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Research Article

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Investigating the Portability of Ogoni Rivers for Economic Utilization

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Abstract Investigation was conducted to examine the portability of some Ogoni Rivers located in Rivers State for economic utilization. The physicochemical parameters of the River water was measured and the results obtained recorded as shown in the research work presented in this paper. River water from station 1 obtained from Kpor Community (Muor River), station 2 from K-Dere Community (Muorder River), station 3 from Bodo community (Mbaemu River) and station 4 from B-Dere community (Boogu River) were sampled for the following parameters such as pH, conductivity, salinity, turbidity, total solid dissolved, dissolved oxygen, biological oxygen demand, chlorine, sulphate, nitrate, handness ($CaCO_3$), iron, manganess, total hydrocarbon, total heterotrophic bacteria concentration and the result obtained was compared with the World Health Organization (WHO) standard. The results of the investigation reveals high in concentration on salinity, conductivity, TDS, DO, BOD, chlorine, suphate, hardness, THB for water samples from K-Dere and Bodo as well as the low in pH, conductivity, salinity, turbidity, TDS, chlorine, suphate, nitrate, hardness, manganese, THC for water samples from Kpor and B-Dere. Finally, the research demonstrates the usefulness of the various rivers sampled for economic utilization, since the values obtained are within the limit of the World Health Organization standard.

Keywords Ogoni, river water, portability, investigation, physicochemical parameters, economic utilization

Introduction

The need for river water to maintain it reliability in terms of portability for human utilization both for domestic and industrial purposes is the ultimate desire of very one, because of its usefulness to all living thing . The famers need clean water for their irrigation process, since contamination of water may influence the yield of their crops as well influence the soil concentrate, that is, either by increasing or decreasing the physicochemical properties of the soil constitutes. It is necessary at this stage in time when there is high lamentation in terms of environmental degradation in Ogoni Kingdom. Investigation conducted revealed high level of environmental degradation in area due to crude oil exploration, exploitation and utilization as presented by Ukpaka [1]. The reliability of a potable water or improved drinking water is when water is safe enough for drinking as well as for food preparation [2-5]. Water obtained in Ogoni zone initial stage when there was no pollution was very most safe but now due to industrial pollution the state of water is now unsafe for these purposes as stated above and when used leads to undesirable disastrous consequences because the toxic nature of water environment as reported by various research groups [5-8]. However, numerous approach have been carried out on how to improve contaminated river water for economic utilization, but the most challenges is the cost effective in carrying out the remediation to an international standard [9-11].

Research conducted revealed that water is a major resource of revenue in some country today as well is the most basic and fundamental component of life and is available for the needs of plant, animal and human life [12-13]. The aim of the investigation was to examine the characteristics of the some Ogoni Rivers water for economic purposes as state: portability for human utilization as well as agricultural purpose as well as to improve and cancel the Ogoni people on the impact of some river within the vicinity. The scope of the research covers the following: the collection and analysis of salt and fresh water Rivers in Ogoni zone, determination of the physicochemical characteristics of the River water sample, comparison of the analyzed results with the World Health Organization (WHO, 2008) standard for potable water and determination of the microbial activity on the River water

Materials and Methods

Sample Collection

The water samples for this investigation were collected within the Ogoni Zones, in Rivers State of Niger Delta Area of Nigeria. Polyethylene plastic bottles of 1 litre were used to collect the water samples. The plastic bottles were thoroughly cleaned with tape water and again rinsed with the sample water to avoid contamination of the water samples from the various rivers sampled. The samples collected were transported to Institute of Pollution Studies (IPS) RSUST laboratory for onward analysis to determine the characteristics of the physiochemical properties.

Materials and Equipment Used

The materials and equipment used in analyzing the collected sampled in the laboratory include: water, containers, thermometer, pH meter, conical flask, conductivity meter, glass beakers, magnetic stirrer, hot plate, graduated pipettes, stop watch, UV spectrometer, water distillation unit, Burettes, filter paper.

Methodology

pH, Conductivity, Salinity and Total Dissolved Solids

The measurements of pH, total dissolved solids and salinity were done using Extech pH–Conductivity ExStik II meter calibrated with buffer pH 4.0, 7.0 and 10.0 as well as 1413 μS/cm conductivity, solutions. Horiba U -10 Water Checker was used for brackish water samples for conductivity, salinity and TDS. The units of measurement are conductivity (μS/cm), total dissolved solids (mg/1) and salinity (‰).

Turbidity

The turbidity was determined using Extech Turbidity Meter TB400 calibrated with 0 and 100 NTU standards. Detection limit is 0.01 NTU.

Dissolved Oxygen and Bio-chemical Oxygen Demand

Two separate water samples were collected in 70-ml BOD bottles at each station (one for DO and the other for BOD). The DO sample was immediately fixed; 0.5ml manganous sulfate (Winkler 1) solution and 0.5ml alkali-iodide-azide regent (Winkler II) were added, stopper placed (excluding air bubbles) and mixed by several inversions. While those for BOD were taken to the laboratory and incubate at 20^0C for five days. At the end of the incubation period the samples were fixed in the same way as the DO samples. After about 10 minutes, 0.5ml conc. H_2SO_4 was added to the fixed samples, re-stopper and mixed for complete dissolution of precipitate. A 50-ml portion of the DO or BOD sample was placed in an Erlenmeyer flask, 5 drops of freshly prepared starch solution added and titrated with 0.025N $Na_2S_2O_3$ (sodium thiosulfate) solution. The titration was continued to the first disappearance of the blue color.

Initial and day 5 Dos in mg/1 were calculated using: $\frac{V\,x\,N\,x\,8000}{ml\,sample}$

Where: V is Volume in ml and N is normality of sodium thiosulfate solution used in titration. BOD_5 was calculated using the following: (A–B)

Where: A is the Initial DO of the sample and B is DO after 5- day incubation.

Sulfate

Sulfate determination was by the turbid metric method [8]. To a 50 –ml sample or portion diluted to 50-ml contained in a conical flask, 2.5-ml of conditioning reagent and a quarter spatula full barium chloride ($BaC1_2$) were added. The mixture was swirled for a minute and the barium sulfate ($BaSO_4$) turbidity read at the fifth minute on Spectronic 21D at 420nm against distilled water. Sulfate level was read from a calibration curve prepared for known sulfate standards treated the same way as the samples and concentration calculated from:

$$\frac{C\,x 1000}{ml\,sample}$$

Where C is mg SO_4/50ml read from calibration curve. The detection limit is 1.0 mg/1.

Nitrate-Nitrogen

Nitrate measurement was by the Brucine method [8]. To a 2.5 ml sample contained in test tube (immersed in ice-cold water), 2.5 ml of 4.0N of H_2SO_4 solution was added and mixed by gentle swirling. After cooling, 0.2 ml brucine sulfate solution was added with mixing. The treated samples in test tube rack was placed in a boiling water bath for 25 minutes for color development. After cooling the absorption of the resulting yellow color was read on Spectronic 21D at 410nm. The nitrate-nitrogen was read from calibration curve treated in the same way as the samples. Limit of detection is 0.05 mg/1.

Chloride

Chloride determination was by the Argent metric titration method [8]. To a 100-ml sample or a portion diluted to 100-ml contained in a conical flask, 0.5-ml of 5% K_2CrO_4 (potassium chromate) solution was added as indicator and titration of the mixture with 0.0141N $AgNO_3$ (silver nitrate) solution done to the brick – red precipitate end point. Samples pH where not in the range 6 – 8 was adjusted with 1N H_2SO_4 or 1N NaOH solution before titration. Limit of detection is 1.0 mg C1/1.

The chloride concentration was calculated using: $$\frac{(A-B)\,x\,N\,x\,35{,}450}{ml\,sample}$$

Where: A (ml titration for sample), B (ml titration for blank), and N (normality of $AgNO_3$).

Hardness

The EDTA titration method was used in determining total hardness. To a 50-ml sample or a portion diluted to 50 –ml placed in 125ml Erlenmeyer flask, 1 – ml ammonium solution buffer was added (to keep pH at 10.0 ± 0.1), as well as a little dry – power of Eriochrome black T –NaCl indicator. Titration of the sample with 0.01M EDTA (di- sodium salt ethylenediamine tetra acetic acid) was completed when the colour changed from wine red to blue. Hardness mg/1 as $CaCO_3$ was calculated using: $$\frac{A\,x\,B\,x 1000}{S}$$

Where: A is volume (ml) 0.01M EDTA used in titration, B is mg $CaCO_3$ equivalent to EDTA titans and S is original volume of sample taken for analysis.

Total Hydrocarbons (THC)

The THC of the samples were determined after extracting 100-ml sample portion with 10-ml Toluene and the absorbance of the extract read on Spectronic 21 at 420nm [14]. The THC was read from a calibration curve of oil in toluene standards measured at 420nm. Detection limit is 0.02 mg/1

Heavy Metals

Two heavy metals (Iron and Manganese) were measured using GBC Avanta Atomic Absorption Spectrophotometer (AAS). The samples were directly aspirated into the AAS after calibrating the instrument with known standard solutions as shown in the calibration curves. The detection limit is 0.001 mg/1 [14].

Microbiology

For Total Heterotrophic Bacteria (THB) pour plate technique with nutrient agar was used. In the case of total and faecal coliform bacteria, the most probable number (MPN) technique was employed for estimation of their numbers in water inoculated into test tubes of MacConkey broth medium. All inoculated media were incubated at 37 ^{O}C for 24 hours except for faecal coliform bacteria set up incubated at 44.5 ^{O}C [8].

Results and Discussion

The results obtained from the research work are presented in Table and figures as well results were compared with the World Health Organization standard (WHO) in other to ascertain the influence of the various Rivers sampled.

Table 1: Results of Physicochemical Analysis of some Ogoni Water Samples

No	Parameters	Station 1 Kpor (muor)	Station 2 K-Dere (muorde)	Station 3 Bodo (mbaemu)	Station 4 B-Dere (Boogu)	WHO Limit/ standard
1.	pH	5.6	6.8	6.9	6.9	6.5-8.5
2.	Conductivity (µS/cm)	83	27900	21300	21	1000
3.	Salinity (‰)	0.03	17.3	12.8	0.01	0.03
4.	Turbidity(NTU)	0	0	2.6	0	5
5.	TDS (mg/l)	59	19530	14910	14	500
6.	DO (mg/l)	4.8	4.0	6.4	5.6	3.5
7.	BOD (mg 02/l)	1.6	1.6	2.4	2.4	-
8.	Chlorine (mg/l)	4.4	8398.0	6422.0	1.4	250
9.	Sulphate (mg/l)	<1.0	679.3	402.8	<1.0	250
10.	Nitrate (mg/l)	1.90	0.35	0.4	0.9	10.0
11.	Hardness (mg/l as $CaCO_3$)	7.6	1344.0	1056.0	5.7	150
12.	Iron, Fe (mg/l)	0.129	<0.001	0.566	<0.001	0.3
13.	Manganese, Mn (mg/l)	<0.001	<0.001	0.011	<0.001	0.5
14.	Total Hydrocarbon, THC (mg/l)	<0.02	<0.02	<0.02	<0.02	-
15.	Total Heterotrophic Bacteria (cfu/ml)	14000	24000	180000	15400	-
16.	Total Coliform Bacteria (MPN/100ML)	Nil	Nil	Nil	Nil	-
17.	Feacal Coliform Bacteria (MPN/100ml)	Nil	Nil	Nil	Nil	-

Note: <1.0 = Less than detection limit

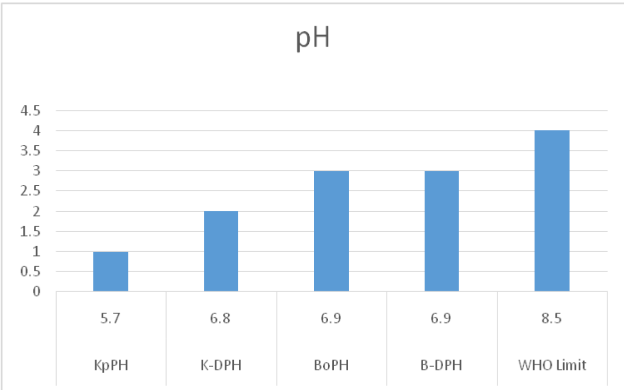

Figure 1: Graph of pH concentration profile against sampled area

Figure 1 Illustrates the relationship on the variation of pH concentration profile in the various rivers sampled. The result obtained indicate that from River Muor (Station 1 - Kpor), River Muorder (station 2-K-Dere), River

Mbaemu (station 3 - Bodo), River Boogu (Station 4 – B-Dere) falls within the recommended World Health Organization. The order of magnitude in terms of the pH concentration profile for the various rivers is as shown thus, B-DpH = BOpH > K-DpH > KppH. The variation in the pH can be attributed to the nature of the river (salt or fresh water), level of pollutant as well as the geographic location of the river as well as level of pollution

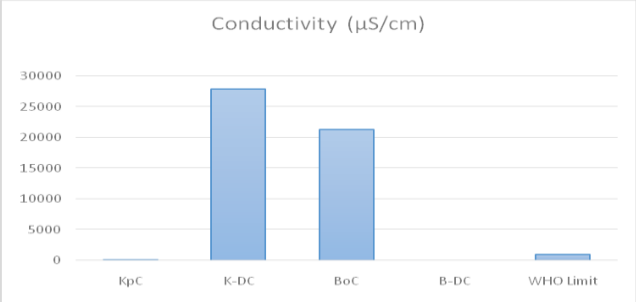

Figure 2: Graph of conductivity concentration profile against sample area

Figure 2 shows the relationship on the variation of conductivity concentration profile in the various rivers sampled. The result obtained indicate that from river Muor (station 1 - Kpor) and river Boogu (station 4 – B-Dere) falls within the recommended WHO standard. While the concentration profile from River Muorder (station – K-Dere) and river Mbaemu (Station 3 Bodo) are far above the recommended WHO standard. The level of magnitude in terms of the conductivity concentration profile for the various Rivers is as shown thus: K-DC > BoC, > WHO limit > B-DC > KpC.

The variation in the conductivity can be attributed to the level of pollutant and the native of the rivers.

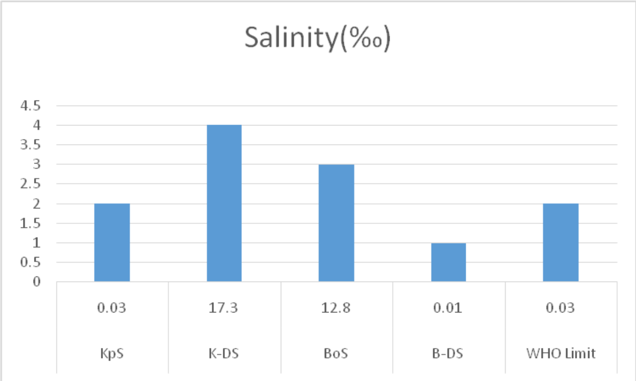

Figure 3: Graph of Salinity concentration profile against sampled area

Figure 3 illustrates the relationship on the variation of salinity concentration profile in the various river sampled. The result obtained shows that from river Muor (station 1 - Kpor), river Boogu (station 4- B-Dere) falls with the World Health Organization limit and the concentration from Muorder (station 2-K-Dere) and river Mbaemu (Station 3 - Bodo) are above the set standard by the World Health Organization. The order of magnitude in terms of the rivers is as shown, thus: K-DS > BoS > KPS > B-Ds. The variation in the salinity can be attributed to the nature of rivers (i.e. the salt content).

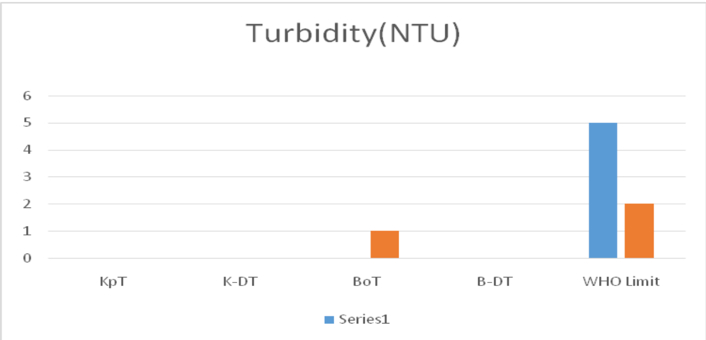

Figure 4: Graph of Turbidity concentration profile against sampled area

Figure 4 shows the relationship on the variation of turbidity concentration profile in the various river sampled. The result obtained indicates that from River Muor station 1, station 2, station 3 and station 4 fall within the recommended WHO standard. The level of magnitude in terms of the turbidity concentration profile for the various rivers is as shown thus: KPT = K-DT = B-DT < BoT. This variation can be attributed to the geographical location as well as level of pollution.

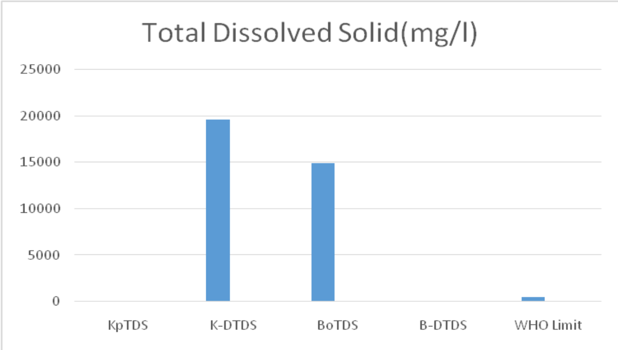

Figure 5: Graph of Total Dissolved Solid concentration profile against sampled area

Figure 5 illustrates the relationship on the variation of total Dissolved solid concentration profile in the various rivers sampled. The result obtained shows that from river Muorder (station 2 – K-Dere) and river Mbaemu (station 3-Bodo) are far above the WHO standard. While the concentration from Muor (station 1-Kpor) and river Boogu (station 4-B-Dere) falls with the WHO standard. The order of magnitude in terms of the Total Dissolved Solid concentration profile for the various rivers is as shown, thus; K-DTDS > BoTDS > KpTDS > B-DTDS. The variation can be attributed to the level of pollutant of the rivers.

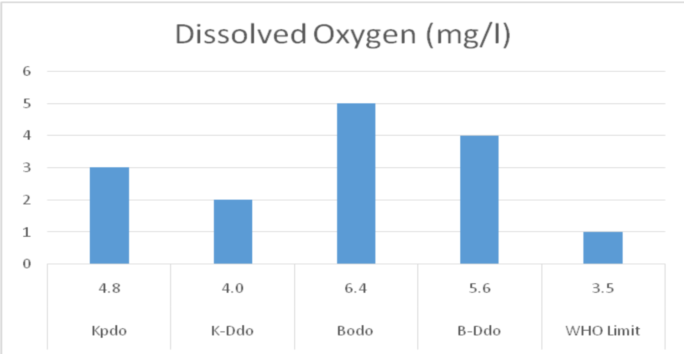

Figure 6: Graph of Dissolved Oxygen concentration against sampled area

Figure 6 illustrates the relationship on the variation of Dissolved Oxygen (DO) concentration profile in the various rivers sampled. The result obtained indicates that the concentrations of DO in all the rivers are above the recommended world health Organization. The order of magnitude in terms of DO profile for various rivers is as shown; BoDO > B-DDO > KpDO > K-DDO. This variation can be attributed to geographical location and the level of pollutant.

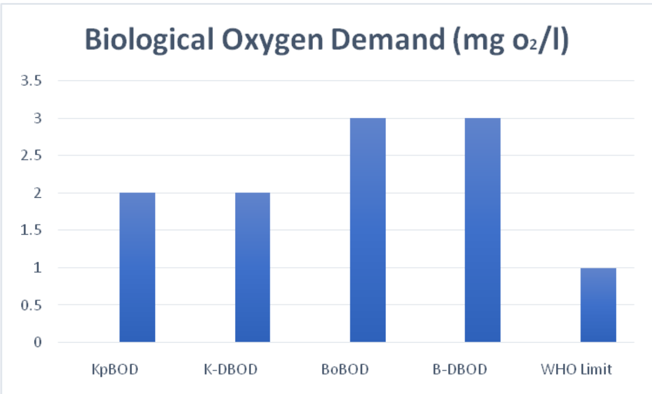

Figure 7: Graph of Biological Oxygen Demand concentration profile against sampled area

Figure 7 shows the relationship on the variation of Biological Oxygen Demand concentration profile in the various rivers sampled. The result obtained show the rivers from the four stations are above the WHO standard. The level of magnitude in terms of the Biological oxygen demand concentration profile for the various rivers is as shown thus; BoBOD = B – BDOD > KPBOD = K-DBOD. The variation can be attributed the human activities and level of pollutant.

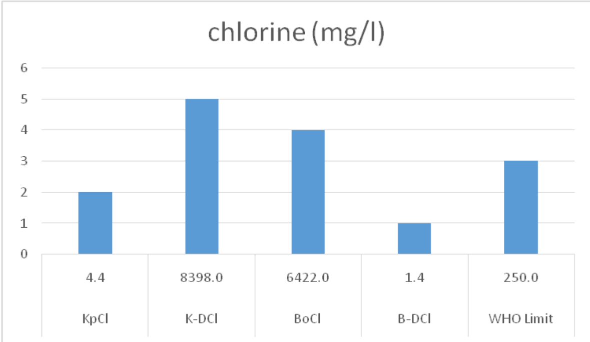

Figure 8: Graph of chlorine concentration profile against sampled area

Figure 8 illustrates the relationship on the variation of chlorine concentration profile in the various rivers sampled. The result obtained indicate that from river Muorde (station 2-K-Der) and river Mbaemu (station 3-Bodo) are above the recommended World Health Organization standard, while the concentration from river Mu or (station 1- Kpor) and river Boog (station 4 – B - Dere) falls within the WHO standard. The order of magnitude in terms of the chlorine concentration profile for the various rivers are shown thus; K-DCl > BoCl > KPCl > B-DCl. The variation can be attributed to the nature of the rivers.

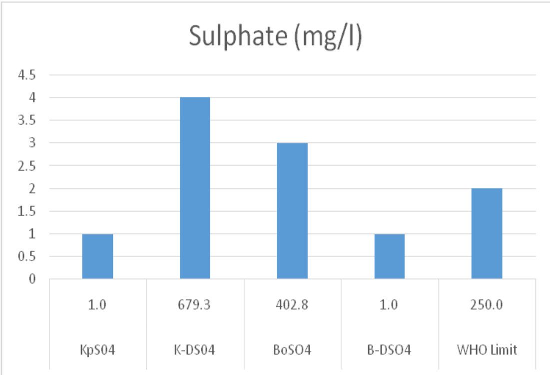

Figure 9: Graph of Sulphate concentration profile against sampled area

Figure 9 shows the relationship on the variation of sulphate concentration profile in the various rivers, sampled. The result obtained indicate that from river Muorde (station 2 – K-Dere) and river Mbaemu (station 3 - Bodo) are above the WHO limit and the concentration from river Mu or (station 1 -Kpor) and river Boogu (station 4-Dere) falls with the WHO limit. The level of magnitude in terms of the rivers shown thus; K-DSO_4 > $BoSO_4$ > $KPSO_4$ = B-DSO_4. The variation can be attributed the geographical location of the rivers.

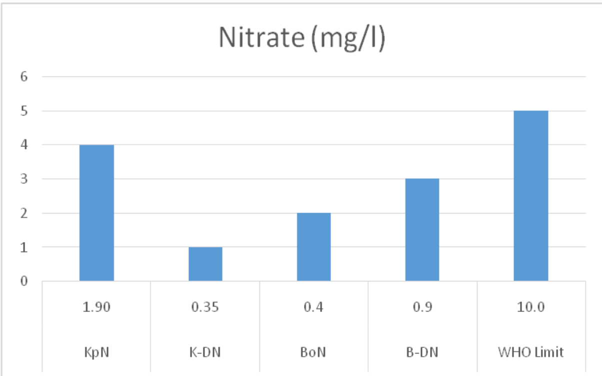

Figure 10: Graph of Nitrate concentration profile against sampled area

Figure 10 Illustrates the relationship on the variation of Nitrate concentration profile in the various rivers sampled. The result obtained shows that all the rivers from each station fall with the recommended world health organization standard. The order of magnitude in terms of the rivers is shown thus; KPN > B-DN > BoN > K-DN. This variation can be attributed to the nature of the rivers and location as well as the degree of pollutant.

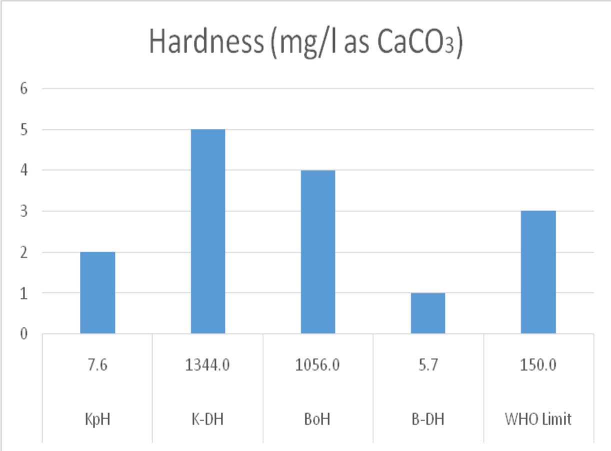

Figure 11: Graph of Hardness concentration profile against sampled area

Figure 11 illustrates the relationship on the variation of Hardness concentration profile in the various rivers sampled. The result obtained shows that from river Boogu (station 4 –B- Dere) and river Muor (station 1- Kpor) falls within the WHO standard, while the concentration from river Muorder (station 2 – K-Dere) and river Mbaemu (station 3- Bodo) falls above the WHO limit. The level of magnitude in terms the rivers is shown thus; K-DH > BoH > KpH > B-DH. The variation can be attributed to human activities and the nature of the rivers.

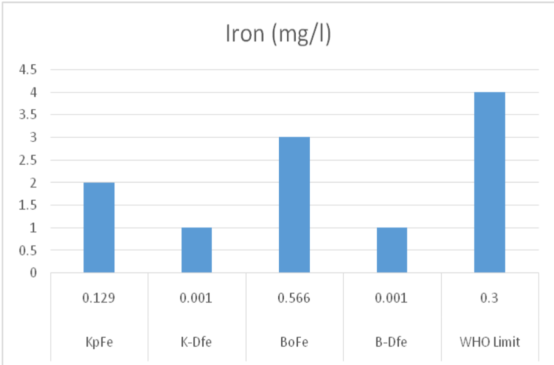

Figure 12: Graph of Iron concentration profile against sampled area

Figure 12 shows the relations on the variation of iron concentration profile in the various rivers sampled. The result obtained indicates that all iron concentration of all the rivers falls with the world health organization standard. The level of magnitude in terms of the rivers is as shown: K-DFc = B-DFc < BoFc. This variation is attributed to the geographical location of the rivers.

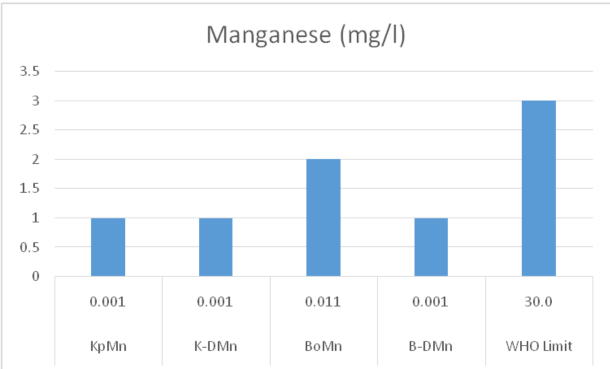

Figure 13: Graph of Manganese concentration profile against sampled area

Figure 13 illustration the relation on the variation of manganese concentration profile in the various rivers sampled. The result obtained shows that the manganese of all the stations falls within the WHO standard. The order of magnitude in terms of the rivers is as shown thus; KpMn = K-DMn = B-DMn < BoMn. This variation can be attributed to the geographical location of the rivers.

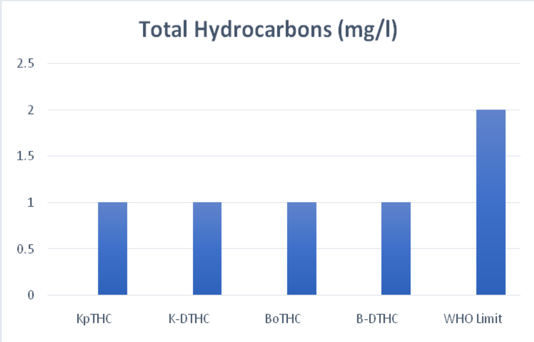

Figure 14: Graph of Total Hydrocarbons concentration profile against sampled area

Figure 14 show the relationship on the variation of total Hydrocarbons concentration profile in the various rivers sampled. The result obtain indicate that al the rivers sample falls with the World Health Organization standard. The level of magnitude in terms of the rivers is as shown thus; KPTHC = K-DTHC = BoTHC = B-DTHC. (i.e. they are all at the same level > 0.02).

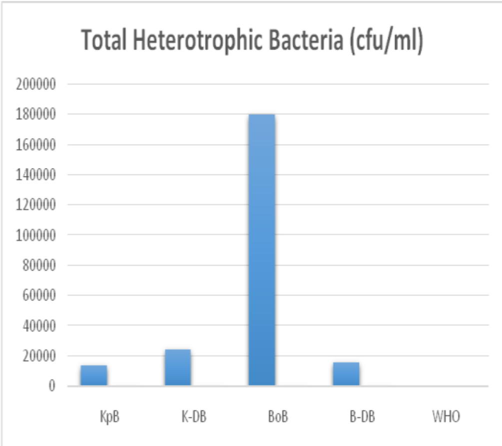

Figure 15: Graph of Total Heterotrophic Bacteria concentration profile against sampled area

Figure 15 illustrate the relationship on the variation of total Heterotrophic Bacteria concentration profile in the various rivers sampled. The result obtained indicate that the level of Bacterial from river Mbaemu (station 3-Bodo) is very great and far above the WHO limit, river Mu or (station 1 - Kpor), river Muorde (station 2 – K-Dere) and river Boogu (station 4-B-Dere) are also above the recommended the World Health Organization Standard. The order of magnitude in terms of the rivers is as shown thus; BoB >> K-DB > B-DB > KpB. The variation can be attributed to human activities and level of waste dump at river Mbaemu (station 3- Bodo).

Conclusion

The following conclusion was drawn from the investigation, such as:

1. The degree of pollution especially for river Muorde and river Mbaemu are far above the WHO standard limit.
2. The above described rivers cannot be useful for effective utilization in terms human consumption as well as for irrigation purposes due high level of contamination.
3. The crude oil exploitation, exploration and utilization can be attributed as a major source of contamination on rives investigated.
4. Treatment of the various river water required to improve the portable and the reliability for human utilization both for domestic and industrial aim.

5. The level of contamination is still low for now, that is while the aquatic inhabits are not duly influenced by the nature of environment, but if the degree of contamination increases there is tendency of environment influencing the living organisms in the aquatic environment.
6. This research will help as a guide in terms of knowledge review to the people of Ogoni as well as to know the level of contamination of some of the rivers water located within their region.

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