Research & Reviews: Journal of
Ecology

ISSN: 2278-2230
Volume 15, Issue 1, 2026
January–April
DOI (Journal): 10.37591/RRJoE

https://journals.stmjournals.com/rrjoe

Research RRJoE

Ecological and Biomonitoring Studies of Freshwater with Reference to Selected Phytoplankton Species of Manar Reservoir, Maharashtra

Bhosle Shivam A.[1,*], Shivanikar Sudhir V.[2], Ashturkar Anand R.[3]

Abstract

Freshwater reservoirs play a crucial role in supporting domestic, agricultural, and fisheries requirements, particularly in semi-arid regions of Maharashtra. Rivers and the surface water are important sources of drinking and several other usages. Aquatic ecosystems are vital in the supply of nutritious food and food source supplementation. Therefore, we selected to study the role of plankton within the aquatic ecosystem systematically here. Plankton are very small organisms; they are of phytoplankton and zooplankton mainly which are plant and animal based also few of Prokaryotes. These organisms are also indicators of ecological and pollution status of freshwater bodies. In food chain ecosystems, the Plankton plays a significant role, form the foundation of aquatic food webs and are highly sensitive to changes in water quality, making them effective bio-indicators of ecosystem health. The present study aims to evaluate the environmental health of Manar Reservoir using plankton diversity and productivity in relation to selected few but useful physico-chemical parameters which support aquatic life system of this freshwater. Hence, we undertook the present study of Manar Dam of Barul, Maharashtra for the role of phytoplankton as vital part of aquatic ecosystem, this study was carried out during year 2023. Results show that water quality is indeed very good for the phytoplankton growth during the winter season. Hence this reservoir was found ecologically and environmentally play significant role for freshwater resources.

Keywords: Aquatic ecological studies, bio-monitoring, freshwater analysis, phytoplankton, freshwater

INTRODUCTION

Freshwater reservoirs in India are increasingly subjected to anthropogenic pressures, such as agricultural runoff, domestic sewage, and fluctuating water levels, leading to changes in nutrient dynamics and biological composition. These alterations often result in eutrophication of water bodies, shifts in plankton community structure and deterioration of water quality. Safe drinking water impacts all biological life forms quite significantly [1]. Systematic Plankton-based biomonitoring is essential for understanding reservoir productivity and ecological health.

Among the biological indicators, Plankton communities respond rapidly to changes in physico-chemical conditions of water parameters, nutrient enrichment as well as pollution loads. Thereby serving as early warning indicators of ecosystem disturbance especially of polluting matters [2].

Manar Reservoir is nearly 50 kms from the Nanded city of Maharashtra; it is a vital waterbody, supports aquatic life and several human activities.

***Author for Correspondence**
Bhosle Shivam A
E-mail: shivambhosle18@gmail.com

[1]Research Student, Department of Environmental Science, Netaji Subhashchandra Bose Senior College, Nanded, Maharashtra, India.
[2]Principal (Former), Department of Environmental Science, Netaji Subhashchandra Bose Senior College, Nanded, Maharashtra, India.
[3]Assistant Professor, Department of Environmental Science, Netaji Subhashchandra Bose Senior College, Nanded, Maharashtra, India.

Received Date: February 21, 2026
Accepted Date: February 25, 2026
Published Date: March 05, 2026

Citation: Bhosle Shivam A., Shivanikar Sudhir V., Ashturkar Anand R. Ecological and Biomonitoring Studies of Freshwater with Reference to Selected Phytoplankton Species of Manar Reservoir, Maharashtra. Research & Reviews: Journal of Ecology. 2026; 15(1): 1–17p.

However, increasing anthropogenic pressures threaten its ecological balance. Plankton communities serve as effective indicators of water quality, reflecting changes in nutrient levels and ecosystem dynamics. This study aims to evaluate the trophic status of Manar Reservoir using plankton-based biomonitoring, providing valuable insights for its sustainable management. Manar Reservoir is an important source for drinking, irrigation, and fisheries resource at Barul in Nanded district, Maharashtra. Despite its socio-economic importance, limited scientific studies have been conducted on its plankton ecology and biomonitoring status. The present research attempts to bridge this gap by integrating physico-chemical parameters with plankton diversity and productivity to assess the environmental status of the reservoir.

Plankton in Freshwater

Phytoplankton is algae, microscopic single-celled plants that float in the surface waters of the oceans, lakes, and rivers. In the ocean, they make up the base of the marine food web and are thus called the "pasture of the sea". Phytoplankton makes food by photosynthesis and thus depends on sunlight and a source of nutrients such as nitrogen, carbon, and phosphorous. Phytoplankton plays an important role, including algae and cyanobacteria in aquatic ecosystems and they are primary producers. Aquaculture organisms must obtain all their nutritional requirements, except for part of the mineral requirements, using the food they consume [3]. In nature, most organisms subsist on living food consisting of plants and animals obtained from the environment, but some do ingest and utilize detritus along with associated organisms. The plant components of all the plankton are the phytoplankton and are primary producers for all aquatic bodies [4].

Study Area

The present investigation was undertaken at Manar Reservoir, located near Warwant village of Kandhar Taluka of Nanded District, Maharashtra. Manar Dam is an earth-fill dam constructed on the Manar (Manyad) River, a tributary of the Manjra River in the Godavari basin. The reservoir is situated approximately 50kms from Nanded city and serves multiple purposes including irrigation, domestic water supply, fisheries, and aquaculture, respectively.

Four sampling stations were selected to represent different zones of the reservoir based on hydrological and anthropogenic influences. The entering of water into the dam and up to the entire storage of water nearly these water sampling sites located as S1, S2, S3, and S4, respectively. These sampling stations are located from entrance of river water up to the huge storage in the dam itself, the details are represented in Figures 1–3 and Table 1.

Figure 1. A view showing large water storage in Manar Dam.

Figure 2. Google map visuals of Manar Reservoir with selected four different water sampling sites.

Table 1. Sampling site of Manar Dam.

S. N.	Sampling site (SS)	Latitude	Longitude
1.	(SS_1)	18°49'52.61"N	77°18'56.49"E
2.	(SS_2)	18°50'38.34"N	77°18'2.03"E
3.	(SS_3)	18°50'57.20"N	77°16'59.15"E
4.	(SS_4)	18°50'09.00"N	77°17'39.60"E

SS=Sampling Site

Few important and essential water quality parameters were analyzed which are necessary to assess the impact of water systems on phytoplankton productivity. These parameters are Temperature (micro-thermometer), pH (digital pH meter), Dissolved Oxygen (Winkler's method), BOD (five days), COD (reflux method), however Phosphate, Sulphate, and Nitrite–nitrogen by (digital spectrophotometer), respectively. Nearly entire year, i.e., 2023, water samples were brought to the laboratory and analyzed systematically, as the results obtained, on this basis we observed, identified few plankton species from this reservoir, finally the conclusions drawn accordingly.

MATERIAL AND METHODOLOGY

The surface water distributed and they are classified as the strata formation and they named as Upper: Epilimnion, Middle: Hypolimnion and Base: Benthos, respectively [5]. We have selected these four sites of Manar reservoir for the period of one year and the result was expressed. Samples were collected in glass tubes/bottles/plastic containers with taken care as per standard methods, widely useful procedure applied. Temperature and pH were observed, checked on site and other water samples were analyzed in the laboratory. Collection of water samples were carried out once a month during January to December of 2023. We applied fresh plankton material/sample and sometimes were preserved using formalin in laboratory.

The water sample of phytoplankton content are indicator, composite samples which were homogenized, allowed to settle the plankton cells and used the small volume of plankton sample for microscopic studies using coverslip, clean slides, etc. Used necessary glassware, equipment, and other required material. The collection of plankton, we used phytoplankton net, from the specified sampling stations of the reservoir, at about the depth of 15 to 60cms as its large surface distributed water body (below Epilimnion, i.e., Hypolimnion, where we observed plankton), filtered the water and collected the plankton material in the bottles and these samples brought in the laboratory. With help of research microscope, we observed (under appropriate magnification), carried out and identified the phytoplankton with specified laboratory techniques. Also focused our concentration on the cell size, shape, structure, chloroplast content, the observed species/values/results were expressed as follows.

RESULTS AND DISCUSSION

Several researchers worked on plankton along with its distribution, diversity, density, nutrient content as well as its vital application in aquatic food chain. Phytoplankton diversity in freshwater lake of Waddepally, Hanamkonda of Telangana State were evaluated during year 2021 to 2022 and they studied and found different class algal members, they recorded and concluded the five dominant class of algal species [6, 7]. studied phytoplankton between March and November of 2008, they carried out evaluation of phytoplankton diversity in seven different lakes around Tumkur, Karnataka, and recorded 26 species belongs to 18 genera, with Chlorophyceae as the dominant group. Phytoplankton density was highest during summer and lowest during monsoon, indicated strong seasonal influence, which will be beneficial for food chain. Panikkar et al. (2024) [8] assessed the phytoplankton diversity in Karapuzha Reservoir located in the Wayanad district of Kerala, India. Study was based on the sampling conducted month-wise for a period of one year, i.e., April 2009 to March 2010 and they recorded 36 genera dominated by Chlorophyceae and Bacillariophyceae. Seasonal variation showed a higher abundance during pre-monsoon and post-monsoon period. Diversity indices showed moderate pollution, and phytoplankton abundance was significantly influenced by physicochemical parameters.

The plankton study investigated phytoplankton diversity in Nagathibelagalu tank of Bhadravathi town, Karnataka. They evaluated for a period of twelve months from January to December 2008 and noted 44 species dominated by Chlorophyceae and diatoms, etc. Elevated nutrient levels, such as nitrate and phosphate, promoted phytoplankton growth. The study confirmed phytoplankton as effective indicators of water quality deterioration [9].

The researcher studied phytoplankton composition at the fish farm of Jayakwadi Paithan, Aurangabad district in Marathwada region of Maharashtra. They reported 18 genera dominated by Chlorophyceae. The research work was performed during the period of Nov 2021 to Oct 2022. Seasonal variation showed maximum phytoplankton density during winter and summer. Higher phytoplankton productivity enhanced fish growth and aquaculture yield. Study highlighted phytoplankton as essential for ecosystem productivity, fishery growth [10, 11]. evaluated phytoplankton diversity and water quality in waterbodies of Bankura, West Bengal and observed significant relationships between nutrient levels and phytoplankton distribution. The study was based on samples which were collected between August 2022 to May 2023. Nutrient enrichment caused algal blooms, especially Euglena species. Diversity indices reflected variations in ecological conditions and trophic status. The study confirmed phytoplankton as indicators of environmental sustainability and ecosystem health. Das et al. (2012) [12] investigated phytoplankton diversity in domestic wastewater-fed urban fishponds of the Chota Nagpur Plateau, India, and recorded 43 phytoplankton taxa belonging to Cyanophyceae, Chlorophyceae, Bacillariophyceae, and Euglenophyceae, etc. The sampling work of the present study was carried out once a month from January 2017 to July 2017. The study revealed that nutrient-rich wastewater significantly enhances phytoplankton diversity and abundance, particularly Chlorophyceae and Cyanophyceae, indicating eutrophic conditions.

The phytoplankton community study carried out in The Scheldt catchment which covers territories in France, Belgium, and the Netherlands. Six sampling campaigns were carried out in the upstream part of the Scheldt catchment at stations monitored in the WFD context. These campaigns took place from 7 to 10 April 2014, 16–23 April 2015, 15–19 June 2015 and 2–7 September 2014. They found strong relationships between phytoplankton diversity and ecological status of water bodies. Environmental factors, such as nutrients and hydrological changes, significantly influenced phytoplankton composition. Mahanty et al. (2024) and Das et al. (2018) [13, 14] investigated plankton species composition and abundance in acid sulfate soil brackish water ponds of Kotabaru Regency, Indonesia, to evaluate water quality and aquaculture productivity. Data collection was carried out from March 29 to April 10, 2016. The study recorded nearly 8 species of phytoplankton dominated by Bacillariophyceae, particularly Nitzschia sp., and 9 species of zooplankton dominated by Crustacea, especially Copepoda. Plankton abundance was highly influenced by physicochemical parameters such as DO, pH, temperature, nutrients, and suspended solids. Increased dissolved oxygen and pH enhanced plankton abundance, whereas high ammonia levels negatively affected dominant species.

The study was conducted of seven sampling sites were set up in the Reservoir for quarterly sampling from 2017 to 2019 in the Danjiangkou Reservoir located in China. They identified 157 phytoplankton species belonging to 9 phyla, with Chlorophyta, Bacillariophyta, and Cyanobacteria as dominant groups. The phytoplankton community showed significant vertical and seasonal variations, with higher species richness, abundance in surface layers and warmer seasons. Environmental factors, particularly water temperature, dissolved oxygen, were identified as key drivers influencing phytoplankton distribution and diversity. The study confirmed that phytoplankton community dynamics are closely associated with environmental conditions, can be effectively used to assess ecosystem health and water quality in reservoirs [15]. Hence, the findings of the present study indicate that the Manar aquatic body is nearly free from major sources of pollution. The values obtained during the investigation are presented in Tables 2–9 and are further illustrated through Figures 3–10, respectively.

Table 2. Values of temperature (°C) found during January to December 2023 from different water sampling sites.

Season/months		Temperature			
		S1	S2	S3	S4
Summer	Feb	23.5	23	23.5	23.0
	Mar	25.0	24.5	25.0	24.5
	Apr	28.0	27	28.0	27.5
	May	29.0	28.5	29.5	29.0
Monsoon	Jun	26.5	26	27.0	26.0
	Jul	24.0	24	24.5	24.0
	Aug	23.0	23	23.5	23.0
	Sep	24.0	24	24.0	24.0
Winter	Oct	23.0	23	23.5	23.0
	Nov	20.0	20	20.5	20.0
	Dec	19.0	18	19.0	18.5
	Jan	20.5	20	21.0	20.0
Average		23.79	23.42	24.08	23.54
Average Conc.		23.7			
Minimum		19.0	18.0	19.0	18.5
Maximum		29.0	28.5	29.5	29.0
Standard Deviation		3.063	3.021	3.066	3.078

Table 3. Values of pH found during January to December 2023 from different water sampling sites.

Season/months		pH			
		S1	S2	S3	S4
Summer	Feb	8.25	8.05	8.05	7.80
	Mar	8.15	8.00	7.95	7.70
	Apr	8.05	7.90	7.90	7.65

	May	8.00	7.90	7.80	7.60
Monsoon	Jun	7.90	7.80	7.70	7.50
	Jul	7.90	7.75	7.70	7.50
	Aug	7.70	7.60	7.50	7.30
	Sep	7.80	7.70	7.60	7.40
Winter	Oct	7.75	7.65	7.55	7.35
	Nov	7.70	7.60	7.50	7.30
	Dec	8.00	7.85	7.80	7.60
	Jan	7.90	7.80	7.75	7.50
Average		7.93	7.80	7.73	7.52
Average Conc.		7.74			
Minimum		7.70	7.60	7.50	7.30
Maximum		8.25	8.05	8.05	7.80
Standard Deviation		0.174	0.148	0.178	0.160

Table 4. Values of dissolved oxygen (mg/L) found during January to December 2023 from different water sampling *sites.*

Season/months		**Dissolved oxygen**			
		S1	**S2**	**S3**	**S4**
Summer	Feb	4.39	4.27	4.44	4.23
	Mar	4.15	4.03	4.21	3.99
	Apr	3.93	3.80	3.99	3.75
	May	3.74	3.59	3.80	3.54
Monsoon	Jun	3.51	3.43	3.62	3.42
	Jul	3.54	3.59	3.66	3.50
	Aug	3.68	3.79	3.87	3.71
	Sep	3.87	4.00	4.07	3.91
Winter	Oct	4.09	4.18	4.27	4.11
	Nov	4.30	4.39	4.46	4.31
	Dec	4.40	4.46	4.40	4.27
	Jan	4.48	4.41	4.49	4.36
Average		4.00	3.99	4.10	3.92
Average Conc.		4.01			
Minimum		3.51	3.43	3.62	3.42
Maximum		4.48	4.46	4.49	4.36
Standard Deviation		0.345	0.354	0.316	0.336

Table 5. Values of BOD (mg/L) found during January to December 2023 Manar Reservoir.

Season/months		**BOD**			
		S1	**S2**	**S3**	**S4**
Summer	Feb	5.95	6.03	5.97	6.01
	Mar	6.46	6.36	6.30	6.38

	Apr	6.32	6.60	6.52	6.56
	May	6.56	6.62	6.70	6.64
Monsoon	Jun	6.43	6.49	6.55	6.51
	Jul	6.13	6.17	6.03	6.15
	Aug	5.89	5.95	5.97	5.93
	Sep	5.85	5.91	5.99	5.93
Winter	Oct	5.75	5.77	5.91	5.83
	Nov	5.89	5.91	5.99	5.93
	Dec	5.77	5.89	5.91	5.85
	Jan	5.85	5.95	5.93	5.91
Average		6.07	6.14	6.15	6.14
Average Conc.		6.12			
Minimum		5.75	5.77	5.91	5.83
Maximum		6.56	6.62	6.70	6.64
Standard Deviation		0.295	0.302	0.289	0.302

Table 6. Values of COD (mg/L) found during January to December 2023 from different water sampling sites.

Season/months		**COD**			
		S1	**S2**	**S3**	**S4**
Summer	Feb	0.90	0.94	0.97	0.92
	Mar	1.04	1.07	1.10	1.06
	Apr	1.07	1.11	1.17	1.10
	May	1.10	1.14	1.19	1.12
Monsoon	Jun	0.94	0.98	1.04	1.00
	Jul	0.80	0.84	0.90	0.86
	Aug	0.57	0.62	0.70	0.64
	Sep	0.62	0.67	0.77	0.70
Winter	Oct	0.74	0.80	0.88	0.82
	Nov	0.82	0.87	0.94	0.90
	Dec	0.88	0.92	0.97	0.94
	Jan	0.90	0.94	0.98	0.95
Average		0.86	0.91	0.97	0.92
Average Conc.		0.91			
Minimum		0.57	0.62	0.70	0.64
Maximum		1.10	1.14	1.19	1.12
Standard Deviation		0.167	0.161	0.147	0.148

Table 7. *Values of sulphate (mg/L) found during January* to December 2023 from different water sampling sites.

Season/months		**Sulphate**			
		S1	**S2**	**S3**	**S4**
Summer	Feb	21.7	21.5	22.0	21.6
	Mar	22.0	22.2	22.7	22.1

	Apr	21.6	21.8	22.4	22.0
	May	21.8	22	22.6	22.1
Monsoon	Jun	20.7	19.9	19.7	20.1
	Jul	19.7	18.9	19.3	19.1
	Aug	17.7	17.7	19.7	18.1
	Sep	18.5	18.3	20.5	18.9
Winter	Oct	19.5	20.7	20.9	20.1
	Nov	20.7	21	21.4	21.1
	Dec	21.4	21.5	22.0	21.7
	Jan	21.8	22	22.2	21.9
Average		20.6	20.6	21.3	20.7
Average Conc.		20.8			
Minimum		17.7	17.7	19.3	18.1
Maximum		22.0	22.2	22.7	22.1
Stand. Deviation		1.432	1.560	1.228	1.423

Table 8. *Values of* phosphate *(mg/L) found during January to December 2023 from different water sampling sites.*

Season/months		**Phosphate**			
		S1	**S2**	**S3**	**S4**
Summer	Feb	0.908	0.903	1.088	0.918
	Mar	0.978	0.980	1.108	0.988
	Apr	0.968	0.973	1.128	0.983
	May	0.948	0.950	1.103	0.958
Monsoon	Jun	0.903	0.916	1.068	0.918
	Jul	0.838	0.883	1.053	0.893
	Aug	0.778	0.808	1.043	0.823
	Sep	0.793	0.818	0.983	0.833
Winter	Oct	0.863	0.873	1.053	0.883
	Nov	0.873	0.886	1.068	0.893
	Dec	0.886	0.888	1.096	0.903
	Jan	0.898	0.896	1.068	0.908
Average		0.886	0.898	1.071	0.908
Average Conc.		0.941			
Minimum		0.778	0.808	0.983	0.823
Maximum		0.978	0.980	1.128	0.988
Stand. Deviation		0.063	0.053	0.038	0.051

Table 9. Values of nitrite–nitrogen (mg/L) found during January to December 2023 from different sampling sites.

Season/months		**Nitrite-nitrogen**			
		S1	**S2**	**S3**	**S4**
Summer	Feb	0.479	0.465	0.479	0.471
	Mar	0.489	0.483	0.491	0.485

	Apr	0.485	0.489	0.488	0.487
	May	0.483	0.485	0.495	0.489
Monsoon	Jun	0.461	0.479	0.485	0.473
	Jul	0.448	0.471	0.461	0.453
	Aug	0.435	0.453	0.455	0.448
	Sep	0.447	0.449	0.465	0.453
Winter	Oct	0.461	0.461	0.477	0.465
	Nov	0.465	0.475	0.471	0.469
	Dec	0.477	0.483	0.489	0.481
	Jan	0.483	0.487	0.487	0.485
Average		0.468	0.473	0.479	0.472
Average Conc.		0.473			
Minimum		0.435	0.449	0.455	0.448
Maximum		0.489	0.489	0.495	0.489
Stand. Deviation		0.018	0.014	0.013	0.014

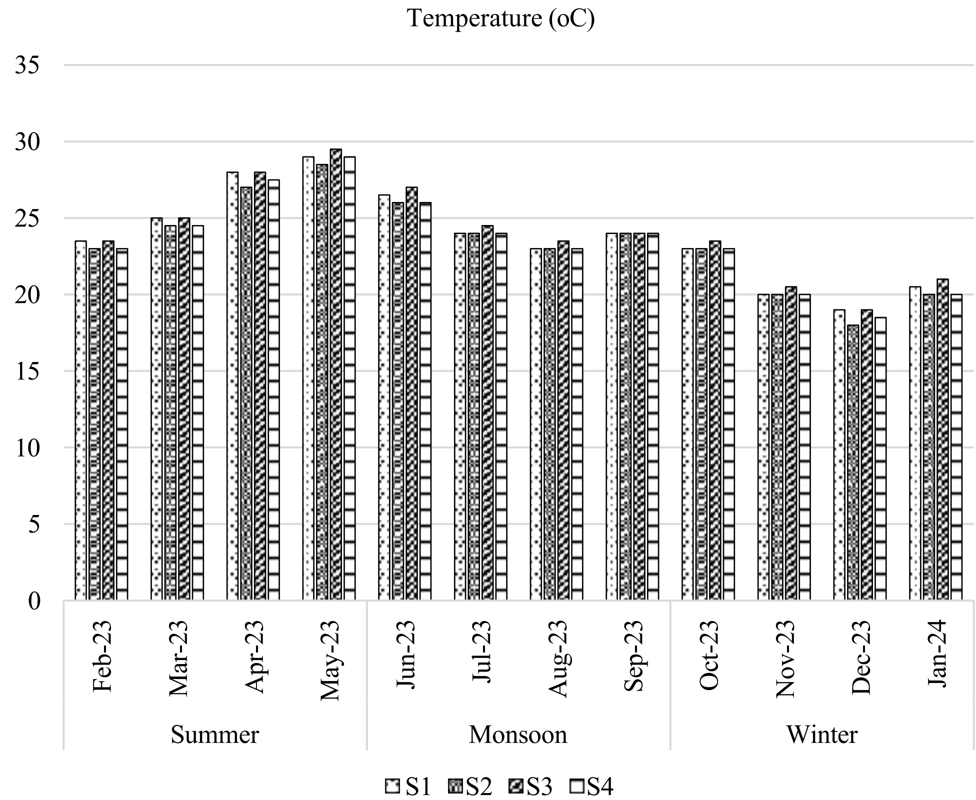

Figure 3. Values of temperature (°C) noted during January to December 2023 of Manar Reservoir.

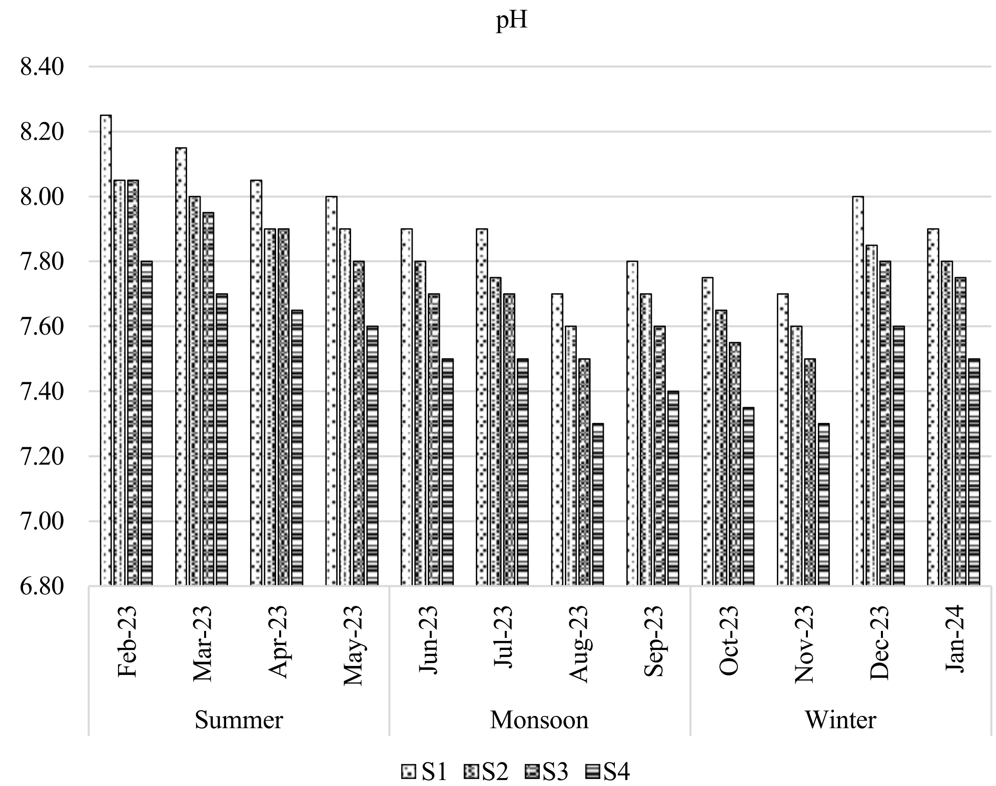

Figure 4. The values of pH recorded from January to December 2023 Manar Dam water.

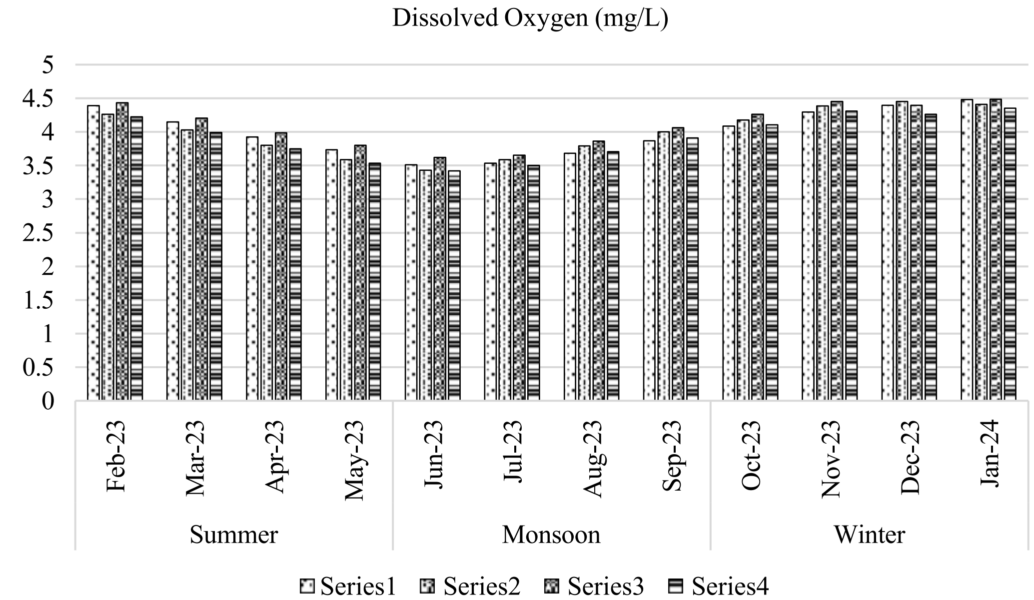

Figure 5. The values of dissolved oxygen (mg/L) found during January to December 2023.

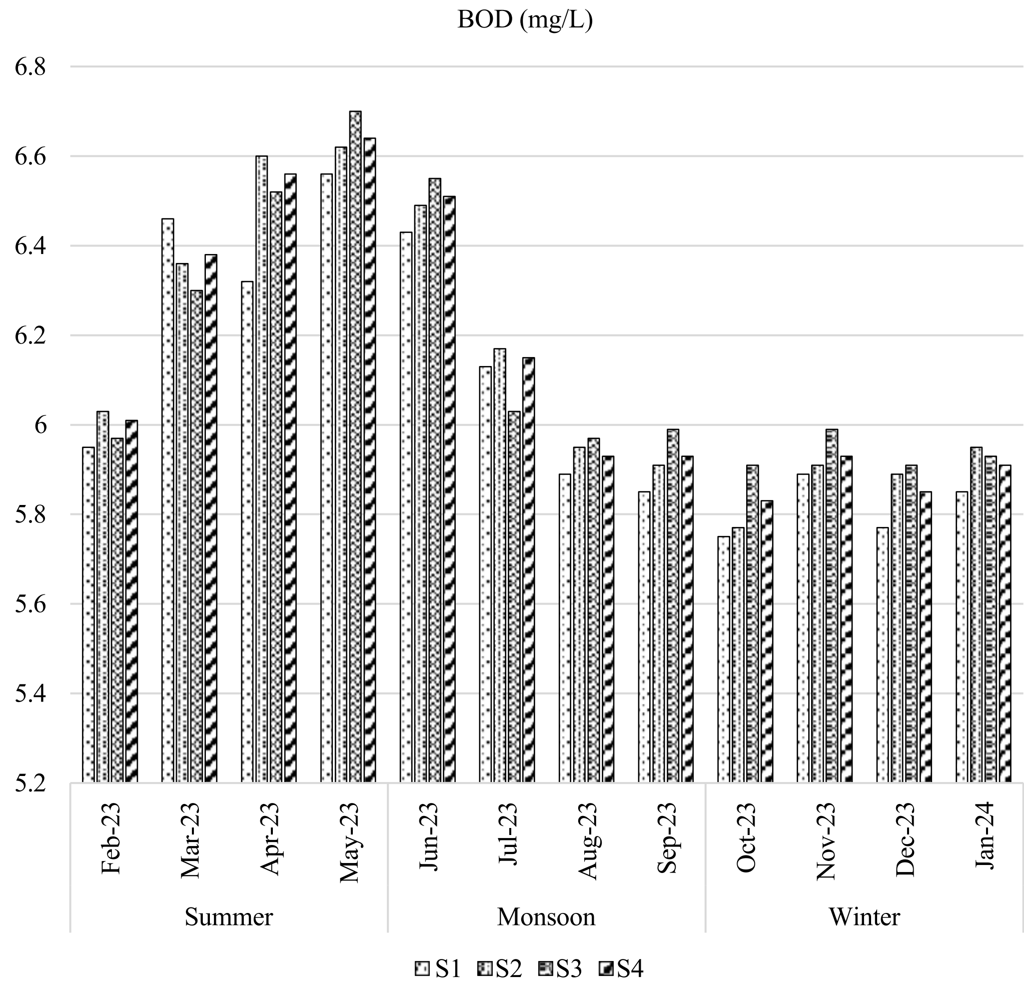

Figure 6. Values of BOD content (mg/L) noted during January to December 2023 of Manar water.

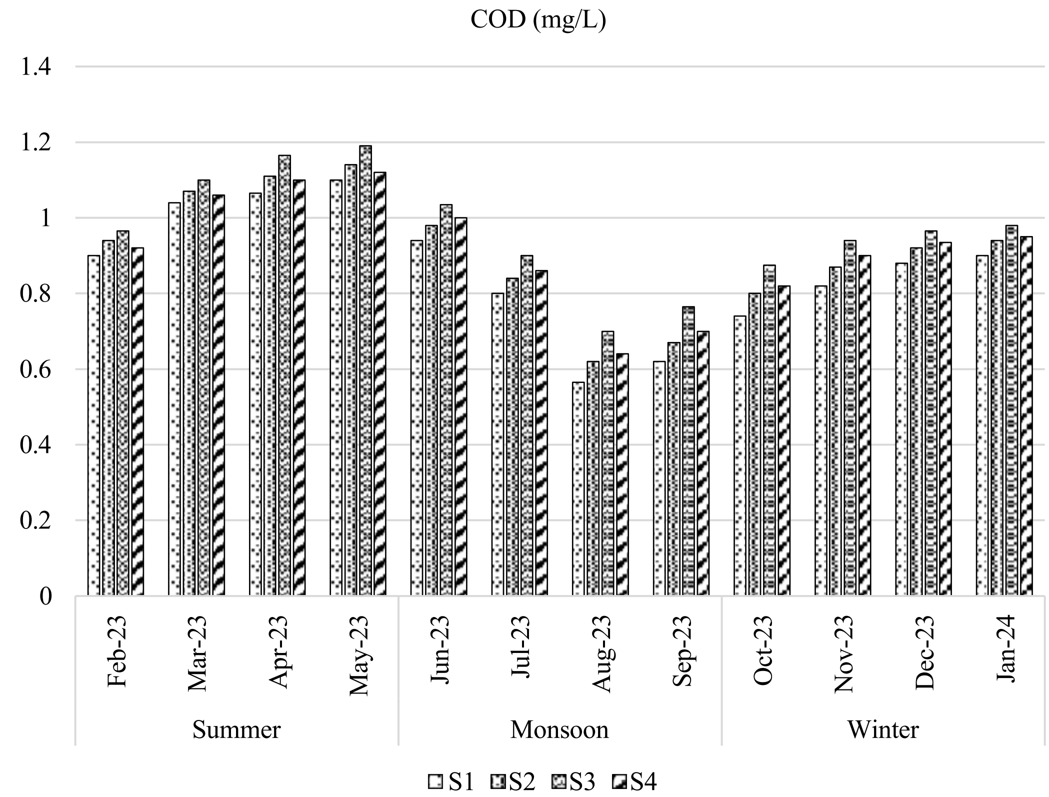

Figure 7. The values of COD (mg/L) observed during January to December 2023 of Manar water.

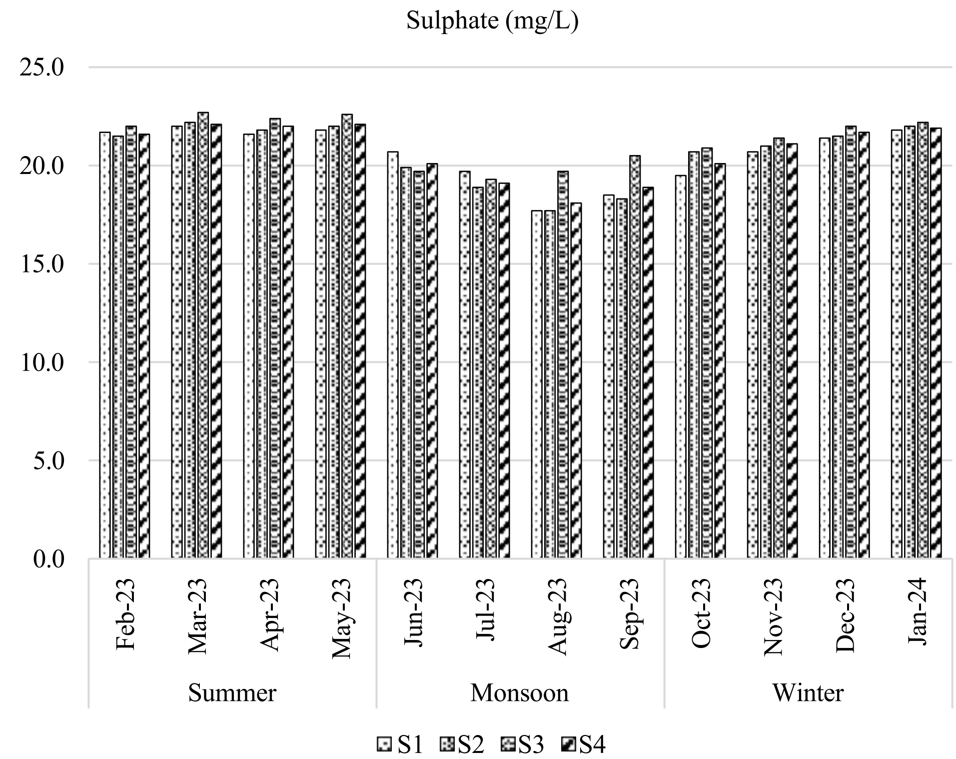

Figure 8. *The values of sulphate content (mg/L) were noted* during January to December 2023 Manar Reservoir.

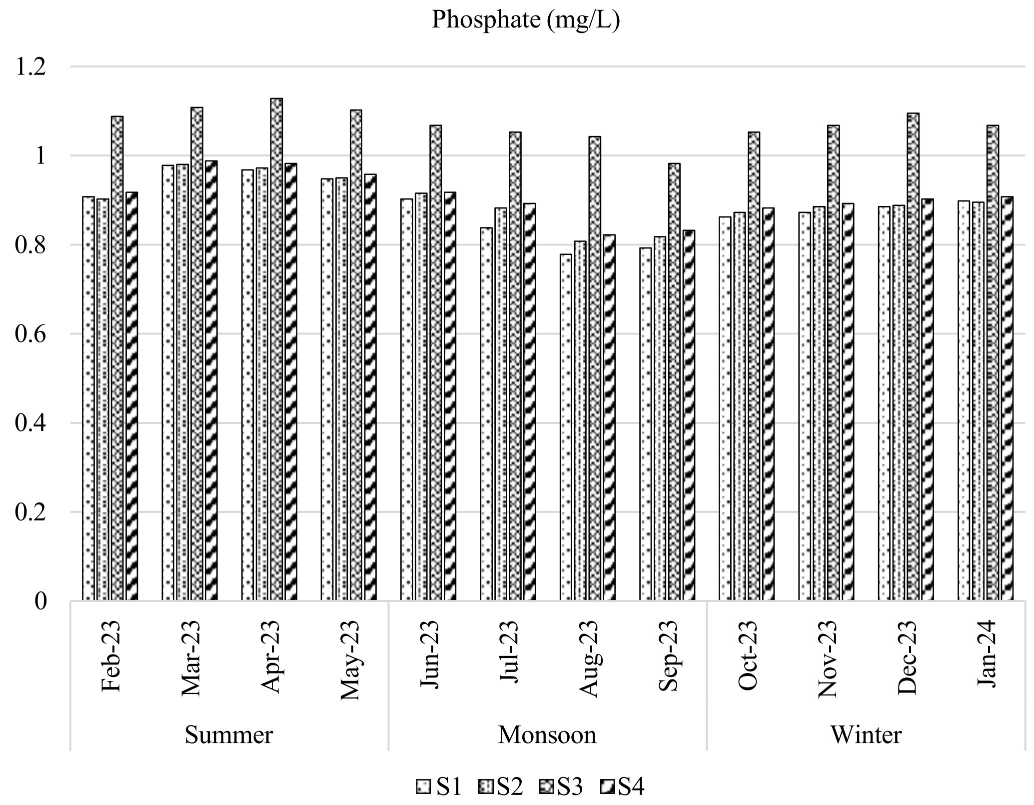

Figure 9. Values of phosphate level (mg/L) noted during January to December 2023 of Manar reservoir.

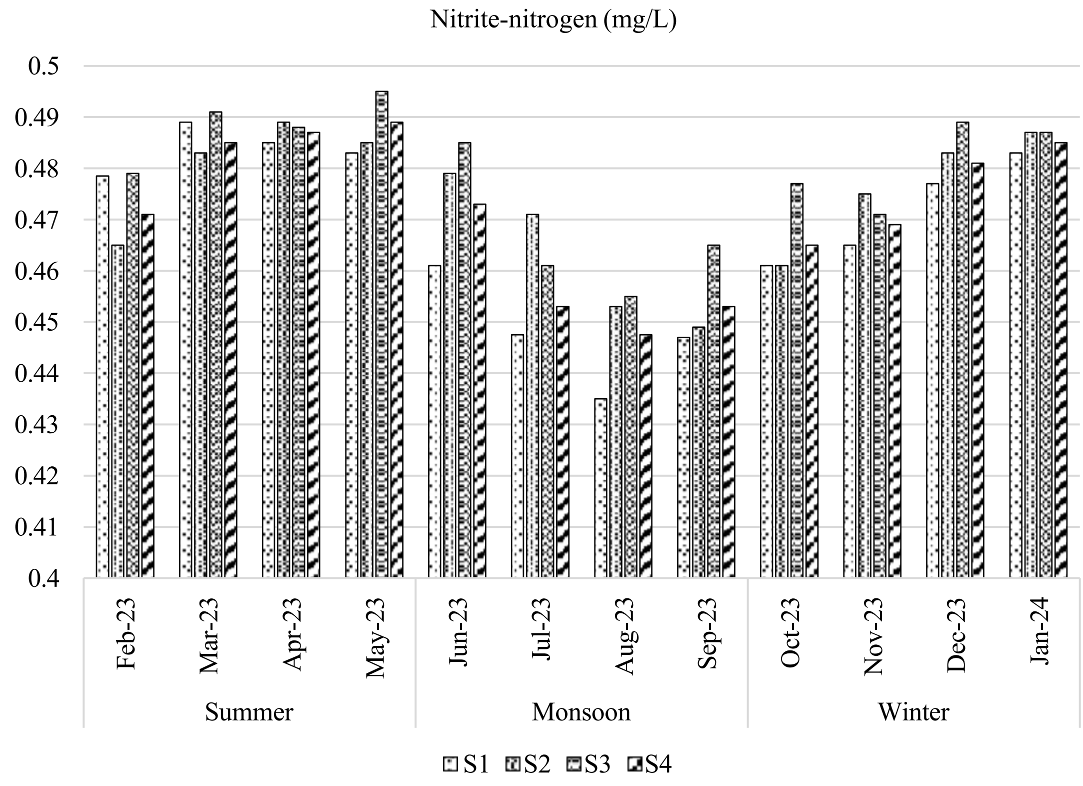

Figure 10. The values of nitrogen–nitrite content (mg/L) during January to December 2023 of Manar dam.

PHYTOPLANKTON SPECIES OBSERVED DURING OUR INVESTIGATIVE WORK AND PRESENTED AS

Chlamydomonas

Chlamydomonas (Figure 11) is a freshwater plankton which is frequently observed across all sampling sites which was undertaken for the present research work, particularly during summer and early post-monsoon periods. Its abundance showed a positive relationship with moderate phosphate and nitrite–nitrogen concentrations, indicating its adaptability to nutrient-enriched conditions. The slightly alkaline pH and elevated temperature during summer months are favorable for its growth, however sufficient dissolved oxygen supports its active metabolic processes. The presence of *Chlamydomonas* species reflects moderate trophic conditions and contributes significantly to primary productivity in the reservoir.

Nostoc

Nostoc (Figure 12) was observed mainly during summer and early monsoon periods, when water temperature and nutrient concentrations, particularly phosphate and nitrite–nitrogen, were relatively higher. The species showed adaptability to nutrient-enriched and slightly alkaline conditions due to its nitrogen-fixing capability, which allows it to survive even under low nitrogen availability. Its occurrence was associated with moderate dissolved oxygen and increased organic matter content, indicating productive environmental conditions. The presence of *Nostoc* reflects nutrient enrichment and enhanced primary productivity in the reservoir. Therefore, *Nostoc* serves as an important biological indicator of mesotrophic to eutrophic conditions in the freshwater ecosystem of Manar Reservoir, as observed in the present study.

Cosmarium

Cosmarium (Figure 13) exhibited higher density during winter and post-monsoon seasons, coinciding with stable temperature, higher dissolved oxygen and lower BOD values. The availability of moderate phosphate levels and relatively clear water conditions favored the proliferation of this desmid. Its dominance indicates good water quality and balanced nutrient status, making *Cosmarium* a reliable indicator of mesotrophic conditions in Manar Reservoir. It is a quite well indicator of freshwater ecosystems, as observed here.

Anabaena

Anabaena (Figure 14) is predominantly recorded during late summer and monsoon periods, when phosphate concentration was comparatively higher and water temperature increased slightly. The species demonstrated tolerance to moderate nutrient enrichment and lower nitrogen availability, owing to its nitrogen-fixing capability. Occasional blooms of *Anabaena* reflect nutrient imbalance and enhanced productivity, suggesting a tendency towards localized eutrophic conditions during certain periods.

Volvox

Presence of *Volvox* (Figure 15) mainly observed during winter and early summer months, corresponding with high dissolved oxygen, low BOD and moderate nutrient availability, etc. Its occurrence was more pronounced at open-water sampling sites, where light penetration was sufficient in the water body. The distribution of *Volvox* indicates relatively clean and well-oxygenated water, contributing to the overall phytoplankton diversity of the reservoir.

Spirogyra

Spirogyra (Figure 16) showed maximum abundance during summer and early monsoon, coinciding with elevated temperature and increased phosphate levels. The filamentous nature of *Spirogyra* enables rapid growth under nutrient-rich conditions, often forming visible mats near the littoral zones. Its presence always indicated nutrient enrichment and reduced water movement, serving as an indicator of organic input and seasonal productivity peaks.

Navicula

Navicula (Figure 17), a dominant diatom genus, was recorded throughout the study period with higher abundance during winter and post-monsoon seasons. The species showed strong association with high dissolved oxygen, low BOD and stable sulphate concentration. The presence of *Navicula* reflects good water quality and silica availability, making it an important contributor to primary productivity and a reliable bio-indicator of ecological stability of the water body.

Pediastrum

Pediastrum (Figure 18) an alga was commonly observed during post-monsoon and winter months, when nutrient levels were moderate and water transparency improved. Its growth correlated positively with phosphate availability and favorable pH conditions, indicating mesotrophic tendencies. The consistent presence of *Pediastrum* highlights its role in maintaining phytoplankton diversity and reflects balanced nutrient dynamics in the reservoir which is good example of freshwater bio-indicator and represents increased level of dissolved oxygen in the reservoir.

Oedogonium

Oedogonium (Figure 19) the freshwater alga appeared mainly in summer and early monsoon periods, particularly near the reservoir margins. Its occurrence corresponded with higher nutrient concentration and warmer temperature, which supported vegetative growth. The presence of *Oedogonium* was moderate organic enrichment and shallow-water productivity, contributing to overall biomass of phytoplankton community. It reflects healthy aquatic ecosystem.

Pandorina

Pandorina (Figure 20) was recorded sporadically across sampling sites, with higher abundance during winter and early summer. The species favoured well-oxygenated water with moderate nutrient levels, indicating stable environmental as well as ecological conditions. Its presence reflects transitional trophic status and supports the interpretation of Manar Reservoir as a system experiencing seasonal fluctuations in the nutrient availability, productivity. It's a freshwater bio-indicator organism, supports healthy ecological status of water body.

Figure 11. Chlamydomonas.

Figure 12. Nostoc.

Figure 13. Cosmarium.

Figure 14. Anabaena. **Figure 15.** Volvox. **Figure 16.** Spirogyra.

Figure 17. Navicula.

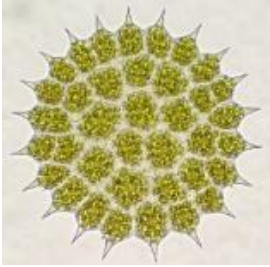

Figure 18. Pediastrum.

Figure 19. Oedogonium.

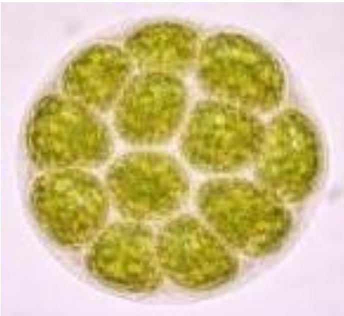

Figure 20. Pandorina.

CONCLUSION

Based on the search inputs from four different sites as mentioned in the table and figures the obtained values of BOD and COD are within the permissible limit. The phytoplankton in this reservoir was found to be quite well and non-polluted as per the results obtained, which is indication of healthy water body/aquatic ecosystem. Compared with our observed values of various physicochemical parameters, this water body did not find any excessive concentrations of chemical contents, hence our studies showed that Manar aquatic body is nearly free from pollution sources. The values obtained in the present are shown in Tables 2–9 also indicated with the help of Figures 4–11, respectively. However, Manar reservoir is a rich source of bio-organisms, phytoplankton, zooplankton, and which has indicated healthy aquatic ecosystem, hence it represents this reservoir highly useful for vital in supplementation of aquatic source of food as well economically benefited to farmer, fisherman, and several other divisions also. The present undertaken analytical, chemical parameter evaluation work and values obtained presented will be significant for future line of work especially on active role phytoplankton as ecological, biogeochemical, and bio-material/bio-indicator studies. The phytoplankton community of Manar Reservoir exhibited marked seasonal variation influenced by physicochemical and nutrient dynamics.

Acknowledgment

The Authors are thankful to the Abhinav Bharat Shikshan Sanstha, Nanded, as well as Principal, Netaji Subhashchandra Bose College, the Department of Environmental Science, Nanded for providing the Laboratory and Library facilities for the present undertaken research work.

REFERENCES

1. WHO. Guidelines for drinking water quality. World Health Organization; 2004.
2. APHA, AWWA, WEF. Standard methods for the examination of water and wastewater. American Public Health Association, American Water Works Association, Water Environment Federation; 2005.
3. Raja P, Amarnath AM, Elangovan R, Palanivel M. Evaluation of physical and chemical parameters of river Kaveri, Tiruchirappalli, Tamil Nadu, India. J Environ Biol. 2008;29(5):765–768.
4. Sjöblom Å, Håkansson K, Allard B. Metal concentrations along a mining region recipient: Some aspects on water quality. 2001:777–786.
5. Standard Methods [Internet]. Standard Methods; 2018. Available from: https://www.standardmethods.org/

6. Moss B. Diversity in fresh-water phytoplankton. Am Midl Nat. 1973;90:341–355.
7. Bhaskar CV, Mansour SA, Nagendrappa G. Phytoplankton studies in relation to physico-chemical environment of some lakes around Tumkur City, Karnataka, India. Nat Environ Pollut Technol. 2009;8(3):533–538.
8. Panikkar P, Khan F, Ramya VL. Assessment of plankton diversity and physico-chemical characteristics for sustainable fish production in a tropical reservoir in South India. Indian J Fish. 2024;71(3):38–47.
9. Sayeswara HA, Naik TV, Patil HSR, Goudaret MA. Study on habitat ecology and phytoplankton diversity of Nagathibelagalu Tank in industrial town Bhadravathi, Karnataka, India. Nat Environ Pollut Technol. 2011;11(3):419–423.
10. Sonawane SD, Shaikh JD, More PR. Composition of phytoplankton and zooplankton for better production of Indian major carps in fish farming of Marathwada Region (M.S.) India. Int J Adv Res Biol Sci. 2024;11(9):116–130.
11. Mahanty S, Saha D, Karmakar A. Assessing the waterbodies through water quality index and zooplankton diversity for environmental sustainability of Bankura, West Bengal, India. AGBIR. 2024;40(2):1021–1029.
12. Das D, Pathak A, Pal S. Diversity of phytoplankton in some domestic wastewater-fed urban fish pond ecosystems of the Chota Nagpur Plateau in Bankura, India. Appl Water Sci. 2018;8:84.
13. Bou A, Mouth C, Bernard A, Coz ML, Buffan-Dubau E, Lesniak C, et al. Phytoplankton and zooplankton in relation to Water Framework Directive status in some regulated lowland watercourses of the Scheldt and Sombre (France and Belgium). Hydrobiologia. 2025;852:3633–3659.
14. Hasnawi, Utojo, Tarunamulia, Kamariah. Species composition and individual abundance of plankton in acid sulfate soil brackish water ponds in Kotabaru Regency, South Kalimantan Province. IOP Conf Ser Earth Environ Sci. 2020;564:012001.
15. Cui Z, Gao W, Li Y, Wang W, Wang H, Liu H, et al. Dissolved oxygen and water temperature drive vertical spatiotemporal variation of phytoplankton community: Evidence from the largest diversion water source area. Int J Environ Res Public Health. 2023;20(5):4307.