



Studies on phytoplankton and water quality of Karanjwan and Palkhed dam Nashik Maharashtra: A comparative study with monsoon and post monsoon seasons

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Abstract

The water of compounded dam made on rivers is mainly remain dependent on the physio chemical parameters which decides its hydrological properties. Once we evaluate the close relationship of these parameters with plankton diversity it gives the precise outputs that how water is polluting and many times by the direction by which it is getting polluted in case of multisite sampling. The present study carried out comparative study of data generated for physiochemical parameters and Palmer pollution index of Karanjwan and palkhed dam water Nashik Maharashtra especially for four sites and monsoon and post monsoon seasons with reference to phytoplankton. The study put forward that phytoplankton are least affected by fluctuations of physiochemical parameters during studied seasons. The study showcased that water quality remained satisfactory during seasons on both dams and that has indicated by better results of palmer pollution index showcasing that Kadava river based Karanjwan dam and Palkhed dam water is not having traces of organic pollution.

Keywords: Plankton diversity, water quality, palmer pollution index, nashik dam water

Introduction

Water is genesis of life which directly affects every creature on earth. The human utilizing present water resources wisely in various forms and in some cases leads to pollution of the same. Every water body marks some values in development and human involves it in agriculture, industry, domestic and recreation activities in better way (Siddamallayy and Pratima, 2008). The large-scale utilization of water in everyday use especially in agricultural, domestic, and industrial sectors polluting the connected water bodies in greater mean and resultant its hydrological parameters are changing (Clausen and Biggs, 1997) [2]. To study the changing quality of water it is better to involve the study of phytoplankton as good indicator for changing environmental factors as per time, season, human involvement, and others (Venkateswarlu, 1969) [10]. In an "aquatic ecosystems" phytoplankton found to be at the base of food chain and gives life to many others (Das and Panda, 2010) [5]. They bring about defined changes in density of dependents and remains dependent on physiochemical parameters of water which affects cumulative properties of water (Cummins *et al.*, 1984) [4].

The phytoplankton manages the total energy production within water bodies by producing many secondary metabolites and primary metabolites which affects overall ecosystems (Contreras *et al.*, 2009) [3]. In the present study we have considered to study two water bodies of Dindori taluka of Nashik district, Maharashtra namely Karanjwan dam and Palkhed dam located on Kadava river for phytoplankton diversity and related to physiochemical parameters of water analyzed during monsoon and post monsoon seasons to understand pollution level in water bodies.

Methodology

In the study two dams' phytoplankton diversity has been studied in detail which are built on Kadava river flows through Dindori taluka of Nashik District, Maharashtra, India. As per latitude and longitude data points are 20° 12'

00 and 73° 49' 59 respectively. As it is important to relate the change in diversity of water with respect to location and seasons (monsoon and post monsoon) this study is planned which is following palmer pollution index as standard (Palmer, 1969) [7]. Not only is that we have studied the water for various parameters and changes recorded in the general as Indian standard protocols as given below and further data related with overall water condition and change in phytoplankton.

1. Collection of water

First, for both dam-based water samples, fresh water of 3 liter each checked for physical, and chemical parameters. Secondly same water samples checked for defined quality of water once transferred through 25 mesh sized phytoplankton net and defined quantity of phytoplankton sample collected as per standard protocol. The collected samples then preserved using iodine solution and 4% formalin for further analysis once exposed to light microscope and set as different resolutions.

2. Physical and chemical properties of water

In the study water collected from two dams recorded for various parameters using Indian standard protocol given and represented with unit used to calculate the quantity or quality. Here temperature (25 °C) recorded by IS3025 (part 9): 1984, colour (Hazen units) IS3025 (part 4) method no. 4 :2021, odor (no unit) IS3025 (part 5) :2018, pH (25°C) (no unit) IS3025 (Part II): 2022, Electrical conductivity (25°C) (µmho/cm) IS3025 (Part 14):1984, Biochemical oxygen demand (3 days. 27°C) (mg/L) IS3025 (part 44): 1993, Chemical oxygen demand (mg/L) alpha 24th Ed. 5220, B, 544: 2023, Total dissolved solids (mg/L) IS3025 (part 16) : 2023, Dissolved oxygen (mg/L) IS3025 (part 38) Method no. 4 1989, Total alkalinity as (CaCO₃) (mg/L) IS3025 (part 21), Method no. 5 : 2009, Acidity BLQ (LOQ: 0.5) (mg/L) IS 3025 (part 22):1986 and carbon dioxide (as CO₂) (free) (mg/L) Is3025 (Part 61): 2008. Here in the result data also reported if it is below unit of quantification (BLQ) and as Limit of quantification (LOQ).

3. Comparative data analysis of phytoplankton

In the study once the presence of various species of phytoplanktons prevalent as per dams' water and seasons recorded, its comparative change has been showcased in a comparative mode and related with palmer pollution index (Palmer, 1969)^[7] for detailed reporting.

Result and Discussion

1. Prevalence of phytoplankton in monsoon seasons

In the present study during monsoon seasons once the prevalence of phytoplankton recorded for two dam waters (Karanjwan and Palkhed), it has been observed that karanjwan dam recorded with three class of phytoplankton namely Chlorophyceae, Cyanophyceae, and Bacillariophyceae. Among Chlorophyceae total six family were recognized namely Chlorococcaceae, Chlamydomonadaceae, Trebuxiophyceae, Zygnemataceae, Scenedesmeceae, and Neochloridaceae. Further based on these families total 11 species found to be present as shown in Table 1 with its variable count recorded for four sites investigated.

In a similar manner Palkhed dam recorded with increase in class presence in which three are common with Karanjwan those were Chlorophyceae, Cyanophyceae, and Bacillariophyceae and two recognized as new as Dinophyceae, Eustigmatophyceae. They are further showcased with total 10 families and total 12 species of phytoplankton found to completely varying as compared to Karanjwan dam water as shown in Table 2.

2. Prevalence of phytoplankton in post monsoon season

In the study once we recorded the water quality for the phytoplankton post monsoon (August-September) the defined change in phytoplankton diversity was recorded once compared to monsoon and certain increase in phytoplankton has been recorded post monsoon. Here at Karanjwan dam total eight phytoplankton class was recorded namely Chlorophyceae, Trebuxiophyceae, Cynophyceae, Bacillariophyceae, Chrysophyceae, Dinophyceae, Eustigmatophyceae, and Xanthophyceae, which was high in count once checked with monsoon data as shown in Table 3. Further it is obvious that family count also recorded on higher side (n=12) which was further noted with total diversity of 22 species prevalence and having higher count indicated that post monsoon season increases the count of Karanjwan dam.

Similarly, once we have recorded the phytoplankton diversity of palkhed dam during post monsoon, once again marginal rise in class of phytoplankton has been recorded namely Chlorophyceae, Trebouxioophyceae, Cyanophyceae, Bacillariophyceae, Oligomenophera and Fragilariphyceae. The distribution of family noted as 13 which are showcasing total 25 species prominently growing with variable count as shown in Table 4 but for sure it has been recorded that in both dams' post monsoon counts of phytoplankton increased and defined change in its diversity also been recorded.

Overall based on the phytoplankton species level identity in both dams it has been put forward that very few species are common in both dams once checked for two seasons and hence the pollution index must be different once confirmed by phytoplankton type, count, and diversity.

3. Representation of algal genus pollution index

In the present study once we have put forward that both dam water during monsoon recorded with lower count of

phytoplankton in terms of its diversity which was found to be increasing in post monsoon season. Further once we have analysed the species level data taking the standard as of Palmar (1969) data published as "Algal genus pollution index" some interesting out put has been put forward. Here according to Palmer, they stated that if the palmer pollution index score remains higher precisely 20 or more that indicates the given water is evident with high organic pollution. Further if the score is between 15 to 19 then it indicated the probable evidence of organic pollution. Lastly any lower figure than this indicates that organic pollution is not high.

As per the given data published by Palmer (1969)^[7] he stated the presence of Anacystis (pollution index 1), Ankistridesmus (2), Chyamydomonas (4), Chorella (3), Closterium (1), Cyclotella (1), Euglena (5), Gomphonema (1), Lepocinlis (1), Melosira (1), Micractinium (5), Pandorina (1), Phacus (2), Phormidium (1), Scenedesmus (4), Stigeoclnium (2), and Synedra (2) indicated with different pollution index (Showcased in bracket). Here we checked the presence of any of the above present in all sets and based on that final palmer pollution of two dams with two seasons recorded as shown in Table 5. Here we have recorded that Karanjwan dam and Palkhed dam both recorded with low score below 15 indicated that in both the seasons water of the dam found to be less affected by the organic pollution and recorded safe once studied in the year 2023-2024.

4. Physio-Chemical properties of water

In the present study we have recorded that water of Karanjwan and Palkhed remains less polluted with organic content once evident by palmer pollution index justified by the types of good phytoplankton growing substantially under low organic pollution and further the count of palmer pollution index remained below 15 indicated the high quality of both water for consumption.

Similar evidence received once we correlate the phytoplankton result, palmer pollution index and water testing data in together. Here dam water of Karanjwan and Palkhed recorded for various parameters which are indicating that in both seasons, the quality of both the dams' water remains on higher side and indicates that water is less affected by organic pollution and thus can be used as a potable water with least treatment as shown in Table 5.

In the present study we have recorded the two lakes' phytoplankton changing biodiversity and parallelly water physicochemical parameters for pollution parameters. It has been put forward that Nashik Karanjwan dam and Palkhed dam water bears unique phytoplankton diversity during monsoon and post monsoon and high-count during post monsoon but relatively remained low in count once compared to positive palmer pollution index (Palmer, 1969)^[7]. In a similar study carried out in Nashik where as stated by Bagul *et al.*, (2019)^[1] showcased that Godavari River water in Nashik is rather affected by the sewage, agricultural activities and that affects the phytoplankton growth in total. They recorded the highest growth of them during may month and reduces or remains on lower side during monsoon. The similar results recorded by us where monsoon season showcased low count of phytoplankton. In another study carried out by Nalawade *et al.*, (2020)^[6] in the year 2017-2018 Nashik city receiving Godvari river water recorded the direct effect on phytoplankton once fluctuation

in physiochemical parameters during selected period. They put forward that Godvari river is polluted by industrial, agricultural, and human activities and based on plankton diversity index, river is badly polluted but our study revealed that Nashik district Kadava river having dams are less affected by human activities and for the most of the season water remains unpolluted which is the good indicator that given Dindori Taluka water is safe for water utility. In another study Pawar and Aher (2021) [8] put forward that phytoplankton adapts to various environment and remains bioindicators of pollution. They reported once phytoplankton from Arjun Sagar dam, Kalwan Nashik (India) recorded about 12 species of phytoplankton recorded mainly Chlorophyceae, Cyanophyceae, Bacillariophyceae, which is common to our study also.

The aquatic life remains dependent on present status of water quality which remains variable at all time. Release of any waste via human involvement or by natural sources affects aquatic biodiversity. Here once we have done the detailed study of two dam-based water for two seasons (monsoon and post monsoon) and further correlated with physiochemical analysis of Nashik region, with low pollution index of both water bodies, sampled water found to be low in organic pollution and registered its potable nature with no evidence of Palmer Pollution Index-based positivity and confirmed by water testing also. Hence hydrological parameters are not found to be affected in both Karanjawan and Palkhed dam water due to industrial pollution and by human activities which suggest that success of efforts taken by local authority for making water body suitable for all activities.

Conclusion

Table 1: Algal distribution in Karanjawan dam during June-July [Monsoon season] and their frequencies in the four sampling stations

Sr No	Class	Family	Name of Phytoplankton	S1	S2	S3	S4
1	Chlorophyceae	Chlorococcaceae	<i>Chlorococcum /oophila amblystomatis</i>	4	-	7	-
		Chlorococcaceae	<i>Chlorococcum humicola</i>	-	1	-	-
		Chlamydomonadaceae	<i>Chlamydomonas mucicola</i>	-	2	-	1
		Trebouxiophyceae	<i>Curcigeniella curcifera</i>	-	6	-	-
		Zygnematacea	<i>Spirogyra</i>	1	-	-	-
		Scenedesmaceae	<i>Desmodesmus quadricauda</i>	-	-	7	-
		Scenedesmaceae	<i>Scenedesmus bijuga</i>	-	-	6	-
		Scenedesmaceae	<i>Coelastrum</i>	4	6	-	-
		Scenedesmaceae	<i>Coelastrum microsporium</i>	-	1	-	-
		Scenedesmaceae	<i>Tetrastrum</i>	-	2	-	-
2	Cyanophyceae	Neochloridaceae	<i>Golenkinia radiata</i>	-	-	-	5
3	Bacillariophyceae	Microcystaceae	<i>Microcystis sp.</i>	-	-	-	3
3	Bacillariophyceae	Aulacoseiraceae	<i>Aulacoseira</i>	23	-	-	-
		Baccillariaceae	<i>Nitzschia frustulum</i>	-	-	-	7
		Fragilariaceae	<i>Synedra sp.</i>	-	-	-	3
Total				32	18	20	19

Table 2: Algal distribution in Palkhed during June- July [Monsoon season] and their frequencies in the four sampling stations.

Sr No	Class	Family	Name of Phytoplankton	S1	S2	S3	S4
1	Chlorophyceae	Characiaceae	<i>Characium fusiforme</i>	-	-	-	-
		Scenedesmaceae	<i>Coelastrum</i>	-	-	-	12
		Actinaceae	<i>Actinastrum gracillium</i>	1	-	-	-
2	Cyanophyceae	Nostoceae	<i>Anabaena circinalis</i>	-	-	12	2
		Nostoceae	<i>Anabaena flos-aquae</i>	-	-	8	1
		Nostoceae	<i>Nostoc</i>	18	15	-	3
		Aphanizomenonaceae	<i>Raphidiopsis</i>	6	-	-	-
3	Bacillariophyceae	Entomoneidaceae	<i>Entomoneis (diatoms)</i>	2	-	-	-
		Diatomallaceae	<i>Diatomella bayourinae</i>	-	6	-	-
		Naviculaceae	<i>Navicula</i>	3	-	-	-
4	Dinophyceae	Gymnodinaceae	<i>Amphidinium</i>	-	4	-	-
5	Eustigmatophyceae	Goniochloridaceae	<i>Goniochloris sculpta</i>	-	-	-	1
total				30	25	20	19

Table 3: Algal distribution in Lake 1 during August-September [Post-Monsoon season] and their frequencies in the four sampling stations.

Sr No	Class	Family	Name of Phytoplankton	S1	S2	S3	S4
1	Chlorophyceae	Scenedesmaceae	<i>Coelastrum chodati</i>	5	-	-	-
		Scenedesmaceae	<i>Coelastrum sphaericum</i>	10	-	3	-
		Hydrodictyaceae	<i>Pediastrum biradiatum</i>	3	-	-	-
		Hydrodictyaceae	<i>Pediastrum tetras</i>	2	8	-	-
		Scenedesmaceae	<i>Coronastrum ellipsoideum</i>	-	-	5	-
		Scenedesmaceae	<i>Scenedesmus quadricauda</i>	-	-	6	-
		Characiaceae	<i>Characium fusiforme</i>	-	4	-	-
		Chlorococcaceae	<i>Chlorococcum humicola</i>	2	-	-	-
2	Trebouxiophyceae	Chlorellaceae	<i>Closteriopsis longissima</i>	23	-	-	-
		Chlorellaceae	<i>Chlorella</i>	3	-	8	5

		Chlorellaceae	<i>Actinastrum gracillium</i>	1	-	-	-
3	Cyanophyceae	Nostocaceae	<i>Anabaena circinalis</i>	-	-	-	2
		Nostocaceae	<i>Cylindrospermopsis</i>	7	-	-	8
		Nostocaceae	<i>Anabaena</i>	5	-	-	-
		Nostocaceae	<i>Nostoc</i>	-	-	-	-
		Aphanizomenonaceae	<i>Nodularia spumigena</i>	3	-	-	7
		Aphanizomenonaceae	<i>Raphidiopsis</i>	7	17	5	-
4	Bacillariophyceae	Entomoneidaceae	<i>Entomoneis (diatoms)</i>	-	-	1	1
5	Chrysophyceae	Chrysamobaceae	<i>Chrysamoeba radians</i>	-	-	1	1
6	Dinophyceae	Peridiniaceae	<i>Peridinium</i>	-	8	-	-
7	Eustigmatophyceae	Goniocloridaceae	<i>Goniocloris sculpta</i>	-	-	-	2
8	Xanthophyceae	Characiopsidaceae	<i>Characiopsis longipes</i>	1	-	-	-
			Total	64	37	29	26

Table 4: Algal distribution in Palkhed during August-September [Post-Monsoon season] and their frequencies in the four sampling stations

Sr. No.	Class	Family	phytoplankton species	S1	S2	S3	S4
1	Chlorophyceae	Hydrodictyaceae	<i>Pediastrum biradiatum</i>	-	1	-	-
		Hydrodictyaceae	<i>Pediastrum tetras</i>	3	-	4	-
		Hydrodictyaceae	<i>Pediastrum simplex</i>	3	-	6	-
		Hydrodictyaceae	<i>Pediastrum duplex</i>	-	-	2	1
		Scendesmaceae	<i>Scendesmus quadricauda</i>	3	-	-	-
		Scendesmaceae	<i>Desmodesmus quadricuda</i>	-	-	2	-
		Scendesmaceae	<i>Desmodesmus itascaensis</i>	-	-	-	3
		Hydrodictyaceae	<i>Tetraedon trigonum</i>	2	2	-	-
		Hydrodictyaceae	<i>Tetraedon staurogeniforme</i>	-	2	-	-
		Chlorococcaceae	<i>Chlorococcum humicola</i>	2	-	-	-
		Microsporaceae	<i>Microspora ameona</i>	-	1	-	-
		Chlamydomonadaceae	<i>Chloromonas sp</i>	-	-	-	1
		Selenstraceae	<i>Kirchneriella contorta</i>	-	-	-	1
2	Trebouxiophyceae	Chlorellaceae	<i>Chlorella</i>	3	-	-	-
		Chlorellaceae	<i>Actinastrum gracillium</i>	1	-	-	-
		Oocystaceae	<i>Wilea rectangularia</i>	-	3	-	-
		Oocystaceae	<i>Oocystis nalanus</i>	-	2	-	-
3	Cyanophyceae	Nostocaceae	<i>Cylindrospermopsis</i>	-	-	-	5
		Nostocaceae	<i>Anabaena</i>	-	-	3	-
4	Bacillariophyceae	Bacillariaceae	<i>Nitzschia acidoclinata</i>	3	3	-	-
		Bacillariaceae	<i>Nitzschia palea</i>	-	1	-	-
		Gomphonemataceae	<i>Gomphonema</i>	-	-	1	-
		Triceratiales	<i>Triceratium</i>	-	-	1	-
5	Oligohymenophorea	Parameciidae	<i>Paramecium aurelia</i>	-	-	-	1
6	Fragilariophyceae	Fragilariaceae	<i>Synedra ulna</i>	-	-	-	4
			Total	20	15	19	16

Table 5: Physio-chemical properties of Karanjwan and Palkhed dam water (2023-2024)

Parameters	Karanjwan	Palkhed
Temperature	28°C	28.2°C
Colour	1 Hazen units	1 Hazen units
Odour	Agreeable	Agreeable
pH values (25°C)	7.76	8.38
Electrical conductivity (25°C)	151 µmho/cm	301 µmho/cm
Biochemical oxygen demand (3 days, 27°C)	2 mg/L	2 mg/L
Chemical oxygen demand	7 mg/L	6 mg/L
Total dissolved solids	84 mg/L	168 mg/L
Dissolved oxygen	6.3 mg/L	6.5 mg/L
Total Alkalinity (as CaCO ₃)	61 mg/L	99.9 mg/L
Total hardness (as CaCO ₃)	68 mg/L	120 mg/L
Acidity	BLQ (LOQ0.5)	BLQ (LOQ0.5)
Carbon dioxide (as CaCO ₂) (free)	BLQ (LOQ0.1)	BLQ (LOQ0.1)

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