Determination of the Water Quality of Mini-Ngulo - A Fresh Water Stream in Isiokpo Ikwerre Local Government Area, Rivers State.

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ABSTRACT: Mini-Ngulo stream like most fresh water sources globally has been threatened by pollution arising from domestic and industrial waste, urbanization and stormwater runoff releasing dissolved organic and inorganic ions which negatively impact their quality and create public health concern. In order to determine the water quality of Mini-Ngulo stream in Isiokpo Community, Ikwerre Local Government Area River State, surface water was sampled. Water samples were analyzed for their physicochemical characteristics including some levels of heavy metals (zinc, cadmium, nickel, lead, manganese and chromium) using Atomic Absorption Spectroscopy (AAS) and other standard methods. The parameters analyzed included temperature, pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), turbidity, salinity, total hardness, alkalinity, nitrate, sulphate and phosphate. The mean pH values (5.21±0.453 to 5.75±0.483) obtained indicated that the surface water was acidic. Other physicochemical characteristics were below National Standard for Drinking Water (NSDW) and World Health Organization (WHO) permissible limits for drinking water. Manganese and Chromium levels however exceeded permissible standards with concentrations that ranged from 0.431±0.483 to 0.589±0.766 mg/l and 0.025±0.407 to 0.092±0.118 mg/l respectively. The water quality index (WQI) of 35.58 (on a scale of 0 – 100) ranked the surface water as safe for human consumption.

Key word: Fresh Water, Heavy Metal, Physicochemical Characteristics, Water Quality Index.

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1 INTRODUCTION

Water, an odourless, tasteless, transparent and nearly colourless chemical substance, covers about 70 percent of the earth surface. It is essential for all known life forms even though it provides no caloric or organic nutrient. However, the quality of this all important resource has been threatened by pollutions arising from domestic and industrial wastes, urbanization, and storm water runoff releasing dissolved organic and inorganic ions. The presence of these substances in water sources raises inherent health *implications* especially when their levels exceed permissible limits.

Globally, several studies have been conducted [1], [2], [3], [6], [7], [8], to determine the quality of drinking water sources, some of such investigations have revealed the presence of high heavy metal levels, pathogenic organisms and other indicators of water pollution. These observations have prompted the conduct of the investigation on the quality of Mini-Ngulo stream in Isiokpo Community, Ikwerre Local Government Area, Rivers State. The study is further informed by the dearth of data on the stretch of the stream being assessed.

Mini-Ngulo stream takes its rise at Isiokpo and empties into Aluu-Choba River system – a tributary of the New Calabar River. It is a black fresh water swamp situated in the low land rainforest region of the Niger Delta. Mini-Ngulo lies within longitude N05° 01′ 09.3″ to N04° 56′ 08.3″ and latitude E006° 52′ 24.2′ to E006° 52′ 65.9″ on global position system. It is non-tidal along some stretch covering four sampled stations. The 5th station at Ogbodo, Isiokpo experiences tidal inflow. The stream drains the entire community receiving storm water and domestic refuse at the banks located at the outskirts of the villages of the Isiokpo Community. In spite of the potential contaminants released from these sources, inhabitants rely on the stream for domestic water supply in the absence of pipe borne water.

A map of the study area (Fig. 1) identifies the five sampled locations as well as the identifiable landmarks along the stream course

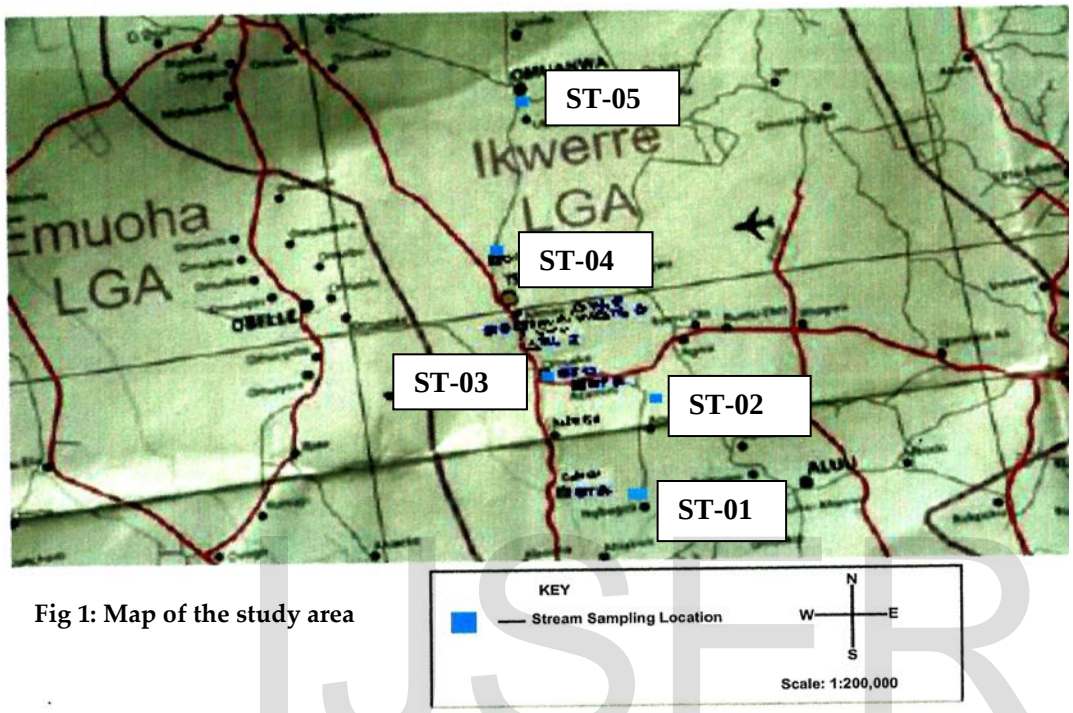

Fig 1: Map of the study area

2 METHODOLOGY

Water samples were collected in plastic containers from five sampling stations for a period of six months from April to September, 2018. Samples, for heavy metal analyses, collected in vial bottles were preserved with concentrated HNO_3. Measurements of temperature, pH, conductivity, salinity Dissolved Oxygen and Total Dissolved Solids were conducted *in-situ* using Extech DO 700 multi parameter water checker. Measurement of pH was carried out after the instrument was calibrated with standard solutions of pH 4.0, 7.0 and 10.0. Determination of nitrate, sulphate, phosphate, total hardness, alkalinity and turbidity concentrations in the surface water was conducted spectrophotometrically. Winkler method was employed in the determination of Biochemical Oxygen Demand. Heavy metals levels were determined by acid digestion followed by Atomic Absorption Spectrophotometer-Agilent (AAS) using SPS 4 MY17090001 Model.

3 RESULT AND DISCUSSION

The physiochemical characteristics of surface water as well as the permissible standards for these characteristics are presented in Table 1. The spatial distribution of temperature ranged from 26.54± 0.676°C to 27.27± 0.356°C. The temperature range was within national and international standards 25°C – 30°C as well as results of other studies in fresh water systems in Rivers State [4], [5]. This observation may be attributed to high humidity and dense vegetative canopy along the stream course.

Mean pH value ranged from 5.21±0.32 to 5.70±0.48. The surface water pH recorded was lower than national and international permissible limits of 6.5 – 8.5 and might be attributed to the presence of some acidic substances such as humic acid which might have resulted from the decomposition of organic materials in water [9]. Electrical conductivity (15.21±3.90 to 41.69±28.60µs/cm) was low when compared to national and international standards and typical of freshwater systems, indicating the absence of inorganic ions. Levels of other physiochemical parameters such as total dissolved solids, dissolved oxygen, biochemical oxygen demand, salinity, turbidity, total hardness, alkalinity, nitrate, sulphate and phosphate were below recommended national and international limits.

Concentrations of Zinc, Cadmium and nickel were below detection limits across the stream stretch. On the other hand, manganese and chromium exceeded [10] and NSDW levels permissible standards for drinking water. The high levels of manganese observed was consistent with 0.06±0.010 to 0.335±0.055 mg/l reported by [5] for shallow and uncovered wells receiving surface runoff. Though manganese is essential for living things including man, chronic exposure may raise public health concerns.

4 CONCLUSION

Water samples of Mini-Ngulo stream were acidic. The concentrations of manganese and chromium were higher than permissible standards. The Water Quality Index (WQI) of 35.58 (on a scale of 0 – 100) ranked the water safe for consumption. However, further investigation should be conducted to determine the microbial load of the stream.

Table 1: Physicochemical characteristics of Mini-Ngulo surface water

S/N	Parameter	ST-01	ST-02	ST-03	ST-04	ST-05	WHO	NSDW
1	Temperature (°C)	26.98 ±0.676	27.16±0.623	26.54±0.182	26.82±0.740	27.27±0.356	25-30	25-30
2	pH	5.21±0,322	5.25±0.519	5.45±0.636	5.75±0.483	5.51±0.443	6.5-8.5	6.5-8.5
3	EC (µs/cm)	37.75±34.87	28.45±0.519	15.21±3.90	40.08±24.43	41.69±28.60	500	25-30
4	TDS (mg/l)	25.99±27.32	19.13±17.20	9.56±3.52	27.21±14.79	29.01±14.82	500	-
5	BOD (mg/l)	2.67±0.489	2.21±0.405	2.18±0.605	2.90±1.032	1.63±0.423	10	5
6	DO (mg/l)	4.62±0.598	4.52±1.307	4.57±1.613	2.93±1.680	3.80±1.139	10	100
7	Salinity (mg/l)	0.006±0.007	0.006±0.007	0.002±0.004	0.01±0.00	0.01±0.011	-	-
8	Turbidity (NTU)	7.4±1.673	16.0±5.099	4.2±1.975	4.8±1,308	22±7.0	5	-
9	Total hardness (mg/l)	264±55,95	364±45.06	190±76.49	164±39.12	204±11.40	500	-
10	Alkalinity (mg/l)	45.80±9.05	33.61±3.39	32.87±3.72	31.93±4.52	30.03±4.94	500	-
11	Nitrate (mg)	0.312±0.047	0.335±0.046	0.237±0.072	0.199±0.06	0.345±0.056	10	250
12	Sulphate (mg/l)	2.434±0.026	5.280±0.03	2.356±0.028	3.022±0.04	6.002±0.026	250	250
13	Phosphate (mg/l)	0.244±0.026	0.247±0.03	0.181±0.028	0.152±0.04	0.193±0.053	5	0.2
14	Zinc (mg/l)	0.054±0.079	0.544±0.619	1.079±1.263	0.159±0.136	0.153±0.156	5	-
15	Cadmium (mg/l)	BDL	BDL	0.003±0.004	0.003±0.003	0.002±0.002	0.03	-
16	Nickel (mg/l)	BDL	BDL	BDL	BDL	BDL	0.01	0.05
17	Lead (mg/l)	0.032±0.062	0.031±0.051	0.168±0.202	0.031±0.040	0.056±0.070	0.1	0.1
18	Manganese (mg/l)	0.486±0.619	0.499±0.692	0.589±0.766	0.431±0.483	0.526±0.674	0.1	0.05
19	Chromium (mg/l)	0.044±0.059	0.042±0.158	0.092±0.118	0.064±0.085	0.0249±0.407	0.05	0.02

BDL = Below Detection Limit.
NSDW = National Standard for Drinking Water.
WHO = World Health Organization.

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