ASSESSMENT OF WATER QUALITY POLLUTION INDEX FOR FISHING IN JIBIA DAM, KATSINA, NIGERIA.

BACKGROUND

The quality (status of physicochemical parameters) of the freshwater ecosystem interacts with the biotic components of the ecosystem such as plankton, aquatic insects, snails and fishes. Water quality affects the abundance, species composition/diversity, stability, productivity and physiological condition of indigenous populations of aquatic organisms. Some species flourish in highly eutrophic waters while others are very sensitive to organic or chemical waste (Auta *et al*., 2023). Pollution refers to Introduction of Harmful Substances, such as Toxic chemicals or Excessive Amounts of Nutrients, into the Environment, resulting in Negative Impacts on the Quality of life for both Humans and other living organism, Including plants and Animals pollution of surface and Ground water is often Caused by a variety of Human Activities such as Industrialisation, Urbanisation and Agriculture, which Release pollutants into these Sources of water. Mustapha *et al*., (2024).

Freshwater sources in the form of rivers are considered a fundamental for the well-being of a hale and healthy society. Unfortunately, during the last decades these natural resources were being contaminated due to anthropogenic activities and natural disasters such as flood (Minakshi and Goswami, 2017; Mohammed and Abdulrazzaq, 2018). Ogbozige, et al., (2017) evaluate the water quality of river Kaduna using a water quality index revealed that the water quality of 4 sampling stations was poor and the overall quality of water was at marginal class since 11 samples out of 15 felt within the marginal stage. Many researchers have used various statistical techniques in evaluating river water quality which includes multivariate statistical techniques (Chabuk, et al.

2020), statistical kriging (Karamouz, et al. 2009), indexing approaches (Anyanwu, and Ukaegbu, 2019), Fuzzy theory methods (Wang, et al. 2014), GIS and remote sensing (Madhloom and Alansari, 2018). Other researchers have applied a water quality index (WQI) to assess the quality of surface water such as Olasoji, et al. (2019). These methods were developed under specific conditions and, therefore, there is a need to choose an optimal water quality assessment method for the specific purpose and particular watershed (Babić, et al., 2019). Therefore, this study aimed at assessing the Water Quality Pollution Index for Fishing in Jibia Dam, Katsina State. The result were compared with international standard safe limits and standards, which will produce the statutory background knowledge to land experts and stakeholders for necessarily actions. Therefore, the Gap here To our knowledge, only little research were performed on water quality index (WQI) was performed to evaluate the quality of Jibia Dam water and the quality of the water has not been fully exploited so far. There is need for periodic monitoring of physico-chemical parameters found in Jibia Dam. Results obtained from this study will reveal the status of fish consumed by the populous from different areas.

MATERIALS AND METHODS

Study Area: The dam was designed in 1987 and completed in 1989 and was built to support irrigation activities in Jibia LGA. The study was conducted on Jibia Dam, located in Jibia Local Government Area of Katsina State, in North-Western Nigeria, bordering Maradi Town of Niger Republic. Jibia Town is located about 43 km west of Katsina Town, in Katsina State. Its coordinates are Latitudes 13°04'18"N, 13°10'N and Longitudes 07°15'06"E, 07°.30'E (Fig. 1).The study was done between 2020 and 2021.

Sampling points: Ten (10) points (Figure 3) was selected in the dam, the edges, upstream, middle and downstream were consider in the selection of samples and 105m interval between each stationwas also look into consideration as Adopted from Warish et al. (2017).

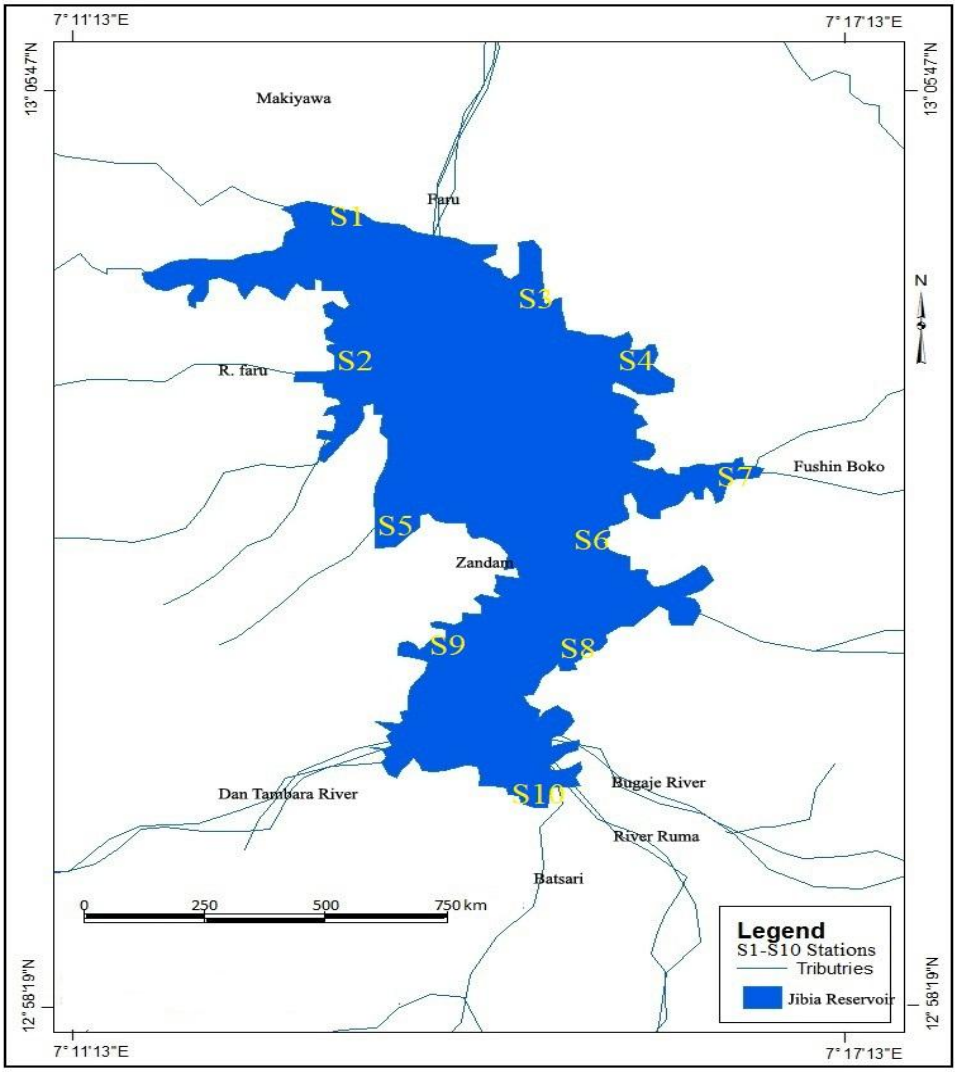

Figure 1: Jibia Dam showing sampling locations.
Source Field work, 2020

Analytical Procedures and Laboratory Analysis

Water samples were analyzed for temperature (T), pH, Electric Conductivity (EC), Total Dissolve Solid (TDS), Turbidity, Total Hardness, Chloride (Cl), Nitrate (NO3), Dissolve Oxygen (DO), Biological Oxygen Demand (BOD), Ammonia (NH3), Nickel (Ni), Lead (Pb). Temperature were measured using Thermometer. Hydrogen ion concentration (pH) were measured using pH meter (pH 3505 Janway). Electrical conductivity (EC) were measured using EC meter (EC 4510 Janway). DO and BOD using HANNA HI 9143 meter. Total

dissolved solids (TDS), chloride (Cl^-) and total hardness (TH) were measured using titrimetric method. Standard method described by American Public Health Association (APHA, 2012) was used in the determination of these parameters.Nitrate was determining by UV-Vis Spectrophotometric method at 220 and 275 wavelength (nm), 1.8 band pass (nm), 1.0 cell length (cm) and cell type "Quartz". Ammonia and nitrite were toxic to the fish, Nitrate is harmless and is produced by the autotrophic Nitrobacter bacteria combining oxygen and nitrite. Nitrate levels are normally stabilized in the 50100 ppm range. For NH_3 The use of bulb pipette quantitatively to transferred a 10ml aliquot of the cleaning solution sample to a 100 ml volumetric flask. Dilute to the mark with distilled water, replace the stopper and mix the contents by inverting and swirling the flask a number of times. Using a bulb pipette, quantitatively transfer a 25ml aliquot of the diluted cleaning solution sample to a 250ml Erlenmeyer flask. Wash down the inside of the flask with about 50ml of distilled water delivered from a wash bottle. Add 2 drops of methyl red indicator and mix well after which readings are obtained (APHA,1999). Nickel (Ni), Lead (Pb) were determined using AAS standard method. The analysis was done at Soil and Water laboratory, Geography department, Umaru Musa 'Yar'adua University Katsina, Nigeria.

RESULTS AND DISCUSSION

WATER QUALITY POLLUTION INDEX

The descriptive statistics of physicochemical parameters and total metal concentrations in Jibia Dam were calculated.

Contamination Index (Cd)

The result reveals the level of contaminated parameters were compared

based on water quality classification value for Fishing. Among the 13 parameters tested, the result indicated low contaminant index (Table 1 and 2 Appendix I). The Cd values for ten parameters were found to be low with contamination of <1, which is 76.92%. This indicate that the Jibia Dam is low polluted with respect to Temperature, pH, Electric Conductivity, Turbidity, Total Hardness, Chloride, Nitrate, Dissolve Oxygen, Nickel and Lead (Table 2). Only BOD is medium contamination index with contamination ranges between (1-3) with constitute 7.69%. TDS and NH3 are high of contaminants index, (>3), cover15.39% of the total parameters analyzed. The result is contrary to that of Edet and Offiong, (2002) Evaluation of water quality pollution indices for heavy metal contamination monitoring, a study case from Akpabuyo-Odukpani area, Lower Cross River Basin (Southeastern Nigeria). This happens due to anthropogenic activities like onload and uploading of oil as well as nature of the barren land in the area.

The findings are of this study are similar to that of El- Hamid and Hegazy, (2017) Evaluation of Water Quality Pollution Indices for ground water resources of New Damietta, Egypt which reveals the values vary between -5.1 to -0.3 which indicate low concentration.

Among all the parameters analyzed the finding shows that Total Dissolve Solid (TDS) has the highest value in all the ten (13) parameters analyzed with mean value of 741.46 and Dissolve Oxygen (DO) in the study shows the lowest value with mean value of -0.076 (Table 2). Results shows that Jibia Dam of the present study is acceptable for fish activities and there is significant acceptable Contamination Index (Cd) status in Jibia Dam.

Table 1 Water Quality Classification Based on Contamination Index (Cd) Value for Fishing

CONTAMINATION INDEX(Cd)	Water quality status
<1	Low
1-3	Medium
>3	High

Source: Mohan et al., (1996)

Table 2. Contamination Index (Cd)

S/N	PARAMETERS	Cn	Ca	Cd	Status
1	TEMP.	30	26.81	-0.106	Low
2	pH	9.0	6.99	-0.223	Low
3	EC	200	116.95	-0.415	Low
4	TDS	0.13	96.52	741.46	High
5	TUR.	80	30.60	-0.618	Low
6	TH	150	196.83	0.312	Low
7	CL	250	96.15	-0.615	Low
8	NO3	100	13.41	-0.866	Low
9	DO	67.13	62.04	-0.076	Low
10	BOD	20	45.93	1.297	Medium
11	NH3	0.02	11.93	595.5	High
12	Ni	0.20	0.24	0.200	Low
13	Pb	0.10	0.13	0.300	Low

Source Survey, 2021

Metal Pollution Index (MPI)

The Result of the analysis of the physicochemical parameters of the Dam shows Temperature, pH, Electrical Conductivity, Total Dissolve Solid, Turbidity, Total Hardness, Chloride, Nitrate, Dissolve Oxygen, Biological Oxygen Demand, Ammonia and Lead are within the range of pure status. Only one variation in Metal Pollution Index (MPI) which is Nickel (Ni) that is slightly affected by pollution (Table 3 and 4, Appendix II). Result is substantiated with El- Hamid and Hegazy, (2017) Evaluation of Water Quality Pollution Indices for ground

water resources of New Damietta, Egypt, result showed that concentration of Metal Pollution Index (MPI) are within the permissible WHO limits, the range between station are 0.00016 to 0.0016, 0.003 to 0.00, 0.00, 0.006 to 0.00, 0.00 to 0.004 and 0.002mg/l. The result is contrary to our work but within the limit. Result of MPI shows 92.31% of the concentration is pure and 7.69 is slightly affected.

Among all the parameters analyzed the finding shows that Total Nickel (Ni) has the highest value in all the thirteen (13) parameters with value of 1.20mg/l and Total Dissolved Solid (TDS) in the study shows the lowest value with 0.503mg/l. There is significant acceptable Metal Pollution Index (MPI)status in Jibia Dam (Table 4).

Table 3 Water Quality Classification using Metal Pollution Index

Class	Characteristics	MPI
I	Very pure	<0.3
II	Pure	0.3-1.0
III	Slightly affected	1.0-2.0
IV	Moderately affected	2.0-4.0
V	Strongly affected	4.0-6.0
VI	Seriously affected	>6.0

Source: (Lyulko et al., 2001; Caerio et al., 2005).

Table 4 Metal Pollution Index (MPI)

S/N	PARAMETERS	MAC	Ci	(MPI)	Status
1	TEMP.	27.00	26.81	0.993	Pure
2	pH	7.27	6.99	0.963	Pure
3	EC	133.58	116.95	0.876	Pure
4	TDS	191.72	96.52	0.503	Pure
5	TUR.	55.66	30.60	0.550	Pure
6	TH	215.57	196.83	0.913	Pure
7	CL	103.49	96.15	0.930	Pure
8	NO3	15.12	13.41	0.887	Pure
9	DO	67.13	62.04	0.924	Pure

10	BOD	51.01	45.93	0.900	Pure
11	NH3	12.84	11.93	0.932	Pure
12	Ni	0.28	0.24	1.200	Slightly affected
13	Pb	0.20	0.13	0.650	Pure

Source: Survey 2021

Water Pollution Index (WPI)

Water Pollution Index (WPI) were compared with Table 4 water quality classification value for Fishing. Among the 13 parameters tested the result indicated Temperature, Electrical Conductivity, pH, Biological Oxygen Demand, Chloride, Turbidity (Tur), Total Hardness (TH), Nitrate (NO3), Nickel (Ni) and Lead (Pb) are very pure which constitute 76.92%. Dissolve Oxygen (DO) is the only pure that is 7.69% (Table 6). Ammonia (NH3) and Total Dissolve Solid (TDS) are the heavily impure that is 15.39% based on water pollution index status remark (Table 5 and 6). The result shows that there is pronounced variation in terms of those parameter at Jibia dam. The result is substantiated to that of Madalina et al., (2020) studied a Comparative Approach to a Series of Physicochemical Quality Indices Used in Assessing Water Quality in the Lower Danube Romania which revealed major as pure based on WPI is rank. Manoj et al., (2016) Studied water Pollution Index assessment of capture and culture fishery in Barpeta district, Assam India, the study reveals in both the capture and culture fisheries that water pollution index is found indicating poor water quality status, which suggest for proper management of the fisheries to yield better growth dynamics were contrary to those findings due to spacio-anthropogenic and climatic factors. Al-Ani, (2019).

Among all the parameters analyzed the finding of WPI shows that Total Dissolve Solid (TDS) has the highest value in all the ten (13) parameters

stations with mean value of 57.14 and Nitrate (NO3) with lowest value 0.01 from Jibia Dam. There is significant acceptable Water Pollution Index.

Table 5 Water Quality Classification Based on the Water Pollution Index (WPI).

WPI Value	Water Quality Class
≤0.3	Very pure
0.3–1.0	Pure
1.0–2.0	Moderately polluted
2.0–4.0	Polluted
4.0–6.0	Impure
≥6.0	Heavily impure

Source: Medalina et al., (2016)

Table 6 Water Pollution Index (WPI)

Parameters	Ai	T	Ai/ T	WPI	Remark
Temperature	28.81	30	0.86	0.069	Very pure
Electrical conductivity (EC)	116.95	200	0.59	0.045	Very pure
Ph	6.99	9.0	0.78	0.060	Very pure
Dissolved oxygen (DO)	62.04	6	8.86	0.68	Pure
Biological oxygen Demand (BOD)	45.93	20	2.30	0.18	Very pure
Chloride (CL)	96.15	250	0.39	0.03	Very pure
Ammonia (NH3)	11.93	0.02	596.5	45.89	Heavily impure
Total Dissolved Solid (TDS)	96.52	0.13	742.46	57.14	Heavily impure
Turbidity (TUR.)	30.60	80	0.383	0.03	Very pure
Total hardness (TH)	196.83	150	1.31	0.1	Very pure
Nitrate (NO3)	13.41	100	0.13	0.01	Very pure
Nickel (Pb)	0.24	0.2	1.2	0.09	Very pure
Lead (Pb)	0.13	0.1	1.3	0.1	Very pure

Source: Field work, 2021

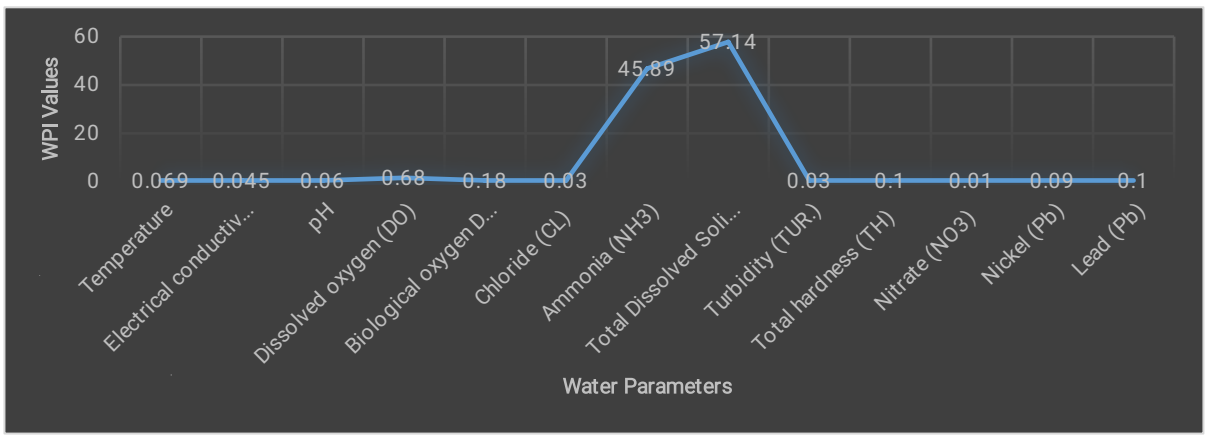

Figure 2 Graphical Presentation of Water Pollution Index Values

SUMMARY

Result reveals the Contamination index (Cd) level of parameters were compared based on water quality classification value for Fishing, values for ten parameters were found to be low with contamination which is 76.92%,

7.69% medium and 15.39% are high. 92.31% of Metal Pollution Index (MPI) are within the range of pure status, only 7.69 are slightly affected. Water pollution index reveals 76.92% very pure, 7.69% pure, and 15.39% heavily impure for fish farming. The water is healthful for fishing.

CONCLUSION

Contamination Index (Cd), Metal Pollution index (MPI) and Water Pollution Index (WPI) remark shows the water is healthful for fishing. Findings reveals without considering the level of water quality in the Dam which may lead to the death of fishes and contamination of the water.

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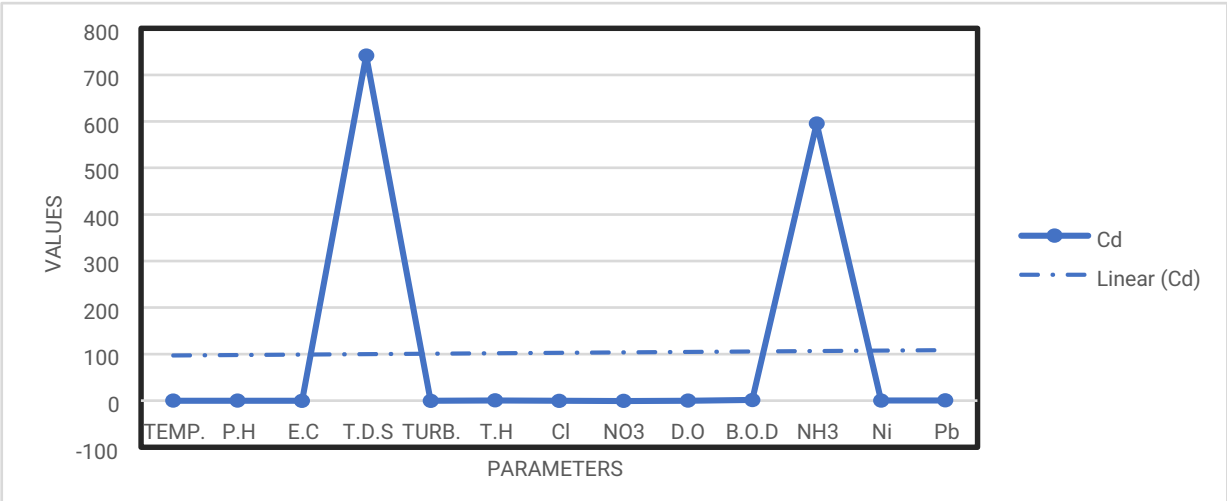
Conflict of interest

The Authors have declared that no conflict of interest exist.

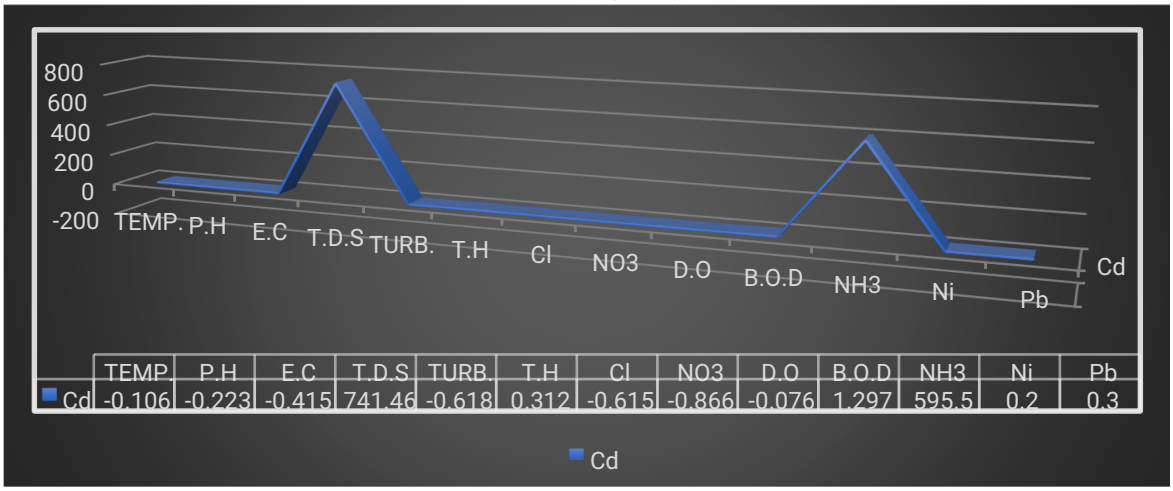
Appendix I

Contaminant Index Status (C_d)



Appendix II

Metal Pollution Index status (MPI)



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