ANALYSIS OF PHYSICO-CHEMICAL PARAMETERS OF KINNERASANI RESERVOIR WATER IN BHADRADRI KOTHAGUDEM DISTRICT OF TELANGANA, INDIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Author GSK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author GR managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

The water quality parameters such as Temperature, pH, Dissolved oxygen, Alkalinity, hardness, Phosphates and Nitrates were reported from Kinnerasani reservoir. The degree of water quality parameters was measured by the simple correlation coefficient (r) that is presented as correlation matrix. The pH has been found to show positive correlation with water temperature (r=0.3855), negative correlation with alkalinity (r=- 0.2207) and TDS (r=-0.4682). Strong correlation has been found to show with DO (r=0.553), turbidity (r=0.505) and Nitrates (r=0.858). The Dissolved Oxygen strongly correlated with hardness and nitrates. Seasonal fluctuations were observed in various physico-chemical parameters. The water quality parameters indicate that the reservoir is rich in nutrients and favourable for plankton and fish growth.

Keywords: Water quality parameters; temperature; ph; dissolved oxygen; nitrates; correlation; r value.

1. INTRODUCTION

Physico-chemical condition of water has its direct impact on growth, survival, reproduction and distribution of fishes. Any adverse change in environmental condition affects the life of fishes. Actually, aquatic life of any water body is governed by the interaction of various physical and chemical conditions. Water is one of the basic element supporting life and the environment. The nature and distribution of flora and fauna in a water body are generally controlled by the fluctuations in the physico-chemical characteristics of water. The health of the rivers and their bio-diversity are directly related to every component of the ecosystem. In freshwater bodies, nutrients play a key role as their

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excesses lead to eutrophication. Phosphorus and nitrogen are important nutrients, essential for aquatic plant and algae growth. Most waters naturally having enough of these nutrients to support the aquatic life. However, excess of these nutrients can over-stimulate the plant and algae growth in such a way that they bring about water quality problems. Monitoring the water quality is the first step that leads to management and conservation of aquatic ecosystem. The management of any aquatic ecosystem is aimed at the conservation of its habitat by maintaining the physico-chemical quality of water within the acceptable level. Kinnerasani reservoir was constructed for irrigation purpose, later on the water use pattern has been changed from agriculture to domestic purpose such as drinking, washing, bathing, fishing etc. There is lack of baseline data on Physico-chemical characteristics of the perennial water bodies of this reservoir.

2. MATERIALS AND METHODS

2.1 Study Area

The Kinnerasani project is a storage reservoir constructed on the Kinnerasani River in the Godavari Basin at Yanambail village of Paloncha Mandal, Bhadradri Kothagudem district of Telangana, India. The dam is located at a distance of 24 km from Kothagudem and 12 Km from Paloncha town. It lies between North latitude 17°11 and East longitude 80°

22. The total catchment area is 1333 sq.km (Fig. 1). The climatic conditions in the study area are hot in summer and cool in winter. This region gets much rainfall from south west monsoon. This place gets most of its rain fall from June to September during the monsoon. Generally highest rainfall is observed in the month of June during the study period. The average rainfall of this study area is 793.06 mm. The reservoir water is used for drinking, agriculture and it supports fish culture.

2.2 Collection of Samples for Analysis

The water samples were collected from the Kinnerasani reservoir during January to December 2019 on fortnightly basis at four stations. The samples for analysis were collected in sterilized bottles. Utmost care was taken to avoid bubbles during sampling. The temperature was recorded at four sample sites. The pH, DO, Turbidity, Alkalinity, Hardness, Phosphates and Nitrates were measured in the field and samples were collected for further physico-chemical analysis [1,2,3,4,5].

2.3 Statistical Analysis

Pearson Correlation Coefficient 'r' and P values were obtained using Pearson Correlation online calculator. The monthly and season wise grouped data were used to calculate for making comparison among the means of three different seasons.
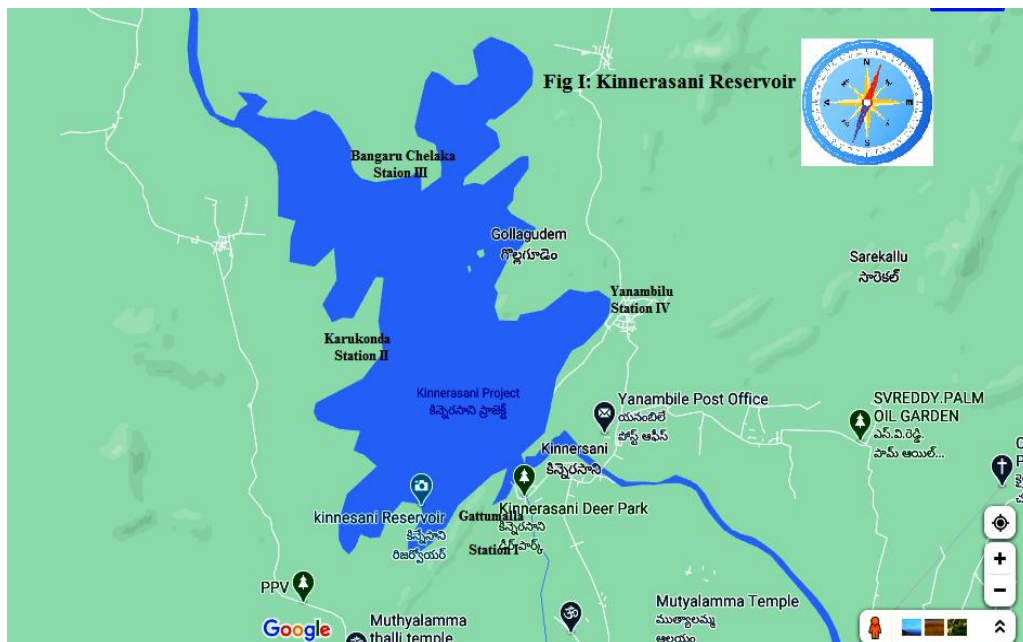

Fig. 1. Kinnerasani reservoir catchment area

3. RESULTS

1. **Water temperature:** In present study, the water temperature ranged from 30.2± 1.51 to 23.5± 0.38°C. The highest water temperature was measured in May due to the summer. The average value recorded is 26.46°c. Water Temperature is positively correlated with pH, Dissolved Oxygen, Turbidity, Hardness, Phosphates and Nitrate and negatively correlated with TDS and Alkalinity (Tables 1, 2, 3, Fig. 2).

2. **pH:** During the present study, pH is ranged from 7.32±0.45 to 7.71±0.40. pH between 8.5 to 9.5 is not favorable for the growth of aquatic organisms. Increased hydrogen ion concentration which was noticed during summer season could be attributed to the enhanced rate of evaporation coupled with human interference. pH is positively correlated with water Temperature, Dissolved Oxygen, Hardness and Nitrates and negatively correlated with TDS, Turbidity, Alkalinity and Phosphates (Tables 1, 2, 3, Fig. 2).

3. **Dissolved Oxygen:** Dissolved oxygen (DO) plays a vital role in water quality determination. By the entry of both organic and inorganic materials causes depletion of DO levels of water bodies. During the present study, DO levels are in between 5.2± 0.57 ml/l to 6.9± 0.36 ml/l. The highest water temperature was measured in monsoon months. The DO is positively correlated with Water Temperature, pH, Turbidity, Hardness, Phosphates and Nitrates and negatively correlated with TDS and Alkalinity (Tables 1, 2, 3, Fig. 2).

4. **Total Dissolved Solids:** The TDS value of the Kinnerasani reservoir water varied between 364±17.42 and 429± 18.52 mg/l. TDS analysis has great implications in the control of biological and physical waste water treatment processes. TDS is negatively correlated with Water Temperature, pH, Dissolved Oxygen, Turbidity, Alkalinity, Hardness, Phosphates and Nitrates (Tables 1, 2, 3, Fig. 2).

5. **Turbidity:** In the present study, turbidity ranged from 0.5± 0.04 NTU to 1.9± 0.02 NTU. High turbidity is known to affect the primary productivity by restricting the light penetration and photosynthesis. The highest water Turbidity was measured in summer and monsoon months. Turbidity is positively correlated with Water Temperature, Dissolved Oxygen, Alkalinity, Phosphates and Nitrates, on the other hand negatively correlated with pH and TDS (Tables 1, 2, 3, Fig. 2).

6. **Alkalinity:** Alkalinity of water is important for biological activity. Alkalinity in natural water bodies is due to the presence of CO_2 in water or HCO_3 produced by the action of ground water on lime stone. Alkalinity is an important parameter for aquatic life in fresh water because it equilibrates pH changes. In the present study, alkalinity ranged from 50± 4.65 mg/l to 120± 8.65 mg/l. The highest was measured in Post monsoon period. The average that was recorded during the study period is 82.083. Alkalinity is positively correlated with Turbidity, Hardness and Phosphates where as negatively correlated with Water Temperature, pH, Dissolved Oxygen, TDS and Nitrates (Tables 1, 2, 3, Fig. 2).

7. **Hardness:** In the present study, hardness range is in between 150± 14.33 mg/l to 200± 14.25 mg/l. These studies revealed that higher hardness values were found during summer and lower values were found during winter months in the entire study period. The average that was recorded during the study period is 180 mg/lit. Hardness is positively correlated with Water Temperature, pH, Dissolved Oxygen, Alkalinity, Phosphates and Nitrates where as negatively correlated with TDS (Tables 1, 2, 3, Fig. 2).

8. **Phosphates:** The phosphates of Kinnerasani reservoir waters recorded highest during the monsoon season. Much variation was observed in the phosphates values of the reservoir water ranged from 0.09 ±0.02 to 0.19 ±0.06 mg/lit. The average value is 0.14 mg/lit. Phosphates are positively correlated with Water Temperature, Dissolved Oxygen, Turbidity, Alkalinity, Hardness and Nitrates whereas negatively correlated with pH and TDS (Tables 1, 2, 3, Fig. 2).

9. **Nitrates:** During the study period, nitrates ranged from 0.26± 0.03 to 0.54 ± 0.02 mg/l. Nitrates play the vital role in controlling and occurrence of phytoplankton in water bodies. Higher concentration of nitrates is an indicator of organic pollution and eutrophication. The average value is 0.356 mg/l. Nitrates are positively correlated with Water Temperature, pH, Dissolved Oxygen, Turbidity, Hardness and Phosphates where as negatively correlated with TDS and Alkalinity (Tables 1, 2, 3, Fig. 2).

Table 1. Physico chemical parameters of Kinnerasani Reservoir from Jan-2019 to Dec-2019

Month	Water Temperature (°c)	PH	Dissolved Oxygen (ml/lit)	Total Dissolved Solids	Turbidity NTU	Alkalinity (mg/lit)	Hardness (mg/lit)	Phosphates (mg/lit)	Nitrates (mg/lit)
Jan, 2019	24.9 ±0.74	7.42± 0.41	5.3± 0.42	423± 22.52	1.2± 0.06	60± 4.22	150± 14.33	0.15 ±0.04	0.34±0.01
Feb, 2019	25.8± 0.55	7.51± 0.21	5.2± 0.57	429± 18.52	0.6±0.05	80± 6.23	160± 13.45	0.09 ±0.02	0.26±0.03
Mar, 2019	26.7± 0.65	7.59±0.35	6.2±0.38	396±14.25	0.5±0.04	60±5.77	180± 16.65	0.14 ±0.04	0.35 ±0.02
Apr, 2019	28.2± 0.98	7.63±0.34	6.1±0.42	364±17.42	0.8±0.04	50±4.65	200± 14.25	0.11 ±0.01	0.42 ±0.01
May, 2019	30.2±1.51	7.71±0.40	6.4±0.62	379±20.22	1.9±0.02	100±7.85	170± 12.25	0.16 ±0.03	0.54 ±0.02
Jun, 2019	29.4±1.27	7.62±0.36	6.2± 0.25	359±18.88	1.6±0.04	80± 5.55	190±15.55	0.19 ±0.06	0.46 ±0.02
July, 2019	27.8± 1.38	7.54± 0.33	6.9±0.36	408±22.65	1.3±0.02	60±5.24	180±13.25	0.14 ±0.04	0.32 ±0.01
Aug, 2019	25.9± 1.41	7.34±0.36	6.4±0.24	398±14.55	1.2±0.01	80±6.20	190±15.25	0.15 ±0.05	0.38±0.01
Sept,2019	24.8±0.46	7.48±0.52	5.6±0.28	410±24.22	1.1±0.01	120±8.65	190±15.24	0.14 ±0.02	0.29 ±0.02
Oct, 2019	25.4± 0.25	7.32±0.45	5.4±0.22	378±18.45	0.9±0.01	115±7.42	180±13.82	0.16 ±0.04	0.32±0.01
Nov, 2019	24.9± 0.45	7.58±0.55	6.1±0.28	390±16.55	0.8±0.02	100±5.55	180±18.25	0.13 ±0.02	0.31±0.02
Dec, 2019	23.5±0.38	7.39±0.45	5.9±0.24	382±13.28	1.2±0.05	80±3.33	190±15.25	0.12 ±0.03	0.28 ±0.02
Mean	26.458	7.498	5.975	393	1.092	82.083	180	0.14	0.356

Table 2. Pearson correlation coefficient 'R' value of water quality parameters

Parameters	Temperature	pH	DO	TDS	Turbidity	Alkalinity	Hardness	Phosphates	Nitrates
Temp.	1	0.39	0.55	-0.47	0.51	-0.22	0.11	0.40	0.86
pH		1	0.44	-0.08	-0.19	-0.50	0.21	-0.14	0.01
DO			1	-0.37	0.40	-0.29	0.45	0.28	0.47
TDS				1	-0.31	-0.05	-0.67	-0.42	-0.61
Turbidity					1	0.18	0	0.64	0.66
Alkalinity						1	0.06	0.25	-0.09
Hardness							1	0.08	0.13
Phosphate								1	0.56
Nitrates									1

Table 3. Pearson correlation coefficient 'p' value of water quality parameters

| Parameters	Temperature	pH	DO	TDS	Turbidity	Alkalinity	Hardness	Phosphates	Nitrates
Temperature	< 0.00001	0.21587	0.06242	0.12494	0.09431	0.49204	0.73291	0.19299	0.00036
pH		< 0.00001	0.14880	0.80959	0.55633	0.09785	0.50892	0.65750	0.96973
DO			< 0.00001	0.23376	0.20355	0.35708	0.14005	0.37683	0.12484
TDS				< 0.00001	0.33008	0.87736	0.16905	0.17746	0.03713
Turbidity					< 0.00001	0.57410	1.00000	0.02407	0.02027
Alkalinity						< 0.00001	0.86130	0.43914	0.77612
Hardness							< 0.00001	0.81825	0.67914
Phosphate								< 0.00001	0.05773
Nitrates									< 0.00001
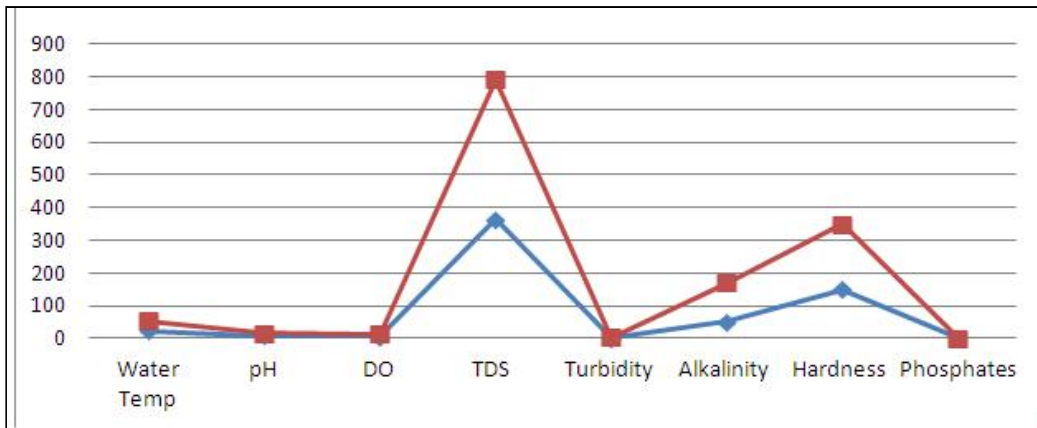
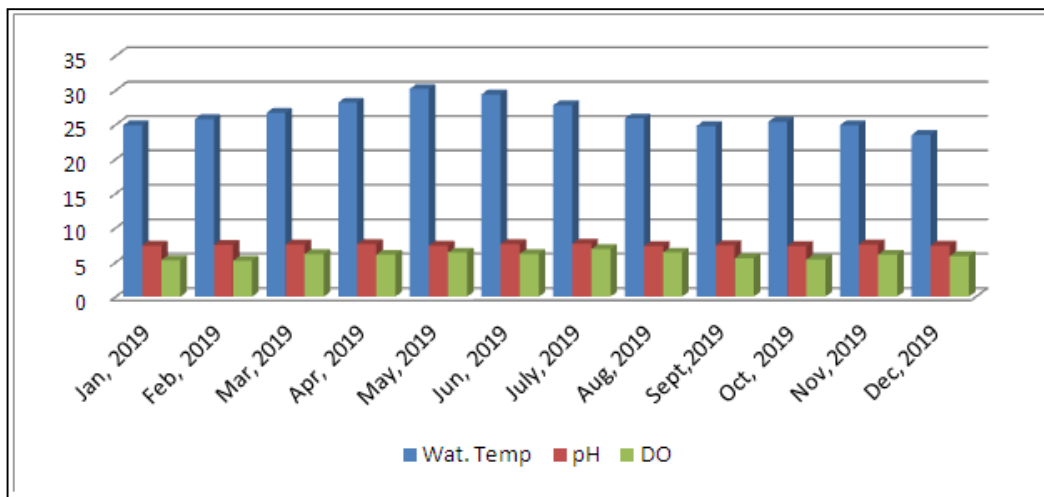**Fig. 2. Lowest and highiest physico chemical parameters**

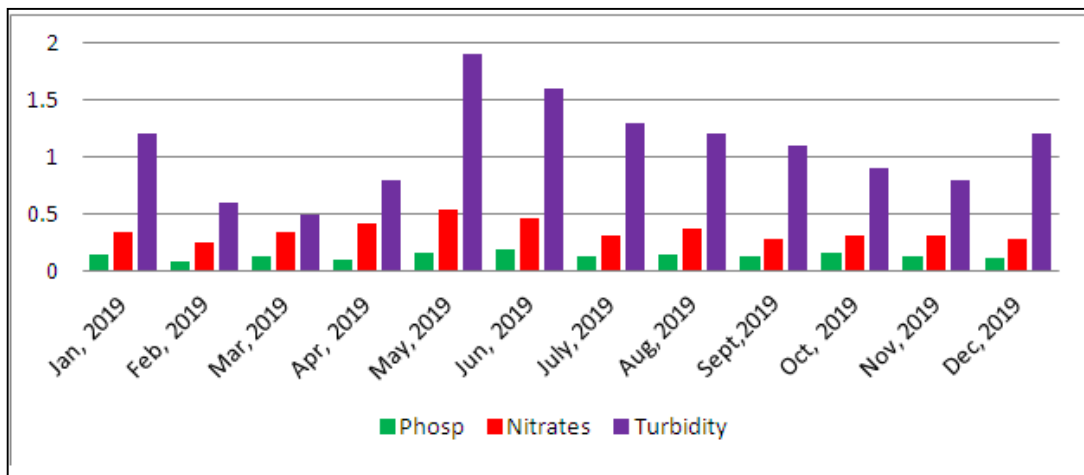**Fig. 3. Comparison of Monthly data**

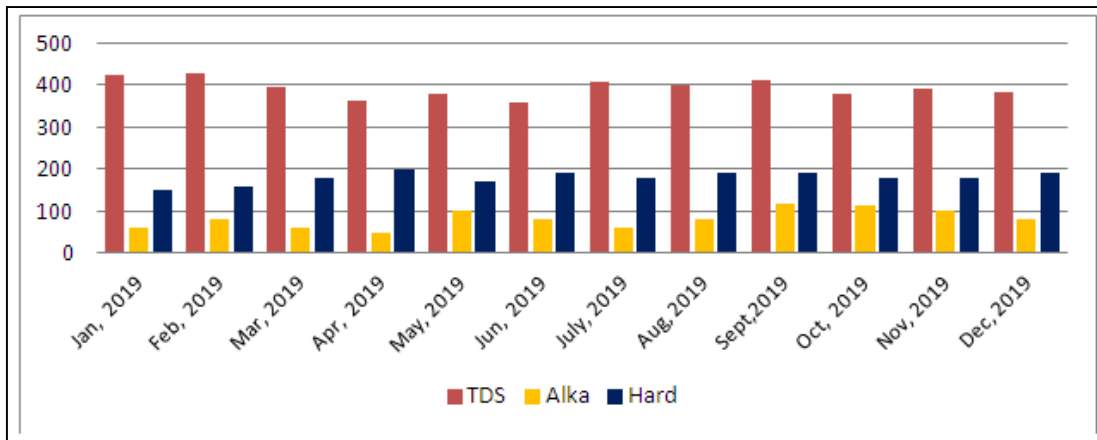**Fig. 4. Comparison of monthly data**

Fig. 5. Comparison of monthly data

3.1 Correlation (r) between Different Parameters

In the present study, the calculated Pearson correlation coefficient (r) between different parameters is shown in the Table 2. Correlation coefficient (r) between any two parameters, x & y is calculated. For this, each time two different parameters were taken from all the studied parameters such as water temperature, pH, dissolved oxygen, alkalinity, hardness, phosphates and nitrates. The degree of linear association between any two of the water quality parameters was measured by the simple correlation coefficient (r) and is presented in Table 2 as correlation matrix. The PH has been found to show positive correlation with water temperature (r=0.3855), negative correlation with alkalinity (r=-0.2207) and TDS (r=-0.4682). Strong correlation has been found to show with DO (r=0.553), turbidity (r=0.505) and Nitrates (r=0.858). The Dissolved Oxygen strongly correlated with hardness and nitrates. The turbidity correlated with phosphates (r= 0.643) and nitrates (r+ 0.657). The nitrates correlated with water temperature (r= 0.858) and phosphates (r= 0.561). The Pearson Correlation Coefficient P Values were uniformly coinciding to all eight parameters in the Kinnerasani reservoir (Table 3).

4. DISCUSSION

High seasonal fluctuations were observed at different sites of Kinnerasani reservoir. The water temperature was high in summer due to the low water levels. The similar results were observed by Sharma et al., [6] where in water temperature fluctuated between 21°C to 29°C during limnological studies of Udaipur lakes. During the present study, water pH values were found to be 7.32±0.45 to 7.71±0.40. It suggests that water possesses alkalinity nature throughout the study period. pH values are important for plankton growth and this was also observed by Chisty [7]. The Dissolved oxygen was >5 throughout the year at Kinnerasani reservoir and it was found to be 5.2± 0.57 ml/l to 6.9 ± 0.36 ml/l. Mohammad M. J et al. [8,9,10] reported a comparative study regarding physico-chemical analysis of Kinnerasani, Palair and Wyra Reservoir waters. The results were quite different from the present study. The similar studies were carried out by Raut K.S et al., Banerjee and Torzwell [11,12,13] and stated that the dissolved oxygen was about 5mg/l throughout the year and was found to be productive for Fish culture. The Total Dissolved Solids value of the Mod Sagar water varied between 180 and 330 mg/l was reported by Shinde Deepak and Ningwal Uday Singh [14]. TDS concentration below 200 mg/l promotes even healthier spawning conditions. Present results exhibit that the Kinnerasani reservoir provides favourable conditions for fish production. Alkalinity noted was from 50 ± 4.65 mg/l to 120 ± 8.65 mg/l during the study period. It has direct relation to the productivity and was reported by Arain et al., Goldman and Wetzel [15, 16]. The chemical parameters like Alkalinity, Phosphates, Nitrates and Turbidity were also shown similar results as were observed in Lakshmipuram tank and Osman Sagar lake reported by Chinna Pujari Ramesh and Gundala Harold Philip [17]. Padmaja et al., [18] also reported on water quality index in relation to seasonal variations of Osman Sagar lake. Total Dissolved Solids and Hardness were noticed highest in April. Similar findings were made by Anita et al., [19] reported in Limnological study of physico-chemical characters that were noticed in Nagaral Dam Chincholli, Kalaburagi, Karnataka. Likewise, nitrate concentration was higher during summer when compare with that of winter season in Yamuna River that was observed by Simerjit Kaur and Indu Singh [20,21].

5. CONCLUSIONS

The present study shows detailed physico-chemical characteristics and quality of water in Kinnerasani reservoir that is good for plankton and fish growth. The water parameters indicate that the reservoir is rich in nutrients. In the summer, monsoon and winter seasons, there are minor fluctuations in various physico-chemical parameters. The water of present reservoir is useful for irrigation as well as fish culture.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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