

Assessment of Cyanobacterial Abundance and Water Quality in Kazaure Dams, Jigawa State Nigeria

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Abstract

Purity of water depends on how less abundance of toxic compounds and substances deposited in it. Cyanobacteria affect the quality of water especially in the Dams that are mostly used for drinking and other domestic uses. The abundance of cyanobacteria and relation to water quality in Kazaure Dams Jigawa State, Nigeria was evaluated. Data collected were recorded, analyzed, tabled and interpreted using standard procedures. The result of physical and chemical properties of water showed variation between the samplings station, months and Dams in both blooming and decaying seasons. The result on the abundance of cyanobacteria revealed that, Anabaena circinalis and Microcystic aeruginosa were more abundant in Dambo Dam when compared with other species. Least number of cyanobacteria was recorded in Wawan Rafi with and the species observed was Oscillatoria limosa. For seasonal variation, correlation matrix indicated positive correlations (0.4 - 0.96) in all the species of cyanobacteria for blooming season with exception of Chroococcus turgidus which was not significantly different in both the seasons. Blooming season had the highest number of cyanobacterial species (61) than decaying season (46). The cyanotoxins analysis indicated that Cylindrospermopsins and Microcystins were higher in concentration (4.4 to 4.9 µg/L) in Dambo Dam, and Kazaure Dam respectively. Anatoxins and 2-methylisoborneols were recorded in least concentration in Wawan Rafi and Dambo Dams respectively. The quality of water in Wawan Rafi Dam is significant when compared with other Dams. It is recommended that all the three Dams water requires treatment before domestic use.

Keywords: Cyanobacteria, Cyanotoxins, Physicochemical Parameters, Water Quality

1. Introduction

Cyanobacteria is commonly called blue-green algae. It is microscopic in nature and algae-like in appearance that inhabit freshwater, coastal and marine waters in low, moderate or higher number (Mah *et al* 2013). It is photosynthetic organism like other plants and requires sunlight, nitrate, phosphate and other basic elements for growth and reproduction (Uka and chukwuka, 2007., Mustapha, 2008 and Ibrahim 2009). Cyanobacteria reproduce rapidly during blooming season than in the decaying season (Bennette, 2017). It causes environmental problems by disrupting drinking water supplies from sea and other source (Water Research Foundation, 2012). Cyanobacteria releases cyanotoxin such as (microcystin, geosmin, cylindropermopsin, anatoxin and 2-methylisoborneol) due to stress in the blooming season and death in the decaying season (Chen, Burke and Prepas 2011). The toxins released can result in hypoxia or anoxia disorders when taken in drinking water (Mokoena *et al*, 2016). Other potential health effect of

cyanotoxin on human includes: gastroenteritis, fever and irritation of skin, eyes, throat and respiratory tract, neurotoxicity and liver damage (WHO, 2014; 2019; Motodz, *et al* 2019). Threats to freshwaters by toxic cyanobacteria result in contamination of water through deposition of cyanotoxins that leads to reduce water quality in the Dams and kazaure dams inclusive. Canada water report (2014) revealed that, cyanobacteria can contaminate drinking water which may lead to disturbance in the physical and chemical properties vis-a-vis health status of both human and animals. In the study area. The objective of this paper was to evaluate the abundance of cyanobacteria and cyanotoxins deposited in selected Dams in Kazaure Jigawa state, Nigeria.

2. Materials and Methods

2.1 Study Locations

The study was carried out in three Dams of Kazaure Jigawa State, Northern Nigeria (latitude 12° 65' and longitude 8° 413'). The Dams were: Dambo Dam, (11°48'52.476''N and longitude 8°01'42.546''E) with an altitude of 501m. Kazaure Dam (12°18'49.902''N and longitude 8°31'26.898''E) with an altitude of 508 m. and Wawan Rafi Dam (12°08'49.188''N and longitude 8°41'19.248''E) with an altitude of 343 m. For the purpose of sampling, the Dams were divided into six sections; inlet, middle and outlet two station each.

2.2 Water Sampling, and Physicochemical Parameters Analysis

Monthly water sampling of the three Dams were carried out from November to April for the winter or dry season (decay season) and May to October 2021 for the rainy or summer (blooming) season between 20th to 25th of every month between 8:00 am and 10:00 am. Water samples were collected in the dark sample bottles and transported to laboratory for determination of physicochemical parameters. Temperature, pH, dissolved oxygen was measured in situ with the use of Mercury in glass thermometer, pHmeter (Jenway 3510) and DO meter (ecdo602plusk) respectively according to the manufacturers guide, nitrate and phosphate were determined ex situ using standard methods (APHA, 2005).

2.3 Cyanobacteria Identification

Water sample was inoculated in Erlenmeyer flask having algal culture medium (Composition in g/L sodium nitrate 0.1gm, dipotassium phosphate 0.25 gm, magnesium sulphate 0.051 gm, ammonium chloride 0.0051gm, calcium chloride 0.005gm and ferric chloride 0.0005 gm) and incubated at room temperature under continuous dark and sunlight period for 15-20 days, growth from the incubated flask were observed in microscope for morphological characterization (Cristiana, *et al* 2014., Patil, *et.al.* 2015 and Mayur, *et al* 2017). Microscopic observation was done by wet mount technique where the culture was spreaded on glass slide, covered with glass cover slips and observed under (10X) and (45X) objective lens of compound light microscope (Mayur, *et al* 2017).

2.4 Cyanotoxins Analysis

The cyanotoxins were extracted and screen by solid phase micro extraction and gas chromatography micro scan analytical technique for detection and quantifying the concentrations of difference cyanotoxins presence in the water samples collected from Dams using ELISA photometer. The absorbance was observed as described by (Tung *et al.*, 2008, Makoens *et al*, 2016 and Matdoz *et al*, 2019).

2.5 Data Analysis

Data collected were subjected to Analysis of Variance (ANOVA) using SPSS version 23. For the physicochemical parameter, significant means were separated using Turkey Honestly significant difference (Turkey's HSD).

3. Results and Discussion

The results of physical and chemical properties were presented in the tables below and the results showed significant variation across the months and Dams.

Table 1: Means Monthly Temperature and pH Interactions between the Months and Dams

Months	Temperature (°C)			pH		
	Locations			Locations		
	Dambo Dam	Kazaure Dam	W. Rafi Dam	Dambo Dam	Kazaure Dam	W. Rafi Dam
Decay	Season					
January	24.22 ± 1.5 ^{kl}	25.99 ± 2.1 ^{hij}	25.14 ± 2.2 ^{ik}	7.21 ± 1.1 ^f	6.98 ± 1.3 ^f	7.30 ± 1.1 ^{ef}
February	23.33 ± 2.0 ^{lm}	23.00 ± 0.3 ^m	24.12 ± 1.1 ^l	7.30 ± 1.1 ^{ef}	6.87 ± 1.4 ^f	7.31 ± 1.2 ^{def}
March	28.11 ± 2.1 ^f	28.14 ± 2.5 ^f	28.11 ± 2.2 ^f	7.00 ± 1.2 ^f	7.22 ± 1.1 ^f	7.97 ± 1.3 ^{cd}
April	30.90 ± 0.6 ^d	31.99 ± 2.1 ^c	31.98 ± 2.1 ^c	6.00 ± 1.0 ^g	6.13 ± 1.4 ^g	7.22 ± 1.0 ^f
November	26.49 ± 2.1 ^{ghi}	26.71 ± 2.1 ^{gh}	26.56 ± 2.1 ^{ghi}	8.88 ± 1.1 ^a	8.14 ± 1.1 ^{bc}	8.94 ± 1.4 ^a
December	26.84 ± 2.2 ^{gh}	25.61 ± 2.2 ^{ij}	25.26 ± 2.1 ^j	7.96 ± 1.2 ^{cde}	7.11 ± 1.1 ^f	8.12 ± 1.5 ^{bc}
Blooming	Months					
May	34.55 ± 0.6 ^a	34.45 ± 0.2 ^a	35.32 ± 0.3 ^a	5.30 ± 1.0 ^h	6.11 ± 1.3 ^g	6.99 ± 1.0 ^f
June	33.46 ± 0.4 ^b	31.98 ± 1.8 ^c	31.97 ± 1.7 ^c	6.86 ± 1.0 ^f	5.22 ± 1.1 ^h	6.88 ± 1.4 ^f
July	33.44 ± 0.2 ^b	29.11 ± 0.2 ^e	30.91 ± 0.4 ^d	6.12 ± 1.1 ^g	5.30 ± 1.2 ^h	6.00 ± 1.2 ^g
August	29.52 ± 0.3 ^c	30.92 ± 0.4 ^d	30.92 ± 0.2 ^d	6.86 ± 1.1 ^f	6.13 ± 1.1 ^g	6.99 ± 1.3 ^f
September	29.89 ± 0.2 ^{eg}	30.91 ± 0.7 ^d	30.88 ± 0.4 ^d	8.12 ± 1.3 ^{bc}	7.98 ± 1.1 ^{cd}	7.30 ± 1.1 ^{ef}
October	28.11 ± 0.2 ^f	29.30 ± 0.6 ^e	29.17 ± 0.1 ^e	8.54 ± 1.2 ^{abc}	8.12 ± 1.1 ^{bc}	8.66 ± 1.3 ^{ab}

Means with different superscripts in the table are significantly different at P≤0.05. While means with the same superscripts are significantly the same at P≤0.05.

Table 2: Total Dissolved Salt and Turbidity

Months	Total Dissolved Salt (ppm)			Turbidity (NTU)		
	Locations			Locations		
	Dambo Dam	Kazaure Dam	W. Rafi Dam	Dambo Dam	Kazaure Dam	W. Rafi Dam
Decay	Month					
January	680 ^{de}	570 ^{gh}	510 ^{hij}	24.40 ± 15.1 ^d	28.14 ± 11.1 ^b	19.11 ± 11.1 ⁱ
February	620 ^f	510 ^{hij}	500 ^{ij}	23.04 ± 14.4 ^{fg}	27.07 ± 14.2 ^{bc}	19.06 ± 11.1 ⁱ
March	650 ^{ef}	620 ^f	500 ^{ij}	22.40 ± 14.1 ^{fg}	25.82 ± 12.1 ^c	18.61 ± 12.1 ^{ij}
April	540 ^{ghi}	650 ^{ef}	480 ^j	21.60 ± 11.1 ^g	26.06 ± 15.1 ^c	17.61 ± 14.1 ^j
November	750 ^c	750 ^c	570 ^{gh}	27.07 ± 14.1 ^{bc}	28.87 ± 11.2 ^b	22.20 ± 11.1 ^{fg}
December	700 ^{de}	700 ^{de}	540 ^{hij}	24.30 ± 13.1 ^{ef}	25.82 ± 11.1 ^c	21.06 ± 11.2 ^h
Blooming	Months					
May	510 ^{hij}	650 ^{ef}	470 ^j	21.06 ± 15.2 ^g	25.82 ± 12.1 ^c	17.61 ± 13.1 ^j
June	770 ^{bc}	700 ^{de}	620 ^f	27.08 ± 11.1 ^{bc}	28.88 ± 13.1 ^b	26.06 ± 13.1 ^c
July	780 ^{bc}	800 ^b	700 ^{de}	29.14 ± 14.1 ^b	31.88 ± 12.1 ^a	27.01 ± 12.1 ^{bc}
August	800 ^b	860 ^a	770 ^{bc}	31.81 ± 11.1 ^a	33.02 ± 11.1 ^a	31.92 ± 11.2 ^a
September	800 ^b	910 ^a	750 ^c	31.92 ± 13.4 ^a	32.14 ± 11.1 ^a	31.81 ± 12.1 ^a
October	750 ^c	777 ^{bc}	670 ^{de}	28.81 ± 13.1 ^b	29.94 ± 12.1 ^b	27.08 ± 08.1 ^{bc}

Means with different superscripts in the table are significantly different at P≤0.05. While means with the same superscripts are significantly the same at P≤0.05.

Table 3: Dissolved Oxygen and Biological Oxygen Demand

Months	Dissolved Oxygen (mg/L)			Biological Oxygen Demand (mg/L)		
	Locations			Locations		
	Dambo Dam	Kazaure Dam	W. Rafi Dam	Dambo Dam	Kazaure Dam	W. Rafi Dam
Decaying	Season					
January	8.61 ± 1.2a	7.71 ± 1.1 ^b	8.44 ± 1.2 ^a	2.91 ± 0.2 ^d	2.84 ± 0.6 ^{de}	2.21 ± 0.2 ^{fg}
February	8.52 ± 2.1 ^a	7.77 ± 1.1 ^b	8.34 ± 1.4 ^a	2.91 ± 0.3 ^d	2.51 ± 0.2 ^{def}	2.52 ± 0.6 ^{def}
March	8.41 ± 1.3 ^a	7.75 ± 1.2 ^b	8.11 ± 1.2 ^a	2.01 ± 0.4 ^g	2.52 ± 0.1 ^{def}	2.82 ± 0.2 ^{de}
April	7.75 ± 1.2 ^b	6.81 ± 1.3 ^c	7.71 ± 2.1 ^b	2.01 ± 0.3 ^g	2.41 ± 0.1 ^{efg}	2.52 ± 0.2 ^{def}
November	8.41 ± 1.3 ^a	6.82 ± 0.1 ^c	8.11 ± 1.2 ^a	2.51 ± 0.5 ^{def}	2.82 ± 0.2 ^{de}	2.51 ± 0.2 ^{def}
December	8.44 ± 1.2 ^a	7.63 ± 2.1 ^b	8.21 ± 1.4 ^a	2.91 ± 0.2 ^d	2.51 ± 0.2 ^{def}	2.01 ± 0.6 ^{fg}
Blooming	Months					
May	6.82 ± 3.1 ^c	6.11 ± 1.2 ^c	6.71 ± 1.1 ^c	2.01 ± 0.4 ^g	2.52 ± 0.5 ^{def}	2.07 ± 0.4 ^g
June	7.63 ± 2.1 ^b	5.71 ± 1.4 ^d	7.75 ± 1.4 ^b	3.52 ± 0.2 ^c	2.01 ± 0.1 ^g	3.62 ± 0.3 ^c
July	6.52 ± 2.0 ^c	5.61 ± 0.5 ^d	6.77 ± 1.2 ^c	3.51 ± 0.2 ^c	3.52 ± 0.4 ^c	3.71 ± 0.2 ^c
August	6.71 ± 1.1 ^c	5.66 ± 0.8 ^d	6.74 ± 2.2 ^c	4.41 ± 0.6 ^{ab}	3.71 ± 0.4 ^c	3.51 ± 0.5 ^c
September	5.51 ± 0.4 ^d	6.70 ± 1.5 ^c	6.70 ± 1.5 ^c	4.21 ± 0.4 ^b	4.81 ± 0.3 ^a	4.22 ± 0.6 ^b
October	5.72 ± 1.1 ^d	5.51 ± 1.2 ^d	7.80 ± 1.2 ^b	3.51 ± 0.6 ^c	4.71 ± 0.1 ^{ab}	3.69 ± 0.3 ^c

Means with different superscripts in the table are significantly different at P≤0.05. While means with the same superscripts are significantly the same at P≤0.05.

Table 4: Phosphate and Nitrate

Months	Phosphate (mg/L)			Nitrate (mg/L)		
	Locations			Locations		
	Dambo Dam	Kazaure Dam	W. Rafi Dam	Dambo Dam	Kazaure Dam	W. Rafi Dam
Decaying	Season					
January	7.77 ± 1.22 ^f	7.92 ± 2.31 ^f	6.18 ± 1.21 ^g	6.92 ± 1.21 ^{de}	7.10 ± 1.21 ^{de}	6.98 ± 1.05 ^{de}
February	7.79 ± 2.10 ^f	7.64 ± 1.91 ^f	6.30 ± 1.87 ^g	7.01 ± 1.71 ^{de}	7.11 ± 1.14 ^{de}	6.11 ± 1.14 ^{ef}
March	7.81 ± 2.22 ^f	7.64 ± 1.96 ^f	6.20 ± 2.72 ^g	6.99 ± 1.43 ^{de}	7.81 ± 1.17 ^d	5.77 ± 1.30 ^{ef}
April	6.30 ± 1.11 ^g	6.22 ± 2.31 ^g	5.60 ± 2.22 ^g	7.87 ± 1.22 ^d	6.88 ± 1.12 ^{de}	4.50 ± 1.21 ^f
May	8.10 ± 2.11 ^f	8.13 ± 2.22 ^f	5.50 ± 2.01 ^g	6.88 ± 1.17 ^{de}	5.00 ± 1.10 ^f	4.71 ± 1.21 ^f
November	11.22 ± 2.10 ^{de}	11.88 ± 2.22 ^d	7.68 ± 2.41 ^f	14.11 ± 3.05 ^b	15.72 ± 2.21 ^a	8.04 ± 1.22 ^d
December	11.92 ± 2.11 ^d	11.21 ± 2.11 ^{de}	7.99 ± 2.01 ^f	12.87 ± 2.17 ^b	14.11 ± 1.88 ^b	7.10 ± 1.82 ^{de}
Blooming	Months					
June	10.44 ± 2.13 ^e	11.22 ± 2.11 ^{de}	7.70 ± 2.02 ^f	7.88 ± 1.18 ^d	7.99 ± 2.10 ^d	6.97 ± 1.19 ^{de}
July	14.92 ± 3.21 ^{cd}	16.22 ± 2.99 ^{ab}	10.44 ± 2.11 ^e	16.61 ± 1.11 ^a	16.77 ± 1.90 ^a	10.10 ± 2.21 ^c
August	14.90 ± 3.11 ^{cd}	15.21 ± 3.11 ^{bc}	10.63 ± 2.12 ^e	16.97 ± 2.21 ^a	16.92 ± 2.10 ^a	10.21 ± 2.11 ^c
September	15.21 ± 3.10 ^{bc}	16.88 ± 3.22 ^a	10.90 ± 2.81 ^{de}	16.99 ± 3.21 ^a	16.88 ± 3.10 ^a	10.88 ± 2.12 ^c
October	14.98 ± 2.99 ^c	14.77 ± 2.88 ^c	11.91 ± 2.97 ^d	16.22 ± 3.31 ^a	15.78 ± 2.81 ^a	8.01 ± 1.31 ^d

Means with different superscripts in the table are significantly different at P≤0.05. While means with the same superscripts are significantly the same at P≤0.05.

3.1 Physical and Chemical Properties of Water in the Dams

Result in table (1) indicate significant difference ($p \leq 0.05$) for temperature and pH where temperature was higher in May across the three Dams (Dambo, Kazaure and Wawan Rafi). Least temperature was recorded in February across all the three Dams. The highest pH values were recorded in October and November at Dambo and Wawan Rafi Dams. However, the least pH was recorded in May at Dambo, June and July at Kazaure Dams. Table 2. Showed the result of total dissolved salt and turbidity. Total dissolved salt was higher In August and September at Kazaure Dam whereas lower total dissolved salt was recorded in April and May at Wawan Rafi dam. Higher turbidity was recorded in July, August and September at Kazaure Dam while in August and September at Dambo and Wawan Rafi Dams and least values were recorded in April and May at Wawan Rafi Dam. Table 3 showed dissolved oxygen, where Dambo and Wawan Rafi had the highest value in November, December, January, February and March. Least values were recorded in June, July and August at Kazaure Dam and in October at Dambo and Kazaure Dams. Biological oxygen demand was higher in August at Dambo Dam and in September and October at Kazaure Dams. Low biological oxygen demand was observed in March, April and May at Dambo Dam, June at Kazaure and May at Wawan Rafi Dams. Table 4 showed Phosphate concentration which was higher in July and September at Kazaure Dam. Likewise low phosphate concentration was observed in March at Dambo and Kazaure Dams so also in January, February, March, April and May at Wawan Rafi Dam. Result of nitrate was also found significant in which higher concentration was recorded in July, August September and October at Dambo and Kazaure Dams while in November at Kazaure. This finding revealed that physical and chemical properties were significantly different ($p \leq 0.05$) across all the months and Dams. Temperature ranges from 20 – 26 °C in decaying season and 27 -34°C in blooming season in kazaure Jigawa Northwest (JARDA 2020). Similar finding was reported by (Water Research Foundation, 2012) that temperature range from 27-33°C in his study on physical and chemical properties of water as alternative and innovation methods against cyanobacteria and algae in some selected Dams. Mustapha (2008) reported slight acidity in the dry season and was attributed to high carbon dioxide concentration occurring from organic decomposition. This finding is in line with the result obtained in this study which found low pH in early rainy season. Dissolved oxygen was significantly higher during the dry season while biological oxygen demand is higher in rainy season across all the three Dams. This was in line with the result of Ibrahim, (2009). who reported that the cool harmattan wind which increases wave action and decrease surface water temperature might have contributed to the increased oxygen concentration during the dry season, while, the torrential rain during wet season, increased turbidity and decreased oxygen concentration. The nitrate and phosphate were higher in rainy season when compared to dry season. This finding agreed with result of Ibrahim (2009), Mukoena, *et al.*, (2016) and Matdoz, *et al.*, (2019), who found that the nitrate and phosphate concentrations ranges between (4-17mg/L) in sample of water from Dams and Tap sources.

3.2 Cyanobacterial Abundance and Cyanotoxins Concentration in the Dams

The results of cyanobacterial abundance and cyanotoxins concentration from water sample collected in the three Dams in both blooming and decaying seasons were presented in Tables 5 and 6.

Table 5: Cyanobacteria species affected by the locations of Dam

Locations	Species							
	An	Ap	Ch	Co	Cy	Mi	No	Os
Dambo Dam	7.0 ^a	2.0 ^{ef}	2.0 ^{ef}	3.0 ^{de}	6.0 ^{ab}	7.0 ^a	2.0 ^{ef}	2.0 ^{ef}
Kazaure Dam	6.0 ^{ab}	2.0 ^{ef}	3.0 ^{de}	4.0 ^{cd}	5 ^{bc}	6.0 ^{ab}	5 ^{bc}	2.0 ^{ef}
W. Rafi Dam	2.0 ^{ef}	3.0 ^{de}	2.0 ^{ef}	2.0 ^{ef}	2.0 ^{ef}	2.0 ^{ef}	3.0 ^{de}	1.0 ^f

Means with different superscripts in the table are significantly different at $P \leq 0.05$. While means with the same superscripts are significantly the same at $P \leq 0.05$. An: *Anabaena circinalis*, Ap: *Aphanizomenon onovalisporum*, Ch: *Chroococcus turgidus*, Co: *Coelosphaerium aeruginum* Cy: *Cylindrospermopsis raciborskii*, Mi: *Microcystic aeruginosa* No: *Nostoc commune*. Os: *Oscillatoria lomosa*

Table 6: Cyanotoxins (µg/L) as affected by locations of Dams

Cyanotoxins	Locations		
	Dambo Dam	Kazaure Dam	W. Rafi Dam
Anatoxins	1.9 ^d	2.7 ^{bcd}	2.0 ^d
Cylindrospermopsins	4.6 ^a	4.4 ^a	3.2 ^b
Geosmins	2.6 ^{bcd}	3.2 ^b	2.4 ^{bcd}

Microcystins	4.8 ^a	4.9 ^a	2.2 ^{cd}
2-methylisoborneols	2.1 ^d	3.1 ^{bc}	1.7 ^d

Means with different superscripts in the table are significantly different at $P \leq 0.05$. While means with the same superscripts are significantly the same at $P \leq 0.05$.

The result in Table (5) showed significant difference ($p \leq 0.05$) for interaction between cyanobacterial abundance and Dams in the sample of water collected. It revealed that *Anabaena circinalis* and *Microcystic aeruginosa* are more abundance in Dambo Dam when compared with other species and Dams. Least number of cyanobacteria was recorded by *Oscillatoria limosa* in Wawan Rafi Dam. Similarly seasonal variation in cyanobacterial abundance indicated positive correlation in all the species of cyanobacteria for both blooming and decaying seasons with exception of *Chroococcus turgidus* which is not significantly different in both the seasons. Blooming season had the highest number of cyanobacterial species than decaying season. Table 6 showed the result of cyanotoxins analysis of samples of water from Dams source. The result is significant ($p \leq 0.05$) for Cylindrospermopsins and Microcystins in Dambo Dam, and Kazaure Dams respectively. Anatoxins and 2-methylisoborneols were recorded in least concentration in Wawan Rafi and Dambo Dams. This finding revealed that, cyanobacteria is responsible for deposition of different cyanotoxins in the Dams. Similar finding was reported by Motodz, *et al.*, (2019) who reported deposition of microcystins in water samples collected from Hartbees Dam and Tap water in South Africa. USEPA (2012) also reported the presence of cyanobacteria and cyanotoxins in water. Cristiana, *et al.*, (2014) and Mayur, *et al.*, (2017) reported the detection of cyanobacteria and cyanotoxins in water samples they examined.

4. Conclusion and Recommendation

The study revealed variation in Physicochemical parameters of water samples among the samplings station, months and across the Dams during both blooming and decaying seasons. The study also revealed that, *Anabaena circinalis* and *Microcystic aeruginosa* were more in abundance in Dambo Dam when compared to other species and across the Dams. Least number of *Oscillatoria limosa* was recorded in Wawan Rafi Dam. For seasonal variation, correlation matrix indicated positive correlations (0.4 - 0.96) in all the species of cyanobacteria for blooming season with exception of *Chroococcus turgidus* which is not significantly different in both the seasons. Blooming season had the highest number of cyanobacterial species (61) than decaying season (46). The study revealed that the two cyanotoxins (Cylindrospermopsins and Microcystins) were higher in concentration (4.4 to 4.9 $\mu\text{g/L}$) in Dambo Dam and Kazaure Dam. while Anatoxins and 2-methylisoborneols recorded least concentrations in Wawan Rafi and Dambo Dams. Hence can be deduced that the quality of water in Wawan Rafi Dam was better when compared to other Dams. It is therefore recommended that all the three Dams studied requires cyanotoxins treatment before domestic and other uses.

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