IMPACT OF HUMAN ACTIVITIES ON SOME SELECTED PARTS OF OGUN RIVER ABEOKUTA, OGUN STATE, NIGERIA.

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ABSTRACT

The problem of getting quality water is increasing as untreated effluents are discharged into surface water bodies. This study aim at assessing the impact of wastes generated from human activities such as Abattoir site, Sawmill, Car Wash, River banks and dumpsites on Ogun river. The Physical, Chemical and Bacteriological parameters were investigated at the Upstream, Point of discharge and Downstream of the river. The results of this study revealed that all the measured parameters has a significant difference in their mean values. The ranges of the mean values of all the parameters measured for pH, Electrical Conductivity (EC), Temperature, Total Dissolved Solids(TDS), Acidity, Alkalinity, Chloride, Total Hardness, Calcium, Magnesium, Total Suspended Solids (TSS), Dissolved Oxygen (DO),Biological oxygen Demand(BOD), Sodium, Potassium, Nitrate, Phosphate, Total Coliform Count, Total Bacteria Count, Lead, Chromium, Iron, Zinc and Copper were 6.50-6.68, 120.40-149.40 µS/cm, 28.10-28.68˚c, 59.60-84.00 mg/L, 5.00-6.80 mg/L, 1.12-2.16 mg/L, 16.20-21.20 mg/L, 53.60-74.80 mg/L, 30.40-38.40 mg/L, 23.20-44.00 mg/L, 400.00-720.00 mg/L,1.21-2.33 mg/L, 30.83-35.03 mg/L, 9.40-14.20 mg/L, 2.60-4.40 mg/L, 0.43-0.65 mg/L, 0.12-0.13 mg/L, 160 cfu/100 ml, 16000-600000 cfu/100 ml, 0.08-0.33 mg/L, 0.01-0.09 mg/L, 0.29-1.2 mg/L and 0.01-0.14 mg/L respectively. From the results, it was discovered that, the values of DO, NO^-_3, PO_4, TSS, K, Total coliform count, Total Bacteria Count, Lead, Chromium and Iron exceeded the permissible limits of WHO (2017) guideline for drinking water. Pollution of Ogun River water along it courses is evidenced by the high concentrations of pollution indicators, nutrients and trace metals above the acceptable limits. The water quality of River Ogun from the waste discharge points, therefore poses a lot of health hazards to users.

Keywords: Effluents, Water quality, Health, River

INTRODUCTION

There has been an increasing concern about the environment in which man lives. Solid wastes, mount of rubbish, garbage and sewage are being produced everyday by our urban society. In an attempt to dispose of these materials, man has carelessly polluted the environment. In the past, men thought the environment had an infinite capacity to devour his waste without any ill effects. More recently, however, man's health and welfare are being affected by environmental pollution. These pollutants are substances present naturally in the environment but when released in significant amount by humans, become toxic. Water can be polluted by substances that dissolve in it or by solid particles and insoluble liquid droplets that become suspended in it (Plant *et al.*, 2001). Even paper is sometimes a high-tech material. It's not just a bunch of fibers that are laid down and put together. It is coated, bonded and got a tremendous amount of technology built in it (Stu, 2002).

Human activities are a major factor determining the quality of surface and groundwater through atmospheric pollution, effluent discharges, use of agricultural chemicals, eroded soils and land use (Niemi *et al*, 1990). The quality of surface water within a region is governed by both natural resources (such as precipitation, weathering process and soil erosion) and anthropogenic effects (such as urban, industrial and agricultural activities and the human exploitation of water resources) (Khali *et al*., 2009). Pathogens, the disease-causing bacteria and viruses associated with human and animal waste, can also make water unsafe for human use. If pathogens or the indicator bacteria associated with human and animal waste are found during water analyses, drinking water supplies may require expensive filtration or disinfection. Waterborne pathogens derived from human and animal waste are a significant water quality concern in many parts of the world. Thus, in the United States of America (USA) “pathogens” are the most frequent cause of “impairment” in waters covered by the US Clean Water Act (USEPA 2009).

Toxicity and sub-lethal toxicity of soaps, detergents and bio-refractory organics create water pollution and affect the ecology and micro-organism, fauna and flora near the pollution load (Morrison et al., 2001 : Liu, et al., 2015). Biological toxic effect is significant to physiology and behaviour of organism to alter its capacity for growth and reproduction or mortality (Griego, *et al*., 2003 : Anikwe *et al*., 2006). Hence soaps, detergents and bio-refractory organics containing water should be avoided to drain in the water reservoir. Despite these improvements, continuing urban growth and nonpoint source runoff of contaminants and storm water are expected to challenge these historic gains (Muchuweti *et al.*, 2006: Ogugbuaja, *et al.*, 2001).

Though, water is essential to all forms of life and makes up 50 to 97% of the weight of all plants andanimals and about 70% of human body (Rene *et al.*, 2008 : Bariweni *et al*., 2000). Despite its importance, water is the most poorly managed resource in the world (Rao,
2006: lzonfuo, *et al.*,2001).

METHODOLOGY

Description of the Study Area

River Ogun is one of the rivers in the southern – western part of Nigeria which covers a total area of about 22.4 km² with coordinates; latitude 6°35’32’’N and longitude 3°27’42’’E. It is located at an elevation of 38 meters above sea level and transverses through Ibarapa, Iseyin, Abeokuta, Owode, Ikorodu, and Ifo local government areas before finally discharging into the Lagos lagoon. Lafenwa market, Abeokuta has become a place with continuous pollution due to the its relevance as a focal point of various commercial activities; buying and selling of agricultural produce and farm animals. The geology of Ogun State comprises the sedimentary and basement complex rocks.

According to Akanni (2000), about 1,200 km of Ogun State is of sedimentary formation while about 400 km is of basement complex rocks of pre-Cambrian formation. There are two main relief regions: first, the creeks and lagoons forming a small section in the south eastern part of the state, the altitude of which ranges from 0 to 40 meters above the sea level. Second, the undulating coastal plain and the low land with the elevation increasing northwards from about 30 to 250 meters above sea level. The plain is broken by sand stone cresta especially towards the western part of the state. There are pockets of rock outcrops dotting the landscape especially around state capital (Abeokuta). The whole state is drained by flowing coastal rivers such as Ogun, Yewa, and Shasha from Oyo state through the thickly vegetated western part of the state. Numerous small rivers and streams are at the south eastern parts flowing perennially through the swampy terrain (Akanni, 2000).

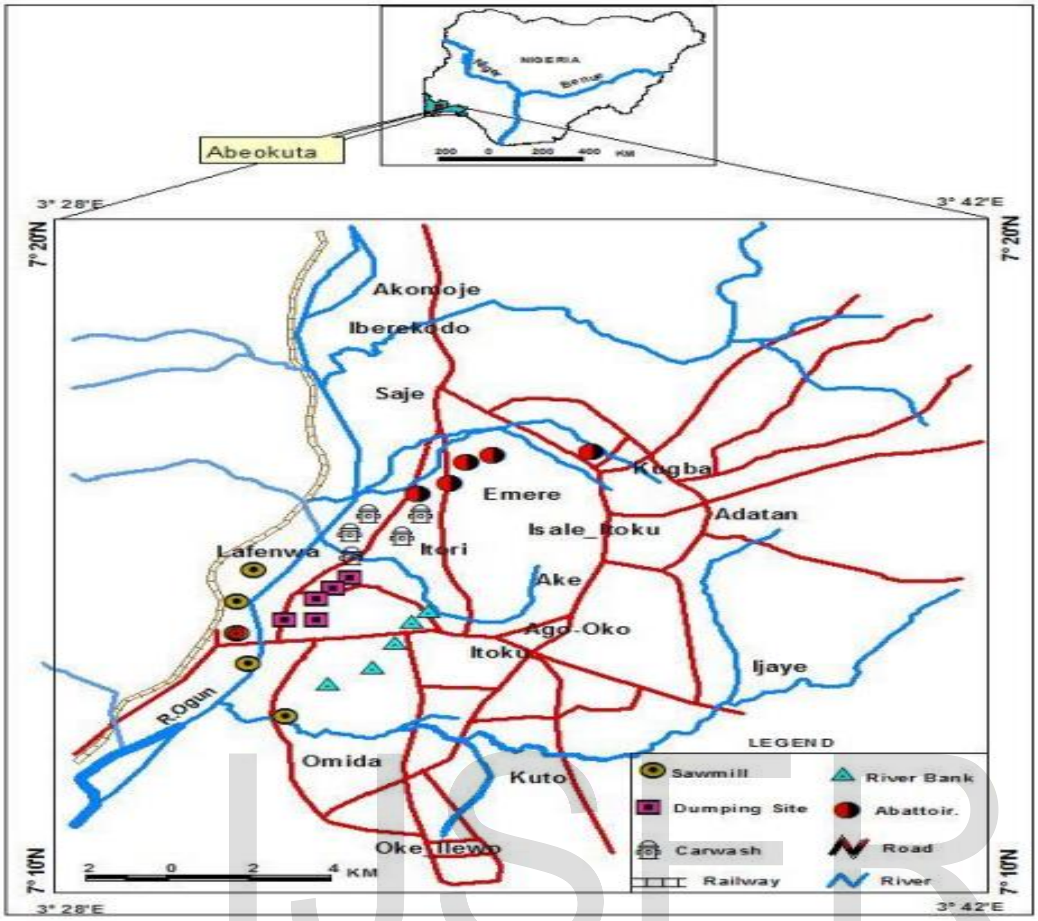

Figure 1: Map of Ogun river showing the sampling locations.

Sampling Procedure

Water samples were collected at five different locations from various points of the river for laboratory analysis. The different locations were chosen based on their accessibility and proximity to pollution sources. Global Positioning System was used to determine the actual positions of each location and referenced to ensure consistency in the sampling points.

Sample Collection

Five samples of water were collected at each location into a 2.5 litre bottle container that have been properly rinsed with distilled water. The bottles were also rinsed with the water sample before collection to avoid interference. The samples were stored in an ice pack and transported to the laboratory for the physical, chemical and bacteriological analyses. Some of the physical parameters were measured in-situ and they includes: pH, Temperature, Electrical Conductivity, Total Dissolved Solids and Dissolved Oxygen.

Wastewater samples from Five (5) different locations at various points of the river were collected for laboratory analyses. Twenty-five samples which are made up of five sampling points each located on the River bank (R1, R2, R4, & R5), abattoir site (A1, A2, A3, A4, &A5), sawmill site (S1, S2, S3, S4, &S5), dumping site (D1, D2, D3, D4, &D5), and Car wash site (C1, C2, C3, C4, &C5) respectively were identified.

DISCUSSION OF RESULT

Results of the physical and chemical parameters on water quality of Ogun River

pH

The mean value of pH from all the water samples ranged from 6.5-6.68 and the values were relatively good throughout the sampling locations (Table 2). They all conform to the WHO guideline value for wastewater quality discharge into water bodies of 6.5 – 8.5 (WHO 2017). Although they all conform to the standard set by the WHO, the mean values of the pH for each sampling locations were all acidic in nature and more likely to be corrosive. Therefore, the water samples are likely to cause health problems such as acidosis (Asamoah and Amorin, 2011).

Temperature

The Temperature of the river varies at each sampling locations (Table 2) and the mean values of temperature on the river is below the WHO guideline value of <40^{o}c (WHO 2017). This could be due to several factors that influence the rise and fall of temperature in a river. The most important factor that affects temperature are the climatic fluctuations and responds to factors such as season, time of day, air circulation, cloud cover, depth and flow of water in the natural system. Many of the physical, biological and chemical characteristics of surface water are dependent on temperature

(Smith, 2002). The optimal health of aquatic organisms from microbes to fish depends on temperature (Pankow, I991).

Electrical Conductivity

From the study, the mean values of Electrical Conductivity on the river is below the (WHO 2017) guideline for drinking water given as 1250 µS/cm (Table 2).This could be due to the low concentration of Dissolved Solids in the water.

Total Dissolved Solid

The TDS values obtained from the study areas ranged from 59.6–84 mg/L (Table 2) which is within the WHO standard of< 600 mg/L (WHO 2017). High significant values of TDS could be due to salt water intrusion because of short distances to oceans (Martins and Awokola 1996).

Total Suspended Solid

The mean values of Total Suspended Solid ranged from 400 - 720 mg/L (Table 2) and the values does not conform to the WHO guideline value for wastewater quality discharge into water bodies of 50 mg/L (WHO 2017). The Total Suspended Solid values were attributed to domestic waste, abattoir waste, car washing, sawmill waste and refuse dumping along the flow path of the river. This poses a health risk to several communities situated around the river who rely on the river primarily as their source of domestic water.

Dissolved Oxygen

The mean values of DO ranged from 1.21- 2.33 mg/L. The sawmill section has a higher value of 2.33 mg/L, as a result of sawmill waste carried out in the area though the other values at other locations fell within the expected WHO value of 2.0 mg/L (WHO 2017).

Biological Oxygen Demand

BOD values ranged from 30.83 – 35.03 mg/L. All the values of BOD samples fell within the permissible guideline of (WHO 2017) standard for drinking water given as 50 mg/L (Table 2). The BOD is an important water quality parameter and is very essential in water quality assessment. Growth of aerobic and facultative anaerobic bacteria will be enhanced by the presence of dissolved oxygen in any water body. The more organic material presents in the river the higher the BOD (Ojekunle *et al*., 2014).

Acidity & Alkalinity

The acidity measured at the sampling locations has shown in (Table 2) are reasonably consistent throughout the sampling period. The sampling locations including river bank, dumping site and car wash has the highest acidity of 6.8 mg/L and the lowest value of 5 mg/L in the abattoir section. The acidity values indicated that, the sample had being polluted by some hydrolyzing salts like iron II.

Alkalinity was also measured from the five sampling locations. At the Abattoir section the alkalinity has higher mean value of 2.16 mg/L than the other location, while the lowest mean values of alkalinity is 1.12 mg/L at the river bank, dumping site saw milling and car wash section. Increase in the level of alkalinity can be traceable to pollution and domestic activities which had taken place around the river.

Calcium

From the study, the mean values of Calcium for the river varies throughout the sampling point. The Calcium values ranges from 30.4 – 38.4 mg/L which is below the WHO standard of 100 mg/L (WHO 2017). From (Table 2), the river bank has the highest value of Calcium given as 38.4 mg/L, while the sawmill section has the lowest value of 30.4 mg/L. Water with low Calcium levels are usually oligotrophic and can support only sparse plant and animal life while high Calcium levels are typical of eutrophic waters.

Total Hardness

Table 2 showed that the mean values of Total Hardness ranged from 53.6 – 74.8 mg/L which is below (WHO, 2017) guideline for drinking water. The Carwash section has the highest value given as 74.8 mg/L, while the sawmill section has the lowest value of 53.6 mg/L. Detergent usage contribute to the increase in Total Hardness values. Thus exposure to hard water has been suggested to be a risk factor that could exacerbate eczema. The environment plays an important part in the ecology of atopic eczema. A suggested explanation relative to hard water is that increased soap usage in hard water results in metal or soap salt residues on the skin (or on clothes) that are not easily rinsed off and that lead to contact irritation especially to local users (Ojekunle and Lateef, 2017).

Magnesium

From the result obtained, the mean values of Magnesium ranged from 23.2 - 44.0 mg/L which is below the WHO standard of 50 mg/L (WHO 2017). The car wash and river bank has the highest mean value of 44 mg/Land 34.8 mg/L while the sawmill section has the lowest value of 23.2 mg/L. The use of Detergent in car wash and river bank for washing also contributes to the increase in Magnesium values and high level of Magnesium in human results to vomiting and diarrhea.

Sodium

From the study, the mean values of Sodium varies from one location to the other (Table 2).Though the values fell within the (WHO 2017) permissible guideline for drinking water, which is given as 20 mg/L.The abattoir site has the highest mean value of 14.2 mg/L, while the dumping site has the lowest value of 8 mg/L. The increase in Sodium level in the abattoir section is due to the abattoir effluents discharged into the river. High level of Sodium causes nausea, vomiting, convulsions, muscular twitching and rigidity, cerebral and pulmonary oedema (Elton *et al*., 1963).

Potassium

The mean values obtained for Potassium ranged from 2.6 – 4.4 mg/L which is higher than the WHO standard given as 2.5 mg/L. This may be as a result of erosion of salt deposits, naturally occurring brackish water of some aquifers, salt water intrusion into the river areas, infiltration of the river contaminated by road salt, irrigation and precipitation leaching through soils which occurs as a result of highSodium and Potassium around the river. High level of potassium causes heart disease, coronary artery disease, hypertension, diabetes and adrenal insufficiency (Gennari, 2002).

Chloride

From the study, the mean values of Chloride ranged from 16.2 – 21.2 mg/L which is below the (WHO 2017) guideline for drinking water given as 350 mg/L. Hence, the river bank and Abattoir section has the highest Chloride value of 21.2 mg/L while sawmill section has the lowest Chloride value of 16.2 mg/L.

Nitrate

From Table 2, the mean values of nitrate obtained ranged from 0.43 mg/L - 0.65 mg/L and these nitrate values were higher than the WHO permissible guidelinewhich is given as 3mg/L. Increase in nitrate level may be due to contamination from domestic activities which increases the nitrate

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content and also consists of nitrogen. When metabolized, it can end up in the form of ammonia (NH_3).

Total Coliform Count

From Table 3, the TCC values obtained from the five sampling locations were above 160 cfu/ml which is higher than the permissible limit of (WHO 2017) guideline given as 10 cfu/ml. The presence of coliform reveals re-growth and possible biofilm function or contamination. They occur in both sewage and natural wastes and can result to deleterious health effect in human if the water is consumed.

However, none of the water samples taken were free from these bacteria. This implies that there is possibility of additional pollutants from humans operating within and around the abattoir. Thus, the drainage outside the abattoir is more polluted than that within the abattoir. This result conforms with (Coker *et al*., 2001) which states that 'abattoir wastewater is heavily polluted regardless of the point from which it is taken'.

Total Bacteria Count

(Table 3) also showed that the mean value for TBC ranged from 16000 – 60000 cfu/ml which exceeds the (WHO, 2017) guideline for drinking water given as 0 cfu/ml. The increase in the values obtained for TBC could be attributed to discharges of untreated sewage, animal waste run off, sawmill waste and waste from dumpsite which conforms with the report of (Fatoki *et al*., 2001). United Nation Environment programme (1991) attributed high faecal pollution of rivers in developing countries to inadequate sanitation. It is important to emphasize that the high coliform value obtained might expose primary users of water from Ogun river to high risk of water borne diseasesand water related diseases which includes; cholera, diarrhea, typhoid and dysentery. This conforms with the report of (Banwart, 2004) who reported that, faecal contamination of drinking water has very serious health implications on human health as a result of deliberate and indiscriminate littering of human and animal waste in adjoining bushesor water courses.

Table 1: Table showing the sampling points and surrounding activities around Ogun River.

SAMPLING POINT	LATITUDE	LONGITUDE	DESCRIPTION	SURROUNDING ACTIVITIES
A1	7°15’30’’N	3°33’90’’E	Upstream of the abattoir site	Slaughter house for cow and sheep
A2	7°16’27’’N	3°32’87’’E	A point some distance away from A1	Cattle Slaughtering, dumping of animal blood and dungs into the river

A3	7°16'26''N	3°32'86''E	A point some distance away from A2	Flow of animal blood and dungs through a channel into the river.
A4	7°16'25''N	3°32'85''E	A point some distance away from A3	Dumping of animal blood and dungs into the river.
A5	7°16'24''N	3°32'864''E	Downstream of the abattoir site	Washing of animal dungs directly into the river.
C1	7°16'20''N	3°32'83''E	Upstream of the car wash	Fetching of water for domestic

Table 2: Comparing the Mean and Standard Deviation values of the Physical and Chemical parameter with the WHO 2017 standard for each sampling locations.

PARAMETERS	ABATTOIR	CAR WASH	DUMPING SITE	RIVER BANK	SAWMILL	WHO STD (2017)
pH	6.55 ± 0.95	6.68 ± 0.82	6.55 ± 0.85	6.54 ± 0.66	6.50 ± 0.96	6.5 – 8.5
EC (µS/cm)	148 ± 44.49	139.80 ± 26.35	120.80 ± 17.80	149.40 ± 36.47	120.40 ± 13.24	1,250
TEMP (˚c)	28.68 ± 1.04	28.44 ± 1.97	28.10 ± 1.98	28.14 ± 1.99	28.48 ± 1.58	< 40˚c
TDS (mg/L)	73.80 ± 21.79	84 ± 43.05	59.60 ± 9.61	78.40 ± 19.23	60.20 ± 6.80	< 500
ACIDITY (mg/L)	5.00 ± 1.73	6.80 ± 3.90	6.80 ± 3.03	6.80 ± 1.79	6.00 ± 2.45	_
ALKALINITY (mg/L)	2.16 ± 1.20	1.12 ± 0.54	1.12 ± 0.39	1.12 ± 0.76	1.12 ± 0.64	_
Cl (mg/L)	21.20 ± 9.73	18.80 ± 6.02	17.40 ± 3.05	21.20 ± 7.29	16.20 ± 2.17	350
TH (mg/L)	66 ± 9.06	74.80 ± 21.71	60 ± 12.33	73.20 ± 23	53.60 ± 5.55	100
Ca (mg/L)	31.20 ± 8.44	36.40 ± 2.97	32.40 ± 14.38	38.40 ± 7.67	30.40 ± 2.61	100
Mg (mg/L)	32.80 ± 10.73	44 ± 19.80	27.20 ± 22.48	34.80 ± 18.85	23.20 ± 7.43	50
TSS (mg/L)	480 ± 303.32	400 ± 282.84	480 ± 178.89	400 ± 200	720 ± 228.04	50
DO (mg/L)	1.85 ± 0.16	1.88 ± 0.21	1.86 ± 0.24	1.21 ± 0.49	2.33 ± 0.82	2
BOD (mg/L)	31.23 ± 5.29	32.42 ± 7.11	30.83 ± 3.75	31.63 ± 5.31	35.03 ± 10.67	50
Na (mg/L)	14.20 ± 7.50	11.60 ± 3.29	9.40 ± 0.89	12.20 ± 4.49	12.20 ± 2.77	20
K (mg/L)	4.20 ± 2.59	2.80 ± 0.45	2.60 ± 0.55	4.40 ± 3.71	3 ± 0.00	2.5
NO_3(mg/L)	0.65 ± 0.08	0.48 ± 0.01	0.43 ± 0.01	0.49 ± 0.02	0.56 ± 0.07	0.02
PO_4 (mg/L)	0.13 ± 0.01	0.12 ± 0.00	0.12 ± 0.00	0.12 ± 0.01	0.13 ± 0.00	0.05

Table 3: Results of the bacteriological parameters for each sampling location with WHO standard.

Parameters	Abattoir	Car wash	Dumping site	River bank	Sawmill	WHO STD (2017)
Total Coliform Count (cfu/100ml)	160	160	160	160	160	10
Total Bacteria Count (cfu/100ml)	450,000	16,000	52,000	600,000	77,000	-

Table 4: Results of the heavy metals parameters for each sampling location with WHO Standard

PARAMETERS	ABATTOIR	CAR WASH	DUMPING SITE	RIVER BANK	SAWMILL	WHO STD (2017)
Lead (mg/L)	0.08	0.19	0.05	0.33	0.25	0.1
Chromium (mg/L)	0.09	0.02	0.03	0.03	0.01	0.05
Iron (mg/L)	0.56	0.29	0.34	1.23	0.38	0.3
Zinc (mg/L)	0.09	0.68	0.01	0.12	0.14	1.5
Copper (mg/L)	0.03	0.12	0.05	0.04	0.07	1

Results of the heavy metals parameters on water quality of Ogun River

Lead

The mean concentration of Lead found in the water samples ranged from 0.05 - 0.33 mg/L and it exceeded the permissible WHO permissible limit given as 0.1 mg/L. Increase in lead could be attributed to dilution from the dumpsite and discharge of waste from abattoir effluent which flows along the path of the river (Table 4).

Iron

Iron concentration in the collected samples ranged from 0.29 - 1.23 mg/L (Table 4) and it is above the maximum contaminant levels of 0.3 mg/L given by WHO. This implies that if the abattoir discharges its wastewater into other waterbodies used for drinking purposes downstream, it could contaminate the water and hence, be hazardous to human health. High concentration of iron also affects the quality of water, leading to bad taste and colouration of cooking utensils and food.

Chromium

From Table 4. The concentration of Chromium ranged from 0.01-0.09 mg/L, the sawmill has the lowest concentration of Chromium to be 0.01 mg/L while the abattoir has the highest concentration of Chromium to be (0.05 mg/L) respectively. All of which fell within the permissible limit of the WHO standard of 1.5 mg/L except the abattoir section.

Zinc

The concentration of Zinc ranged from 0.01-0.68 mg/L, the dumpsite has the lowest concentration of Zinc of 0.02 mg/L while the car wash has the highest concentration of Zinc (0.68 mg/L).But all the samples fell within the permissible limit of the WHO standard given as 1.5 mg/L. This result conforms with the report of African inland waters (Calamari and Naeve 1987).

Copper

From Table 4, the Carwash and the Abattoir had the highest and lowest concentration of copper with values ranging from 0.03 – 0.12 mg/L. it is also found that he value of copper in the river were below the (WHO, 2017) guideline for drinking water given as 1.0 mg/L.

CONCLUSIONS

From this study, the major source of surface pollution is the indiscriminate discharge of untreated abattoir effluents, domestic waste and agricultural waste discharged directly into the surface water bodies.

There is no doubt that the pollution generated by Abattoir, Car wash, dumpsite and river banks are evidences that these industries located around this areas generates a large quantities of wastes. The waste generated from these pollution points were high in DO, Nitrate, Phosphate, Total Coliform Count and Total Bacteria Count, which affect human health.

The result obtained from this study indicates that Ogun river is highly polluted. The concentration of the heavy metal such as Lead, Chromium and Iron in the water sample were higher than the permissible limits of (WHO, 2017) guideline for drinking water. Although some physicochemical parameters like pH, EC, TDS, Chloride, Calcium and Phosphate fell within the permissible limits.

Therefore, toxic level of harmful materials can aggravate due to the continuous generation of these effluents. This calls for concern, as most of the parameters analyzed were above the recommended standards, which is dangerous to human health and aquatic life.

RECOMMENDATIONS

Swift intervention by the government and other stakeholders by putting in place effluent treatment facilities to treat wastes from abattoirs in Ogun River as well as adoption of cleaner technologies will go a long way to curb the environmental health risks posed by these hazardous effluents.

Construction of septic tanks and toilet facilities by each household should be put in place, and, the government should come out with strategic action plan for the restoration of Ogun river due to anthropogenic activities.

Direct disposal of wastes into the river should be avoided. The government must ensure provision of adequate sanitary facilities in the communities around Ogun River and prosecute any individual that fails to abide by the law.

The government should put in place an awareness programme for the people to know the importance of consuming portable water.

Environmental Protection Agency (EPA) should educate the residents about the links between their behaviour in terms of waste handling and its impact on Ogun River. They must also enforce environmental protection laws through regular monitoring of effluents discharged into water bodies.

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