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# Assessment of physicochemical parameters and heavy metals of water samples from bodo river, south-south, Nigeria

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**Abstract**
The physicochemical parameters and some heavy metal concentrations of surface water samples from Bodo River were investigated in dry and wet seasons. The analysis was done using standard procedures. Physicochemical parameters such as temperature, conductivity, salinity, pH, chemical oxygen demand, turbidity, total suspended solids were examined in the study. Heavy metals such as Cu, Zn, Fe, Pb, Cd, Ni, K and Cr were also analysed in the study. The result shows that the pH, salinity, TSS, TDS values were lower in the river than WHO recommended standard value for drinking water. Though, Turbidity, temperature were higher the the WHO value. Similarly, during wet season, conductivity was noted to be very much higher than the recommended value and low in dry season. Result shows that the heavy metal values were lower than the recommended values except for potassium that was predominantly high which was traceable to solid waste due to run off from the surrounding. It was concluded that water from this river is not suitable for domestic purposes. Hence, our study would provide useful information to fishermen and farmers around that area on the potency of the river.

**Keywords:** Physicochemical parameters, heavy metals, Bodo River, pollution

## Introduction
The quality of some rivers in Nigeria has been investigated and proven to have lost their positive nature thus, grossly polluted. However, our relationship with the environment has gone through several stages which can be summarized into two folds namely, the primitive times when man lived in symbiosis with nature and the industrial age a period of increasing mastery over nature, culminating into rapid material exploitation and increased environmental degradation.

Heavy metals are chemical elements with a specific gravity that is at least 5 times the specific gravity of water. Some metals are indispensable for the support of daily life and even for sustaining life. For instance, copper, selenium and zinc are essential to maintain the metabolism of human body (Akpabi and Drah, 2001) [2]. Though, the toxicity, bioaccumulation and threat to human life of the heavy metals in the environment pose a great concern when they are present in high concentrations (Appelo and Postma, 2005) [3].

Asante *et al;* (2005) [4] opined that the primary sources of heavy metal pollution are industries, mining sites as well as atmospheric routes. Water quality is a major priority governing the health of human beings, animals as well as plants (Edet and Ubuo, 2013) [8]. The physical, chemical and biological properties of water is a function of both natural processes such as precipitate, erosion, weathering of crystal materials and anthropogenic processes such as urbanization manufacturing, mining and agricultural activities (Diersing, 2009; Pravat *et al*; 2013) [7, 21]. Streams and rivers in most rural areas serve as the major sources of drinking water and any condition that causes their contamination renders them useless. Polluted drinking water causes many diseases such as diarrhea, vomiting, dysentery, typhoid, kidney problems etc (Muhammad *et al;* 2013) [18]. The important physico-chemical parameters affecting the aquatic environment are temperature, pH, salinity, dissolved oxygen; total suspended and dissolved solids, acidity and heavy metals (Lawson, 2010). Among other sources of water pollution, heavy metals has remained the major indicator and it is of a great concern to researchers (Edet and Ubuo, 2013, Essien *et al;* 2016) [8, 11].

In marine and lacustrine waters, organic matter exists in the form of a solution (that is, dissolved organic matter) as colloids, suspension of detritus and particulate organic matter

(POM). It is expected that each type of organic component has a specific process of incorporation into the sediments. However, two things are common to the organic matter on the surface of the water before sedimentation. They may be used as food by heterotrophs in the water column and they may be decomposed in an oxic environment by aerobic bacteria and other organisms.

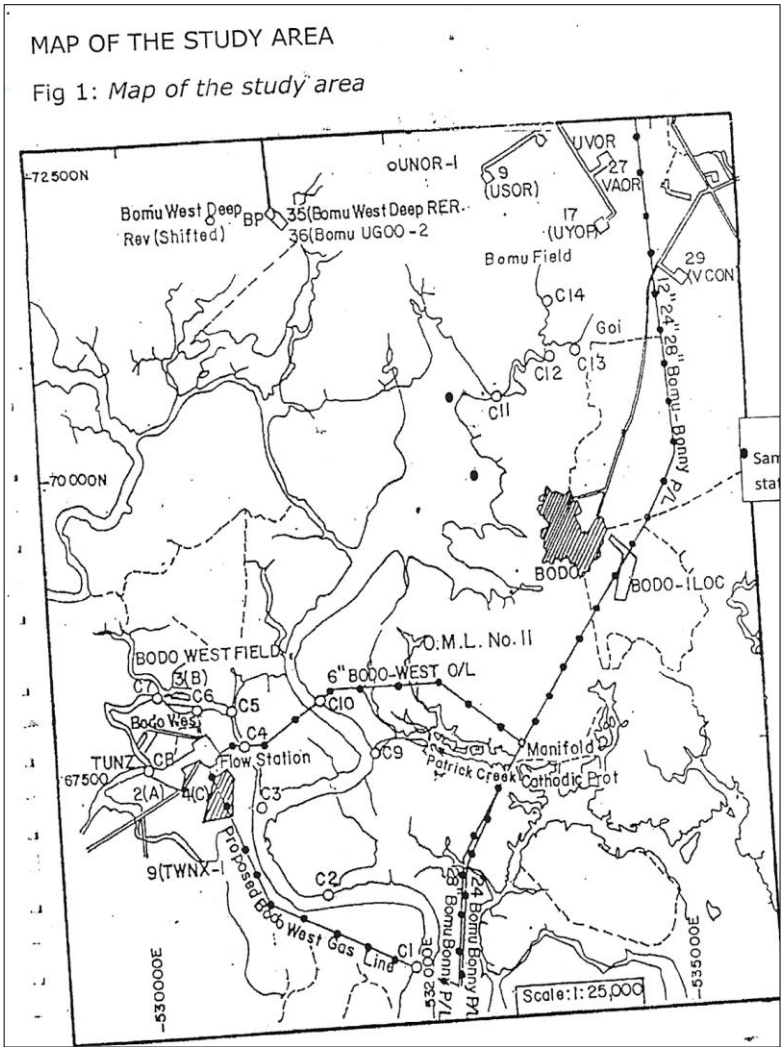
Numerous studies showed the concentration and distribution of heavy metals and physicochemical parameters in different aquatic systems. Tahir *et al;* (2016) [23] studied the physicochemical parameters and heavy metals of water and sediments from Gho/Dam in Pakinstan. The study revealed the sources and presence of heavy metals such as Pb, Cu, Zn, Cr etc. The study area is noted for oil spillage and bunkering activities due to oil wells around the area. It is on this account that this present study is carried out. This study aimed at; Assessing the level of heavy metals in Bodo river and to determine the level of the physicochemical parameters present (PH, COD, TDS, conductivity, Turbidity, and TSS) in the Bodo river.

**The Study Area**

Bodo city is an Ogoni community administratively located in Gokana Local Government Area of Rivers State, South-South Nigeria. The area is a low-lying mesh of wetlands compounds of numerous small streams, creeks and swampland with biota characteristic. Bodo creek is a network of blackish water creek and creeklets flanking Bodo city upper reaches of the Andoni-Bonney River. The Bodo River is influenced by tidal cycles of the entire Bonny estuary as well as frequent precipitation that spans the long rainy season (March-November) in the Niger Delta. Bodo river like New Calabar River, San Bathalomea, Ramos, Forcados and Brass Bonny rivers are short coastal rivers usually between 150-200km in length. The Bodo river is strongly influenced by the hydrology of the Bonny River because of its proximity to the main river mouth. The Bodo river is located approximately between latitude $6^0 75^{'}$N, $6^0 53^{'}$N and longitude $5^0 31^{'}$E and $5^0 35^{'}$E. The marginal vegetation of the Bodo River is predominantly red mangrove. The main occupation of the habitants is farming and fishing.

MAP OF THE STUDY AREA

Fig 1: *Map of the study area*




**Materials and Methods**

**Sample Collection**

The water sample containers (2 litre plastic containers with a screw cap) were washed thoroughly with detergent, leached with concentrated $HNO_3$, rinsed with distilled water until acid free and finally with the water sources. And were labeled appropriately. Grap samples of water were collected from two different locations (upstream and downstream) singly along the rivers into the prepared containers. This was done in January and February for dry season, July and August for wet season. The samples were collected and the temperature and pH were measured at the sampling site using standard mercury thermometer and pocket pH meter and then preserved at $4^0$C prior further analysis. For heavy metal determination, some were presented by adding a few drops of hydrogen trioxonitrate (vi) acid at the point of collection (Lawal *et al*; 2014 and Enuneku *et al*; 2013) [14].

## Experimental

Water samples were tested for different physicochemical parameters. Temperature was measured with glass mercury thermometer, conductivity was measured using Hanna potable conductivity meter, turbidity was determined by absorbance method, Ph was measured using a digital pH meter and total solids, dissolved solids and suspended solids was measured using gravimetric methods. Metallic elements were analyzed using atomic absorption spectrophotometric method (Dapam *et al*; 2016) [6].

## Results and Discussion

The present study was conducted on the water collected from Bodo River in order to analyse for physicochemical parameters and heavy metals concentrations. Their results are presented in table 1 and table 2 respectively.

**Table 1:** Mean value of the physicochemical parameters of the water samples

| Parameters | Dry season | Wet season | Who |
|---|---|---|---|
| pH | 4.9 | 4.7 | 6.5 – 8.5 |
| Conductivity | 243 | 10200 | 500 |
| Turbidity | 19 | 8 | 5.0 |
| Salinity | 0.63 | 0.07 | 200-250 |
| COD | 0.63 | 49 | 10.0mg/k |
| TDS | 20 | 18 | 1000 |
| Temperature | 28.4 | 27.0 | 25 |
| TSS | 12 | 16 | 30.00 |

**Table 2:** Mean concentration of heavy metals of water samples

| Metals (PPm) | Dry season | Wet season | Permissible Limited by WHO |
|---|---|---|---|
| Cu | 0.02 | 0.02 | 1.0mg/l |
| Zn | 0.1 | 0.1 | 5.0 |
| Fe | 0.5 | 0.4 | 0.3 |
| Pb | 0.01 | 0.01 | 0.023 |
| Cd | 0.07 | 0.07 | 0.01 |
| Ni | 0.02 | 0.02 | 0.02 |
| K | 8.4 | 6.3 | 0.5 |
| Cr | 0.02 | 0.02 | 0.05 |

The result for the physicochemical parameters and concentration of heavy metals are shown in table 1 and 2 respectively. In table 1, the mean value of the temperature for the river during dry season was $28.4^0$C and $27.0^0$C during wet season showing that there was a slight variation by $1.40^0$C higher than the wet season. PH values were lower than the WHO limit for drinking water. The values were acidic and therefore not good for human consumption. A low pH value implies the possibility of the water to hold more heavy metals. This is due to the corrosive ability of acids. Conductivity values observed in this study were lower than the WHO value in the dry season but higher than the WHO limit in the wet season. Conductivity measurements or values indicate the presence of ions species which conducts electricity. It also gives idea on the presence or availability of metal ions in solution. When conductivity values are high taste is observed in water (Waziri and Bomai, 2012) [24]. The turbidity values ranged from 8-19 Nin in the seasons. The values obtained in both seasons were higher than the 5.0 Nin recommended by WHO. Turbidity is an indication of how clear or transparent the water is. Salinity values was 0.63mg/l in the dry season when compared with the 0.07mg/l observed in the wet season. Lower salinity values in the wet season may have resulted as a result of dilution effect of increase in the volume of water during the wet season. The amount of chloride present in any water body can be roughly estimated from the values obtained from salinity results (Edori & Kpee, 2016) [9]. The observed result for TDS in both dry and wet seasons were lower than the WHO requirement for consumption. The palatability and taste of water is a function of the amount of dissolved solids present in the water (Waziri and Bomai, 2012) [24]. Chemical oxygen demand (COD) is a measure of the amount of oxygen that can oxidize organic matter. The concentrations of COD observed in this work was 0.63 and 49.00mg/l in the dry and wet seasons respectively. The increase in COD during the wet season over the WHO required limit may have resulted from runoffs of chemical from agricultural lands close to the river, or from dumps or increase in industrial effluents discharged into the river (Sharma and Walia, 2017) [22].

Total suspended solids (TSS) result obtained from the samples in the seasons were lower than the values required for drinking water by WHO. The total suspended solids (TSS) in this research were lower than the WHO standard of 30.0mg/l. Suspended solids is a combination of both organic and inorganic fraction carried along by water body. High values of TSS contributes to cloudiness of water which can best be described as muddy water. High values of TSS affects other water quality parameters such as temperature and dissolved oxygen. Other effects of TSS are on aquatic animals which need visibility to move about the environment.

The result obtained for heavy metals in the Bodo River indicated that Cu, Zn, Pb and Cr were below the WHO standard for drinking water, while Fe, Cd and k were above the standard and Ni fall within the standard. The presence of heavy metals in water is a serious concern to consumers. When they occur above the set limit, they become toxic to both plants and animals (Manoy *et al*, 2012). The variation of the heavy metals in the seasons were not well established, except for K. This conformity in both seasons may be that there were no new input sources arising within the period of metal analysis.

Copper were below the standard required by WHO. The importance of Cu lies in its use in metabolic processes. However, Cu at high concentrations causes kidney failure in children (Hussain *et al*, 2017) [13]. Zinc, though very important in protein-enzyme production, replication and genetic material translation (Galdes and Vallee, 1983) [12], yet at higher than required values causes growth and reproductive impairment (Nolan, 2003) [19]. Iron (Fe) is very important in man due to its functions. It is a known component in some human tissues such as cytochromes, porphyrins and metalloenzymes. Excessive intake is associated with tissue damage and hemochromatosis (Mesias *et al*, 2013) [17].

Lead (Pb) is a very common metal lead is a well-known poison that is not required in human and animal system at any concentration. It is associated with many physiological imbalance or diseases when taken in orally or through inhalation. Lead poisoning is related with such diseased conditions as kidney dysfunctions, chronic damage to the nervous system reproductive failure and effects on the joints (Ogwuegbu and Muhanga, 2005) [20].

Cadmium is a poisonous metal that is not desired by humans. The contamination of water bodies by Cd results from industrial activities. Cd is known to cause both liver and kidney damage at both acute and chronic exposures (ATSDR, 2012) [1].

Nickel (Ni) is a micronutrient for animals and plants species. Ni causes allergic skin reactions on contact with human or

animal skin. Skin patches is a regular occurrence associated with Ni toxicity (Cavani, 2005) [5].

Chromium is both a micronutrient and a toxicant, depending on the concentration the oxidation state it is (Zayed *et al*, 1998) [25]. The Cr (iii) oxidation state at low concentration is a micronutrient, but high concentration interferes with metabolic processes thereby acting as a toxicant (Zayed *et al*, 1998) [25].

## Conclusion

From the study of physicochemical parameters of water collected from Bodo river at both dry and wet seasons, it was concluded that water from this river is not suitable for any domestic purposes since all the parameters analyzed did not fall within the WHO standard. However, a higher level of turbidity was observed in dry season. cadmium and potassium were higher above the WHO limits for drinking water which may have a devastating effect on the community. The results of the study showed that potassium was available predominantly in both seasons indicating anthropogenic origin. The noticeable level of heavy metals concentration in the River may probably be due to the faecal and solid material waste into the river as well as the effluent water discharge into the river system during the oil/water drilling. The high conductivity in the Bodo River was deduced to be due to dissolved solid waste. High COD value during wet season could be traceable to high microbial population in the river system. The study thereby recommends that the water is not a good source for domestic purposes.

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