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Bacteriological Investigation of Kolo Creek Surface Water Status in Ogbia Local Government Area of Bayelsa State, Central Niger Delta, Nigeria

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A B S T R A C T

The study investigates the bacteriological characteristics of the Kolo Creek surface water in Ogbia Local Government Area of Bayelsa State, the central Niger Delta. The main objective of the study was to assess the seasonal variation of microbial load in the Creek in relation to human health, since the Creek remain the major source of drinking water. Samples were collected both in the rainy or wet season (July) and dry season (December). The bottles were fixed before they were taken for sampling. The samples were taken with the mouth of the bottles facing the water current and were covered under the water to avoid atmospheric contamination. The samples were preserved with ice-park. Analysis of variance (ANOVA) was used to analysis the data-set. The values from the laboratory analysis were compared with WHO and FEPA standards for drinking water. The findings of the study reveals that the Kolo Creek is highly polluted with feacal coliform. The total microbial load were higher than WHO and FEPA standards for all the samples. The total coliform count and the Escharichia coli were also higher than the values of the WHO and FEPA standards. Therefore, Kolo Creek surface water requires basic treatment before use.

INTRODUCTION

In order of importance, air, water and food are the basic necessities of life. Man can survive for about a month without food, about a week without water and less than five minutes without air (Ayoada and Oyebande 1983. NEST, 1991; Akanyeneand Atser, 2003, Chima, 2018]. Water plays important role in regulating the body temperature, transporting body nutrients to the vital organs and carrying wastes out of our internal body organs. It is very obvious that water is vital to our existence (NEST) 1991). The quality of water is a concern to mankind, since it is directly linked with human welfare. Water pollution is a state of deviation from pure condition, where its normal function and properties are affected (Chauhan, 2008; Digha, 2021). Surface water can be polluted in different ways. The major sources of surface water pollution include bacteriological or feacial pollution, viral pollution, metallic pollution, thermal pollution, radioactive activities photo-chemical, pesticides from agricultural farmland, solid wastes, industrial waste water, run-off from urban centres, oil spillage and fallout of gases from the atmosphere. (Santra, 2005; Asthana and Asthana, 2007; Khopkar, 2007; and Chauhan, 2008). Pollutants come from almost all types of human activities in society. Much of the focus on marine pollution in Niger Delta context to date has been emphasizes on crude oil (oil spills), metallic and-Physico-chemical pollution. However, some unique kinds of water pollutants are not well recognized, a key pollutant in the marine ecosystem has been given the pride of place (Kumeretal, 2003; Digha and Martha, 2022). One of such challenging issue is feacial pollution by human defecations in the marine ecosystem.Water of drinkable quality is supposed to be clean, pure and safe but unfortunately, water existing in nature is been polluted by environmental factors and human activities. According to the Human Development Report (2006), that about 1.1 billion people do not have access to safe quality water and 2.6 billion people lack access to sanitation. More than 1 billion people in developing countries lack access to safe drinking water and 2.2 million people die annually of diarrhea. Lack of safe drinking water is one of the major causes of high morbidity rate in developing countries like Nigeria. Water pollution is responsible for a number of health and social problems of our environment. Water borne diseases account for 80% of illness in the developing world, killing a child every eight seconds. Half of the world's hospital beds are occupied by people suffering from borne and water related diseases (Population Reports 1998; Digha et al, 2022). The story is not different. Cases are bound of water borne and water related epidemics. In 1998, there was serious cholera epidemics in Idema Community which claimed 20 lives within two days. In the year 2000, there were cholera and diarrhea epidemics at Emeyal I and Emeyal II communities. Various interventionist attempts have been made but they are yet to yield lasting results. By and large, there is need to examine the bacteriological quality of the water. The study therefore seeks to ascertain the bacteriological quality of the Kolo Creek surface water status and its health implications in the study area.

Study Area

Geographically, the study area is located between longitude 60 1011 and 60 2811East of the Greenwish meridian. It is bounded by latitude 403511and 50 0011 North of the equator, see figure 1. The study lies in Ogbia Local Government Area of Bayelsa State within the central Niger Delta of Nigeria. It is about 25km distance from the Atlantic Ocean and 8 km East of Yenagoa city. (Chima et al, 2007). The surface geology of the study area is made up of three tertiary lithostratigraphic units. The Benin, Agbada and Akata formations (Akpokodje, 1987). The central Niger Delta topography is characterized by a maze of effluents, creeks and swamps crisis-crossing the uniclinal low-lying plains in varying dimensions (Oyegun, 1999). The topographical terrain of the study area slopes from north-south direction; Oruma, Otusesga Imiringi lying 6 meters above mean sea level while Olobiri at south lies 5 meters above mean sea level (Chima, and Digha, 2007,chima et al,2007]. The area is drained by large and small channels, rills, rivulets and streams of high tides. These rivers include, Anyama (Ekole Creek) Otuoke, Oloibiri, Abobiri, Emakalakala and the Kolo Creek. They all flow in North-South direction. Kolo Creek is distributary of the Orashi River which a branch of the River Niger. The Kolo Creek empties its water into Otuoke River via Abobiri River to Okoroma and finally leading to Twon-Brass into the Atlantic Ocean. The downstream of the Kolo Creek is influence by tidal movement. Communities like Otuogidi, Otuabagi, Otakeme, Otuagila and sometimes Kolo experience tidal movement of the water. The major industrial activity in the study area is oil exploration and exploitation. Oil fields from different location are connected to the Kolo Creek flow station which generates the Bayelsa State gas turbine for supply of electricity (Digha, 2008, Yaguo, et al, 2021).

The area is characterized by two main seasons. The dry and wet seasons, with double maxima annual rainfall regime. The study area experiences heavy rainfall for about 8-9 months annually. The climate of the study area is 'A' type of Koppen's classification system (Oyegun, 1999). The weather condition of the area is control by the influence of the moist tropical maritime air mass and the dry dusty tropical continental air mass. The highest rainfall values are obtained in June (322.93 mm), August (438. 34 mm), and September (439. 84 mm).

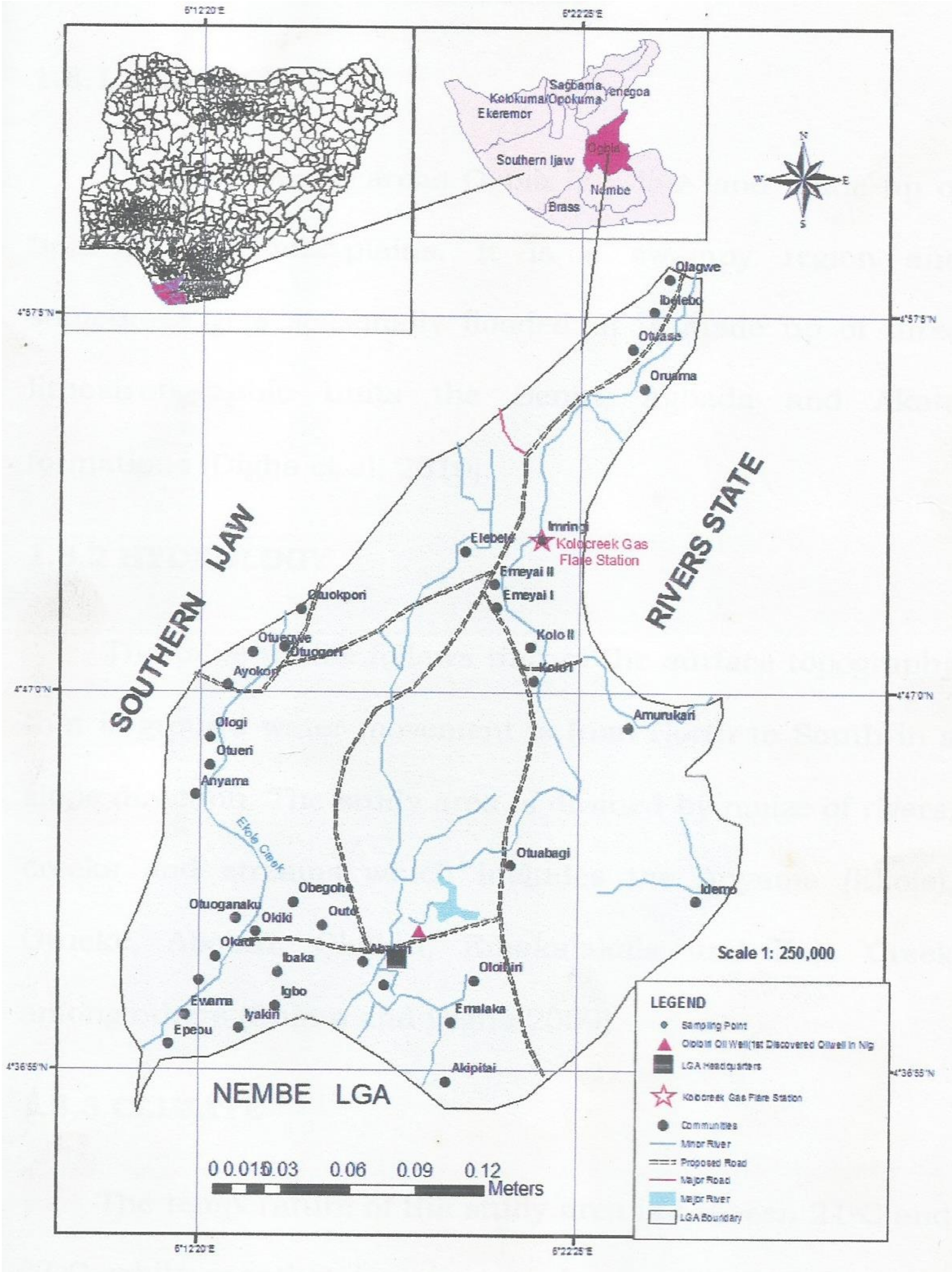

Figure 1. Map of Ogbia LGA Showing the Study Area
Source: Bayelsa State Ministry of Land and Housing

MATERIAL AND METHODS

Two set of water samples were collected. Rainy (wet) season (July) and dry season (December) from the Kolo Creek. All the samples were integrated samples. The samples were further preserved in ice-packs in a cooler until they were further preserved in ice-packs in a color until they were taken to the laboratory for analysis in less than 6 hours from the time of collection. The sampling locations are shown in figure 1. Finally, a total of fifteensamples were collected. The parameters tested includes total microbial load per (ML). Total coli form count (MPN/100 ML), Escherichia coli count (MPN/100 ML) and insitu temperature in degree Celsius were recorded at the sampling locations. All the tests were carried out in accordance with American Public Health Association (APHA, 1995) standard methods for examination of water and waste water.

Data Analysis

The data generated in this investigation were subjected to standard statistical analysis to ascertain their significance. Such statistical methods adopted include ANOVA and graphs.

The formula is in the form

Factor 1

	C_1	C_2………………C_k		total
R_1	X_{11}	X_{12}……………..X_{11}		R_1
R_2	X_{21}	X_{22}	X_{21}	R_2
Factor 2				
R_p	X_{p1}	X_{p2}	X_{pk} R_p	
C_1	C_2	………………….C_1 C		

Where: R, is the total of i^{th} row

C, is the total of J^{th} column

a. Correction factor = G2 (1)

P x K

b. Total sum of squares (TSS) = (X_{11} + X_{12} + …………..X_{pk}) – CF……………(2)

c. Rows sum of squares = (RSS)

$$\left(\frac{R_1^2}{K} \div \frac{R_2^2}{K} - - - - - - - + \frac{R_p^2}{K}\right) - CF - - - - (3)$$

d. Colum sum of square = (CSS)

$$= \left(\frac{C^{2_1}}{P} \div \frac{C^{2_k}}{P} - - - - + - - - \frac{C^{2_k}}{P}\right) - CF - - - (4)$$

e. Total sum of square = RSS + CSS + ESS

(where ESS is the Error of Square)

:. ESS = TSS --- RSS --- CSS ……………(5)

RESULTS AND DISCUSSION

The result of the laboratory analysis in table 1 indicates that the total microbial load for all the samples were above the WHO and FEPA standards for drinking water (WHO, 0-1 & FEPA, 5-10). The mean X for the rainy season samples was 138, while the mean (X) of the Kolo Creek surface water was 192 in 100ml. the mean X for both rainy and dry seasons was 165 per 100ml. this also was abovethe World Health Organization (WHO) and Federal Environmental Agency (FEPA) Standards for drinking water. The highest concentration of microbial load occurred in sampling location (SPL) 1, 4, 5, 6, 7, 8 and 10, while among these sample locations, 7 and 10 has the highest occurrence.

Table 1. Bacteriological Analysis of the Kolo Creek Surface Water Samples (July) and (December)

WATER QUALITY	1		2		3		4		5		6		7		8		9		10		Mean (X)			WHO STANDARD FOR DRINKING	FEPA STANDARD FOR DRINKING
Parameter	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W&D	1996	1992
TML	150	142	8	40	6	40	116	174	166	204	141	260	335	424	155	190	59	84	285	335	138	192	165	0<1	5-10
TCC	5	8	4	2	0	2	2	5	2	6	4	10	130	146	0	2	0	2	8	15	15	25	20	0>1	0
ECC	4	6	3	1	0	1	1	4	1	4	3	100	115	0	1	6	12	11	6	11	11	13	15	0	0
TEMP^{0}C	30	32	30	31	29	31	29	30	28	30	30	29	28	29	28	28	27	28	27	28	290C	26	29.5	26.6	29.5
TIME	12	12	11	12	11	11	11	11	10	1035	10	10	10	10	9.5	9.3	9.00 M	9.2 5	9.25 AM	11.00 AM	11.00 AM				

TML = Total Microbial Load (per ml)
D = Dry Season
W = Wet Season
TCC = Total Coliform Count (MPN/100)
ECC = Escherichia Coli Count (E. Coli)
SPL = Sampling Location
X = Mean

Table 1 further indicate that all the samples analyzed for total coliform count (TCC) were above WHO standard of O>1 and FEPA standard for drinking water of 0-2. The mean X for the wet season was 15.50, while the standard deviation (S) was 40.31 and standard error was 12-75 (see table 2 below). The dry season sample also had a mean X of 20.10 with a standard deviation of 44.43, while the standard error was 14.05. More so, table 1 indicates that the Escherichia coli count (ECC) for all the samples were above the WHO standard for drinking water of O and the FEPA stand of O.two-way analysis of variance (ANOVA) statistical techniques was applied on the data-set from the results laboratory analysis of samples. The statistical results show that sst, df = 3, ss = 3140474.50, mss = 1046824.84, F1 = 33.03. While 556: df = 1, ss = 49928, mss = 95083, mss = 3169433. Total = fd = 7 (see table 3).

Table 2. Samples of Kolo Creek Surface Water Totals

PARAMETERS SEASONS	TML	TCC	ECC	TEM	TOTAL
WET	1396	155	188	286	1935
DRY	1911	202	156	298	2567
TOTAL	3287	357	274	584	4502

TML = Total Microbial Load
TCC = Total Coliform Count
ECC = Escherichia Coli Count
TEM = Temperature (0c)

Table 3. Statistically Computed Values from Table 2

	Df	Ss	Mss	F
Sst	3	3140474.3	1046824.8	F1 = 33.0291
Ssb	1	49928	49928	F2 = 1.5753
Error	3	95083	31694.33	
Total	7	3285485.5		

The findings of this study were in support of Rim-Rukeh (2013). In their study of biocoration risk assessment of the Niger Delta swamp environment. They had a mean total coliform as against the values of 15.5 and 20.10 for both wet and dry seasons for this study. Although there is slight variation, the difference is due to spatial geographic attributes and other anthropogenic factors. However, the findings reveal that there is evidence of difference in sample parameters. But there is no statistically significant season effect on the bacteriological parameters (see table. 3, figure 2, 3 and 4).

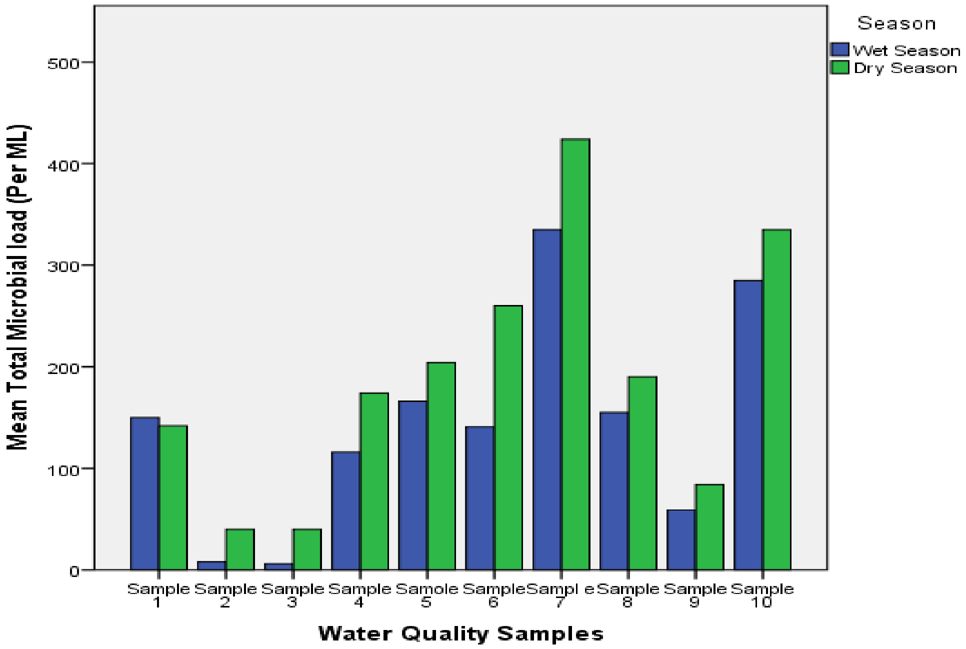

Figure 2. A Bar Showing Concentration of Total Microbial Load (Per Ml)

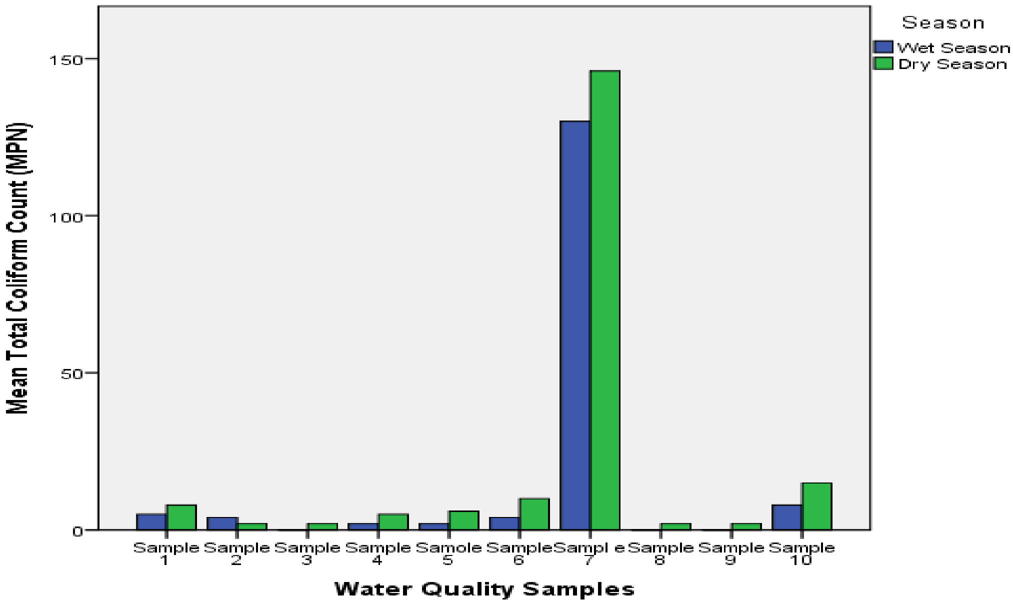

Figure 3. A Graph Showing the Distribution of Total Coliforms Count (Mp)

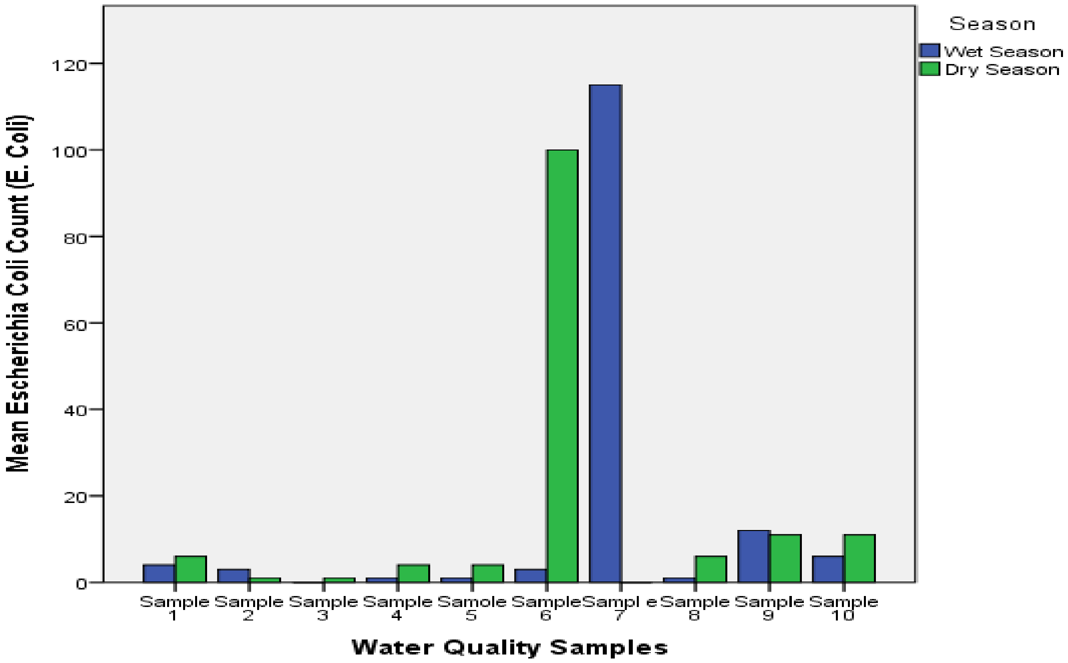

Figure 4. A Bar Graph of Showing the Concentration of Escherichia Coli Count (E. Coli)

Implications of the Results on Human Health

From the analysis above, it can be inferred that the major source of domestic water supply is highly polluted with faecal coliform. The parameters analyzed exceeded the WHO and FEPA recommended standards for drinking water portend negative implications on the health of the inhabitance. The high coliform count, microbial count, and eschrichia were also evidence of faecal contamination. This provides a conducive environment for pathogens which causes cholera diarrhea, dysentery, trachea and other water related diseases. Communities which are not having adequate sanitation facilities e.g. good toilet system are exposed to a high risk of infection with excreta-related diseases. Children under the age of five particular susceptible to diarrhea disease[Digha and Abua, 2017]. Older children and adults are likely to be infected with intestinal worms (Khitoliya, 2008). No wonder why, Nnodu and llo (2000) viewed water as the life blood of all living system. Human beings, like other animal and plants are made up mostly of water. This was reaffirmed by Khitoliya, (2008). According to WHO cited in Nnodu and llo (2000) portable water be in condition fit for human consumption. The above statement indicates that the Kolo Creek water cannot be consumed without treatment. In the same vein, Van Pocteren and Pur (1987) and Gibbs (1987) affirmed that there is a direct relationship between faecal pollution and diseases, and the use of poor quality water.

They both pointed out that the consumption of contaminated water enhances the proliferation of faecatoral transmission of diseases. These diseases arising from polluted water sources have been threatening the study area over the years. This has rekindled the vicious cycle of poverty and underdevelopment resulting to annual epidemics arising from the consumption of contaminated water.

CONCLUSIONS AND RECOMMENDATIONS

Arising from most reveling findings, the Kolo Creek is highly polluted by bacteriological parameters such as microbacterial load,total coliform count and esherichia coli count. This is case of most Nigerian rivers and lakes. This situation account for the high incidence of water borne and water related diseases in the study region. This in order for country like Nigeria to meet Sustainable Development Goals (SDGs) for access to safe drinking water by 2030, it requires a cognate spirit to fast track development in our water resources. This implies that there should be proper environmental monitoring of water sources by individuals, NGOs and government at all levels.

The study has been expository; the findings indicates that, over the years the inhabitance of Kolo Creek having been making use of this water without basic treatment. It necessary at this juncture to give the following recommendations:

1. The government should provide toilets with water system in these communities.
2. Well treated boreholes should be provided in all the rural communities of Kolo Creek.
3. The Local Government Council should create awareness through Environment Education. The mass media may be very effective in information dissemination.
4. It is believed that if the populace is that aesthetically, attractive and colourless water can be dangerous and unsafe for human ingestion, therefore the river water should be treated before consumption.

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