen. In recent time, considerable studies have been carried out on heavy metal levels in various media and surface water; there is a paucity of information in the heavy metal concentrations in the ecosystem.

The effect of various heavy metals entering microbial food web is still not well understood (Nduka and Orisakwe 2011). Some of the important pollutants in the Niger Delta may not necessarily be on the oil spills, rather, on agricultural fields and gas flaring from flow stations. No investigation has taken cognizance on the status of the stream and its impact on Ughoton ecosystem. The present study evaluate the pollution status and shed light on potential toxic effluent in the stream water, its impact on human health and ecosystem.

II. MATERIALS AND METHODS

The study area along the Ughoton stream, Fig 1, encompasses the stretch between Benin river and Osse river transverses through Ekehuan and Ughoton village. The freshwater stream is a typical mangrove canopy with thick tropical vegetation cover along the bank. An oil well head situated 50 meters adjacent to the stream bank spills oil on regular basis and empty itself into larger Benin river. The potentially toxic elements- iron (Fe), manganese (Mn), Zinc (Zn), calcium (Ca), chromium (Cr), cadmium (Cd), nickel(Ni), lead (Pb) and Total hydrocarbon (THC) composition were taking at different distances . Water samples were analyzed twice daily for pH, electrical conductivity, turbidity, salinity,

Surface water samples were collected between 9 and 11 in the morning from the downstream of Ughoton stream near the mouth of the oil well, 50,100, 250, and 500 meters. Five replicates of water samples were collected and their physico-chemical and microbiological parameters were analyzed

following standard methods (APHA et al., 1989). Water samples were filtered through a 0.45mm whatman No. 1 filter paper. Water samples (100ml) were acidified to a final concentration of 2% with nitric acid. Two samples were divided into two and portion of each half was spiked with known concentrations (0, 2.5, 5.0.and10.0ppm) of the eight analyzes in order to determine percent recovery. Unspiked samples, blanks and spiked samples were analyzed by atomic absorption spectrophotometer (Perkin Elmer 5000). The average of five samples for each parameter studied was considered as one reading. The water temperature, pH, dissolved oxygen (DO) were determined in the field and other parameters were analyzed in the laboratory within 48hr. Water temperature was measured using a mercury thermometer and pH by digital pH meter. DO was estimated by the azide modification of Winkler's method. Total dissolved solid (TDS) was determined as the residue left after evaporation of filtered sample.

Chloride, calcium, and magnesium were determined by titration methods. Sodium and potassium were estimated by flame photometer. Nitrite and nitrate were measured calorimetrically. The total nitrogen was estimated by micro-kjeldahl distillation method. Organic phosphorus was calculated as the difference between the total phosphorus and inorganic phosphorus. Coliform counts were made using membrane filter (MF) technique results and discussion.The results of physico-chemical characteristics of the Ughoton stream are summarized in Table 1.

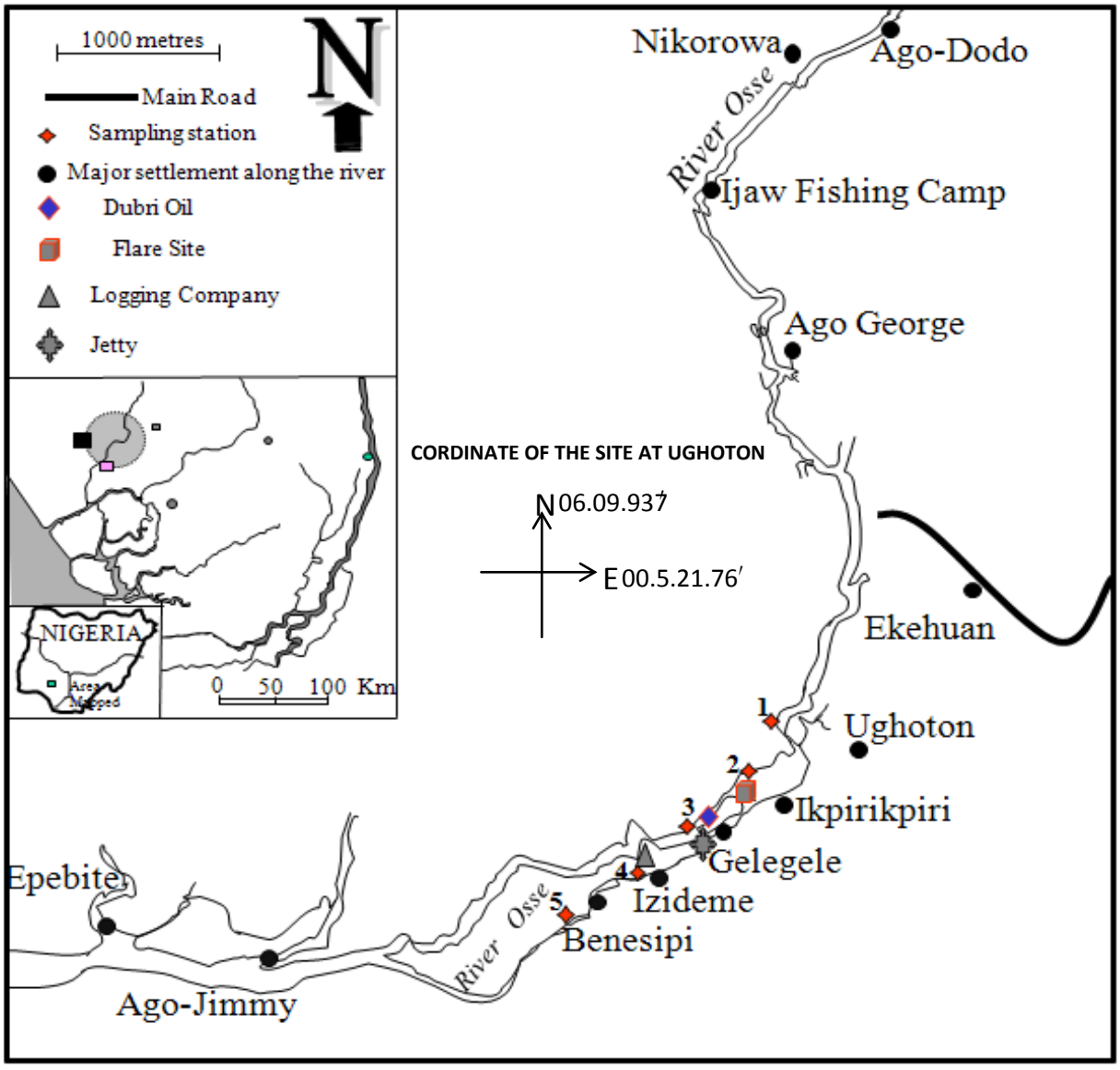

Fig. 1: Study Area and Sampling Station

Table 1. Physico-chemical and microbiological characteristics of Ughoton stream between November 2007 and September 2009 **

Parameters	**Range**	**Mean± SD**
Water temperature	**17.5 ^{0}C**	**22.88 ^{0}C**
pH	**6.14**	**7.63**
Dissolved oxygen	**3.8**	**6.2**
Total dissolved solids	**0.40**	**0.60**
Chloride	**5.40**	**8.5**
Calcium	**2.0**	**4.8**
Magnesium	**0.4**	**1.8**
Sodium	**0.2**	**4.5**
Potassium	**1.8**	**6.0**
Nitrite-nitrogen	**0.38**	**0.68**
Nitrate-nitrogen	**1.104**	**2.894**
Total nitrogen	**1.460**	**4.264**
Inorganic phosphorus	**0.068**	**0.152**
Organic phosphorus	**0.186**	**0.624**
Total phosphorus	**0.027**	**0.712**
Coliform bacteria/100 ml	**96**	**520**
Heterotrophic bacteria/100 ml	**48**	**284**

All values are expressed as mg/l, except pH, temperature (^{0}C), coliform/heterotrophic bacteria (cfu/g).

** Mean of two replicate

Table 2. Heavy metal and Total hydrocarbon of the analyzed water in four locations **

Sample	Fe µg/g	Mn µg/g	Zn µg/g	Cu µg/g	Cr µg/g	Cd µg/g	Ni Ug/g	Pb µg/g	THC
Control	0.22±0.01	0.10±0.01	0.02±00	0.04±00	0.01±00	0.00	0.01±00	0.008±00	ND
50	0.34±0.05	0.14±0.01	0.03±00	0.05±00	0.03±00	0.08±0	0.08±0	0.01±00	5.6±0.01
100	0.36±0.01	0.17±0.01	0.04±00	0.05±00	0.08±00	0.01±00	0.01±00	ND	6.20±0.01
250	0.29±0.01	0.12±0.00	0.02±00	0.04±00	0.05±00	ND	ND	0.01±00	4.50±0.01
500	0.25±0.02	0.12±0.01	0.02±00	0.04±00	ND	ND	ND	ND	3.40±0.01

** Mean of two replicates

The Table indicates that surface water temperature fluctuates from7.5 0C to 22.8 0C with an average value of 20.1 0C. The pH range showed normal daily fluctuations with average of 6.9. Electrical conductivity (EC) of 92 µohms/cm and 140 µohms/cm is normal and suitable to support plants and aquatic fauna. The mean sodium, potassium, magnesium, chloride and calcium contents of stream samples were observed within the tolerance limits of Federal Environmental Protection Agency (FEPA), 1996 and Regulation Enforcement Agency (NESREA), 2007.

The concentration of nitrogen and phosphorus in the stream water were high. The average concentration of inorganic phosphorus (0.11 mg/l) in the present investigation was found to be higher than the standard permissible limit (50µg/l) recommended by USEPA 1976, World Health Organization (WHO) 2008, Waziri and Ogugbuaja 2010. Both

nitrite and inorganic phosphorus concentrations averaged 0.53mg/l and 0.11mg/l respectively. The high concentration of nutrients in the stream water may be attributed to the fact that the stream receives large amount of domestic sewage and solid wastes from the village including the surface runoff, and the effluent from oil spill and surrounding agricultural fields. Though, the stream water may be considered suitable for aquatic and wild life propagation as the pH and DO, BOD and COD values are within the set limits for water (NESREA 2007 and WHO 2008). In contrast, the microbial analysis of probable number (MPN) of coliform and heterotrophic bacteria counts ranged from 96 to 520 and 48 to 284 (100 ml/l) respectively. These concentrations were high due to effluent discharge from the catchment area. The present findings indicate microbial contamination in the stream water and therefore not suitable for drinking.

Data on heavy metal and Total hydrocarbon of the analyzed water from five different locations is shown in Table 2.

Heavy metal characteristics revealed that in most cases, the values were lower than recommended standard permissible limit (NESREA 2007) for stream. These values are accompanied by low levels of DO, BOD, COD and effluent temperatures. Thus it may be concluded that the low values, for these pollution parameters reflect the reduced activity of indigenous micro flora present in the effluent, responsible for natural bioremediation. These changes with increasing distance suggest that the stream undergoes the process of self purification, which may be due to synergistic action of indigenous microorganisms, aeration, pH changes, photochemical effects and dilution.

However, It is clear that downstream of Ughoton stream water is polluted as it has high concentration of nutrients, coliform and heterotrophic organisms. Polluted nature of the stream water is further confirmed by oil films (from the oil spillage, overtime) in the polluted environment. The stream may be considered as a threat to the Ughoton stream ecosystem as its nutrient concentration exceeded the tolerance limit of any stream water discharging into a major river. In addition, the effects of heavy metal contamination are viewed as an international problem because of the effects on human health and ecosystem (Ayas et al. 2007; and USEPA 1996). Proper conservation measures should be taken up to protect the stream water and the ecosystem from further deterioration.

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