Extended Abstract

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Quality Assessment of surface and underground Water in Ipoti-Ekiti, South West Nigeria

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Abstract:

The quality of surface and underground water obtained from Ipoti-Ekiti, Southwest Nigeria were subjected to physicochemical and microbiological qualities assessment with a view to determine their level of pollution.

The result of the analyses shows that the pH, SO42- and NO3- are below the World Health Organisation's (WHO's) recommended limits for domestic water while theCl-, BOD, COD and turbidity are above the WHO standard. Also, parameters like NO3-, SO42-, Cl-, BOD and COD are affected by seasons as their values in the surface water are less at dry season than the wet season.

The result of microbiological analysis shows that some of the water samples contain pathogenic organisms and the bacterial counts reveal that the values for wet season for surface water are more than those of dry season.

From the study, it could be said that the spring and borehole water are suitable for most domestic uses while other water would require one form of treatment or the other to make them suitable for all uses.

Ways to improve the qualities of the surface and underground water in the community to assist government to achieve its Sustainable Development Goals (SDGs) on water are recommended.

Introduction:

There are about 1.5 billion Km3 of water in the hydrosphere. However, about 95% of this is sea water, 4% exists as snow in mountains and cold regions and only 1% is available for human activities. This small amount is confined to ground water, rivers, lakes, soil profile, atmosphere and biological systems (Ellis, 1998).

The body's need for water exceeds its need for food. A man can live for days or even weeks without food but only a few days without water would result in death (Shalom, 2011). It is therefore necessary for a man to have regular and adequate intake of it in order to remain alive.

The usual sources of drinking water include the streams, rivers, wells and boreholes which are mostly untreated and associated with various health risks (Agbarie and Obi, 2009)

One of the targets of the Millennium Development Goals (MDGs) in terms of healthy living for masses is adequate supply of safe and quality water for citizenry (Orewole et al, 2007).

However, in anticipation of comfort, wealth, power and rapid industrialization, the activities of man have resulted in the discharge of waste and toxic chemicals into our water bodies thereby polluting them. In the olden days, when waste was small, these water bodies have self-purification mechanisms through which they re-purify themselves. But the rate of waste dump in recent time has outstripped the self-purification capacities of the rivers and streams. Consequently, aquatic eco-systems are not only adversely affected; human lives are threatened with water borne diseases like dysentery, cholera and typhoid to mention but few (Ademoroti 1996a).

Therefore, in our rapidly industrializing world where many organic and inorganic substances sometimes in high concentrations are constantly being introduced into water bodies and soil, the periodic knowledge of physical, chemical and biological characteristics of our water bodies especially drinking water has become very essential (Duru et al, 2008).

Safe drinking water is a human birth right as much as clean air. However, much of the world's population does not have access to it. Of over six billion people on earth, more than one billion (one sixth) lack access to safe drinking water. Moreover, about two and half billion (more than a third) do not have access to adequate sanitation services. These short comings put together spawn water borne diseases that kill more than six million children each year (TWAS, 2002).

Inadequate water supply is peculiar to developing countries (Akpor and Muchie, 2011), a situation which can be attributed to poor water supply infrastructure, technical capacity and absence of appropriate regulatory framework (Ali, 2012). Furthermore, the economic losses resulting from lack of access to improved basic water and sanitation in Africa cannot be overemphasized (Aladejana and Talabi, 2013).

The aim of the research was to assess the quality of surface and underground water in Ipoti-Ekiti, a community in Ijero Local Government area of Ekiti State, Southwest Nigeria where government water supply does not flow regularly, a situation that leaves the people with no option than to use the available water sources like river, streams springs, borehole for their domestic uses.

Materials and Method:

2.1 Study Area:

Ipoti-Ekiti, the study area is located between latitudes 70 50' and 70 55'' north of equator and longitudes 50 00'' and 50 05'' east of Greenwich Meridian. It is situated 7km north of Ijero-Ekiti, the local government headquarters and 50km northwest of Ado-Ekiti, the state capital. It is bounded by other towns like Odo-Owa, Iloro and Oke-Ila Orangun.

Ipoti community, like most part of Southwest Nigeria, is underlain by metamorphic rocks of Precambrian basement complex, the majority of which are ancient in age. The basement complex rocks show great variations in grain size and in mineral composition (Daramola, 2013).

2.2 Sample Collection:

Samples were taken from different locations in the community to ensure a geographical representation of all the quarters. Six water samples consisting of three surface water and three underground water were taken by grab method at dry and wet season using clean plastic bottles: one spring water at Okenibata/Iwaro quarter (UW1), one river water at Iloro Road (UW2), one fish pond water at Eyigbo quarter (UW3), one river water at Araromi/Ariyo quarter (UW4), one hand dug well water at Asa/Olusi quarter (UW5) and one borehole water at Aporin/Ajana quarter (UW6). The various water samples and their locations are as shown in the figure above. The samples were transported in an ice packed box to the laboratory where they were kept in a refrigerator pending analysis.

2.3 Sample Analysis

The temperature was determined in situ at the site using mercury in glass thermometer while pH and conductivity were assessed by electrometric method using pH meter (Hanna H19813 Grocheck meter) and conductivity meter respectively. Total solids, total dissolved solids, total suspended solids were assessed using gravimetric method, turbidity was assessed using nephlometer, chloride was assessed Mohr's method as described by AOAC (1984), Sulphate by Tabatabau method (1974), dissolved oxygen by Winkler's method. The BOD and COD were determined using method prescribed by APHA (1965), hardness, calcium, magnesium, acidity and alkalinity by titrimetry method as described AOAC (1990). The nitrate was by colorimetric method using spectrophotometer at 410nm.

Results and Discussions

The results of physicochemical analyses for wet and dry seasons of surface and underground water in the study area are presented in Table 1.

The temperature values for wet and dry seasons respectively ranged between 26-290C and 26.5-300C. The temperatures at dry season were higher in surface water. This may be attributed to the fact that weather is always hotter at the time than the wet season. However, the temperature was found to be lower during dry season in underground water as could be seen for UW4 and UW5.

The pH values are between 6.50-7.30 and 6.60-7.20 dry and wet seasons respectively. The values recorded are within the World Health Organisation's and the Nigerian's Drinking Water Quality Standards (NDWQS). The values are in agreement with values recorded by Chinedu et al, 2011 and Olowe et al, 2016 who analysed drinking water qualities in Ado-Ekiti and Ota respectively.

Sample	Temp°		pH		Conductivity µmhos/cm		Total Solids		Suspended Solids		Dissolved Solids		Turbidity NTU		Colour HU	
	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS
UW1	27.00	27.50	7.20	7.10	1.50	1.55	41.54	38.25	13.50	11.97	28.04	26.28	1.10	0.9	5.00	5.00
UW2	26.00	27.00	6.50	6.60	1.20	1.30	57.38	51.78	43.50	30.22	13.88	21.56	8.90	6.40	15.00	10.00
UW3	26.50	26.50	6.70	6.80	4.70	5.80	59.66	53.09	34.45	30.01	25.21	23.08	11.40	9.50	20.00	10.00
UW4	27.50	27.00	6.95	6.70	3.45	4.20	51.50	45.34	41.38	32.31	10.12	13.03	8.50	6.10	15.00	10.00
UW5	28.00	27.50	7.30	7.10	10.10	9.95	45.40	43.56	21.11	29.31	24.29	32.27	3.40	3.20	10.00	10.00
UW6	29.00	30.00	7.10	7.20	14.00	14.20	50.30	49.51	17.60	21.59	32.70	42.81	1.60	1.34	10.00	10.00
MEAN	27.33	27.58	6.96	6.92	11.67	8.33	5.83	6.17	50.96	46.92	28.59	25.90	5.82	4.57	11.67	8.33
S.D	0,90	1.03	0.27	.0.21	4.28	4.22	5.73	4.68	11.72	7.08	7.88	9.28	3.61	2.78	5.05	2.15
C.V	0.04	0.04	0.04	0.03	0.73	0.68	0.11	0.10	0.41	0.27	0.35	0.35	0.61	0.61	0.43	0.26

Table 1: Physical Characteristics of Surface and Underground Water Sources at Ipoti-Ekiti

The colour values were 5-20Hu and 5-10Hu for wet and dry seasons respectively. The values are higher for surface water in wet season than in dry season, a phenomenon that can be attributed to run offs that are common during the wet season at the former than the latter. The values for surface water are above the WHO and NDWQS. Excessive turbidity is known to protect microorganisms from effect of disinfection and can stimulate bacteria growth in water (Gideon, 2013). The result is in agreement with study conducted by Tembekar et al, 2012.

Sample	Total Hardness mg/L		Ca2+ Hardness mg/L		Mg2+ Hardness mg/L		pH		Acidity mg/L		Alkalinity mg/L	
	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS
UW1	26.10	25.61	12.10	11.56	10.14	13.85	7.20	7.10	7.54	5.71	9.70	10.80
UW2	29.25	27.87	10.25	10.80	17.75	16.97	6.50	6.60	32.50	29.06	56.65	59.10
UW3	75.50	74.90	26.54	27.16	48.10	46.74	6.70	6.80	43.75	38.22	86.32	92.35
UW4	46.30	45.76	20.70	18.90	23.55	26.36	6.95	6.70	38.95	35.27	79.59	95.55
UW5	98.90	96.53	36.14	39.55	62.20	56.48	7.30	7.10	13.40	12.90	56.40	54.98
UW6	83.75	82.65	70.38	65.27	10.92	17.08	7.10	7.20	6.25	6.05	92.25	93.80
MEAN	59.97	58.89	29.35	28.87	28.78	29.58	6.96	6.92	23.75	21.20	62.65	64.44
S.D	25.28	24.94	18.50	17.33	17.89	14.87	0.27	0.21	13.83	12.25	24.92	25.75
C.V	0.42	0.42	0.63	0.60	0.62	0.50	0.04	0.03	0.58	0.58	0.40	0.40

Table 2: Chemical Characteristics of Surface and Underground Water Sources at Ipoti-Ekiti

Sample	DO mg/L		BOD mg/L		CODmg/L		SO42-mg/L		NO3-mg/L		Cl-mg/L	
	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS
UW1	2.00	2.00	4.25	4.05	46.10	43.20	5.72	5.99	1.61	1.24	87.97	82.54
UW2	2.50	2.00	6.25	5.95	230.00	211.50	12.68	10.78	7.59	5.99	103.64	96.20
UW3	4.50	4.00	42.00	33.60	379.50	356.10	28.85	22.45	34.20	31.51	355.89	294.88
UW4	3.50	3.50	28.60	22.10	272.00	249.70	13.54	12.26	31.40	30.98	295.91	227.70
UW5	2.00	2.00	8.20	7.70	38.20	39.20	12.92	11.66	28.75	29.19	47.55	41.09
UW6	1.50	2.00	5.30	5.20	26.90	25.30	18.27	16.80	2.55	3.02	19.32	18.62
MEAN	2.66	2.58	15.80	13.06	165.45	154.16	15.33	13.32	17.45	16.37	151.71	126.83
S.D	0.94	0.77	13.08	10.08	124.15	115.08	6.45	4.71	12.58	11.92	116.25	91.58
C.V	0.35	0.30	0.83	0.77	0.75	0.75	0.42	0.35	0.72	0.73	0.77	0.72

Table 2: Chemical Characteristics of Surface and Underground Water Sources at Ipoti-Ekiti

The water analysed recorded higher values of colour that ranged between 5-20Hu during the wet seasonand 5-10Hu for wet and dry seasons respectively. The values are higher for surface water in wet season than in dry season, a phenomenon that can be attributed to run offs that are common at the former than the latter. The values for surface water are above the WHO and NDWQS. The results follow the same trend in the turbidity values due probably to the same reason. Excessive turbidity is known to protect microorganisms from effect of disinfection and can stimulate bacteria growth in water (Gideon, 2013).

From the result of the hardness, the water samples can be described as being moderately soft (Adejuwon and Adelakun, 2012) while the hardness ranged between 26.10-98.90 and 26.61-96.53 mg/L. The Ca2+ hardness in all the samples are within WHO maximum permissible limit. However, the Mg2+ hardness for the three of the locations: UW3, UW4, and UW5 are above the WHO recommended limit which may be as a result of the geological nature of the soil with which the water is in contact with. High magnesium value can reduce mobility and mortality for cardiovascular and motor neuronal diseases, pregnancy disorder and pre-eclampsia while high calcium value can reduce the risk associated with fracture in children (Balanet al, 2012). But high values of these ions in water wastes soap.

The values for total solids ranged between 41.54-59.66 and 38.25-53.08mg/L for wet and dry season respectively. In all the surface water, the suspended values were more than the dissolved values unlike in the underground water in which the dissolved values were more than the suspended values. The trend may be due to the fact that surface water is more prone to particulate contamination from atmosphere than the underground water. However, since drinking water should be free of any suspended entities, there is the need for the water to be treated to remove the suspended particles. The total solid and dissolved solids values are below the WHO recommended values. The total dissolved solids is a measure of the overall quality of the water just as it reveals the amount of organic and inorganic substances dissolved in the water (Mandal and Nand, 2014). Therefore, high amount of it in drinking water reduces water quality by imparting bitter taste and causing scaling in pipes (Ackah et al, 2011).

The acidity values were between 7.54-43.75 and 5.71-38.22mg/L while the alkalinity values were between 9.70-92.35 and 10.80-93.80mg/L for wet and dry seasons respectively. There is no much difference in the alkalinity values of the water samples as can be seen in their coefficient of variation whereas there is in the acidity values. Both the alkalinity and acidity values are below the WHO recommended limit.

The conductivity values ranged between 1.25 x 102 and 14 x 102μmhos/cm for wet season and 1.30 x 102 and 14.20 x 102 μmhos/cm. It could be seen that the conductivity values for underground water were higher than those of surface water except in spring water as a result of mineral intrusion. This shows that the mineral content is generally lower in the surface water than in the underground water. The conductivity values for the underground water (UW5 and UW6) are above the WHO permissible limit but that of spring water is within it.

Chloride was found to be low in underground water than the surface water. The chloride values fall between 19.32-355.89 and 18.62-294.88mg/L for wet and dry seasons respectively. The higher chloride values of the surface water may be attributed to contamination from run-offs. High chloride content is known to impart taste and cause corrosion (WHO, 2011). The presence of chloride in water has been attributed to natural and anthropogenic sources including use of inorganic fertilizers, landfills, effluents from industries, sewage, dissolution of salt deposits and refuse leachates among others (Lathamani et al, 2014). The chloride values of the fish pond water (UW3) and river water (UW4) are above the WHO desirable limit of 250mg/L.

The Biological Oxygen Demand (BOD) of the fish pond water is the highest. BOD, being a measure of pollution strength of water, shows that the fish pond water is the most polluted. This may be attributed to the fact that virtually all the run offs from the town empty into the pond. This high BOD value portends great danger for the aquatic animals in the fish pond as the organic matter in the water, in its attempt to get decomposed, would deplete the dissolved oxygen in the pond. This may spell doom for the aquatic animals in the pond. A better erosion management policy is therefore suggested in the town.

Nitrate in surface water is higher than the underground ones. While nitrate ranged between 1.24 and 34.20mg/L, the sulphate concentration in the samples analysed is between 5.72 and 28.85mg/L.The values of nitrate and sulphate are below the WHO standard. High nitrate imparts taste and causes physiological distress just as it is known to cause methaemoglobinemia in infants while sulphate in particular induces gastro-intestinal irritation, catharsis, dehydration and corrosion in distribution systems (Ibu and Onu, 1998; Adesina and Akinyele, 2006).

The Chemical Oxygen Demand (COD) values are higher in the surface water than the underground water. As could be seen, the highest COD value was recorded for pond water. Since COD is a measure of pollution strength, it could be said that the pond water is the most polluted followed by the two river water. This situation may be attributed to higher amounts of run offs from rainstorms which run into the surface water than the underground water.

Sample	TBC cfu/mL x 10^2		TFC cfu/Ml		TC MPN/100mL		FC MPN/100mL	
	WS	DS	WS	DS	WS	DS	WS	DS
UW1	2.95	2.90	29	31	0	0	0	0
UW2	5.75	4.66	73	67	6	4	0	0
UW3	8.03	6.89	96	95	12	9	5	2
UW4	7.25	5.71	59	36	9	5	1	1
UW5	3.49	3.22	52	59	2	1	1	1
UW6	2.05	1.99	0	0	0	0	0	0
WHO Limit	1.0	1.0	0	0	0	0	0	0
Mean	4.92	4.23	51.5	48	4.83	3.17	1.17	0.67
Std Deviation	2.47	1.85	33.90	24.75	12.17	1.94	1.94	0.82
C.V	0.50	0.44	0.66	0.52	2.52	0.61	1.66	1.22

Table 3: Microbiological Characteristics of Surface and Underground Water in Ipoti-Ekiti.

The result of the microbiological analysis of the untreated water samples as presented in Table 3 shows that the total bacteria count (TBC) was lowest in borehole water (UW6) for both wet and dry seasons while the counts were fairly higher in the two river water (UW2 and UW4), pond water (UW3) and well water (UW5). Total Fungal counts (TFC), Total Coliform (TC) and Faecal Coliform (FC) reveals the unwholesomeness of the water samples except the borehole water, the river water (UW2) and the spring water. This could be attributed to the fact that the three water sources are not located where they could be polluted by seepage from sewage and run off from erosion water. The faecal pollution of the other three water sources calls for concern as their consumption could lead to water borne diseases.

4.0 Conclusion and Recommendation

The results of the analyses show that parameters like temperature, pH, total solid, dissolved solid, calcium hardness, alkalinity, sulphate and nitrate are below the WHO's recommended limits at both wet and dry seasons while parameters like colour, conductivity, suspended solid, magnesium hardness, chloride, BOD, COD and turbidity have values that are above WHO limits in some of the water samples. The colour, suspended solids, turbidity, NO3-, SO42-, Cl-, BOD and COD are affected by seasons as their values at wet season are more than those recorded at dry season.

Generally, the quality assessment of the spring and borehole water as revealed by the results of the physicochemical and microbiological analyses confirm both water suitable for drinking, cooking and other industrial purposes. However, the borehole water would require treatment to remove hardness causing ions to make them suitable for washing without wasting soap. The water sources would need one form of treatment or the other for them to be useful for domestic purposes.

From this study, it is hereby recommended that governments at all levels in Nigeria should take the issue of provision of potable water more serious so as to prevent water borne diseases. To this end, government should expand the various dams and water facilities as regularly as possible to ensure potable water is within the reach of the teeming population at all times. This is necessary in order to achieve the government's Sustainable Development Goals (SDGs).

References

1. Ackah M., Agyemang O., AnimA.K., Osei J.,Bentil N.O., Kpattah L. (2011). Assessment of ground quality for drilling and irrigation: The case study of Teiman-Oyerifa Community, GA East Municipality Ghana Proceedings of the International Academy of Ecology and Environmental Sciences; 1(3-4): 186-194.
2. Adejuwon J.O. and Adelakun M.A. (2012).Physicochemical and bacteriological analysis of surface water in Ewekoro Local Government Area of Ogun State, Nigeria.Case study of Lala, Yobo and Agodo Rivers. International Journal of Water Resources and Engineering, 4(3):66-72.
3. Ademoroti C.M.A (1995a).Environmental Chemistry and Toxicology Foludex Press Ltd., Ibadan.
4. Adesina, K. and Akinyele S.A. (2006).Quality Assessment of Spring Waters in Ado-Ekiti Metropolis; Nig. Journal of Env. Management, Vol.7, pp.11-14.
5. Agbaire P.O. and Obi C.G. (2009).Seasonal Variations of some Physicochemical Properties of River Ethiope Water in Abraka, Nigeria. J. Appl. Sci. Environ. Manage. Vol.13(1);55-57
6. Akpor, O.B. and Muchie, M. (2011). "Challenges in meeting the MDGs: The Nigerian Drinking Water Supply and Distillation Sector". Journal of Environmental Science and Tech, 4 no 5: 480-

489.

7. Aladejana, J.A. and Talabi, A.O. (2013).“Assessment of ground water quality in Abeokuta South west Nigeria”.International Journal of Engineering and Science, 2 no 6: 21-30.

8. Ali, K.A. (2012). “Development of Water Supply Infrastructure in Nigeria: Challenges and Prospects”. Delivered at “2012 Nigerian Society of Engineers October Lecture. October 4, 2012 available at www.nse.org.ng.

9. AOAC (1984).Official Methods of Analysis, 14th Edition, Association of Official Analytical Chemists, Washington D.C.

10. AOAC.(1990). Official Methods of Analysis, 15th Edition, Association of Official Analytical Chemists, Washington D.C.

11. American Public Health Association (1965).Standard Methods for the Examination of Water and Water Wastes.12th Ed. APHA N. York.

12. Balan I.N, Shivakumar M, Kumar RDM (2012). An assessment of ground water quality using water quality index in chennai, Tamil Nadu, India Chronicles of young scientists 3(2): 146-150.

13. Chinedu, S.N, Nwinyi O.C, Adetayo, Y.O, Eze V.N (2011). Assessment of water quality in Cannanland, Ota, Southwest Nigeria. Agric. Biol. J.N. Am, 2(4): 577-583.

14. Daramola, S.O. (2013).Groundwater quality assessment of some boreholes from Odo-Oro Ekiti, South West Nigeria (2013). J. Environ. Sci, Toxico and Food Techn; 7(2): 58-62.

15. Duru C.E. Njoku, V.O. and Obi C. (2008). Heavy metal concentration in urban water wells: Acase study of Owerri Municipal. J. Chem. Soc. Nigeria Vol. 33, No. 2, pp.89

16. Ellis K.V. (1989).Surface water pollution and its control, 3rd Ed., Macmillan Publishers Ltd., London pp.174-190.

17. Gideon, Y.B; Fatoye, F.B, Omada, J.I. (2013).Quality assessment of physico-chemical characteristics of Okura River, Kogi State, Nigeria. Int. J. Sci. Tech, 2(12): 891-899.

18. Ibe K.M. and Onu N.N. (1998).Nig. J. Tech. Educ. 15, 64.

19. Lathamani R, Janardhana M.R., Smesha S. (2014).Application of water quality index method to assess groundwater quality in Mysore City, Karnataka, India. Inter. J. Innovative Res. Sci., Eng. Tech., 3(5): 501-508

20. Mandal, N.S., Nand, D. (2014). Study of some physicochemical water quality parameters of Karolariver, West Bengal- An attempt to estimate pollution status. International Journal of Environmental Protection, 2(8): 16-22.

21. Olowe B.M., Oluyege, J.O. and Famurewa O. (2016). An Assessment of Drinking Water Quality using Water Quality Index in Ado-Ekiti and Environs, Nigeria. ACSJ. 12(2):1-7.

22. Orewole M.O and Makinde O.W., Adekalu K., Shittu K.A. (2007). Chemical examination of piped water supply of Ile-Ife in Southwest Nigeria. Iran J. Environ. Health. Sci. Eng., 4(1): 51-56.

23. Shalom, N.C., Obinna, C.N., Adetayo, Y.O., Vivienne N.E. 2011). Assessment of water quality in Cannanland, Ota, Southwest Nigeria. Agric. Biol. J.N. Am, 2(4): 577-583.

24. Tabatabau M.A. (1974).Determination of sulphatein water samples.Sulphur Institute Journal, Vol. 10 pp. 11-13.

25. Tembekar P., Morey P., Batra, R.J., Weginwar R.G. (2012).Quality assessment of drinking water.A case study of Chandrapur District. J. Chem. Pharm. Res; 4(5): 2564-2570.

26. TWAS (2002).“Safe Drinking Water”.The need, the problem, solutions and action plan. Third World Academy of Science, Italy, pp.8 12.

27. World Health Organisation (2011).Guidelines for drinking water quality.4th Edition. W.H.O. Press, Geneva, Switzerland; 223-230.