

Role of Phytoplankton and Zooplankton Diversity as Bioindicators in Assessing Water Quality of Surface Water Bodies in Mahendergarh District, Haryana

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Abstract

The current study will estimate biodiversity of phyto and zooplanktons based on the surveys of three surface water bodies (JLN Canal (Haryana state, Mahendergarh district), Chalak Nala (Haryana state, Mahendergarh district) and Khatoti Khurd Pond (Haryana state, Mahendergarh district)) to estimate biodiversity in each of the three water bodies and carry out the two-year difference (2022Rec2024Rec). The water samples were then collected seasonally (pre-monsoon, monsoon and post-monsoon season) to be able to understand the association pattern between water condition and the diversity of the planktons in such water bodies. A comprehensive analysis of the various shape of algae has been done on four larger groups which are Chlorophyceae (green algae), Cyanophyceae (blue-green algae), Bacillariophyceae (diatoms) and Euglenophyceae (euglenoids). At the same time, the diversity of the zooplankton was assessed based on such taxonomies as Rotifera, Cladocera, Protozoa as well as Copepoda. It has been ascertained in the research that, the most diverse and rich phytoplankton and zooplankton site is Chalak Nala (Site 2) and this is a sign that such site is nutrient rich and eutrophic. JLN Canal (Site 1) on the other hand presented the lowest amount of diversity, as well as the indication of a high water quality. It was made apparent that the variations of the seasons were present and higher quantities of plankton were observed during the pre-monsoon times when the quantity of heat and the increased access of nutrients prevailed. The results help establish why plankton community should be monitored as a pointer to the health condition of the aquatic ecosystems, or as a pointer to the water purity. The outcomes also highlight the importance of effective interventions on water quality management in an attempt to worsen such important water bodies further.

Keywords: Phytoplankton, Zooplankton, Water Quality, Bioindicators, Eutrophication, Aquatic Ecosystems,

1. INTRODUCTION

Aquatic system ecosystems have very high dependence on the quality of surface water resources, and you find that such ecosystems determine the diversity of organisms in the entire region. Phytoplankton and zooplankton play a major role in the bioindication of the aquatic health since they react to the perturbation of the aquatic environment, i.e. nutrient levels in their environment. The evaluation of plankton diversity and abundance is of vital information on the healthiness of these ecosystems and the evaluation can be capitalized as a powerful means of controlling and regulating aquatic resource. The proposed study aims at gaining access phytoplankton and zooplankton biodiversity of three water bodies including JLN Canal, Chalak Nala and Khatoti Khurd Pond located in three major water bodies of Mahendergarh district of the Haryana state of India. The researcher in the given study will take into account the seasonal variation of the plankton populations in order to find out how this depicts the water quality in different seasons; i.e. (pre-monsoon, monsoon and post-monsoon) after every two years (2022-2024). The algae in conjunction with zooplankton (the tiny organisms found in water and these included the rotifers, cladocerans, protozoans and copepods) were collected on a regular basis with the aim of establishing the relationship between plankton diversity and the water quality. There is likely to be a seasonal variation in the planktons and there will be certain conditions of availability of important nutrients and environmental variables such as temperature, cloud cover, etc. that may have impact on the make-up of a plankton and its distribution. This study aims to determine the key parameters that affect populations of phytoplankton and zooplankton in these water bodies and whether such organisms are bioindicators of nutrient pollution and eutrophication in such waters. Findings of the current study are critical in the understanding of the variability of the water quality of surface water resources of Mahendergarh with the aim of guiding healthy water management and improvement in the health of the eco-system.

2. LITERATURE REVIEW

The indicator of the water health which is the role of plankton especially phytoplankton and zooplankton has been put under consideration a lot. The community of Plankton is very sensitive about the alterations of the aquatic environment i.e. changes in temperature, nutrients concentration, clarities and contamination. The phytoplankton and zooplanktons form great bioindicators due to their sensitivity to any occurrences which happen within their environment particularly in the areas of nutrients level and organic pollution (Ali & Ghareeb, 2023; Garf et al., 2025). In this segment pertinent literature is discussed concerning the diversity and activity of plankton, how the plankton responds to various conditions of the environment, and why it forms one of the key considerations in measuring the health status of the aquatic environments.

2.1. Phytoplankton Diversity and Its Role in Water Quality

In aquatic ecosystem, phytoplanktons are also the primary producers and the diversity of the phytoplankton is produced depending on light infiltration, temperature, availability of nutrients and water movements. Different phytoplankton have four main groups, which include Chlorophyceae or green algae, Cyanophyceae or blue-green algae, bacillariophyceae or diatoms and euglenophyceae or euglenoids and they are commonly explored to the water conditions. Nutrient rich waters have been proved to tend to increase the abundance of some species of phytoplanktons like Cyanophyceae and Bacillariophyceae and this will be regarded as a pointer to eutrophic conditions (Palmer, 1969). An example of this is that, *Nostoc* sp. and *Oscillatoria* cultures which are organisms with high concentration of nitrogen fixation have frequently been applied as a general evidence of nutrient enrichment of fresh waters (Adejuwon & Akinola, 2025). It has been reported that enhanced availability of nutrients, specifically the availability of nitrogen and phosphorus, leads to the proliferation of phytoplankton species that are commonly involved in harmful algal blooms (HABs) namely, *Anabaena* sp. and *Arthrospira* sp. (Ahmad 2024). Also, as extant critiques show, diatoms (Bacillariophyceae) happen to be immensely sensitive to changes in nutrient availability and thus wonderful bioindicator organisms of water wellbeing (Beshir et al., 2024). The research conducted by Yeboah and colleagues (2022) makes evident the fact that the assemblage of phytoplankton and its abundance, especially diatoms, is strongly connected with the health of the aquatic conditions, the high diversity of diatoms is commonly associated with the lower quantity of nutrient pollution.

2.2. Zooplankton Diversity and Ecological Health

Animals, such as Rotifera, Cladocera, Protozoa, and Copepoda, make up zooplankton, and it is an important part of the food web in the water. They are studied with respect to the quality of the waters, which in most cases is described in terms of the nutrient contents, and are therefore quite dependent on the quality. They are also aware that rotifers like *Brachionus* sp. thrive well in highly nutritious conditions, which are largely described by a higher concentration of nitrogen and phosphorus (Ghimire et al., 2023). Research of *Daphnia* species (Cladocera) has also shown that it is critical to achieve an equilibrium of phytoplanktons in the environment as it is their food and the so-called ecosystem stability process is a factor (Rahman et al., 2021). These various species of Copepoda are very helpful in assessing the welfare of aquatic life in the sense that they are very crucial source of food by the larger portion of the marine life, and that they have the ability to react to changes in the availability of breathing and nutrients (Ni et al., 2025). The zooplanktons population can be used as the indicator of the extent to which the organic pollution in the water bodies in the rivers and lakes is poor. The existence of organisms like *Keratella* sp. and *Asplanchna* sp also has been found to be in association to high nutrient concentrates and organic pollution (Lilian, 2009). Just like *Cyclops* species, they are also valuable indicators of the health of the freshwater community as they adapt to population change due to the changes in the state of the surrounding environment (Perveen, 2023).

3. METHODS AND MATERIAL

3.1 STUDY AREA

The Mahendergarh District is found at south West of the Haryana state and it is found in the waterfall of latitudinal coordinates 27472826 and another is latitudinal 7556276. The administrative centre of this district is Narnaul. It is bound by Bhiwani, Jhajjar Districts in Haryana state in the north, Rewari District and Rajasthan state, Alwar, Jaipur, and Sikar Districts in the south and Sikar and Jhunjhunu Districts in the west. The total territory is 1899 kilometres squared. The district has got five blocks of development and they are Mahendergarh, Kanina, Atali, Narnaul and Nangal Chaudhary. Above the normal sea level,

the elevations of the flatlands measure between 270.6 and 294.6 meters in the South, 217.1 and 267.0 meters in the North, 252.9 meters and 294.6 meters in the West and 218.6 and 270.6 meters in the East. Long season of scorching, dry climate that has a semi arid climatic condition is also identified in Mahendergarh district. The annual rainfall of the area is 407mm and annual rainfall is about, 90 percent of the rainfall falls between June and September. The availability, existence, composition, and origin of ground water in the district is associated with recent geological dynamics of the area and it fails to constitute high quantity of ground water (Seema Singh, InderJeet, 2016). Mahendergarh district is a district whose river runs along the river Dohan which was seasonal River but now it is on the brink of extinction.

3.2 SELECTION OF SAMPLING STATIONS:

The research was conducted by choosing three distinct sampling locations, taking into account the origin and nature of the pollution. The locations chosen for the gathering of samples are as follows-

1. JLN CANAL

In 1966, a severe famine occurred, yet its impact on Haryana was minimal. During the devastating famine of 1969, the regions that suffered the most were Rajasthan, Gujarat, Haryana, and Uttar Pradesh. The regions included Tamil Nadu, Andhra Pradesh, and Karnataka. The inhabitants of these regions were yearning for every morsel of bread and drop of water, as survival became increasingly difficult without sufficient hydration. In response to this dire situation, the government of that era devised a strategy to channel the river to Rohtak, aiming to satiate the thirst of the populace and avert the recurrence of future famines. At that time, Minister Sir Chhotu Ram earnestly urged the populace that with his backing, all those enduring this challenging predicament could be liberated from the perpetual water scarcity. In response, the community pledged their unwavering support. Inspired by the call of Sir Chhotu Ram, approximately one thousand individuals departed from their agricultural roots and resolved to excavate the canal. The government compensated individuals with 6 paise for each person daily for their labour in excavating the canal. During this period, no one attended to their family farming or personal tasks; they tirelessly worked on the canal from dawn until dusk, dedicating their entire day and night to the endeavour (from 8 am to 5 pm). The canal stretches over a distance of 30 kilometres, with its construction completed in a span of 93 days. All the accolades belong to the remarkable 103-year-old Kanwar Singh, the visionary who dedicated his life to constructing this canal for the benefit of the community. The water from this canal is primarily utilised for irrigation purposes (Fig. -3. 1).



Figure-3.1: - JLN Canal, Water sample Collection Site (S1)

2. CHALAK NALA

It can be found throughout Narnaul, stretching in a northeastern direction for approximately 90 to 150 feet. This area extends from the Modawala Mandir near the bus stand, and during the rainy season, it tends to overflow. According to the historical context, a river that once flowed through the city has now transformed into a filthy drainage system. It is significant to mention that the Chalak nala flows through the city of Narnaul; however, it has transformed from a river into a polluted drain. In bygone eras, its expanse was remarkably vast; however, in contemporary times, it exhibits a fluctuating nature, with certain regions appearing wide while others are more constricted. Over the passage of time, it has continued to diminish (Fig. -3. 2).



Figure-3.2:- Chalak Nala, Water Sample Collection Site (S2)

3. KHATOTI KHURD, POND

Located in the village of Khatoti Khurd, this area is part of the Narnaul Tehsil within the Mahendragarh District of Haryana, India. This is part of the Gurgaon Division. Situated 12 kilometres to the west of the district headquarters in Narnaul (Fig-3.3).



Figure -3.3:- Khatoti Khurd, Pond Water Collection Site (S3)

In order to fulfil the aims and aspirations of the research, specimens were gathered monthly from designated sites at a specified location throughout three distinct seasons: pre-monsoon, monsoon, and post-monsoon. Between March 2022 and April 2024, samples were collected every month.

Surface water specimens for physicochemical and biological analyses were gathered from 7:00 to 9:30 A.M. in 5-liter containers, which had been meticulously cleaned using diluted HNO₃ and detergent, followed by rinsing with distilled water. Prior to the sampling process, they underwent another thorough rinsing with the designated sampling water. Following their gathering, they were transported to the laboratory. The essential parameters were examined on the same day, whereas the remaining parameters were stored at 4°C in the refrigerator for preservation. The temperature was documented right after collection in the field, and the dissolved oxygen was preserved using Alkaline KI and Manganous sulphate on-site.

3.3 METHODOLOGY FOR PLANKTON STUDY

The plankton study was conducted over 24 months (April 2022 - April 2024) across three sites: JLN Canal, Chalak Nala, and Khatoti Khurd Pond, with samples collected monthly during the first week in the morning. Water samples were filtered through a 24 mesh per square millimetre plankton net, and preserved with 5% formaldehyde. The samples were analyzed in the lab using a light microscope, with slides prepared for identification and enumeration of phytoplankton and zooplankton. The Sedgwick Rafter Chamber was used for plankton counting at 100X magnification. Plankton abundance was calculated using the formula: $N \text{ (individuals/liter)} = A \times 1000 \times C/L$, following standard protocols for classification and diversity indices.

RESULTS AND ANALYSIS

Table 4.1:-Identified Algal diversity from Water Samples Collected in Summer Season (May to June)

S. No	Algae	Site1	Site 2	Site 3
	Chlorophyceae			

1	<i>Spirulina sp.</i>	09	20	12
2	<i>Cladophora sp.</i>	17	10	13
3	<i>Chlorella vulgaris</i>	05	10	07
4	<i>Ulothrix sp.</i>	10	20	14
5	<i>Pediastrum simplex</i>	08	20	11
6	<i>Oedogonium sp.,</i>	0	03	01
7	<i>Pediastrum sp.</i>	06	12	08
8	<i>Closterium acerosum</i>	08	10	09
Total		63	105	75
Cyanophyceae				
9	<i>Choroococcus sp</i>	03	08	05
10	<i>Nostoc sp.</i>	10	20	12
11	<i>Oscillatoria sp</i>	07	16	09
12	<i>Anabaena sp</i>	11	15	12
13	<i>Arthospira sp.</i>	10	16	12
Total		41	75	50
Bacillariophyceae				
14	<i>Gyrosigma sp.</i>	10	17	14
15	<i>Nitzschia sp.</i>	20	30	10
16	<i>Synendra ascus</i>	8	18	10
17	<i>Pinnularia viridis</i>	9	18	11
18	<i>Diatoma sp.</i>	08	15	10
19	<i>Coccomis sp.</i>	21	30	14
20	<i>Cyclotella sp.</i>	12	21	15
21	<i>Melosira sp.</i>	15	30	17
22	<i>Navicula. sp.</i>	07	21	09
23	<i>Asterionella sp.</i>	10	18	13
24	<i>Fragilaria sp</i>	19	27	22
25	<i>Synedra ulna</i>	10	17	13
26	<i>Tabellarea sp.</i>	08	16	11
Total		157	278	169
Euglenophyceae				
27	<i>Euglena</i>	05	10	07
28	<i>Trachelomonas</i>	04	09	06
Total		09	19	13
Total Algae		270	477	307

The study conducted in May and June focused on the algae populations in three water bodies: JLN Canal (Site 1), Chalak Nala (Site 2), and Khatoti Khurd Pond (Site 3). The algae were divided into four main groups: Chlorophyceae (green algae), Cyanophyceae (blue-green algae), Bacillariophyceae (diatoms), and Euglenophyceae (euglenoids), which are key indicators of water quality and ecosystem health. Site 2, Chalak Nala, had the highest abundance of Chlorophyceae with 105 individuals, followed by Site 3 with 75, and Site 1 with 63. *Ulothrix sp.* was the most abundant species across all sites, indicating the presence of nutrient-rich environments. In the Cyanophyceae group, Site 2 again recorded the highest abundance (75), with species like *Nostoc sp.* and *Oscillatoria sp.* suggesting high nitrogen availability and potential eutrophication. Diatoms, part of the Bacillariophyceae group, were most abundant at Site 2 (278), followed by Site 3 (169) and Site 1 (157), with the diversity of diatoms being particularly high at Site 2 due to nutrient enrichment. Euglenoids, found in the Euglenophyceae group, were most abundant at Site

2 (19), with Euglena being the dominant species, further pointing to warmer temperatures and nutrient-rich conditions. Overall, Chalak Nala had the highest total algal diversity (477), indicating the most favorable conditions for algal growth, likely due to high nutrient levels and temperatures. This suggests potential water quality issues, including eutrophication, which could negatively impact aquatic life. The findings underscore the importance of monitoring and managing algae populations to prevent harmful blooms and ensure water quality.

Table 4.2 :-Identified Algal diversity from Water Samples Collected in Rainy Season (July to August)

S. No	Algae	Site 1	Site 2	Site 3
Chlorophyceae				
1	<i>Spirulina sp.</i>	05	10	06
2	<i>Cladophora sp.</i>	08	09	09
3	<i>Chlorella vulgaris</i>	03	08	04
4	<i>Ulothrix sp.</i>	05	12	07
5	<i>Pediastrum simplex</i>	04	10	06
6	<i>Oedogonium sp.,</i>	0	01	0
7	<i>Pediastrum sp.</i>	02	06	04
8	<i>Closterium acerosum</i>	03	08	04
Total		30	64	40
Cyanophyceae				
9	<i>Choroococcus</i> sp.	0	05	03
10	<i>Nostoc sp.</i>	05	15	06
11	<i>Oscillatoria sp</i>	03	10	05
12	<i>Anabaena sp</i>	06	10	07
13	<i>Arthospiras</i> sp.	05	09	06
Total		19	49	27
Bacillariophyceae				
14	<i>Gyrosigma</i> sp.	06	10	08
15	<i>Nitzschia</i> sp.	10	15	05
16	<i>Synedra acus</i>	04	10	05
17	<i>Pinnularia</i> viridis	5	11	06
18	<i>Diatoma</i> sp.	03	12	05
19	<i>Coccomis</i> sp.	11	21	13
20	<i>Cyclotella</i> sp.	06	10	08
21	<i>Melosira</i> sp.	08	17	10
22	<i>Navicula</i> sp.	03	12	05
23	<i>Asterionella</i> sp.	05	09	07
24	<i>Fragilaria</i> sp	09	14	11
25	<i>Synedra ulna</i>	04	09	06
26	<i>Tabellaria</i> sp.	03	10	05
Total		77	160	94
Euglenophyceae				
27	<i>Euglena</i>	03	08	04
28	<i>Trachelomonas</i>	02	07	03
Total		05	15	07

Total Algae		131	288	168
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During the rainy season, algae populations were monitored at three sites: JLN Canal (Site 1), Chalak Nala (Site 2), and Khatoti Khurd Pond (Site 3). Site 2 had the highest algae diversity (288), with a dominance of green algae (Chlorophyceae), blue-green algae (Cyanophyceae), diatoms (Bacillariophyceae), and euglenoids (Euglenophyceae). High nutrient levels, likely from agricultural runoff, contributed to this growth, especially at Site 2, where species like *Nostoc* sp., *Anabaena* sp., and *Ulothrix* sp. thrived. The increased algae diversity at Site 2 suggests eutrophication, which could negatively impact water quality and aquatic life, emphasizing the need for nutrient management to prevent further degradation.

Table 4.3:-Identified Algal diversity from Water Samples Collected in Winter Season (December to January)

S. No	Algae	Site1	Site 2	Site 3
Chlorophyceae				
1	<i>Spirulina</i> sp.	06	12	07
2	<i>Cladophora</i> sp.	08	09	09
3	<i>Chlorella vulgaris</i>	05	10	06
4	<i>Ulothrix</i> sp.	07	14	09
5	<i>Pediastrum simplex</i>	06	12	08
6	<i>Oedogonium</i> sp.,	0	03	01
7	<i>Pediastrum</i> sp.	03	09	04
8	<i>Closterium acerosum</i>	04	00	06
Total		39	69	50
Cyanophyceae				
9	<i>Choroococcus</i> sp	0	07	05
10	<i>Nostoc</i> sp.	07	16	09
11	<i>Oscillatoria</i> sp	05	14	07
12	<i>Anabaena</i> sp	04	12	09
13	<i>Arthospiras</i> sp.	06	11	08
Total		22	60	38
Bacillariophyceae				
14	<i>Gyrosigma</i> sp.	07	11	08
15	<i>Nitzschia</i> sp.	12	17	07
16	<i>Synendra ascus</i>	06	13	08
17	<i>Pinnularia viridis</i>	07	14	09
18	<i>Diatoma</i> sp.	04	14	08
19	<i>Coccomis</i> sp.	13	21	15
20	<i>Cyclotella</i> sp.	08	13	10
21	<i>Melosira</i> sp.	10	19	12
22	<i>Navicula</i> . sp.	04	13	06
23	<i>Asterionella</i> sp.	05	10	07
24	<i>Fragilaria</i> sp	10	16	12
25	<i>Synendra ulna</i>	04	09	06
26	<i>Tabellarea</i> sp.	05	12	08
Total		95	182	116
Euglenophyceae				
27	<i>Euglena</i>	04	10	05
28	<i>Trachelomona</i> sp	04	08	04
Total		08	18	09
Total Algae		164	329	213

During the winter (December 2009 to January 2010), algal diversity was highest at Chalak Nala (Site 2), with significant growth of green algae (*Chlorophyceae*), blue-green algae (*Cyanophyceae*), and diatoms (*Bacillariophyceae*). Site 2 had the most algae (329), indicating nutrient-rich conditions, likely from agricultural runoff. This site also showed eutrophic characteristics, with species like *Nostoc* sp. and *Anabaena* sp. thriving, which could lead to harmful algal blooms. The findings highlight the need to monitor nutrient levels and water quality to prevent further degradation and manage algal growth, especially in nutrient-rich areas.

Bacillariophyceae> Chlorophyceae>Cyanophyceae>Euglenophyceae

During the present investigations, it was observed that the phytoplankton fluctuates in different seasons (Table 4.1, 4.2 and 4.3) due to the changes in physico- chemical nature of water. From all the three observed sites the highest diversity was found to be at S2 and lowest diversity was reported at S1 site. Phytoplankton groups recorded in certain waterbodies of the Mahendergarh district comprises four major groups viz., *Bacillariophyceae*, *Chlorophyceae*, *Cyanophyceae* and *Euglenophyceae*. Among 4 groups members *Bacillariophyceae* dominated followed by *Chlorophyceae*, *Cyanophyceae* and *Euglenophyceae* respectively, but it was recorded in minimum number in monsoon season at the three stations of shown charts.

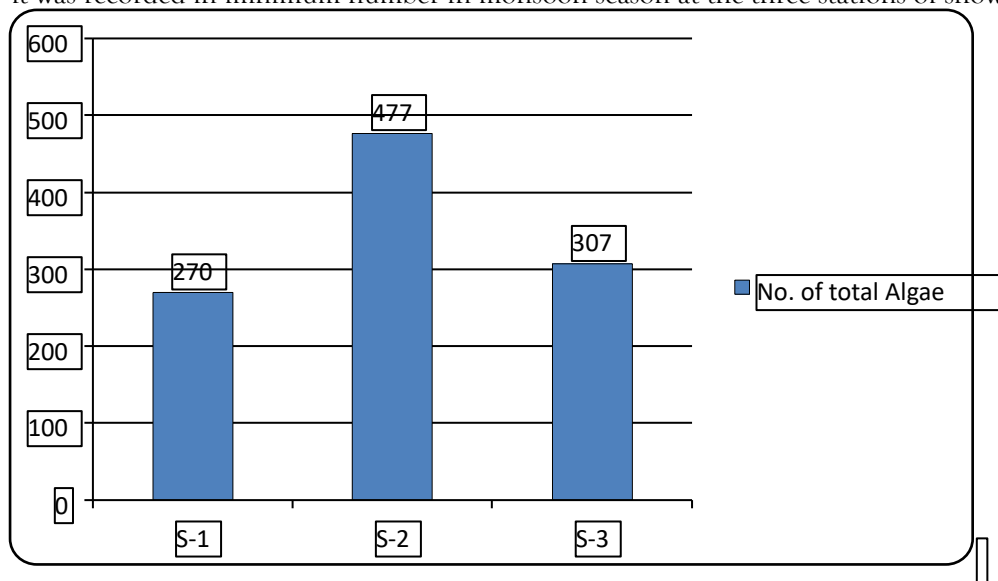


Figure - 4.1 Total count (Ind/L) of Phytoplankton in summer season

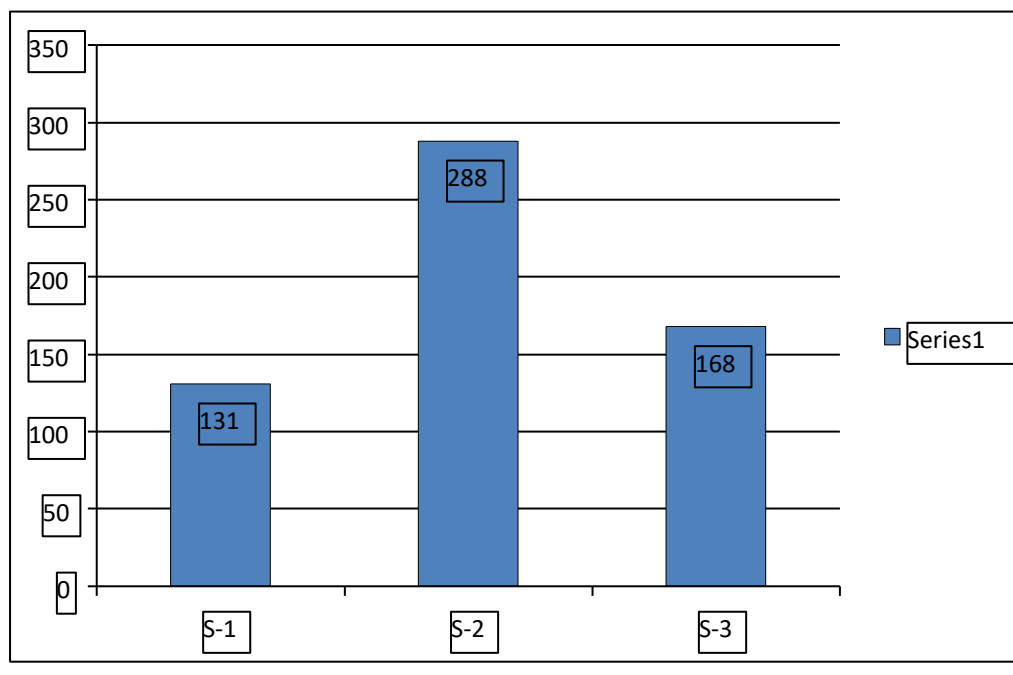


Figure - 4.2 Total count (Ind/L) of Phytoplankton in rainy season

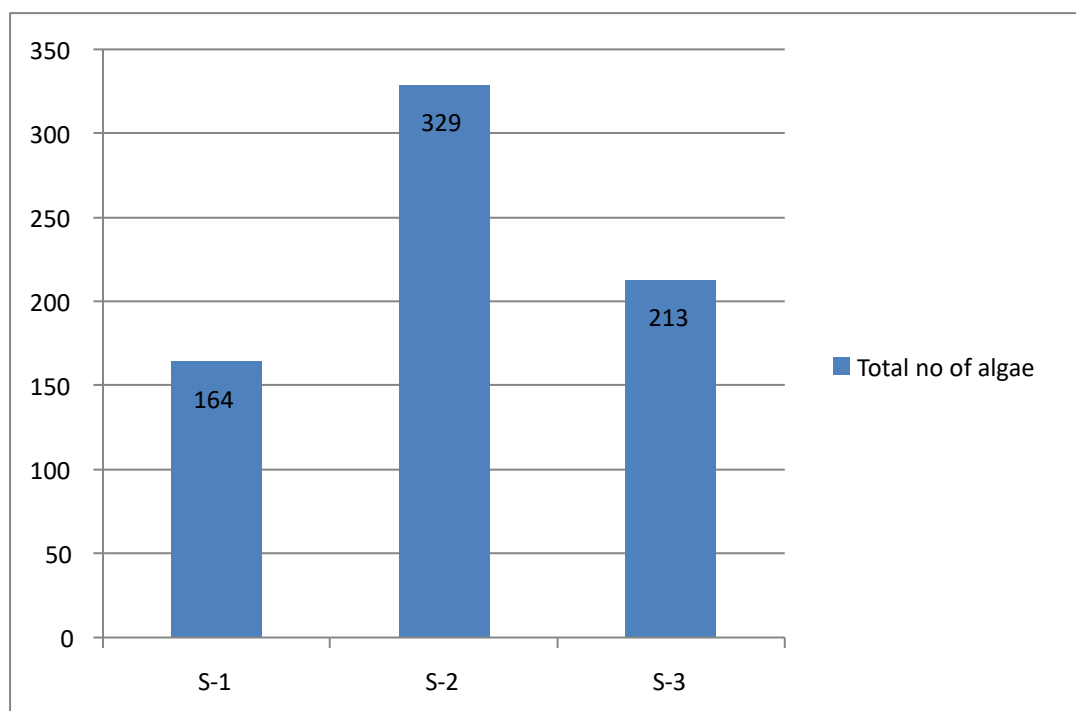


Figure - 4.3 Total count (Ind/L) of Phytoplankton in winter season

This was because of low values of penetration of light, high turbidity and fast water current. The maximum count of phytoplankton density during pre-monsoon season was due to the high temperature and minimum during the monsoon season due to the dilution and addition of slit in water.

4.2 PHYTOPLANKTONS AS BIOINDICATORS AT S1, S2 AND S3 OF THE SURFACE WATER

Phytoplankton species like *Fragilaria sp.*, *Tabellaria sp.*, *Pinnularia sp.*, *Spirogyra sp.*, *Nitzschia sp.*, and *Euglena sp.* were found to be abundant year-round, while other species exhibited more variable distributions. The total algae counts in the summer, rainy, and winter seasons were as follows: Site 1 (S1) - 270,477 in summer, 131 in rainy, and 163,329 in winter; Site 2 (S2) - 307 in summer, 288 in rainy, and 213 in winter; Site 3 (S3) - 307 in summer, 168 in rainy, and 213 in winter. Sites 2 and 3 showed higher algae counts, indicating organic pollution, while Site 1 exhibited minimal pollution. *Oscillatoria*, found mainly at Sites 2 and 3, is known for its resilience to organic pollution. *Euglena* also appeared in high numbers across all sites, serving as an indicator of water pollution. Species like *Closterium*, *Navicula*, *Nitzschia*, *Chlamydomonas*, and *Cyclotella* were identified as successful indicators of organic pollution. *Chlorella vulgaris* was notably abundant at Site 2, suggesting high heavy metal and sewage waste presence. The higher phytoplankton abundance at Site 2 indicates more pollution, while Site 1 showed less. These bioindicator species help assess water quality and pollution levels in surface water bodies.

Table - 4.4: -Identified Zooplankton diversity from Water Samples Collected in Summer Season (May to June)

S. No.	Zooplankton	Site- 1	Site-2	Site -3
Rotifera				
1.	<i>Brachionus angularis</i>	8	10	9
2.	<i>Brachionus caudatus</i>	8	10	10
3.	<i>Brachionus forficula</i>	8	10	9
4.	<i>Brachionus pilicates</i>	8	11	10
5.	<i>Brachionus diversicornis</i>	7	10	8
6.	<i>Brachionus quadridentata</i>	7	10	8
7.	<i>Brachionus roundiformis</i>	9	12	9

8.	<i>Brachionus</i> sp.	8	10	9
9.	<i>Asplanchna brightwelli</i>	8	8	8
10.	<i>Asplanchna intermedia</i>	9	11	9
11.	<i>Asplanchna</i> sp.	9	12	9
12.	<i>Keratella</i> sp.	8	13	9
13.	<i>Keratella procurva</i>	7	112	9
14.	<i>Keratella tropica</i>	7	9	8
Total		111	148	133
Cladocera				
15.	<i>Daphnia pulex</i>	6	7	6
16.	<i>Daphnia cuculata</i>	5	9	7
17.	<i>Daphnia magna</i>	4	12	8
Total		15	28	21
Protozoa				
18.	<i>Vorticella</i> sp.	5	7	5
19.	<i>Paramecium caudatum</i>	4	6	4
20.	<i>Paramecium aurilia</i>	3	6	4
Total		12	19	13
Copepoda				
21.	<i>Cyclops bicuspiditus</i>	14	16	16
22.	<i>Cyclops viridis</i>	09	12	10
23.	<i>Eucyclops</i> sp.	10	14	10
24.	<i>Metacyclops</i> sp.	14	12	12
25.	<i>Naupilus larvae</i>	9	9	9
26.	<i>Mesocyclops</i> sp.	5	5	5
27.	<i>Thermocyclop shyalinus</i>	7	8	8
Total		68	76	70
Total ZP		206	271	237

The study of zooplankton diversity at JLN Canal (Site 1), Chalak Nala (Site 2), and Khatoti Khurd Pond (Site 3) during the summer season revealed important insights into water quality and ecological health. Zooplankton, including **Rotifera**, **Cladocera**, **Protozoa**, and **Copepoda**, play a critical role in the aquatic food web, providing food for higher trophic levels and helping to regulate algae populations. Site 2 (Chalak Nala) showed the highest zooplankton diversity, with **Rotifera** being most abundant (148 individuals), followed by **Cladocera** (28), **Copepoda** (76), and **Protozoa** (19). The prevalent species, such as **Brachionus angularis**, **Daphnia pulex**, and **Cyclops bicuspiditus**, indicate that Site 2 provided favorable conditions for zooplankton growth, including abundant nutrients and stable water quality. Site 2's high abundance of **Rotifera**, **Cladocera**, and **Copepoda** suggests it was the most productive site, supporting larger zooplankton populations. The presence of **Daphnia** species, known for consuming algae, also indicates a good balance in nutrient levels, which may help control algal blooms. **Protozoa** were less abundant but still notable, with **Vorticella** sp. and **Paramecium caudatum** found at Site 2, indicating the presence of organic matter and microbes. Site 1 had the lowest zooplankton diversity and abundance, possibly due to poorer water conditions or limited food availability. Overall, Site 2's higher zooplankton diversity and abundance reflect its better ecological conditions, making it the healthiest site in terms of zooplankton populations. The study emphasizes the importance of zooplankton as bioindicators for assessing water quality and ecological health.

5. DISCUSSION

The study of phytoplankton and zooplankton at JLN Canal (Site 1), Chalak Nala (Site 2), and Khatoti Khurd Pond (Site 3) in Mahendergarh District showed that **Chalak Nala (Site 2)** had the highest diversity

and abundance of both phytoplankton and zooplankton throughout the year, particularly in summer. This site was more nutrient-rich, with species like *Oscillatoria sp.*, *Anabaena sp.*, and *Chlorella vulgaris*, indicating eutrophic conditions likely due to agricultural runoff. The presence of *Daphnia* species and *Brachionus angularis* showed good water quality and controlled algal blooms. In contrast, **JLN Canal (Site 1)** had lower diversity and abundance of both phytoplankton and zooplankton, suggesting healthier water quality but lower productivity. Overall, **Chalak Nala** was the most productive site, with higher biodiversity, while **JLN Canal** had more stable, cleaner water with lower plankton populations.

6. CONCLUSION

In this case, particular emphasis has been given to strengthen the larger role of diversity in phytoplankton and zooplankton which shows the quality of water in surface water bodies of Mahendergarh District. These findings denote that the communities of planktons intrinsically depend on nutrient levels particularly the agricultural run-off has revealed the highest count of the planktons diversity in the Chalak Nala (Site 2) which is a sign of waters in high nutrients. Meanwhile, less varied plankton in JLN Canal (Site 1) showed that the water quality there was good and the loads of contributors of nutrients were weak. Such results can only remind that it is necessary to implement effective measures of water quality management, particularly, in the areas at risk (nutrient enrichment and organic pollution). The monitoring of the plankton communities can also be of help as it gives some valuable clues as to the functioning of the water lands and it can prove to contribute in the attempts to come up with some actions that will be undertaken to tackle degradation of water quality in the region. Such consistent monitoring of phytoplankton and zooplankton can play a big role in the process of the actual realization of the season change and addressing the issue of the water purity wiring it up to the time when it becomes a topic of interest.

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