Assessment Of Some Physicochemical Parameters Of Gubi And Waya Reservoir In Bauchi State, Nigeria

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Abstract: This work was conducted to evaluate the physicochemical parameters of the Gubi and Waye reservoir located in Bauchi and Ganjuwa LGA, Bauchi state Nigeria. The main aim of this research was to find out the suitability of the water from the reservoirs for domestic and irrigation purposes. Water samples were collected monthly for two successive months (March to April 2019) at three sampling sites and were analyzed for various physicochemical parameters such as temperature, PH, Electrical Conductivity, Turbidity, Total dissolved solids (TDS), Nitrate (NO3-), Nitrogen (N), Silicates (SiO2-), phosphate (PO4-), Dissolve Oxygen, Biological oxygen demand (BOD5) The study showed that the mean value of studied parameters, except turbidity and pH in April at Gubi reservoir, all the parameters measured were within the permissible limit of WHO for drinking water and FAO for irrigation water. Therefore, the water was found to be fit for human consumption and was found to be safe and utilizable for irrigation purposes.

Key Words: Assessment, Gubi, Physicochemical, Parameters, Pollution, Reservoir, Waya

1. INTRODUCTION

Water is one of the most important and available compounds of the ecosystem. Every living organism existing on earth needs water to enable them reproduce, survive and grow [1]. One of the characteristics of water is, it is a universal solvent and has the capacity to neutralize many substance including organic and inorganic substances. Because of this outstanding characteristics of water can be ascertained to be inconceivability to collect water in its pure form [2]. Water quality believes to be the component of water present at the optimum level for favorable growth of plants and animals. Aquatic lives prefer a healthy and clean environment to live and enough nutrients to support their growth; the productivity depends on the physicochemical properties of water body [3], [4]. Higher production can be possible only when the physical and chemical properties of the water body are at optimum level. Water use for human consumption must be pure and free from organisms and chemical substances with large concentration that is capable of creating health effects [5]. There has been increased in pollution as a result of growing human population, industrialization, the use of fertilizers for agricultural purposes and man-made activity, knowledge of water body parameters such as temperature, ph, turbidity, dissolve oxygen, biooxygen demand etc. is an important factors that determines water quality and the important factors that determines water quality and the abundance of organism in the water body [6].

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Persistent monitoring off physicho-chemical parameters of the water body has been carried out for decades In different developed countries [7], [8]. Evaluation of universal water quality and dissolved metal concentrations of aquatic ecosystems have been comprehensively conducted [9]. [10]. However, at hand is limited research on water quality and pollution height of water bodies in the developing countries.[11], [7]. The main objective of this research were (i) to find out the suitability of the water from reservoir for domestic and irrigation purposes and (ii) to generate the baseline information of the physicochemical parameters and determine its suitability for various domestic and irrigation purpose of the reservoirs.

2. MATERIALS AND METHODS

2.1 STUDY AREA 1: GUBI DAM

Gubi reservoir is located at a village called Piro in Bauchi, Bauchi State, Nigeria. Longitude $10^{o}25''$N to $10^{o}26''$N and latitude $90^{o}51''$E to $9^{o}52''$E. The main source coming from three tributaries namely Gubi, Tangwaye link with Shadawanka and Ran River. The function of the reservoir is to supply the State Capital and its environs with portable water supply, fishing and irrigation. The Reservoir has a length of 3.8km with a reservoir area hectare of 590ha. It has a maximum height of 27km and storage capacity of 3.840,000 cubic meters. The catchment area is 19000m^3 /d [12].

2.2 STUDY AREA 2: WAYA DAM

Waya reservoir is located at Ganjuwa LGA, Bauchi State, Nigeria and about 25km away from Bauchi town, longitude 10.0142^{o}N and latitude 10.3453^{0}E. Waya reservoir is the main source, created mainly to supply portable water for domestic consumption and irrigation, small hydropower station. Constructed by Upper Benue River Basin from 1994-1999. The reservoir has a maximum length of 26m, [13], base width of 96m: crest width of 6m; crest length of 370m and 505m above sea level [14]. The surface area is 4.5 km^2 while the net water storage capacity is 3,000,000 cubic meters. The water retention time is between 3–4

months in the raining season, while the water residence time in the dry season is few days due to high evaporation .

2.3 SELECTION OF SAMPLE SITES

The water samples were collected from three different points of the lake. The points can be classified into three types. 1. Inlet point – As sample A. 2. Centre point – As sample B. 3. Outlet point - As sample C

2.4 COLLECTION OF SAMPLES

The water samples were collected in the plastic bottles. Initially, the prewashed bottles were rinsed with sample water. The closed bottle was dipped in the lake at the depth of 0.5 m, and then a bottle was opened inside and was closed again to bring it out at the surface. The samples collected in three replicates from three different points were mixed together to prepare an integrated sample.

2.5 PHYSICO-CHEMICAL PARAMETERS

To study the physico-chemical properties of the lake water content, water samples were collected from the lake surface in a clean plastic container for the period of two months, March 2019 to April 2019. Samples were collected during morning hours in between 7.00 to 10.00 a.m. using one litre container. The physical and chemical parameters were analyzed for March and April respectively. Parameters including temperature, PH, Electrical Conductivity, Turbidity, Total dissolved solid (TDS), Nitrate (NO_3^-), Nitrogen (N), Silicates (SiO_2^-), phosphate (PO_4^-), Dissolve Oxygen, Biological oxygen demand (BOD_5), were analyzed. We adopted standard guidelines of water sampling and physico-chemical parameters evaluation [15]. Parameters such as temperature, PH, Electrical Conductivity, Total dissolved solid (TDS), Turbidity, Dissolve Oxygen, Biological oxygen demand (BOD_5), Nitrate (NO_3^-), Silicates (SiO_2^-) phosphate (PO_4^-) and temperature were directly evaluated in the study area whereas other parameters were analyzed in laboratory using Dissolve oxygen meter, Ph/TDS/Ec/^{O}C meter, DR/890 Colorimeter

2.6 DATA ANALYSIS

The Analysis of variance (ANOVA) for data obtained was analyzed using Minitab 16.0. The variation between the reservoir was done using one way ANOVA at $p<0.05$ level of significance.

3 RESULTS AND DISCUSSIONS

TEMPERATURE (^{0}C)

Temperature is an key factor in controlling physicochemical and biological parameters of water, especially in the aquatic environment mostly in freshwater [16]. In our study, in March the temperature recorded at Gubi reservoir was 29.2 and 31.0^{0}C, while at Waya reservoir in March 29.1 and 31.2^{0}C. In both the sites temperature had not differed significantly at 95% confidence level. Waya dam had the highest temperature of 31.2.The increased in temperature in both the dams could be due to high solar radiation, low water level, clear atmosphere and high atmospheric temperature [17]. These is found within the permissible limit of [18]

PH

pH is an indication of the intensity of the acidic or basic behavior of a particular water and it can be controlled through dissolved chemical compound and biological process in the solution [19]. During the month of March the PH of 8.5 was recorded at Gubi reservoir, and 6.8 in March. Similarly at Waya reservoir we recorded 9.0 in March and 7.2 in April. In both the sites pH had differed significantly at 95% confidence level. Optimal range of pH for sustainable aquatic life and irrigation is 6.5-8.5 according to [18] and [20]. This shows that the pH of both the reservoir in March and April 2019 is within the permissible limits. Except at Gubi reservoir in April. The lower pH in the reservoir may be attributed to removal of CO_2 by photosynthesis through bicarbonate degradation, dilution of water with fresh water, reduction of temperature and decomposition of organic matter [21].

ELECTRIC CONDUCTIVITY (µs/cm)

Electric Conductivity (EC) is not a human or aquatic health concerns, it play role as an indicator of other water quality problems. When the values of EC are high, it shows a confirmation of huge quantity of ionic material within the water [22]. The mean for electric conductivity in April at Gubi reservoir was 66.7 and 56.7µs/cm was recorded in March. Similar trait was observed at Waya reservoir in April 83.3 and 80.0µs/cm in March. From the value recorded, the maximum EC was obtained in Waya reservoir with 83.3(µs/cm). In both the sites EC had differ significantly at 95% confidence level. The acceptable range of EC for inland surface water is 1200µs/cm [23], [18] is 750µs/cm and [23] is 3000µs/cm [18],[20]. From our study, the results obtained from Gubi and Waya dam were within the acceptable range.

TURBIDITY (NTU)

The turbidity of water can be related to the expression of optical property and reflects the intensity of light scattered by the particles inside the water. High turbidity was recorded in both the reservoirs in the month of March with Gubi reservoirs having 34.0 and 25.7NTU in April. The same traits were obtained in Waya reservoir with 34.1 March and 22.3 NTU in April. Comparing between the two dams in questioned the highest turbidity was observed in Waya reservoirs with 34.1NTU in March, although just slightly than Gubi reservoir in March with 34.0. The low turbidity was observed in April at Waya reservoir. Turbidity mean values recorded had differed significantly at 95% confidence level. The turbidly mean value obtained for the both two sites are above permissible limit set by [18] for drinking water and [20] for irrigation. The higher turbidity recorded in March could be due to the growth of aquatic vegetation and lowered water volume.

TOTAL DISSOLVED SOLID (mg/l)

The total dissolve solid shows the level of the salinity of the water [25]. Water having more than 500mg/L of TDS could be dangerous for drinking water supplies [19]. Water with high TDS is destructive or complex for human and aquatic life. It may have a pungent taste, it can also be salty, and or metallic can also have unfriendly odors. High TDS water is also thirst less quenching thirst and can interfere with the taste of foods. Few of these mineral salts which make up

TDS causes variety of health hazards. Also using water with high TDS result in soil salinization and can therefore can cause decrease in micro-porosity although not decrease in crop yields, relative to irrigation with low TDS water. Our present study in Gubi reservoir. in March 48.67 was recorded and 55.33mg/l in April. However, at Waya reservoir in March the TDS value recorded were 64.0 and 66.0mg/l in March. The statistical analysis at 95% confidence level showed that TDS had not differed significantly in Gubi and Waya reservoir. Although the maximum TDS 66.0 (mg/l) was recorded from Waya reservoir in the month of April. This value was within the permissible limit of [18] for drinking and [20] for irrigation water.

DISSOLVE OXYGEN (mg/l)

Dissolve oxygen play important role as regulator of metabolic activities of organism and therefore take charge of metabolism of the living community as a whole and used as an indicator of tropic status of the water [26]. In this our study the highest dissolved oxygen 5.9 was recorded at Gubi reservoir in March and 4.4 mg/l recorded in April. Similarly, 4.4 was obtained in march and mean recorded for April was 3.5 mg/l. Comparing the results from the two sites, the maximum mean 5.9mg/l DO was recorded at Gubi in march, while the least was recorded at Waya. The increased DO in March could be due to increased solubility of oxygen at lower temperature, whereas the lower DO recorded in April could be related to the high temperature and addition of sewage and other wastes can drastically reduce the dissolved oxygen content. The statistical analysis at 95% confidence level showed that DO had not differed significantly in Gubi and Waya reservoir. Similar result was obtained by [27] reported that DO was 6.02 to 7.01mg/l at oinyi River, Nigeria. The result obtained from the both sites is within the [18]WHO set for drinking water and [20] for irrigation.

NITROGEN & NITRATE (mg/l)

Nitrogen in water exist as bound forms like nitrate, nitrite ammonia and organic forms of nitrogen such as urea, amino acid etc. total nitrogen is a level of all forms of nitrogen (organic & inorganic). Nitrogen is an important plant element and is often the small nutrient in marine waters. Nitrites are outcome of oxidation of organic nitrogen by bacteria existing in soil and water where is oxygen abundant. Maximum concentration of nitrite is important in irrigation but their much abundant in water resource increase the growth of nuisance algae macrophytes and trigger eutrophication and pollution [28]. The concentrations of nitrate constantly encountered during treating wastewater, is as a result of ammonium nitrogen Ali, [29]. Numerous workers several times reported to have potential health traits from nitrate in drinking water that above threshold of 45 mg/L, which has lead to the condition called methaemoglobinemia in as reported in infants and pregnant women [30]. Natural soil nitrogen or organic and inorganic fertilizers are one of the primary sources, more also nitrogen in the water for irrigation has been reported to have similar effects like soil-applied nitrogen fertilizer and therefore, an excessive irrigation can also cause problems, similar to too much fertilizer would. If excessive quantities are found or applied, production of several commonly grown crops may be affected due to overstimulation of growth, delayed maturity or poor quality. In our study the concentration of nitrate in the water samples are 14.8 in March to 14.4mg/L in April at Gubi reservoir; while in Waya reservoir the value recorded was 12.0 in March and 7.6 mg/L in April. The statistical analysis at 95% confidence level showed no significance differences among the studied sites. The maximum result was recorded in the month of April with 14.8 at Gubi reservoir. Consequently, our trial findings showed the amount of nitrate, was within the permissible limit of [18] and [20] for drinking and irrigation purposes. Although 3.3mg/L nitrogen was recorded in March and April at Gubi reservoir, while in Waya reservoir in March 2.9 was record and 1.7 mg/L in April. In all the reservoir nitrate and nitrogen had not differed significantly.

SILICATE (mg/l)

The results obtained for SiO_3 that in Gubi reservoir in April 6.3 and 7.8 mg/L in March, while in Waya reservoir in April it was 8.3 and 8.5 mg/L March. Statistical analysis for SiO_3 between the two sites (Gubi & Waya reservoir) showed that SiO_3 had not differed significantly, although the maximum SiO_3 recorded at Waya reservoir in March. 50mg/L Silicate was reported by [31].

BIOCHEMICAL OXYGEN DEMAND

Biochemical oxygen demand (BOD_5) is the amount of oxygen in water that is required by aerobic organism [32]. When BOD level is high in water, it result to lower dissolve oxygen, this is due to because the oxygen in the water are utilized by bacteria and can affects the survival of fish and other organism in the aquatic community[33] . In our present study, 1.5 was recorded in March and 3.0 mg/L of BOD_5 in April at Gubi reservoir, while at Waya reservoir 2.4 in March and 1.8 mg/l of BOD_5 in April. The maximum of BOD_5 between the two sites was in April at Gubi reservoir with 3.0 mg/L of BOD_5. The high BOD5 in April could be due to socioeconomic activities around the reservoir which could lead to deposition of organic waste. Similar findings showed a high level of BOD_5 causes decrease to the value of dissolved oxygen in water [34].

PHOSPHORUS

Phosphorus is a limiting nutrient they support algal growth as such it controls the primary productivity in a water body [26]. Phosphorus is an essential nutrient and also an indicator of anthropogenic biological pollution. When the concentration of phosphate is high, it is responsible in eutrophic condition in a water body. Eutrophication troubles in warm water systems begin at phosphate concentration of order 0.34 to 0.70 mg/l [19]. The mean value for PO_4^{-3} in March Gubi reservoir was 0.2 and April 0.5mg/l. However, in Waya reservoir, in March the mean value recorded was 0.1 and in April 0.4mg/l. The maximum mean 0.5mg\l for PO_4^{-3} was realized at Gubi in March. The mean P_2O_5 at Gubi reservoir in March was 0.2 and 0.4mg/l in April. While at Waya reservoir the mean value was 0.1 in March and 0.3mg/l in April. Similar train was recorded in P_2O_5, the maximum mean 0.4mg\l for P_2O_5 Was realize at Gubi in March. In both the two sites, PO_4^{-3} and P_2O_5 had differed significantly at 95% confidence level. The values recorded at the both sites for PO_4^{-3} and P_2O_5 were above the

recommended values of [18] and [20] for drinking and irrigation water except in Waya reservoir in March.

Table 1: *COMPARISON OF PHYSICOCHEMICAL PARAMETERS OF GUBI AND WAYA RESERVOIR WATER FROM MARCH TO APRIL 2019*

S/n	Parameters Measured	Gubi dam March	Gubi dam April	Waya dam March	Waya dam April	WHO [25]	FAO [28]
1	Temp. (^0C)	0.12± 29.0^a	0.06±31 a	0.57± 29.1^b	0.10± 31.2a	<40	-----
2	PH	0.35± 8.5^a	0.51±9.0 a	0.46± 6.8^a	0.38± 7.2b	6.5-8.5	6.0-8.5
3	E C (µs/cm)	5.77± 56.7^b	5.77±66. 7b	0.00± 80.0^a	5.77± 83.3a	750	3000
4	Turbidity (NTU)	19.10 ±34.0 ^{a}	1.53±34. 7a	7.64± 25.7^a	7.77± 22.3a	5.0	------
5	TDS (mg/l)	2.52± 48.67 b	0.58±55. 33b	1.00± 64.0a	2.65± 66.0a	500	2000
6	NO_3^- (mg/l)	8.92± 14.8^a	5.05±14. 4a	1.21± 12.0^a	4.81± 7.6a	45	50
7	N(mg/l)	2.03± 3.3a	1.12±3.3 a	1.25± 2.9a	1.08± 1.7a	------	------
8	SiO_3 (mg/l)	1.38± 6.3^a	0.70±7.8 a	0.11± 8.3^a	0.62± 8.5a	------	------
9	PO_4^{-3} (mg/l)	0.45± 0.2^a	0.22±0.5 a	0.03± 0.1^b	0.7±0. 4a	0.1	2
10	P_2O_5 (mg/l)	0.04± 0.2^a	0.17±0.4 a	0.07± 0.1^b	0.67± 0.3a	------	------
11	DO (mg/l)	0.70± 5.9^a	52.2±4.4 a	1.24± 4.4^a	0.87± 3.5a	5.0-7.0	>40
12	BOD_5 (mg/l)	0.87± 1.5^a	1.75±3.0 a	1.25± 2.4^a	1.3±1. 8a	2.0-5.0	8.0

-- Not found, Means that do not share a letter are significantly different.

4. CONCLUSION

The study found that the physicochemical measured were within the permissible set limit by WHO and FAO except turbidity in both the two sites and pH in April 2019at Gubi reservoir.

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