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Assessment on Effect of Anthropogenic Activities on Water Quality Parameters at Gundutse River in Kano, Northern Nigeria

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Abstract

Drinking water has always been a major issue in many countries, especially in developing countries like Nigeria. The study was aimed to assess the effect of anthropogenic activities on water quality parameters at Gundutse River in Kura Kano, Northern Nigeria for a period of 3 month (April - June, 2019). Surface water sample for the study were collected from three (3) different sampling (A, B and C) sites based on the depth of the water and analysis of water was conducted either *in situ* or transported to the laboratory for further analysis. The physicochemical and microbiological properties of the water were determined using standard method. The result of physicochemical properties of the water showed that the temperature, pH, turbidity and electric conductivity ranges from 25 to 26^{0}C, 7.3 to 7.7, 140 to 155 NTU and 617 to 628µs/cm respectively. The average values of nitrate, phosphate, Dissolve Oxygen and Biochemical Oxygen Demand (BOD) of the water ranges from 1.80 to 2.13 mg/L 1.0 to 1.16 mg/L, 3.73 mg/L to 4.10 mg/L, 1.96 to 2.23 mg/L respectively. The result of microbiological analysis of the River showed that *Escherichia coli*, *Salmonella typhi*, *Proteus mirabilis*, *Enterobacter sp.* and *Klebsiella pneumoniae* were identified. The use of the river water for drinking may be hazardous. The study therefore, stresses on the need to control the faecal pollution of the water before use.

Keywords: Anthropogenic activities; Gundutse; Microbiological; Physicochemical; River water.

INTRODUCTION

Water is one of the most essential natural resources needed by every living thing. Whether it is used for drinking, bathing, food production or recreational purposes, portable and accessible water supply is crucial for public health [1]. Water is the commonest solvent for many substances and it rarely occurs in its pure nature. Water can be obtained from a number of sources, among which are streams, lakes, rivers, ponds, rain, springs and wells [2]. Drinking water has always been a major issue in many countries, especially in developing countries like Nigeria. In Nigeria, majority of the rural populace do not have access to potable water and therefore, depend on well, stream and river water for domestic use [3]. Contaminated water sources are vehicles for the transmission of waterborne diseases such as cholera, shigellosis, and Campylobacteriosis [4]. The World Health Organization (WHO) estimated that about 1.1 billion people globally drink unsafe water and the vast majority of diarrheal diseases in the world (88%) are attributable to unsafe water, sanitation and hygiene. Approximately 3.1% of annual deaths (1.7 million) and 3.7% of the annual health burden world-wide (54.2 million) are attributable to unsafe water, sanitation and hygiene [5].

Untreated water sources such as surface waters (streams, rivers, lakes, etc.) or unprotected open wells are vehicles for waterborne bacterial diseases such as cholera and typhoid fevers [4]. Untreated waters may also play a role in the transmission of water washed viral enteric diseases such as hepatitis, gastroenteritis, as well as an unknown number of ill-defined diseases caused by other enteric viruses. The fecal-oral route is probably the major route for transmission of these bacterial and viral diseases as well as of many parasitic

diseases in poor sanitary conditions. An improvement of water quality and water usage for improving sanitary conditions should result in a decrease of waterborne as well as water-washed diseases [4, 5].

Major factors affecting microbiological quality of surface waters are discharges from sewage works and runoff from informalsettlements. Indicator organisms are commonly used to assess the microbiological quality of surface waters and faecal coliforms (FC) are the most commonly used bacterial indicator of faecal pollution [6]. They are found in water that is contaminated with faecal wastes of human and animal origin. Total coliforms (TC) comprise bacterial species of faecal origin as well as other bacterial groups (e.g. bacteria commonly occurring in soil). The coliforms are indicative of the general hygienic quality of the water and potential risk of infectious diseases from water [6].

Assessment of the water conditions will givean insight into the relationships between the organism and their environment and can be usedin determining water quality, productivity of the water body, understanding of the structureand function of a particular water body and its relation to its inhabitants. In view of this, importance of monitoring water quality cannot be overemphasized. Anthropogenic influencesare known sources of water pollution and include urban, industrial and agricultural activitiesincreasing exploitation of water resources as well as natural processes, such as precipitationinputs, erosion and weathering of crustal materials degrade surface waters and damage theiruse for drinking water, recreational and other purposes [7]. The study was therefore aimed to assess the effect of anthropogenic activities on water quality parameters at Gundutse River in Kano, Northern Nigeria

MATERIALS AND METHODS

Study Area

Gundutse town is located in eastern part of Kura. Kura is one of the Local Government areas of Kano State. It is located in the southern part of the state along Kano-Zaria express with a distance of about 35 Kilometer from the state capital. Geographically, it is located at latitude $11^0$46'N and Longitude $8^0$25'E. It covers an area of about 206 Km^2 of land. According to 2006 population census, it has a total population of 144,601 and the projected population of 199,002 as of 2016 [8]. Kura Local Government shares common boundaries with Garun-Mallam (West), Dawakin-kudu (East), Bunkure (South) and Madobi Local Government (North). Farming and irrigation remain the major occupations in the area. However many educated indigenes in the area are employed in the formal sector while others engaged in various trading activities.

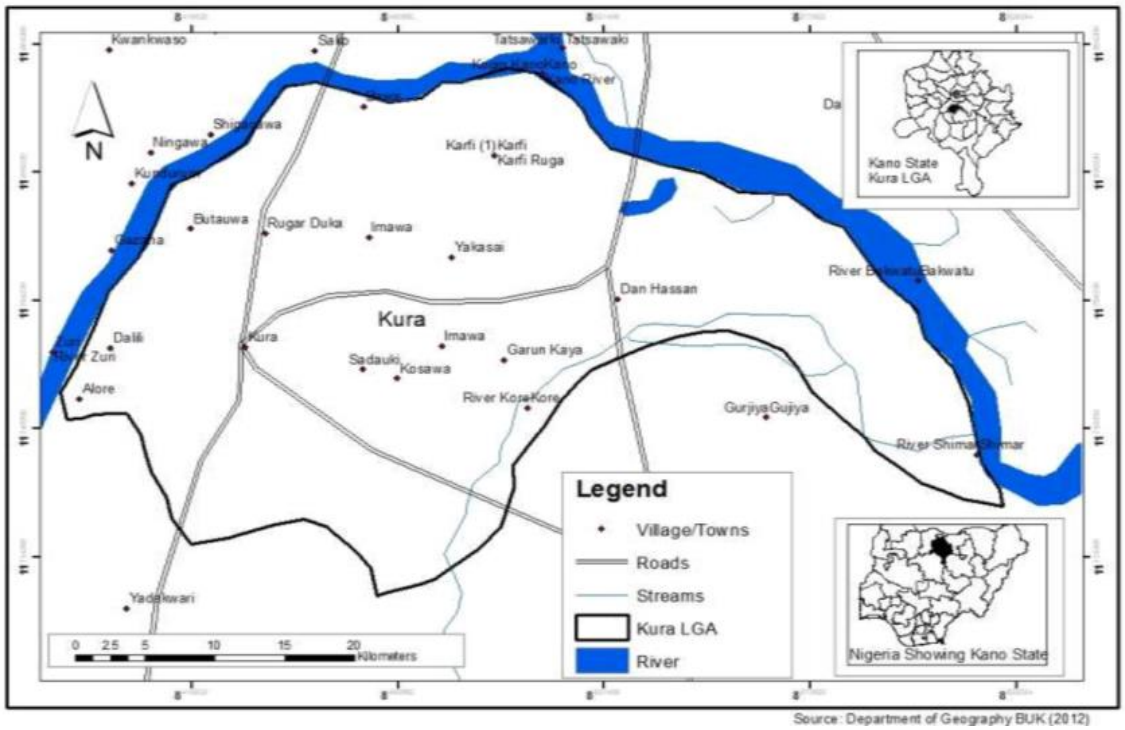

Figure 1: Map of Kura Local Government Kano, Northern Nigeria

Collection of Water Samples

Surface water sample for the study were collected from three (3) different sampling (A, B and C) sites based on the depth of the water. Collection of water was done at about 6 am for a period of 3 month (April – June, 2019) and analysisof water was conducted either *in situ* or transported to the laboratory for further analysis.

Determination of Physico-chemical Properties of the River water

The pH of the river water was determined using pH meter as described by APHA [9]. Surface water Temperature was determined *in situ* with mercury in glass thermometer as described by Offem, *et al.*, [10]. The Electrical conductivity of the water was determined using conductivity meter as described by APHA [9]. The turbidity was measured using Nephelometer, Nitrate and Phosphate was determined using DR/2010 Spectrophotometer. Dissolved Oxygen was determined using Dissolved Oxygen Meter as described by APHA [9]. Biological Oxygen Demand was determined after 5 days incubation method as described by APHA [9].

Microbiological analysis

Membrane filters (MF) method was used. The method described by Ali *et al*., [11] was adopted with slight modification; 100 ml of each water sample was filtered through sterile membrane which retained the bacteria on its surface. The membrane was removed aseptically and placed on a Nutrient agar (NA) as a basal medium and MacConkey agar as a differential medium to determine coliforms bacteria. All the plates were incubated at 37°C for 24 hrs. Each colony was isolated in a pure form by sub culturing in fresh Mac Conkey agar plates for further studies and identification. Distinctive morphological properties of each pure culture such as colony form, elevation of colony and colony margin were observed [12]. Presumptive colonies were confirmed by gram staining and biochemical (Indole, Methyl-red, Voges Proskauer, Citrate utilization and Oxidase) tests and each plate were graded as positive or negative. Bacteria isolates were identified and characterized according to Bergy's manual of systemic determinative Bacteriology by Holt *et al*., [13].

RESULTS

Physico-Chemical Properties of the River Water

Table 1 represents the average values of temperature, pH, turbidity, and electric conductivity of the water of River Gundutse from April to June. The results showed the average temperature for the month are 26, 26 and 25^{0}C. The pH of the river ranges from 7.3 to 7.7. The highest pH was recorded in site A for the month of April (7.7) while least pH was recorded in site B for the month of June. Highest turbidity for the river was recorded in June with site A having the highest value (155 NTU). The turbidity recorded for April (140 NTU) in both sites is lower when compared to May (152 NTU) and June (155 NTU) respectively. The results for electric conductivity indicated that the average result recorded were 617, 628 and 628µs/cm for the month of April, May and June respectively.

Table 1: Results of Temperature, pH, Turbidity and Electric conductivity of River Gundutse from April to May 2019

Parameters	Month	Site A	Site B	Site C	Average	WHO standard
	April	26	26	26	26	
Temperature (^{0}C)	May	26	26	26	26	27
	June	25	25	25	25	
	April	7.7	7.5	7.6	7.60	
Ph	May	7.6	7.4	7.4	7.47	6.5 –8.5
	June	7.4	7.3	7.5	7.40	
	April	139	136	129	135	
Turbidity (NTU)	May	142	138	140	140	5
	June	155	146	151	152	
	April	612	621	619	617	
Electric Cond(µs/cm)	May	621	627	625	624	1000
	June	625	630	628	628	

Table 2 represents the average values of nitrate, phosphate, Dissolve Oxygen and Biological Oxygen Demand (BOD) of the water of River Gundutse from April to June. The results showed the average nitrate for the month of April, May and June are 1.80, 1.86 and 2.13mg/L respectively. The phosphate level of the river ranges from 1.0 to 1.16 mg/L. The highest phosphate level was recorded in site C for the month of May and June (1.2 mg/L) while least phosphate level (1.0 mg/L) was recorded in site A for the month of April, May and June. Highest dissolve oxygen level for the river was recorded in June with site C having the highest value (4.1mg/L). The dissolve oxygen level recorded for April (3.56 mg/L) in both sites is lower when compared to May (3.73mg/L) and June (4.10mg/L) respectively. The results for Biological Oxygen Demand (BOD) indicated that the average result recorded were 2.23, 2.13 and 1.96mg/L for the month of April, May and June respectively.

Table 2: Average Nitrate, Phosphate, Dissolve Oxygen and Biological oxygen demand (BOD) of River Gundutse from April to May 2019

Parameters	Month	Site A	Site B	Site C	Average	WHO standard
	April	1.8	1.8	1.8	1.80	
Nitrate (mg/L)	May	1.8	1.9	1.9	1.86	45
	June	2.1	2.2	2.1	2.13	
	April	1.0	1.0	1.0	1.00	
Phosphate (mg/L)	May	1.1	1.1	1.2	1.13	100
	June	1.1	1.2	1.2	1.16	
	April	3.5	3.6	3.6	3.56	
Dissolve Oxygen (mg/L)	May	3.7	3.7	3.8	3.73	> 4
	June	4.0	4.2	4.1	4.1	
	April	2.2	2.3	2.2	2.23	
BOD (mg/L)	May	2.1	2.1	2.2	2.13	5
	June	1.9	2.0	2.0	1.96	

Bacteriological analysis of water

The bacterial isolates recovered from water samples are presented in (Table 3). The result showed that *Escherichia coli*, *Salmonella typhi*, *Proteus mirabilis*, *Enterobacter sp.* and *Klebsiella pneumoniae* identified. *Escherichia coli*, *Salmonella typhi*, and *Klebsiella pneumoniae* were present in all the water samples examined.

Table 3: Bacteriological analysis of River Gundutse from April to May 2019

Isolates	Site A	Site B	Site C
Escherichia coli	+	+	+
Salmonella spp	+	+	+
Enterobacter spp	-	+	+
Klebsiella spp	+	+	+
Proteus spp	+	+	+

DISCUSSION

The physico-chemical properties defined the physical and chemical state of substances. The Measurement and determination of physico-chemical parameter is very important because it enable one to determine the quality of water for public consumption as well as the distribution of aquatic organisms in the water especially algae and phytoplankton. The mean physico-chemical properties of River Gundutse are recorded in Table 1 and 2. The average surface temperature of the water greatly influences other physico-chemical properties of the water. According to the result of this study, temperature is higher in April and dropped in June. This is in conformity with the finding of Ahmad and Indabawa [14]. The high values of temperature recorded in the month of April could be associated with high solar radiation, high evaporation and absent of rainfall. The pH of the water slightly neutral with higher pH in April compared to May and June. The values of pH recorded in this study fall within the WHO [15] standard and correlates positively significantly with temperature. The highest value of pH recorded could be attributed to run off from the neighbouring farm land as well as discharge into the water bodies.

On the other hand, the value of electric conductivity decreases in the month of April but increase in June. The result of electric conductivity of this study correlates with that of Ahmad and Indabawa [14]. The electric conductivity of water gives a good indication of total salt content. The turbidity value across the river ranges from 135 – 152 NTU from the month of April to June. This showed that the turbidity of water is increasing. Turbidity depends on the clarity of water, the clearer the water the lower the turbidity and the darker the water the higher the turbidity which affects the distribution of aquatic organism [16]. Turbidity usually occurs in most surface water as a result of suspended clay, silts, organic and inorganic matter, planktons and other micro-organisms.

Nitrate and phosphates are the two most important factors contributing to eutrophication in water. The highest mean nitrate value recorded is 2.1 mg/L while the least value recorded was 1.8 mg/L. The nitrate values recorded in this study fall within WHO [15] limit. From the result, the nitrate amount was higher in June than April and May. This could be attributed to the runoff from neighbouring farm land fed with inorganic fertilizers by farmers, discharged in to the water bodies due to rainfall. Similar observation was made by Watanabe *et al*., [17], who reported that nutrients are potential determinant of ultimate productivity, as evidenced by many limnological

studies correlating high nitrate and phosphate values to abundant phytoplankton flora.

The highest value of dissolve oxygen recorded was found to be 4.1mg/l due to the decrease in temperature and the lowest was found to be 3.6mg/L due to increase in temperature. This result was in conformity with the finding of Shawai *et al*., [18] who recorded high dissolve oxygen with decrease in temperature and vice versa. The dissolve oxygen is one of the best indicators of the health of the water in aquatic ecosystem. Also the distribution of oxygen in water varies accordingly to the type of water body i.e. for past flowing water bodies the oxygen concentration is uniform or nearly uniform from top to the button due to the mixing of water while in standing or stagnant water there is variation from top to the bottom, high concentration of oxygen was found at the surface but lower concentration at the button. The highest biological oxygen demand (BOD) was found to be 2.23 mg/L and the lowest BOD value was found to be 1.96 mg/L. this correspond with the work of Shawai *et al*., [18] and Ezra [19] which ranges between 1.3mg/L - 3.9mg/L reported in the study of planktonic algae in relation to physico-chemical parameters, properties of some fresh water ponds in Kano and Bauchi Nigeria respectively. In general the higher the BOD, the decrease in dissolve oxygen concentration in the water is due to the decomposition of organic matter found in the water that consumes the dissolve oxygen [20].

Coliforms are the most frequent bacteria in water responsible for water borne diseases such as cholera, dysentery, diarrhea, typhoid fever which is responsible for mortality across the world especially in Africa [21-23]. All the samples analyzed show positive test for *E. coli, Salmonella typhi, Proteus mirabilis, Enterobacter spp.* and *Klebsiella pneumoniae*. This indicates high pollution of the River Gundutse. The poor microbiological quality might be due to contamination caused by human activities and livestock [24]. It is a common practice for people living along the River catchment to discharge their domestic and agricultural wastes as well as human wastes into rivers. In addition to using the River as a source of drinking water people use the source for bathing, washing of clothes and for recreational purposes such as swimming [25]. Wild and domestic animals seeking drinking water can also contaminate the water through direct defecation and urination [26]. The result of this study was in conformity with several results of similar findings which showed the presence of coliforms such as *E. coli, Salmonella typhi, Proteus mirabilis, Enterobacter spp.* and *Klebsiella pneumoniae* in most water sources [27-29]. Olorode *et al*., [30], study the physicochemical and microbial analysis of some rivers in Rivers State, Niger-delta in Nigeria, the result of microbial analysis show the presence of bacteria such as *Escherichia coli, Campylobacter, Pseudomonas, Salmonella, Vibrio, Proteus, Shigella, Enterococcus*. The bacteriological quality of most of the stream waters in the tropics is poor, mainly due to pollution from widespread and indiscriminate human and animal defecation and very poor waste disposal practices [31]. A study on Physico- Chemical and microbiological analysis of well water samples in settlements around Akperan Orshi College of Agriculture, Yandev in Benue State, Nigeria was conducted by Mwekaven *et al*., [22]. The results of microbiological analysis of the samples indicated that most of the wells were grossly contaminated with bacteria pathogens especially, *Escherichiacoli* (100%), *Proteus* species (47%) and *Salmonella* specie (7%). This result was in conformity the present study.

CONCLUSION

The result of this study has shown that most of the physicochemical parameters of water in River Gundutsewere found below the WHO standards for drinking and Agricultural activities. However, the water was found to be grossly polluted as a result of microbial contamination due to feacal coliforms such as *E. coli Salmonella* spp, *Proteus* spp, *Enterobacter* spp and *Klebsiella* spp.

REFERENCES

1. Eboh, J. O., Ogu, G. I., & Idara, M. U. (2017). Micro biological quality of borehole and well water sources in Amai kingdom, ukwuani local government area of delta state, Nigeria. *International Journal of Advanced Academic Research Sciences, Technology Engineering*, 3(7), 1-10.
2. Omezuruike, O. I., Damilola, A. O., Adeola, O. T., Fajobi, E. A., & Shittu, O. B. (2008). Microbiological and physicochemical analysis of different water samples used for domestic purposes in Abeokuta and Ojota, Lagos State, Nigeria. *African Journal of Biotechnology*, *7*(5), 617-621.
3. Shittu, O. B., Olaitan, J. O., & Amusa, T. S. (2008). Physico-chemical and bacteriological analyses of water used for drinking and swimming purposes in abeokuta, nigeria. *African Journal of Biomedical Research*, *11*(3), 285-290.
4. Burgess, J. E., & Pletschke, B. I. (2010). Microbiological water quality assessment (catchment to tap). *Water and health*, 2(1), 1-10.
5. World Health Organization (WHO). Guidelines for drinking-water quality 2004 (3rd edn), World Health Organization, Geneva, Switzerland.
6. Antony, R. M., & Renuga, F. B. (2012). Microbiological analysis of drinking water quality of Ananthanar channel of Kanyakumari district, Tamil Nadu, India. *Revista Ambiente & Água*, *7*, 42-48.
7. Rashid, I., & Romshoo, S. A. (2013). Impact of anthropogenic activities on water quality of Lidder

River in Kashmir Himalayas. *Environmental monitoring and assessment*, *185*(6), 4705-4719.
8. National Population Commission (NPC). (2006). National population census result Abuja Nigeria.
9. APHA. American Public Health Association. (1988). Standard methods for the examination of water and wastewater. 20th Edition. American Water Works Association/Water Environmental Federation, Washington.
10. Offem, B. O., Samson, Y. A., Omoniyi, I. T., & Ipki, G. U. (2009). Dynamics of the limnological features and plankton populations of Cross river system. S. E Publishers Calabar, 46.
11. Ali, M., Farouk, S. N., Abdullahi, A. M., & Musa, A. D. (2018). Isolation and Evaluation of Antibiotic Resistivity Pattern of Faecal Coliforms Bacteria Isolated From River Wudil Kano, Nigeria. *Advancements Bioequiv Availab. 2018; 1(2)*. ABB.000509
12. Gambo, S. B., Ali, M., Diso, S. U., & Abubakar, N. S. (2018). Antibacterial Activity of Honey Against Staphylococcus Aureus and Pseudomonas Aeruginosa Isolated from Infected Wound. *Arch Phar & Pharmacol Res*, 1(2): APPR.MS.ID.000506
13. Holt, J. G., Krieg, N. R., Senath, P. H. A., Staley, J. T., & Williams S. T. (1994). Bergey's manual of determinative bacteriology (9th edn), Williams and Wilkins, Baltimore, USA.
14. Ahmad, H. K., & Indabawa, I. I. (2015). A study of Algal species of Kano River, Tamburawa, Kano State, Nigeria. *Bayero Journal of Pure and Applied Sciences*, *8*(1), 42-49.
15. WHO Guidelines for Algae and Cyanobacteria in Freshwater, California, U.S.A, 2003, 150.
16. Simoons, F. J. (1990). Food in China: a cultural and historical inquiry. CRC Press.
17. Watanabe, M. F., Harada, K., Carmichael, W. W., & Fujiki, H. (1995). *Toxic Microcystis*. Boca Raton CRC Press, 272.
18. Shawai, R. S., Ahmad, H. K., Auwal, A. U., & Indabawa, I. I. (2015). Survey of Algal Flora in Tamburawa Water Treatment Plants. *International Journal of Engineering & Science Research*, 59(10), 1290-1297.
19. Ezra, A. G. (1999). The Ecology of algae in Gubi reservoir, Bauchi Nigeria (Doctoral dissertation, Ph. D Thesis, Abubakar Tafawa balewa University, Bauchi State Nigeria).
20. Brower, J. E., Zar, J. H., & Von Ende, C. N. (1998). *Field and laboratory methods for general ecology* (Vol. 4). Boston: WCB McGraw-Hill.
21. Raji, M. I. O., & Ibrahim, Y. K. E. (2011). Prevalence of waterborne infections in Northwest Nigeria: A retrospective study. *Journal of Public Health and Epidemiology*, *3*(8), 382-385.
22. Mwekaven, S. S., Aorkwagh, M. T., Gundu, E. G., & Yange, T. (2017). Physico-chemical and microbiological analysis of well water stations In settlements around Akperan Orshi College of Agriculture, Yandev. *International Journal of Science and Technology*, 6(1), 1-8.
23. Yusuff, A. S., John, W., & Oloruntoba, A. C. (2014). Review on prevalence of waterborne diseases in Nigeria. *Journal of Advancement in Medical and life sciences*, *1*(2), 1-3.
24. Agbogu, V. N., Umoh, V. J., Okuofu, C. A., Smith, S. I., & Ameh, J. B. (2006). Study of the bacteriological and physicochemical indicators of pollution of surface waters in Zaria, Nigeria. *African Journal of Biotechnology*, *5*(9), 20-30.
25. Olabisi, O. E., Awonusi, A. J., & Adebayo, O. J. (2008). Assessment of bacteria pollution of shallow well water in Abeokuta, Southwestern Nigeria. *Life Science Journal*, *5*(1), 59-65.
26. Ahiarakwem, C. A., & Onyekuru, S. O. (2011). A comparative assessment of the physico-chemical and microbial trends in Njaba River, Niger Delta Basin, Southeastern Nigeria. *Journal of Water Resource and Protection*, *3*(9), 686-693.
27. Ndamitso, M. M., Idris, S., Likita, M. B., Tijani, J. O., Ajai, A. I., & Bala, A. A. (2013). Physico-chemical and Escherichia coli assessment of selected sachet water produced in some areas of Minna, Niger State, Nigeria. *International journal of water resources and Environmental Engineering*, *5*(3), 134-140.
28. Anake, W. U., Siyanbola, T. O., Ehi-Eromosele, C. O., Edobor-Osoh, A., Adeniyi, I. O., & Taiwo, O. S. (2013). Physico-chemical and microbial assessment of different water sources in Ota, Ogun state, Nigeria. *International Journal of Current Research*, *5*(7), 1797-1801.
29. Aminu, T., & Amadi, A. N. (2004). Bacteriological Contamination of Groundwater from Zango Local Government Area, Katsina State, Northwestern Nigeria. *J Geoscience Geomatic*, 2(5), 186-195.
30. Olorode, O. A., Bamigbola, E. A., & Ogba, O. M. (2015). Comparative studies of some river waters in port Harcourt based on their physico-chemical and microbiological analysis, Niger Delta Region of Nigeria. *International Journal of Basic and Applied Science*, *3*(3), 29-37.
31. Ezeigbo, H. I. (1989). Groundwater quality problems in parts of Imo State, Nigeria. *Nigerian Journal of Mining and Geology*, 25(5), 1-9.