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Review Article

Water Quality Status of Nigeria Surface Water through Physicochemical Parameters: An Empirical Review

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ABSTRACT
The importance of water to man and aquatic organisms cannot be overemphasized. Neither aquatic animals nor plants can survive outside water. Despite this, many water bodies, especially surface water are unfit for domestic use because of water pollution as a result of several factors such as, anthropogenic activities, discharge of untreated industrial waste into the water bodies, run off of agricultural waste and chemical into the water bodies. Polluted water has a serious effect of aquatic organism as they require healthy environment for growth, development and productivity. Drinking polluted water can also lead to several diseases which can eventually lead to death. One of the key ways to determine the quality of water is through their physicochemical properties, the physicochemical properties of water is a pointer to the water quality standard. This review was conducted to determine the current status of Nigeria surface water by synthesizing current knowledge on research done on the physicochemical properties of the water in Nigeria water bodies between 2015 and 2025. Based on the finding from this work, it was discovered that most of the Nigeria surface water is polluted as most of the physicochemical parameters were above the WHO limit. By synthesizing recent knowledge this review aims to guide future research on the necessary remediation processes and decision making that help reduce the pollution levels of these water bodies.

Keywords: Anthropogenic activities; Physicochemical parameters; Pollution; Surface water; Water quality

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INTRODUCTION

Water pollution has become a general problem in different part of the world. This pollution is as a result of growing population and anthropogenic activities which has led to the pollution of surface water bodies' (Victor *et al*., 2024). Surface water monitoring is very essential because it forms the basic sources of drinking water for several household and communities, especially for developing countries like Nigeria (Aralu *et al*., 2022). Surface water serve as a medium for waste disposal, especially industrial effluents and agricultural waste, these industrial and agricultural waste are untreated which can lead to the deterioration of water quality and the degradation of these water bodies that receives such waste (Edori and Aniekun, 2021). Access to good quality drinking water has shown to have a direct impact on the people's health and the society at large. Consumption of polluted water has several

negative impacts on human health and also on the aquatic organisms (Edori, 2020). Aquatic organism such as plant and animals need a suitable healthy environment for growth and development (Adewuyi, 2017). One of the key way of monitoring water quality is through their physicochemical properties, the physicochemical parameters of water is a pointer to the pollution status of any water bodies. The assessment of water parameter are important to determine the rate to which the quality of water can be appreciated and also is a medium toascertain the level of water acceptability for domestic functions (Banunle *et al*., 2018) . Therefore, when considering the quality of water for domestic function, the physicochemical properties of water is a key tool (Onyegeme-Okerenta *et al.,* 2016). Therefore, this empirical review is to show the current water quality status of Nigeria surface water through their physicochemical properties by exploring recent published work within 2015-2025.

Selection Criteria

For a comprehensive review, original article was downloaded from different data base such as semantic scholar, google scholar, research gate, ISI web of Knowledge and Pub MED. This review includes articles published 2015-2025. Which were searched using several keywords such as water quality, physicochemical parameters, water pollution, etc

Empirical Studies

Table 4.1 is the collection of about twenty five (25) published articles that was used for this review, and research must be conducted on Nigeria surface water.

Table.1: Summary of the physicochemical parameters of some of the Studies on Pollution of Surface Water in Nigeria

S/N	Author	Research topic	Results	Conclusion
1	Onyegeme *et al*. (2017)	Seasonal variations in physicochemical and bacteriological parameters of Ulasi river, Okija, Anambra	The results showed that the water parameters were above the permissible limit	This study demonstrated the influence of rural land use and seasonal effects on water quality in Ulasi river. The data clearly shows that the downstream is more polluted than upstream.
2	Enetimi and Okogbue (2016)	Physicochemical quality assessment of river Orashi in Estern Niger, Delta State	The result showed that temperature and ph was higher in dry season	There were mild anthropogenic activities in terms of parameters assessed.
3	Ayandiran *et al* (2018)	Water quality assessment of Bitumen polluted Oluwa river, South Western Nigeria	All the physical parameters of the water samples were from two sampling sites did not show deviation from Nigeria industrial standard for permissible levels of these parameters in drinking water. All chemical parameters investigated during the dry season was significantly different from rainy season except for BOD at $p<0.05$ Heavy metals in river oluwa exceeded	From this studies, surface water and sediment of Oluwa river was found to be grossly polluted with organic and heavy metal as evident in high COD and BOD and low DO observed in this study

permissible levels for drinking water

Table1. Continued

S/N	Author	Research topic	Results	Conclusion
4	kalu et al. (2024)	Assessment of selected physicochemical parameters of selected rivers around Umudim Nnewi, Anambra State, Nigeria and its environs	The physicochemical parameters significantly deviated from WHO standard	Water was polluted as a result of anthropogenic activities in, and beside the river
5	Egesi*et al* .(2023)	Analysis of physicochemical characteristics of River Benue, Nigeria	The value of the physicochemical parameters tested in this study were within the permissible limits recommended by WHO except for TSS, pH, turbidity, temperature, fluoride BOD and COD.	The results of the study showed that anthropogenic pressure is a key player influencing water quality at the four sampling stations of River Benue.
6	Iwar *et al*. (2021)	Assessment of heavy metal and physic-chemical pollution loading of river Benue at Makurdi using quality index (WQI) and multivariate statistics	The physicochemical parameters of the water were above the permissible limit by WHO.	It was concluded that the increasing and diverse nature of anthropogenic activities on the river course was responsible for the deteriorating quality of the water.

7	Abdulmalik *et al*.(2018)	Assessment of physicochemical and element quality of water from river Lavum, Bida, Niger state	The physicochemical parameters of the river water , namely : temperature, pH, alkalinity, conductivity, phosphate, nitrate, biochemical oxygen demand, chemical oxygen demand evaluated was within acceptable limit set by WHO and Nigeria industrial standard while DO, was above the limit	The presence of heavy metals above the allowable limit makes the river water unsafe for domestic use and consumption.

Table1. Continued

S/N	Author	Research topic	Results	Conclusion
8	Ukenye and Taiwo (2019)	Studies on the physicochemical status and biological characteristic of some rivers in Nigeria costal states.	The water quality of the coastal rivers is in normal condition because the physicochemical parameters were within the tolerable limit for aquaculture	The result indicated that the environment was conducive for the organism during the study period
9	Oseji *et al* (2019)	Assessment of physical and chemical characteristics of surface water from river Niger, Illushi, Edo State	The study revealed that turbibidity, dissolved oxygen, biochemical oxygen demand , water temperature were higher than the recommended limit from drinking water	It then stressed the need for compliance of environmental laws to prevent the river from further deterioration.

10	Edori *et al* (2020)	Variation of some physicochemical parameters in surface water of Elelenvo river, River state, Niger Delta	The result showed variation of the parameters in the sampled location. Conductivity, turbidity, chloride and sulphates were higher than the recommended limit for domestic water by WHO while other parameters such as TSS, TDS, temperature , pH , redox potential, salinity , nitrate and phosphorus were within the acceptable limit	The underlining condition showed human influences on the concentration of some parameters and salt water influence on chloride.
11	Okoye and ogbebor (2024)		This study found that the water quality of all chosen rivers was poor and unfit for drinking without previous treatment	The anthropogenic activities near the water surface have affected the water quality.

Table1. Continued

S/N	Author	Research topic	Results	Conclusion
12	Ogbe *et al* .(2020)	Assessment of physicochemical characteristic of lower river Niger at Kpata, Adankolo and Gadumo station in Kogi State	The study showed that the water parameters were within the range that support fish growth and survival	The result indicated that the environment was conducive for the organism during the study period
13	Dienye and woke (2015)	Physicochemical parameters of the upper and lower reach of the new caliber river , Niger delta	The water across the season exhibited variation in the increase and decrease in the physicochemical variation parameters	

15	ThankGod and Ruth (2016)	Comparative evaluation of the physicochemical parameters of major rivers in Enugu Urban	The result showed that some physicochemical parameters which were above WHO permissible limits but the obtained values of the physicochemical in the water samples showed a significant difference when compared with WHO permissible limits for those physicochemical	

Table1. Continued

S/N	Author	Research topic	Results	Conclusion
16	Okey-Wokeh *et al,* (2023)	Anthropogenic impacts on physicochemical and heavy metal concentration of Ogbor hill river water, Southern Nigeria	The water parameters were elevated beyond the threshold for surface water	This was an indication that the water river was badly impacted due to human pressure and needed to be kept safe from human use.
17	Davies and Efekemo (2022)	Physicochemical parameters and heavy metals distribution in selected shell fishes along the opuro-Ama Creek in River state	The physicochemical parameters of the water such as ph, temperature, conductivity, Total dissolved solid, biological oxygen demand, dissolved oxygen and salinity were within the acceptable levels in the guidelines for drinking. Although chemical oxygen demand and total suspended solid were above the persimissible level.	The river water was slightly affected by anthropogenic activities
18	Okere and Davies (2021)	Variation of the physicochemical parameters, nutrients and some selected heavy metals around the waters of the Tincan Island in Lagos	The DO was lower than the WHO recommended for water quality assessment with a significant difference ($p < 0.05$) recorded across the station and months.	The concentrations of the heavy metals in the water samples were within the safe limit but posit a potential human and fisheries health implications from continuous usage.
19	Adestina *et al* (2024)	Dynamics of physicochemical parametersistic as indicator of water quality: a case study of Ogun River	The result indicate that the factors that increase the turbidity, electrical conductivity and total dissolved solid levels will decrease the level of pH, and do while exerting a less significant effect on BOD.	The study provides valuable insight into the changes and integrations of parameters that affect the water quality, which is crucial for the sustainable and quality

management of the water system.

Table 1. Continued

S/N	Author	Research topic	Results	Conclusion
20	Dele et al, 2023	Physicochemical characteristics and heavy metals levels in surface waters from Aba- Ila, Ibadan, Oyo State.	All the parameters were below the WHO permissible limits. Self-reported response responses of the participants to the questioner indicate pollution from cement quarrying site.	The quality of surface water in the study area was compromised and polluted in significant proportions.
21	Umoren *et al.* (2024)	Impact of human activities on the physicochemical quality of streams around Ijeun-Titun and Kuto community in Abeokuta, Ogun state	The temperature (except the upstream D) dissolved oxygen, electrical conductivity, total dissolve solid, and total alkalinity across the streams was within the WHO standard. Salinity across the stream was higher than the WHO standard. Chloride ion was higher than the WHO standard.	The study revealed an unacceptable concentration of salinity and DO across stream, the stream, chloride ions in stream B (ijeun-Titun) and c (Isale-oja) and temperature upstream of stream D (Isabo) in the community.
22	Victor et al., 2024	Evaluation of selected physicochemical properties of River Otamiri, Imo state	The study showed that the river water is acidic (Low pH) with electrical conductivity, turbidity, and nitrate value above the recommended lit according to the national standard for drinking water quality.	The concentrations of the heavy metals in the water samples were within the safe limit but posit a potential human and fisheries health implications from continuous usage.
23	Olorunjuwon et al., 2023	Evaluation of the physicochemical properties and bacterial loads of selected rivers in Ondo State	Most physicochemical parameters showed no significant differences from the WHO permissible limits for drinking water	The study revealed that the river investigated are mostly unfit for domestic purposes

Table1. Continued

S/N	Author	Research topic	Results	Conclusion
24	Nasirudeen and Jude, 2020	Assessment of physic-chemical properties and water quality of river Kandami near the Adudu lead mining site in Nasarawa State.	The physicochemical parameters of water from river Kandami analysed were within the threshold of WHO recommended limit except for total dissolved solid.	The water quality index revealed that the water is of good quality.

25	Edori and Aniekan 2021	Physical and chemical characteristic of water from Okamini Stream,Obio/Akpor, Rivers State, Niger Delta.	The result revealed that electrical conductivity, total dissolved solids, total suspended solid, chlorides, sulphates, nitrates and Phosphates were within the range of value acceptable for domestic water use by WHO. Others such as turbidity, pH and salinity were not within acceptable limit range in water for human consumption.	The water from this stream at the time of evaluation may not be at alarming situation but call for protection to avert possible decay that looks eminent.

CONCLUSION

Nigeria is blessed with a lot of water bodies, especially surface water bodies like, river, lake, and stream. These water bodies are used for different purpose such as aquaculture activities such as rearing of fish; most communities make use of this water for their domestic activities and agricultural activities. This water bodies also serve as a source of income to several communities who live within the range of these water bodies. Therefore, it is very important to maintain the quality of this water by protecting the water bodies from contaminant that will pollute these water and make it unfit for use. From the evidence of results showed by this study, most of the Nigeria surface water is polluted and unhealthy for domestic use. This water should be treated before use to avoid disease causing organism and pathogens. This review also suggests that the Nigeria government should take necessary major to remediate this situation and formulate policies that will prevent the public and industries from discharging untreated waste into the body of water.

Conflict of interest: The authors declare that they have no conflict of interest.

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