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Rapid assessment of reservior water quality and suitability indices for drinking purpose: A case study of ero and ele reserviors in Ekiti state Nigeria

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Abstract
Water is essential for sustenance of life and determines the overall socio-economic development of any nation. However, with rapid increase in the population of the country, the pollution of water courses from human activities and the demand for potable water to satisfy the growing demography cannot be over emphasized. In this perspective, an attempt has been made to assess the drinking water quality in Ele and Ero reservoirs. The two reservoirs were constructed for drinking purposes. The results obtained from chemical and microbiological analyses were compared with two water quality standards namely National Standards for Drinking Water Quality (NSDWQ) and WHO. The parameters analyzed were the physio-chemical and microbiological parameters. These include; Temperature, Electrical conductivity, Total dissolved solid, pH, Total hardness, turbidity, chloride, iron, nitrate, fluoride and magnesium. The entire physio-chemical parameters were found to be within the permissible limits of NSDWQ and WHO, while microbiological quality parameters such as total coliform and feacal coliform were found to be beyond the limits. The high values observed with microbiological parameters in these water bodies suggest that they are not suitable for drinking purpose, unless some possible remedial methods are to be adopted to treat these water bodies.

Keywords: Physio-chemical, microbiological parameters, Ele and Ero Reservoirs, Drinking water supplies, Ekiti State, Nigeria.

1. Introduction
Water is one of the most important natural resource and a basic human need required in all aspect of life. It is required for the improvement in health and well-being, food production, agricultural activity, energy generation, maintenance of environment for sustainable life and development (Gupta *et. al.* 2009; Plappally, 2012). Human activities such as urbanization, agricultural development, over use of fertilizers, inadequate land use management and sewage disposal have directly or indirectly affected the quality of water and making it unfit for domestic purpose (Singh & Mathur, 2005; Ashraf *et al*., 2015; Vrebos *et al*., 2015). Fresh water has become a scare commodity due to over exploitation and pollution (Mahobe & Mishra, 2013). According to figures issued by the World Health Organization (WHO, 2006), an average of 50,000 people die each day from diseases associated with contaminated water, that is one person every second. This is a grim reminder of how much we need potable water. Water in its natural state, shows marked difference in quality depending on the type and location of sources hence it is necessary to evaluate quality of water of that area in order to assess its suitability for various uses and to evolve policies for the best use of water resources. The study attempts to analyse the physio-chemical and microbiological parameters of water samples from the two reservoirs to determine their suitability for drinking purposes.

2. Study area
The Ero and Ele rolled earth dams were commissioned in 1985 and 1975 respectively. These reservoirs were constructed on Ero and Ele Rivers. These reservoirs were constructed basically to provide water for domestic purposes. The reservoirs are in located in Ekiti State in Ekiti-Moba and Ikole Local Government Areas of Ekiti State, Nigeria. The water of these reservoirs is supplied to nearby towns for various activities. They are located in latitude 7^0 57^1 N, 7^0 59^1N and longitude 5^0 29^1E, 5^0 11^1E. The design capacities of the dams are 105,000 m^3/day for Ero and 5175m^3/day for Ele. The annual rainfall of the state is over 2000mm

(www.ekitistate.gov.ng). These reservoirs are located within the tropical climate which experiences two distinct seasons i.e. the rainy seasons (April to October) and the dry season (November to March). The temperature ranges from 21^0C and 28^0C with high humidity (www.ekitistate.gov.ng).

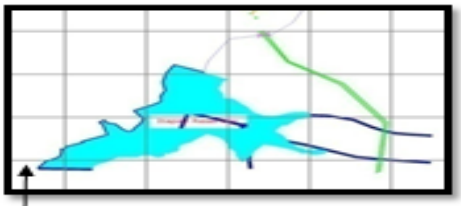

Fig 1: Ero Dam

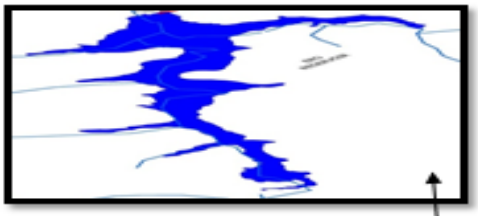

Fig 2: Ele Dam

Fig 3: Map of Nigeria showing Ekiti State (Source www.ekitistate.gov.ng)

3. Materials and Methods

The present study was carried out in the month of March 2013. Surface water samples were collected from Ero and Ele reservoirs in clean polyethylene container. The temperatures (^{0}C) and pH of water samples were recorded at the site. Water samples were analyzed by standard methods for hydrogen ion concentration (pH), electrical conductivity (EC), total hardness (TH), total dissolved solids (TDS) and important cations such as magnesium (Mg^{2+}), sodium (Na^+), as well as anions such as chlorides (Cl^-), nitrate, fluoride and Iron. The pH and EC values were measured in the field using a portable conductivity and pH meter. TDS were computed from EC multiplied by a factor 0.64 (Lloyd and Heathcote, 1985). Na^+ and K^+ were determined by flame photometer, SO_4^{2-} was analysed spectrophotometrically. TH as $CaCO_3$, CO_3^{2-}, HCO^{3-} and Cl^- were analyzed by volumetric method. Mg^{2+} was calculated from Total Hardness contents. The Microbiological parameters analyzed were the total coliform and feacal coliform.

4. Result and Discussion

The analysed physio-chemical and microbiological parameters were tabulated in Table 1. Comparison of the various physio-chemical and microbiological characteristics of the studied water samples were made with the WHO (2006) and NSDWQ Standards (2007).

Table 1: The mean observed values of the physio-chemical and microbiological parameters in Ele and Ero reservoirs

S/N	Parameter	Ero Reservoir	Ele Reservoir	NSDWQ	WHO
1	pH	6.8	7.3	6.5-8.5	6.5-8.5
2	EC	212µs/cm	247µs/cm	1000	1000
3	TDS	108mg/l	128mg/l	500	500
4	Temperature	28.2	28.4	Ambient	-
5	Turbidity	2.92NTU	2.56NTU	5	5
6	Nitrate	0.20 mg/l	0.30mg/l	50	10-50
7	Chloride	12 mg/l	9.9mg/l	250	200-250
8	Total Hardness	56 mg/l	64mg/l	150	100-500
9	Sodium	7 mg/l	9mg/L	200	200
10	Magnesium	5.85 mg/l	8.7mg/l	20	20
11	Iron	0.03mg/l	0.03mg/l	0.3	0.3
12	Flouride	0.04 mg/l	0.03mg/l	1.5	1.5
13	Total Coliforms	<21cfu/100ml	<31cfu/100ml	<10cfu/100ml	<10cfu/100ml
14	Faecal Coliforms	9cfu/100ml	12cfu/100ml	0cfu/100ml	0cfu/100ml

4.1. The Physio - Chemical Parameters Aspect

4.1.1 PH: The pH plays a very crucial part in waste water treatment and for fixing alum dose in water supply. Kumar, (2002) reported that higher values of pH hasten the scale formation in water heating apparatus and reduce germicidal potential of chlorine. Water generally becomes more corrosive with decreasing pH. However, excessively alkaline water also may be corrosive (USEPA, 1994a). The Table 1 above shows that the pH level is slightly alkaline and acidic *i.e.* 7.3 and 6.8 for Ele and Ero respectively. The observed values are within WHO and NSDWQ permissible limits.

4.1.2 Electrical conductivity: Electrical conductivity can be used to determine the approximate concentration of dissolved solids. A sudden increase in conductivity of the water is the indicator of the addition of the pollutant to the water (Trivedi & Goel, 1984). Conductivity is an important criterion in determining the suitability of water for drinking purpose. The conductivity values of samples were found to be 247µs/cm and 212µs/cm for Ele and Ero respectively. The results of the study are within the limits of WHO and NSDWQ. Electrical conductivity value lies in the range of medium salinity zone (250-750 micro mho/cm^2).

4.1.3 TDS: TDS indicates the general nature of salinity of water. Water with high TDS have salty taste and produce scales on cooking vessels and boilers. The palatability of water with a total dissolved solids (TDS) level of less than about 500 mg/l is generally considered to be good (WHO, 2006). In Table 1 above the TDS were found to be 128 mg/l in Ele and 108mg/l in Ero reservoirs respectively. The mean values are within the NSDWQ and WHO permissible limits.

4.1.4 Temperature: Temperature has implications on the usefulness of water for various purposes. Generally, users prefer water of uniformly low temperature (USEPA, 1994a). Dwivedi & Pathak (2007) reported that temperature plays a very important role in physical-chemical and biological behavior of aquatic system. It can also impact on palatability of water (WHO, 2006). Higher temperatures has encroaches growth of microorganism and may increase taste, odour, colour and corrosion problems. The mean temperature values of water were found to be 28.4^{0}C for Ele reservoir and 28.2^{0}C for Ero reservoir.

4.1.5 Turbidity: The raw water samples are commonly colored due to the presence of colloidal substance, inorganic impurity, aquatic growth and decomposition of vegetation. Turbidity can also indicate problems associated with treatment processes especially with coagulation/sedimentation and filtration (Yates *et al*. 2014). The mean values of turbidity obtained for the samples are 2.56 NTU for Ele and 2.92 NTU for Ero reservoirs. These are within the NSDWQ and WHO permissible limits. The water samples were also found to be odourless, colourless and clear for both reservoirs.

4.1.6 Nitrate: The main sources of nitrate in water are human and animal waste, industrial effluent, use of fertilizers and chemicals and silage through drainage system (Henriques *et al*. 2015). When nitrate concentration is above 40 mg/dm^3, it may lead to a disease called "Methamoglobinemia" or "blue baby" in children. Table 3.1 mean values for nitrate in Ele and Ero reservoirs are 0.30mg/l and 0.20mg/l respectively indicate that the values are within the NSDWQ and WHO permissible limit.

4.1.7 Chloride: Large concentrations increase the corrosiveness of water and, in combination with sodium, give water a salty taste (USEPA1994a). WHO (2006) recommended that when chloride exist in excess of 200-300mg/l, it impacts salty taste to water and people who are not accustomed to high chloride are subjected to laxative effect. The chloride content of the samples in Table 1 shows 9.9mg/l for Ele and 12mg/l for Ero reservoirs which indicates that the values are within the desirable limits of NSDWQ and WHO.

4.1.8 Total hardness: The total hardness has been attributed mainly due to Calcium and Magnesium (Patel & Sinha, 1998; WHO, 2006). The water containing excess hardness is not desirable for potable water as it forms scales on water heater and utensils when used for cooking and can result to excessive consumption of more soap during washing of clothes. The total hardness value of samples for Ele and Ero are 64mg/l and 56mg/l reservoirs respectively and are within the desirable limits (Table 1).

4.1.9 Magnesium: The sources of Magnesium (Mg) in natural water are as a result of weathering of various types of rocks, industrial waste and sewage (Samantara *et al*. 2015). The Mg concentrations of the samples were found to be 8.7 mg/l for Ele and 5.85mg/l for Ero reservoirs respectively. It reveals that values are within the permissible limits WHO and NSDWQ standards.

4.1.10 Iron: The primary concern about iron in drinking water is its objectionable taste**.** Kidney stone related problem may develop if iron contents are high (WHO, 2006). The presence of iron can also stains laundry and plumbing fixtures. Table 1 shows concentration of iron in present sample for Ele as 0.03mg/l and 0.03mg/l for Ero reservoirs respectively and are within the acceptable limits.

4.1.11 Fluoride: Fluoride content is an important factor for the development of normal bones and teeth. Excessive fluoride gets deposited on teeth causes dental fluorosis, deposited on bones causes skeletal damage in both children and adult (WHO, 2006) and (USEPA, 1994a). The required level is 1-1.5 mg/l for drinking purpose. Table 1 above indicated that the fluoride values within the desirable limit (0.03 and 0.04mg/l for Ele and Ero respectively).

4.2 The Microbial Aspect

Total coliform: Total Coliform bacteria occur in both sewage and natural waters. Some of these bacteria are excreted in the faeces of humans and animals, but many coliforms are heterotrophic and able to multiply in water and soil environments (WHO, 2006). The presence of E. coli (or, alternatively, thermos tolerant coliforms) provides evidence of recent faecal contamination, and detection should lead to consideration of further action, which could include further sampling and investigation of potential sources such as inadequate treatment or breaches in distribution system integrity. The values of total coliform (31 and 21 CFU for Ele and Ero respectively) and total feacal coliform (12 and 9 CFU for Ele and Ero respectively) are beyond the acceptable limits of WHO and

NSDWQ. Therefore this water can be used for drinking purpose only after suitable treatment of water.

5. Conclusion

The present study leads to the following conclusions that, water samples analysed indicate that physio-chemical parameters such as pH, alkalinity, hardness, Ca, Mg, nitrate, fluoride, chloride, TD and electrical conductivity values are within the WHO and NSDWQ permissible limits for drinking water. The values of Microbial parameters are well above the WHO permissible limit. Microbial parameters are measures of water quality that reflect the amount of Total Coliform bacteria that occur in both sewage and natural waters. Therefore this water can be used for drinking purpose only after suitable treatment of water. Therefore the water of Ero and Ele reservoirs is suitable for drinking purpose.

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References

1. Ashraf, M. A., Sarfraz, M., Naureen, R., & Gharibreza, M. Metallic Elements in the Mining Areas: Water Quality Assessment. In *Environmental Impacts of Metallic Elements*. 2015; 53-75. Springer Singapore.
2. Dwivedi, S. L., & Pathak, V. Studies of water quality of Mandakini River in chitrakoot for irrigation purposes. *Indian journal of environmental protection*. (2007); 27(8), 751-754.
3. Gupta, P., Vishwakarma, M., Rawtani, P.M. Assesment of water quality parameters of Kerwa Dam for drinking suitability. *International Journal of Theoretical & Applied Sciences*, 2009; 1(2), 53-55.
4. Henriques, C., Garnett, K., Weatherhead, E. K., Lickorish, F. A., Forrow, D., & Delgado, J. The future water environment-Using scenarios to explore the significant water management challenges in England and Wales to 2050. *Science of The Total Environment*. 2015; 512, 381-396.
5. Kumar, A (2002): Ecology of polluted waters (vol. 2). New Delhi. APH Pub. 2002; 144.
6. Lloyd, J. W. and Heathcoat, J. A. A Natural inorganic hydrochemistry in relation to groundwater. Clarendon Press, Oxford, England. 1985.
7. Mahobe, H., & Mishra, P. Study of Physico-Chemical Characteristics of Water Ponds of Rajnandgaon Town, Chhattisgarh. *International Journal of Scientific & Engineering Research*. 2013; 4(8).
8. NSDWQ. National Standard for Drinking Water Quality: *Standard Organization of Nigeria, Abuja, Nigeria*. NIS.554; 2007.
9. Patel, N. K & Sinha, B. K. Study of the pollution load in the ponds of Burla area near Hirakud Dam of Orissa. *Journal of Environment and Pollution*. 1998; 5(2), 157-160.
10. Plappally, A. K. Energy requirements for water production, treatment, end use, reclamation and disposal. *Renewable and Sustainable Energy Reviews*. 2012; 16(7), 4818-4848.
11. Samantara, M. K., Padhi, R. K., Satpathy, K. K., Sowmya, M., & Kumaran, P. Groundwater nitrate contamination and use of Cl/Br ratio for source appointment. *Environmental monitoring and assessment*. 2015; 187(2), 1-13.
12. Singh, R. P & Mathur, P. Investigation of variations in physico-chemical characteristics of a fresh water reservoir of Ajmer city, Rajasthan. *Indian Journal of Environmental Sciences*. 2005; 9(1), 57-61.
13. Trivedy, R. K & Goel, P. K. Chemical and biological methods for water pollution studies. *Environmental publications*. 1984.
14. USEPA. Water-quality criteria, standards, or recommended limits for selected properties and constituents U.S. Environmental Protection Agency. 1994a
15. Vrebos, D., Staes, J., Struyf, E., Van Der Biest, K., & Meire, P. Water displacement by sewer infrastructure and its effect on the water quality in rivers. *Ecological Indicators*. 2015; 48, 22-30.
16. WHO. Guidelines for Drinking Water Quality, First Addendum to the Third Edition Vol. 1, 2006: 491-493.
17. World Health Organization. (1993). *Guidelines for drinking-water quality: recommendations* (Vol. 1). World Health Organization.
18. www.ekitistate.gov.ng.
19. Yates, B. J., Zboril, R., & Sharma, V. K. Engineering aspects of ferrate in water and wastewater treatment–a review. *Journal of Environmental Science and Health, Part A*. 2014; 49(14), 1603-1614.