

Effect of Seasonal Variation on the Diversity of Algae in Kadwa Dam in Igatpuri Tehsil of Nashik district of Maharashtra

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Abstract

Kadwa dam is a major reservoir built on the Kadwa river, a major tributary of the Darna River. The dam caters to the needs of drinking waters of one-fourth of Nasik city, Sinnar an upcoming industrial town from Nashik districts and Ahmednagar district, besides providing water for irrigation in about five tehsils of both districts. Considering the importance of dependency on the water from the Kadwa dam, a study was conducted to record the algal diversity of the Kadwa dam regarding seasonal variation. Samples were taken from four different sites of the Kadwa reservoir from December 2019 to November 2021. Different physicochemical parameters such as temperature, pH, turbidity, D.O, Sulphate, phosphate, nitrate, silicates etc. were recorded and the correlation between them was recorded. It was found that Algal diversity increased with increased temperature, D.O., and different nutrient factors. Many algal species were recorded during the study period. Chlorophyta members dominated in mostly all compositions and Euglenophyta are least in number. This indicates that algal diversity is low on rainy and increase in the winter and summer season.

Key words: Seasonal variation, Physicochemical parameter, Nutrient factors, Kadwa dam

Algae are a diverse group of plant kingdoms found in aquatic as well as terrestrial habitats. Algae are phototropic living organism which grows well in sufficient photon radiation. They are largely distributed in freshwater, sea and terrestrial environment [1]. Algae play important role in the basis of most aquatic food webs and algae can be valuable indicators of water quality. Freshwater algae are found growing in rivers, streams, lakes, ponds dams, etc. Generally, they grow more abundantly in slow-flowing streams than in fast-flowing rivers. Chlorophyta, Cyanophyta, and Diatoms are the algal groups abundantly found in freshwater ecosystems. Like other living organisms, algal flora is also largely affected by the environment in their vicinity [2-3]. Different Physicochemical parameters play a major role in regulating the diversity and occurrence of algae in freshwater systems. Changes in physicochemical parameters in freshwater give an impact on the algal species that live within them. Seasonal variations in such parameters play an important role in the distribution and diversity of freshwater biota [4-5].

In India, many Ponds and reservoirs have been studied for water quality assessment and algal diversity. Several studies on the algal diversity of lakes and reservoirs have also been conducted in India [6]. The most recent data suggests that more than 40,000 algal species are found worldwide. Still, many

aquatic ecosystems have remained unexplored [7]. The present study intends to study the biodiversity of algal species in three different seasons (consecutive years of 2019 to 2021) of the Kadwa dam of Igatpuri tehsil of Maharashtra, India. It is the first attempt to find out the effects of seasonal variations on the algal diversity of the Kadwa dam.

MATERIALS AND METHODS

Study site

The Kadwa reservoir (Latitude. 19°45'19.86"N, Altitude. 73°47'37.81" E) is a freshwater body situated on the Kadwa river near Igatpuri, in the south region of Nashik district in the state of Maharashtra in India. The height of the dam is 31.84 m (104.5 ft) while the length is 1,660 m (5,450 ft). The volume content of the dam is 1,245 km³ (299 cu mi) and the gross storage capacity is 59,590.00 km³ (14,296.40 cu mi). The water from the dam is utilized for irrigation and drinking purposes for the Igatpuri, Nashik, Sinnar, and Niphad tehsils of Nashik district, or sometimes it is used for Aurangabad and Ahmednagar district for drinking purposes.

Sample collection

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Water samples were collected from four different sites of the kadwa dam in the morning period of three seasons of two years (December 2019 to November 2021). The water sample was collected and preserved in 4% formaldehyde and the species were identified and computed under a compound microscope according to the method of Utermöhl, modified by Legendre and Watt. The algal identification is done through different literature and monographs viz. Prescott and Collins [8], Tiffany and Britton [9], Desikachary [10], Scott and Prescott [11], Philipose [12], Bey and Ector [13]. Another set of samples was used for testing the physicochemical parameter.

The temperature of the water was measured by using a mercury thermometer by dipping directly in the water. The pH of the water sample was measured by a digital pH meter. Biochemical Oxygen Demand, Chemical oxygen demand, Total Dissolved solids, Dissolved oxygen, Calcium, Nitrate, Sulphate, and Total Phosphates were measured by methods of APHA 1998.

RESULTS AND DISCUSSION

Physicochemical factors

Seasonal variations in water quality parameters in Kadwa dam are given in (Table 1). The average temperature of water in winter, summer and rainy seasons were recorded as 18°C, 28.75°C and 25.38°C, respectively. Similarly, the average pH of water in winter, summer and rainy seasons were 7.61, 7.95 and 7.25 respectively. The average dissolved oxygen (DO) of water in winter, summer and rainy seasons were recorded as 6.2 mg/l, 6.7 mg/l and 6.8 mg/l, respectively. The average temperature, pH and DO of water were found maximum in the summer season. The average temperature of the water was low in winter but both pH and DO were lowest in the rainy season [14-15].

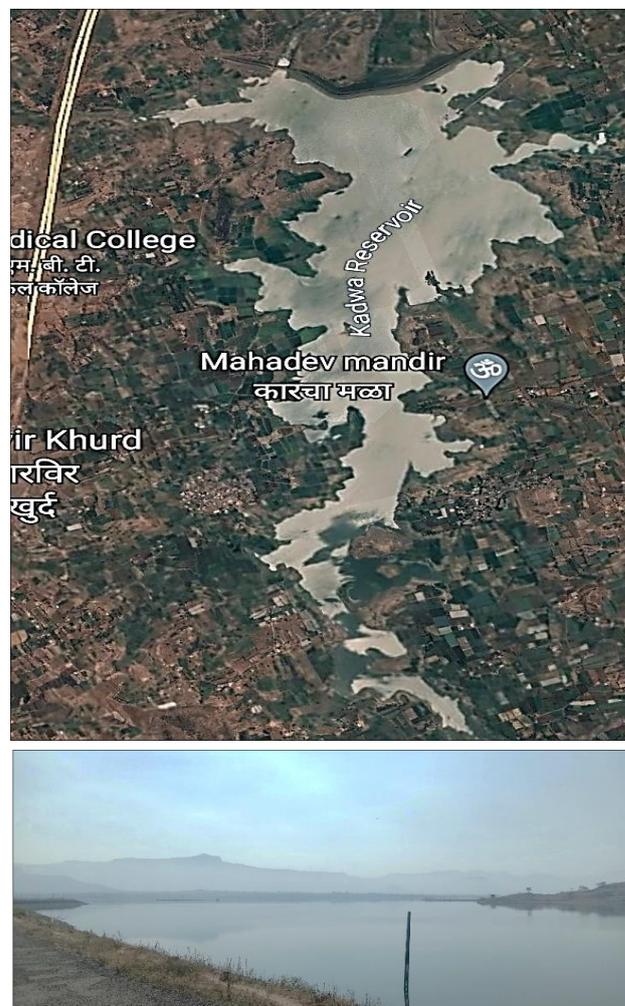


Fig 1 Satellite image and panoramic view of Kadwa dam

Table 1 Seasonal variation in physicochemical parameters of Kadwa Dam over the period of two years from December 2019 to November 2021 (Mean \pm SEM)

S. No.	Parameters	Monsoon	Winter	Summer
1	ATOC	28.13 \pm 0.39	21.5 \pm 0.62	32.63 \pm 0.88
2	WT0C	25.38 \pm 0.26	18 \pm 0.46	28.75 \pm 0.61
3	pH	7.25 \pm 0.05	7.61 \pm 0.05	7.95 \pm 0.11
4	Dissolved Oxygen (DO) mg/L	6.2 \pm 0.27	6.5 \pm 0.21	6.9 \pm 0.22
5	Chloride (Cl) mg/L	12.13 \pm 1.18	8.5 \pm 0.44	7.9 \pm 0.75
6	Nitrates (NO ₃) mg/L	1.1 \pm 0.02	0.94 \pm 0.035	0.55 \pm 0.02
7	Total Phosphates (P) mg/L	0.089 \pm 0.03	0.066 \pm 0.04	0.043 \pm 0.03
8	Sulphates (SO ₄) mg/L	3.6 \pm 0.33	2.10 \pm 0.37	1.57 \pm 0.34
9	Magnesium (Mg) mg/L	9.73 \pm 0.99	10.04 \pm 1.24	12.13 \pm 1.27
10	Calcium (Ca) mg/L	15.2 \pm 0.46	11.19 \pm 0.82	26.4 \pm 1.1
11	Potassium	1.2 \pm 0.6	0.42 \pm 0.02	0.89 \pm 0.06
12	Silica	0.32 \pm 0.02	0.62 \pm 0.02	0.71 \pm 0.02
13	Total Dissolved Solids (TDS) mg/L	148.3 \pm 4.81	125.2 \pm 3.04	131.8 \pm 3.83
14	Total Suspended Solids (TSS) mg/L	21.5 \pm 1.85	16.38 \pm 1.06	18 \pm 1.25
15	Turbidity (NTU)	4.69 \pm 0.04	2.69 \pm 0.04	1.89 \pm 0.04
16	Electrical Conductivity	161 \pm 6.64	110 \pm 3.64	123 \pm 4.64
17	Total Hardness (TH) mg/L	126.5 \pm 3.46	142.5 \pm 2.39	168.5 \pm 6.64
18	Total Alkalinity mg/L	111 \pm 1.46	150 \pm 3.46	138 \pm 2.46
19	BOD mg/L	1.8 \pm 0.26	2.2 \pm 0.33	2.8 \pm 0.35
20	COD mg/L	4.69 \pm 0.04	7.88 \pm 0.04	9.64 \pm 0.04

Algal composition

In the current study a total of 53 algae belonging to 4 classes (Chlorophyceae 34%, Bacillariophyceae 32%, Cyanophyceae 30% and Euglinophyceae 4%), were recorded from four different sites of Kadwa dam (Table 2).

Chlorophyceae

The chlorophyceae are a large and important group of freshwater ecosystems. Chlorophyceae are free-living phytoplankton that is largely found in freshwater or filamentous and attached to submerged plants. During the study period, the Chlorophyceae is the first dominant algal group of the Kadwa dam. This group included 18 species and 16 genera. The Chlorophyceae of Kadwa dam includes *Spirogyra sp.*, *Ulothrix*

sp., *Pediastrum duplex* and *Zygnema sp.* etc. In the present investigation effect of seasonal variation on Chlorophyceae

showed maximum density was reported in winter and maximum in the monsoon period [16-18].

Table 2 Diversity of algae in Kadwa dam

Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae
1. <i>Spirogyra biformis</i>	1. <i>Cymbella cistula</i>	1. <i>Anabaena cylindrica</i>	1. <i>Euglena sp.</i>
2. <i>Pediastrum tetras</i>	2. <i>Synendra ulna</i>	2. <i>Anabaena torulosa</i>	2. <i>Phacus sp.</i>
3. <i>Pediastrum duplex</i>	3. <i>Cymbopleura sp.</i>	3. <i>Aphanocapsa sp.</i>	
4. <i>Ulothrix sp.</i>	4. <i>Fragilaria sp.</i>	4. <i>Coelospharum sp.</i>	
5. <i>Cosmerium sp.</i>	5. <i>Stauroneis anceps</i>	5. <i>Merismopedia elegans</i>	
6. <i>Cladophora sp.</i>	6. <i>Cyclotella sp.</i>	6. <i>Microcystis sp.</i>	
7. <i>Coelastrum sp.</i>	7. <i>Navicula menisculus</i>	7. <i>Phormidium sp.</i>	
8. <i>Hydrodictyon sp.</i>	8. <i>Gyrosigma sp.</i>	8. <i>Nostoc calcicola</i>	
9. <i>Zygnema oudhense</i>	9. <i>Amphora ovalis</i>	9. <i>Scytonema sp.</i>	
10. <i>Zygnema sp.</i>	10. <i>Cylindrothica sp.</i>	10. <i>Oscillatoria limosa</i>	
11. <i>Staurastrum leptocladum</i>	11. <i>Nitzschia sigma</i>	11. <i>Oscillatoria sp.</i>	
12. <i>Chlamydomonas sp.</i>	12. <i>Pleurosigma sp.</i>	12. <i>Cylindrospermum sp.</i>	
13. <i>Mougeotia sp.</i>	13. <i>Pinnularia dolosa</i>	13. <i>Calothrix sp.</i>	
14. <i>Tetrastrum sp.</i>	14. <i>Navicula sp.</i>	14. <i>Lyngbya sp.</i>	
15. <i>Ankistrodesmus spiralis</i>	15. <i>Rhopalodia sp.</i>	15. <i>Chroococcus sp.</i>	
16. <i>Scenedesmus sp.</i>	16. <i>Gomphonema intricatum</i>	16. <i>Spirulina sp.</i>	
17. <i>Pandorina sp.</i>	17. <i>Gomphonema sp.</i>		
18. <i>Monoraphidium sp.</i>			

Bacillariophyceae

A Bacillariophyceae is a member of a large group containing several genera of algae, specifically microalgae found in the ocean and freshwater. Diatoms are good indicators of environmental changes. Different physicochemical factors affect the abundance of Bacillariophyceae. The maximum density of diatoms is recorded in summer and the minimum in the rainy season. During the study period, Bacillariophyceae is the second dominant algal group in Kadwa dam. This group included 17 species and 15 genera [19-21]. This group includes *Synendra ulna*, *Navicula sp.*, *Amphora ovalis*, *Pinnularia dolosa*, *Gyrosigma sp.* etc.

Cyanophyceae

Cyanophyceae (blue-green algae) are a group of photosynthetic microorganisms, that only occurred in fresh water and polluted water bodies. Cyanophyceae differs from other algae that have prokaryotic cell organization. Cyanophyceae has been reported dominant algal community during the minimum light condition. At the study site, Cyanophyceae is the third large group of algae in the Kadwa dam. In the present study, Cyanophyceae shows maximum density was observed in winter and minimum during the monsoon period. This group included 16 species and 14 genera [22-24]. This group includes *Anabaena sp.*, *Oscillatoria limosasa*, *Merismopedia elegans*, and *Cylindrospermum sp.* etc.

Euglenophyceae

Euglenophyceae is unicellular flagellated algae found in

freshwater. A total of 2 species belonging to 1 genus have been recorded from the study site and constitute about 4% algal population. The maximum density of Euglenophyceae is recorded in the rainy season and the minimum in the summer season [25-26]. This group includes *Euglena* and *Phacus* species.

CONCLUSION

The present limnological studies involve water quality analysis, its season-wise fluctuations and its effect on algal diversity. In this study, the spatial changes in algal community structure were significantly affected by a physicochemical parameter (pH, temperature, total hardness, TDS and nutrients like nitrate, phosphate and silicate) Hence, this study shows variation in different algal taxa accurately reflects water conditions of Kadwa dam. This observation shows the stable condition of the dam, which suggests that the water is still suitable for various purposes like irrigation, fishing etc.

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Conflicts of interest

The authors stated that no conflicts of interest.

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