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ASSESSMENT OF THE PHYSICO-CHEMICAL QUALITY OF UTURU SECTION OF AKU RIVER IN SOUTHEASTERN NIGERIA

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Abstract

The physicochemical monitoring of water quality is very key both to aquatic life and public health. To date little is known about the water quality downstream of Aku river, located in Uturu, Isuikwato local government area of Abia state. Therefore the aim of the study is to determine the water quality downstream of Aku river in terms of several physicochemical parameters and heavy metals analysis to ascertain the water quality properties and reveal pollution problems. Samples were collected at 15m, 30m, 45m, 60m, 75m, 90m and 105m interval downstream for both seasons. Results of the study shows that temperature, conductivity, hardness, salinity, Total Dissolve Solid (TDS), Total Suspended Solids (TSS), turbidity, pH, Dissolve Oxygen (DO), chlorine, nitrate, lead, iron, arsenic, copper and zinc, were ranged: 24.19^0C-26.50^0C, 165.18-275.46µs/cm, 100.26-139.11mg/L, 520.15-815.24ppt, 380.52-710.08mg/L, 15.12-30.68mg/L, 0.32-1.73NTU, 6.6-7.9, 6.21-11.63mg/L, 1.14-3.30mg/L, 65.01-128.05mg/L, 35.53-58.00mg/L, 0.0002-0.007ppm, 0.02-0.15ppm, 0.002-0.006ppm, 0.44-1.03ppm and 0.1-0.27ppm respectively. The presence of TDS, TSS, turbidity and nitrate above World Health Organization (WHO) tolerance limits, confirmed the presence of contaminants in the water body, and hence not suitable for drinking and thus poses a potential threat to aquatic life.

Keywords: Water quality, Physicochemical parameter, Aku river, Downstream, Pollution.

1.0 INTRODUCTION

Water is a key component needed for existence and survival of life on earth. It contains minerals needed for humans as well as for aquatic survival [1]. A good and balance quality water is essential for the subsistence of all living organism. The availability of water in sufficient quantity is as important as its quality [2]. Quality of water is a function of the concentration of various solutes at a given place and time [3 4]. The physico-chemical properties are key to test the water, before it is deployed for drinking, domestic, agricultural or industrial purpose [1]. Water quality values provides the basis for judging the suitability of water for its designated uses and to improve existing conditions [5], hence the need to use various physicochemical parameters to determine its quality.

Selection of the tested parameter is dependent on the purpose to which the water is to be deployed and the extent of quality and purity it calls for [1].Water becomes contaminated when pollutants enter it and cause it to become physically or chemically altered. If these pollutants are present in excessive amounts, they may have adverse impact on humans or the environment. Water occupies a larger percentage of the earth surface, with merely a small portion of the largely occupied water resources available for human and animal's consumption and use [3]. It is a fact that more than 97% of total waters on earth, happens in the form of sea and ocean, whose salinity makes it un-usable for man, while fresh water accounts for only 2.6% of the water available for usage [6]. Hence the quality of water is of great concern to man as it is usually consumed and use for other domestic activities [7].

Human activities (washing, bathing, crop cultivation, animal husbandry and trading) in the last decades have greatly compromised and deteriorated the quality of reservoirs and dam water [8]. The impact of longer stay in dams and the activities of man enhance pollutants and organic matter sedimentation [9 10]. Dams, lakes and surface water reservoirs are the most important sources of fresh water resources, as it provides numerous benefits, ranging from irrigation, domestic and habitat for aquatic ecosystems especially fish, which serves as a source of protein to man [1]. Amongst the most harmful of the elemental pollutants are heavy metals and are of particular concern because of their toxicities to man. They include essential elements such as Fe, Cu, Zn, Co and Mn, which are needed by biological systems while Cd, As, Hg, Pb and Se are toxic in all concentrations [11 4].

Water quality analysis is the systematic approach geared at ascertaining the physical, chemical and biological properties of water and the antecedents cause or source of possible pollution in the water body resulting to reduced quality [12]. Pesticides, domestic waste, agricultural run-offs, heavy metals and residues have been linked to poor quality water [6]. Numerous standards for inspecting the rate of water quality and pollution have been established, and can result to protect these quality standards [12].

Several studies round the world have been conducted on getting the physicochemical properties of water bodies. Amongst such studies include but not limited to the following: [13 14 15 16 17 3 18 19]. To the best of our knowledge nothing has been done on assessing the water quality of Aku river from the literature review. This presents a knowledge gap knowing that Aku river with many tributaries which empties into them together with agricultural waste, organic matter debris and solid wastes can be huge source of contamination to downstream users. Hence the study is aimed at determining the physicochemical parameter downstream the Aku river to determine the water quality, pollution problems and suitability level in terms of domestic and agricultural use.

2.0 METHODOLOGY

2.1 Study Area

Aku River is located in Uturu Isuikwato Local Government Area of Abia State, Nigeria. The research region lies between Latitude 5°53' 59" N and Longitude 7°33'56" E. Aku river is a year round river with maximum discharge during the rainy season. The river supplies water for irrigation purpose, subsistence fishing activities and a source for domestic water consumption to a population of about 5000 people. The river has its source from the Inyi Ike and flows south easterly and empties into Ivo river [20], other streams within the vicinity that serves as tributries are Nwaomaiyi, Ikwa and Akwukwo which all empty into Ivo river in Ebonyi State.

2.2 Sample Collection and Analysis

Fourteen surface water samples in line with, American Public Health Association (APHA) established standard for water sampling and handling [21], were collected at wet season (July, 2020) and dry season (February, 2021) of the year. Samples were collected at 15 m, 30 m, 45 m, 50 m, 75 m, 90 m and 105 m downstream for both seasons using pre-rinsed clean/ sterile plastic container and stored in ambient temperature to obtain a representative sample, each samples were labelled with the site details, time and date of collection, prior to analysis. In-order to stabilize the metal ions and prevent precipitation and adsorption, water samples were acidified using 1.5 mL of concentrated HNO_3. Figure 1 and Table 1 shows the location of the sample points and details of the sampling point respectively.

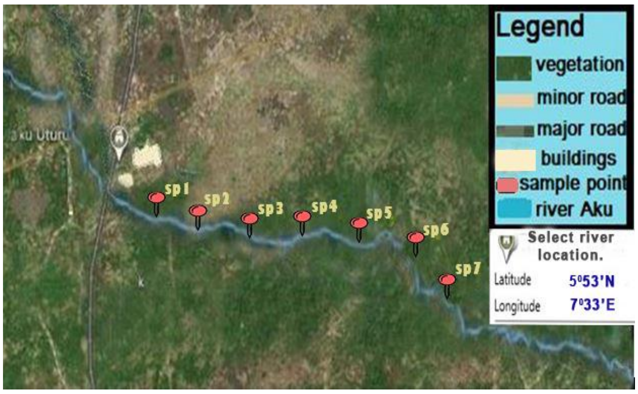

Figure 1: Map of the Study Area Showing Sampling Points

Table 1: Sampling Details

Samples Points	Latitude	Longitude	Description
Sample points 1 (15 m)	5°53' 05" N	7°33' 01" E	Downstream
Sample points 2 (30 m)	5°53' 14" N	7°33' 09" E	Downstream
Sample points 3 (45 m)	5°53' 23" N	7°33' 18" E	Downstream
Sample points 4 (60 m)	5°53' 35" N	7°33' 26" E	Downstream
Sample points 5 (75 m)	5°53' 43" N	7°33' 35" E	Downstream
Sample points 6 (90 m)	5°53' 51" N	7°33' 46" E	Downstream
Sample points 7 (105 m)	5°53' 58" N	7°33' 53" E	Downstream

Temperature was measured using mercury in glass thermometer to an accuracy of 0.1°C. The pH and Total Dissolve Solids (TDS) was measured using pH /TDS meter Hanna model H1991300 and Electrical conductivity (EC) was obtained using APHA 2510B guideline, model DDS-307. Total Suspended Solid (TSS) measured using gravimetric method and turbidty by turbidimeter (Model No. HACH2100Q). Dissolved Oxygen (DO) was measured using winker Azide method, while Biochemical Oxygen Demand (BOD) using winklers method. Chemical Oxygen

Demand (COD) was measured using dichromate reaction method [22]. Chlorine was determined by titration. Hardness by ETDA titrimetric method, while sulphate and nitrate were done using APHA 1998 method [23]. Heavy metals analysis was carried out using Varian AA240 Atomic Adsorption Spectrophotometer by APHA 1995 method [21]. The outcome from the study was compared with standards recommended by World Health Organization (WHO).

3.0 RESULTS AND DISCUSSION

3.1 Results of Physical Properties of Water Samples Collected

Table 2: Results of Physical Properties of Water Samples Collected for Wet Season

PARAMETERS	SAMPLE A (15 m)	SAMPLE B (30 m)	SAMPLE C (45 m)	SAMPLE D (60 m)	SAMPLE E (75 m)	SAMPLE F (90 m)	SAMPLE G (105 m)	WHO Health Based Guidelines [24]
Temperature 0^0C	24.35	24.58	24.82	25.56	24.32	24.35	24.19	24-27
Conductivity (µs/cm)	180.27	202.44	215.35	227.42	200.02	174.31	165.18	1000
Total Hardness (mg/L)	120.13	111.08	107.25	104.49	116.08	127.46	139.11	100-300
Salinity (ppt)	600.02	618.42	625.17	656.72	615.53	589.32	520.25	1200
Total Dissolved Solids (mg/L)	450.11	510.72	505.43	670.33	710.08	685.56	660.46	600
Total Suspended Solid (mg/L)	16.00	19.21	22.04	28.14	26.27	18.41	15.12	25
Turbidity (NTU)	0.90	1.34	1.73	0.88	0.63	0.53	0.44	0.50

Table 3: Results of Physical properties of Water Samples Collected for Dry Season

PARAMETERS	SAMPLE A (15 m)	SAMPLE B (30 m)	SAMPLE C (45 m)	SAMPLE D (60 m)	SAMPLE E (75 m)	SAMPLE F (90 m)	SAMPLE G (105 m)	WHO Health Based Guidelines [24]
Temperature 0^0C	25.52	26.10	26.34	26.50	26.00	25.81	25.43	24-27
Conductivity (µs/cm)	230.40	255.22	266.31	275.46	250.10	245.44	215.32	1000
Total Hardness (mg/L)	113.08	106.17	100.26	104.00	111.48	119.05	127.11	100-300
Salinity (ppt)	700.06	770.56	800.29	815.24	768.12	700.23	677.15	1200
Total Dissolved Solids (mg/L)	380.52	490.68	440.73	615.00	680.14	660.21	605.05	600
Total Suspended Solid (mg/L)	18.48	22.30	24.16	30.68	27.33	21.57	18.24	25
Turbidity (NTU)	0.73	1.10	1.54	0.75	0.73	0.48	0.32	0.50

3.1.1 Temperature

Temperature is an important regulator of many important physical, chemical and biological processes. It affects fish spawning, growth and immunity [25]. Temperature also plays an important role for the metabolism of organisms. The temperature range of 24.19^0C-25.56^0C in wet season and 25.43^0C-26.50^0C in dry season as shown in table 2 and table 3, confirms that the river houses tropical species of aquatic organisms like fishes. Water temperature changes affects growth rates and length of the growing season for many species [26]. However, the temperature of the river were within permissible limit as shown in table 2 and table 3, hence not expected to cause any adverse effect on the aquatic ecosystem. This may be due to the amount of shade provided by trees within the vicinity, which helps to cool the watershed, depth of the watershed, which allows deeper waters to remain cooler and vice versa.

3.1.2 Electrical conductivity (EC)

From table 2 and table 3 the conductivity ranges from 165.18-227.42 (µs/cm) in the wet period and 215.32-275.46 (µs/cm) in the dry period which fell within permissible limit. Higher EC value as noticed in the dry period may be caused by low flow and reduced volume. Categories of fish like Hemigrammus, Corydoras spp., Pimelodus spp, Melanotaenia spp, Pseudotropheus spp are some species of fish found in Aku river are doing well, which is seen in their breeding rate and physical appearance (colours).

3.1.3 Total hardness

The level of calcium and magnesium ions is a measure of the hardness of water. Natural flowing water is composed of many compounds (calcium and magnesium ions) that are at a partially dissolved state. This compound contributes to the hardness level of the water. More dissolved compounds means the harder the water. Table 2 and table 3 shows the hardness values, which range from 104.49-139.11 mg/L in wet season and 100.26-127.11 mg/L in dry season. The range shows that the water is moderately hard and falls within permissible limit of 100-300 mg/L for human and aquatic consumption.

3.1.3 Salinity

This is a measure of how much dissolved salts are present in the water. From table 2 and table 3, the salinity ranges between 520.15-656.72 ppt in wet season and 677.15-815.24 ppt in dry season which is within acceptable limit of less than 1200 ppt for domestic use.

3.1.4 Total dissolved solids (TDS)

The portability of water with a TDS below 600 mg/L is said to be good for human consumption [24]. From table 2 and table 3 the TDS ranges between 450.11-

710.08 mg/L in wet season and 380.52-680.14 mg/L in dry season, which is higher than the permissible limit at some sample points. TDS is highest in the wet season, possibly as a result of run offs from sediment and anthropogenic activities from water carrying particles from the block factory in close proximity to the river and drainage of organic solutes from urea. The low value recorded in dry season according to [27] may be attributed to the uptake of ions and settling of organic solutes and dissolved salt. Above permissible limit, TDS level becomes toxic to aquatic life by altering the make-up of the water [28].

3.1.5 Total suspended solid (TSS)

Measures all suspended solids, organic and inorganic, by mass. TSS can be used to calculate sedimentation rate. High level of suspended solids experienced mostly in slow moving water/ stagnated water is inimical to aquatic species and water quality. From table 2 and table 3, shows the TSS ranges between 15.12-28.14 mg/L in wet season and 18.24-30.68 mg/L in dry season, which is above permissible limit at sample point 60 m and 75 m away downstream as shown in table 2 and table 3. This is caused by the activities of man at those sample location point, indicating high presence of pesticides, bacteria and nutrients in the water. The agrarian nature of the host environment is also a factor that influenced the high TSS level above the benchmark. However it was observe from the study that the TSS improved as distance increases downstream.

3.1.6 Turbidity

Turbidity is another thing also affecting the water quality as it interferes with photosynthesis and algal development. From table 2 and table 3, the turbidity values falls within 0.44-1.73 NTU in wet season and 0.32-1.54 NTU in dry season, which is high and above WHO permissible limit. The high presence of turbidity is attributed to the presence of suspended inorganic particles and sediment concentration. Increase in turbidity normally accounts for an increase in the concentration of suspended solids in the water, which affects the quantity of illumination available to biological life in the stream.

3.2 Results of Chemical Properties of Water Samples Collected

Table 4: Results of Chemical Properties of Water Samples Collected for Wet Season

PARAMETERS	SAMPLE A (15 m)	SAMPLE B (30 m)	SAMPLE C (45 m)	SAMPLE D (60 m)	SAMPLE E (75 m)	SAMPLE F (90 m)	SAMPLE G (105 m)	WHO Health Based Guidelines [24]
pH	7.7	7.4	7.2	7.2	7.5	7.6	7.9	6.5-8.5
Dissolved oxygen (mg/L)	10.43	9.12	8.63	8.01	9.60	10.82	11.63	-
Chemical Oxygen demand (mg/L)	23.10	21.27	19.48	62.19	55.04	22.51	18.06	-
Biochemical oxygen demand (mg/L)	3.32	4.14	4.71	5.74	7.40	3.55	3.08	-
Chlorine (mg/L)	1.70	1.43	1.14	1.83	2.42	1.50	1.33	5
Chloride (mg/L)	35.34	30.90	28.82	45.67	46.31	41.43	38.71	200-300
Sulphate (mg/L)	85.01	103.04	117.00	128.05	94.30	91.22	88.43	<250
Nitrate (mg/L)	58.00	54.22	51.53	56.52	52.38	48.44	42.10	50

Table 5: Results of Chemical Properties of Water Samples Collected for Dry Season

PARAMETERS	SAMPLE A (15 m)	SAMPLE B (30 m)	SAMPLE C (45 m)	SAMPLE D (60 m)	SAMPLE E (75 m)	SAMPLE F (90 m)	SAMPLE G (105 m)	WHO Health Based Guidelines [24]
pH	7.2	6.9	6.8	6.6	7.1	7.4	7.8	6.5-8.5
Dissolved oxygen (mg/L)	7.80	7.24	6.82	6.21	7.33	7.60	9.21	-
Chemical Oxygen demand (mg/L)	20.00	19.23	17.31	55.48	38.02	18.46	12.44	-
Biochemical oxygen demand (mg/L)	4.03	4.90	5.23	5.85	5.65	4.50	3.23	-
Chlorine (mg/L)	2.60	1.82	1.45	2.94	3.30	2.23	1.42	5
Chloride (mg/L)	46.24	41.31	44.40	49.32	53.04	49.52	40.20	200-300
Sulphate (mg/L)	65.01	95.00	105.12	110.23	90.42	86.33	75.04	<250
Nitrate (mg/L)	52.12	49.27	40.34	50.00	41.50	38.84	35.53	50

3.2.1 pH

Table 4 and table 5 shows that the surface water pH fluctuated between moderate alkalinity and slight acidity. The range of the water body pH ranges between 7.2 -7.9 in wet season and 6.6-7.8 in dry season. This values falls within the acceptable WHO range of 6.5-8.5 as confirmed in table 4 and table 5. The slight acidicity (pH=6.6) in the dry period can be attributed to the high presence of carbon dioxide concentration due to decomposition of organic materials, exposure of the water body to atmosphere and temperature changes. Increase water volume and high flow in the wet season is likely the cause of pH to be in the moderate alkaline range. Also the lowest pH value was observed at sample location 60 m downstream. This may be as a result of anthropogenic activities like washing of exhaust, chemicals etc within that sample location. However, the pH value was observed to increase in value downstream as a result of continuous flow and dilution effect from the catchment areas and tributaries. Increase in pH produces more, non ionized ammonia from NH_4 that is toxic to fish and hence not support the growth of plants, fish, or invertebrates.

3.2.2 Dissolved oxygen (DO)

From table 4 and table 5 the DO level falls within the range of 8.01-11.63 mg/L in the wet period and 6.21-9.21 mg/L in dry season. Higher values of DO noticed in the wet period could be as a result of low temperature, increased flow and increased mixing of water, while lower DO experienced in the dry period may be attributed to increased temperature, high rate of decomposition, higher turbidity and increased suspended materials which affected dissolution of oxygen [27]. Dissolved oxygen is a key indicator of water health, quality, ecological status and productivity [27]**.** DO content in water is greatly reduced by the level of organic pollution, as organic compounds when decomposed in water consume more oxygen, which reduces the DO concentrations and causes adverse effect on aquatic bio-data like gas bubbles disease, inhibit photosynthesis, fish kills and algal blooms. Anthropogenic activities (addition of sewage and other wastes) at 60 m might be accountable for the low unusual variables of DO recorded. These values of DO steadily increased along the downstream river indicating that the DO content was first impacted by human activities at that point, but was gradually diluted and increased as it moves downstream.

3.2.3 Biochemical oxygen demand (BOD)

It is used to ascertain the level of oxygen used by microorganisms to break down waste. BOD shows the level of both industrial and sewage pollution in water. Aquatic bio-data do well in BOD level below 10 mg/L. From table 4 and table 5, the BOD level ranges between 3.08**-** 7.40 mg/L in wet season and 3.23-5.85 mg/L in dry season. The sources of BOD in the water are attributed to agricultural, not chemically based, which includes leaves, dead plants and animal, etc causing the BOD level to be considerably good enough. From table 4 and table 5, it is seen that the BOD level varies inversely with DO level, due to the fact that the oxygen available in the water is being depleted by bacteria.

3.2.4 Chemical oxygen demand (COD)

It x-rays the depletion of oxygen in a water body during the decomposition of organic matter and the oxidation of inorganic chemicals [2]. From table 4 and table 5, the COD value ranges between 18.06-62.19 mg/L in wet season and 12.44-55.48 mg/L in dry season. Water samples 60 m and 75 m, showed highest value of COD as shown in table 4 and table 5, which is not surprising owning to the anthropogenic activities, been a choice spot for washing of vehicles using detergents and other ancillary chemical substances, sewage and agricultural run-offs. However COD values improved significantly downstream i.e at increasing distance downstream the COD improved significantly as a result of aerated water, resulting in high DO helped lowered the COD concentration substantially downstream.

3.2.5 Chlorine and chloride

From table 4 and table 5 the values of chlorine and chloride ranges between 1.14-3.30 mg/L and 28.82-53.04 mg/L respectively, which all fell within WHO recommended range as shown in the table 4 and table 5. When chlorine and chloride are above permissible limits they give problem of taste to drinking water.

3.2.6 Sulphate

The main source of sulphate in water bodies is rain water, followed by artificial causes from municipal or industrial discharges. Table 4 and table 5, presents a very low level of the presence of sulphate (65.01-128.05 mg/L) in the water bodies. This is so because the host environment as at the time of the study has no industrial plants and activities happening that may release sulphate in the water. Hence the only major source of sulphate in the water body is from rain water leading to high sulphate values in wet season as shown in table 4; the level of sulphate is good for aquatic life as well as for domestic uses.

3.2.7 Nitrate

Nitrate concentration indicates the nutrient level and the extent of organic matter pollution in a water body [2]. From table 4 and table 5, the level of nitrate ranges between 42.10-58.00 mg/L in wet season and 35.53-52.12 mg/L in dry season. This is higher than the recommended permissible range of less than 50 mg/L in wet season. Effects of human activities on the river are much reflected on the variations seen in nitrate concentration**.** The concentrations of these ions were higher during the rainy season; because the period is usually the peak of agricultural activities were, fertilizers and manure a main source of nitrate is deployed by farmers to aid the cultivation of their crop. Washing of cow dungs and bathing can also contribute to high nitrate concentration downstream the river. Also studies has shown that, open defecation, waste from human settlement in the corridors of the river and its tributaries are likely sources of nitrates downstream the water body [2].

3.3 Results of Heavy Metal Analysis of Water Samples Collected

Table 6: Results of Heavy Metal Analysis of Water Samples for Wet Season

PARAMETERS	SAMPLE A (15 m)	SAMPLE B (30 m)	SAMPLE C (45 m)	SAMPLE D (60 m)	SAMPLE E (75 m)	SAMPLE F (90 m)	SAMPLE G (105 m)	WHO Health Based Guidelines [24]
Mecury (ppm)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.006
Lead (ppm)	0.0005	0.0003	0.0003	0.0002	0.0004	0.0004	0.0005	0.01
Nickel (ppm)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.07
Iron (ppm)	0.0300	0.0700	0.0770	0.0860	0.0500	0.0200	0.1500	0.3
Arsenic (ppm)	0.0060	0.0042	0.0040	0.0035	0.0030	0.0020	0.0034	0.01
Cadmium	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.003
Copper (ppm)	0.8700	0.9300	0.9900	1.0300	0.9300	0.7700	0.5300	2.0
Zinc (ppm)	0.3000	0.2500	0.1900	0.1700	0.2700	0.2300	0.1000	4

Table 7: Results of Heavy Metal Analysis of Water Samples for Dry Season

PARAMETERS	SAMPLE A (15 m)	SAMPLE B (30 m)	SAMPLE C (45 m)	SAMPLE D (60 m)	SAMPLE E (75 m)	SAMPLE F (90 m)	SAMPLE G (105 m)	WHO Health Based Guidelines [24]
Mecury (ppm)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.006
Lead (ppm)	0.0007	0.0005	0.0004	0.0004	0.0006	0.0004	0.0003	0.01
Nickel (ppm)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.07
Iron (ppm)	0.0200	0.0360	0.0470	0.0560	0.0270	0.0200	0.1300	0.3
Arsenic (ppm)	0.0040	0.0030	0.0027	0.0024	0.0020	0.0018	0.0011	1.0
Cadmium	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3
Copper (ppm)	0.7800	0.8500	0.8800	0.9300	0.8300	0.7400	0.4400	0.001
Zinc (ppm)	0.2400	0.2380	0.2360	0.2300	0.2300	0.2100	0.1000	4

3.3.1 Heavy Metals

From table 6 and table 7, it was observed that arsenic and lead at 15 m downstream were at the highest level. As distance increases downstream, there was a decrease in the concentration of these heavy metals present, except for lead at 75 m downstream owning to anthropogenic activities from exhaust of cars, lead batteries, natural causes and leached plumbing system like fittings, pipes from irrigation systems. Generally, the presence of lead from table 6 and table 7 in the water body ranges from (0.0002-0.0007) ppm. This falls within permissible level of 0.01 ppm. While arsenic was found in a very minute quantity within acceptable limit, between the range of (0.0020-0.0060) ppm.

The presence of arsenic is mobilized in the water body through combustion of fossil fuels, arsenical pesticides; arsenic additives used for poultry feed, herbicides etc. More so there was presence of non-toxic metals at several distances downstream the Aku river, as shown in table 6 and table 7. The presence of Iron, Copper and Zinc were more at downstream distances of 105 m, 60 m and 15 m respectively, with higher concentration in the wet period of the year. The presence of these non-toxic metals were all found within permissible or tolerance limits for both humans and aquatic life, as confirmed in table 6 and table 7. As at the time of this study, Nickel, Mercury and Cadmium which are amongst the most dangerous pollutants, that adversely affects humans and aquatic life, were not found.

4.0 CONCLUSION

The physicochemical parameters assessed in this study were within recommended limits except for TSS, TDS, turbidity and nitrate level which were above the recommended limit. The high presence of TDS, TSS, Turbidity and Nitrate above limits, confirmed the presence of organic and inorganic materials in the water body, possibly from pollution sources mainly from natural sources (Runoffs from fertilizers and herbicides) and anthropogenic activities. It was observed that the water quality downstream were impacted by natural and anthropogenic activities particularly at sample point 60 m and 75 m which showed higher values of TDS, TSS turbidity and nitrate above recommended limits. The water showed variations in seasons, as it was observed that the water quality improved during the period of high flow i.e the rainy season in terms of the DO, pH, and temperature. The presence of toxic and non toxic heavy metals was found in a very mild concentration within acceptable limits. Toxic heavy metals like mercury, nickel and cadmium were not found in the study area as at the time, this study was conducted. Hence from the outcome of the study, the Aku river is not suitable for drinking and poses a threat to aquatic life.

5.0 RECOMMENDATION

The state government should implement a treatment process in the Aku river to improve the quality and health of the locals who rely on the river for their day to day activities. While routine investigation is required to always showcase the water and sediment quality of the river. It is important to control and check the level of anthropogenic activities around the river that causes pollution of the water body.

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