International Journal of Advanced Multidisciplinary Research
ISSN: 2393-8870
www.ijarm.com
(A Peer Reviewed, Referred, Indexed and Open Access Journal)
DOI: 10.22192/ijamr Volume 13, Issue 4-2026

Research Article

DOI: http://dx.doi.org/10.22192/ijamr.2026.13.04.001

Study on Physico-chemical Parameters and Plankton Fauna in Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh, India

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Abstract

Plankton fauna is the important component of aquatic flora serve as a major component of aquatic food chain . Also it maintain proper equilibrium between biotic and abiotic components of aquatic ecosystem. The present investigation deals with the study of physico- chemical parameters and diversity of aquatic plankton fauna of fresh water body of Tedhi Nadi at Balpur of district Gonda. The work was carried out for the period of 09 month that is September 2024toMay 2025. In the present work several physico- chemical parameters such as temperature (12.5-20.5°C), pH (7.0-7.8), DO (9.2-16.0 ppm), FCo2 (2.0-4.5 ppm), Carbonate alkalinity (69.0-95.0ppm), Bicarbonate alkalinity (105-184 ppm), Total alkalinity (114-185ppm), Nitrate (0.18-0.50 ppm), Calcium (97-144 ppm), Chloride (18.5-47.0 ppm), Phosphate (0.030-0.082 ppm), Total organic matter (5.5-12.5ppm) and Total nitrogen (1.20-2.51 ppm) were studied.

In the present work reported that presence of 04 genera of Phytoplankton contains-*Lemna minor, Oryza sativa, Eichhornia crassipes, Ipomea aquatica* and 04 genera of Zooplankton contains-Euglena sp., Amoeba sp., Eristalis larvae and Ptychoptera larvae were identified in Tedhi Nadi at Balpur which indicate the polluted nature of the water body. Thus keeping in view the importance of study steps, should be taken for conservation and maintenance of Tedhi Nadi. It is the necessarily step which have to be followed for the safety of water body.

Keywords

Plankton,
Physico-chemical Parameters,
Tedhi Nadi,
Balpur,
Gonda,

ARTICLE INFO

Article History:

Received 20th March, 2026
Received in revised form 11th April, 2026
Accepted 19th April, 2026
Published online 30th April, 2026

Introduction

Water is an essential requirement for all kinds of life and the most abundant on the planet earth and among the best solvents and unique in many physico-chemical ways. It is medium of life. Every cell contains some water and all life process reactions take place in water medium. Food and nutrients move from cell to cell through this medium. Water is also the raw material in the manufacture of carbohydrates through photosynthesis in green plants.

Animals are dependent on the food prepared in the body of green plants. Two things immediately become clear, first : that water is very abundant and second : that is the very basis of that is elixir in the real sense. Because of its capacity to dissolve an extremely wide variety of substances it is both very useful in making solutes available to cellular organelles for biosynthetic activities and harmful in getting readily polluted by dissolving harmful substances toxic to organisms and man.

Water like air has been one of the major environmental component. It is an indispensable and the most precious natural resource on this planet, as prime necessity of life and natural water bodies are of great importance to mankind.

India is very rich in water resources and stands second in the world. Its inland water resources occupy and area of about 1.37 million hectare. The inland water resources are scattered in the form of river, dams, lakes, ponds, stream and other freshwater bodies. India is having 2,167 natural and 65,254 manmade wetlands occupying 14,58,580 hectares and 25,87,965 hectares of land respectively. Moreover the association of man and wetland in Prehistoric India also represent a rich variety of Inland and coastal wetland habitat.

Uttar Pradesh is having 125 natural and 28 manmade wetlands occupying 12,832 hectares and 2,12,470 hectares of wetlands respectively.

The organisms in the aquatic environment can be divided in to three large groups-the plankton, nekton and benthos. In the benthos are include sessile, creeping or burrowing organisms found in the bottom of water bodies. The nekton is composed of swimming animals such as the fish and in the plankton is included all of the floating or drifting organisms. The term plankton is proposed by Victor Hesner (1887) to designate the “Heterogeneous assemblage or organisms which float and move at the will of the waves and other water movements”.

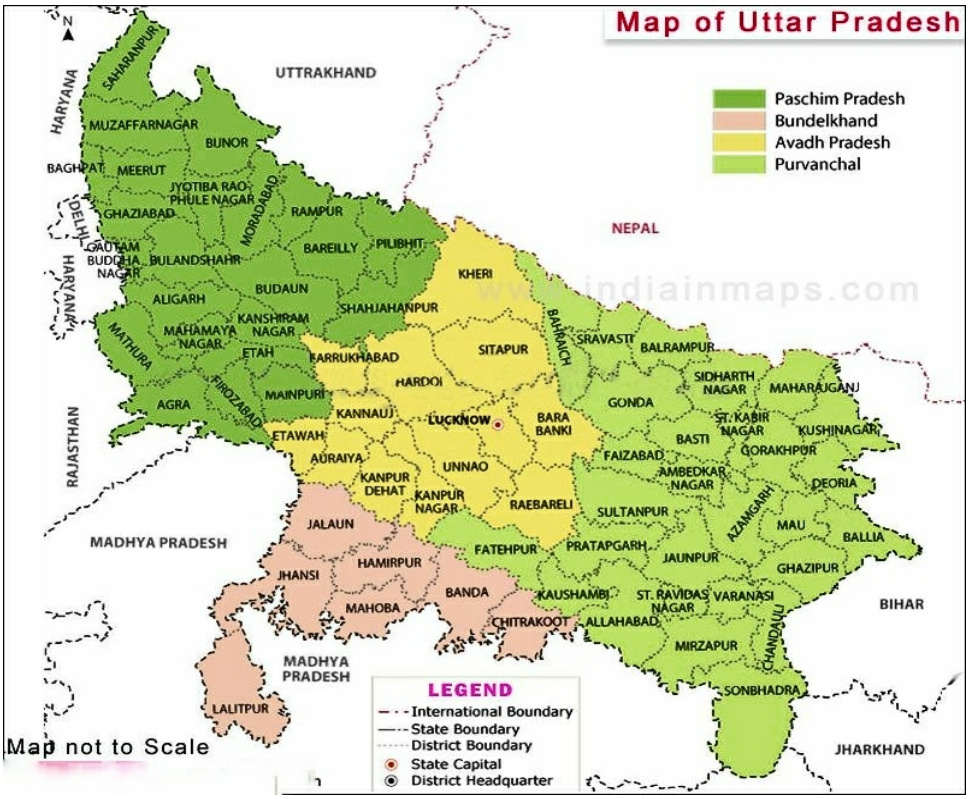
There is need of suitable environment interaction for the organisms found in such niche where the life depends upon the continuation of the proper circulation or transfer or exchange of essential macro and micronutrients and energy flow or their transfer in the organisms inhabiting the river or lake. The organisms either influenced or affected by physico-chemical conditions of water which serve as immediate environment for the biota of the ecosystem under investigation. Biological productivity in Tedhi Nadi at Balpur of district Gonda Uttar Pradesh and other ecosystem are also influenced by their various physico-chemical parameters assume importance in evaluating the water quality in relation to other biota of the pond.

The Plankton play an important role in the study of faunal diversity of aquatic ecosystems. They include representative of almost every taxa of the animal kingdom and occur in the pelagic environment either as adults or eggs and larvae. The zoobenthos are also utilized to assess energy transfer at secondary trophic level. They feed on phytoplankton and facilitate the conversion of plant material into animal tissues and in turn constitute the basic food for higher invertebrates and vertebrates including fishes particularly their larvae. Knowledge of abundance, composition and seasonal variation of Plankton is an essential requirement for any successful fishery development and management programme. The Plankton also serve as good indicator of water quality because they are influenced by environmental conditions and respond quickly changes in the quality of water.

The study of Plankton has been a subject of a great interest among zoologists in general and hydrobiologists in particular. The Plankton communities have been shown to respond to a wide variety of disturbances including nutrient loading. The Plankton are susceptible to variation in a wide number of environmental factors including water parameters, food availability (algae and bacteria) and predation by fish and invertebrates are of great significance in the study of aquatic ecosystems. In Uttar Pradesh ,however, little attention has been paid toward the study of Plankton and water parameters. Quite a few workers have described Plankton from some of the lakes, dams and reservoir of the state Tripathi (2006), Pandey (2007), Tripathi (2015,2016). The aim of the present study to deal with the study on Physico-Chemical water parameters and Plankton Fauna in Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh, India.

Location of Study area: Tedhi Nadi at Balpur is one of the important site of the district Gonda, Uttar Pradesh. It is situated 5 km from the district head quarter. The district Gonda lies between 26°47' and 27°20' north latitude and 81°30', 82°46' east longitude (Map-1, 2 & 3). Tedhi Nadi originated from Chittaura Jheel and Join river Ghaghara. Flows in the range about 269 km from Chittaura Jheel to river Ghaghara (Fig.1).

Map-1: Location of study area in India



Map-2: Location of study area in Uttar Pradesh

Map-3: Location of study area in Gonda district

Fig.-1: Tedhi Nadi at Balpur in district Gonda, U.P.

Climatic condition:

The data of temperature and atmospheric humidity in Gonda district at Balpur for the study period of September 2024 to May 2025 have been shown in table.

(a)-Temperature:.

Table-1: Temperature (°C) recorded in Tedh Nadi at Balpur of district Gonda (Data of September 2024 to May 2025)

Months	Maximum Temperature average (°C)	Minimum Temperature average (°C)	Average (°C)
September	33.2	30.5	31.8
October	30.0	29.0	29.5
November	29.0	28.2	28.6
December	27.5	26.0	26.7
January	24.0	23.0	23.5
February	28.0	25.0	26.5
March	30.2	26.0	28.1
April	33.2	29.2	31.2
May	33.3	30.0	31.65

Random variation of the temperature due to overall climatic fluctuations in the area have been recorded September 2024 to May 2025 during investigation, which have been given in (Table-1). The maximum temperature (33.3°C) was recorded in May 2025 and minimum (23.0°C) was recorded in January 2025. During study period, the trends of monthly fluctuation of temperature revealed that it rises gradually from January to onward.

Relative humidity:

Table -2: Humidity (%) recorded in Tedh Nadiat Balpur of district Gonda, Uttar Pradesh (Data of September 2024 to May 2025)

S.No.	Months	Humidity Maximum (%)	Humidity Minimum (%)	Humidity Average (%)
1	September	87	74	80.5
2	October	86	62	74.0
3	November	88	57	72.5
4	December	89	52	70.5
5	January	90	65	77.5
6	February	80	68	74.0
7	March	78	62	70.0
8	April	75	48	61.5
9	May	79	55	67.0

As indicated in Table-2, the value of relative humidity varied from 48% to 90 % in April 2025 to January 2025 of investigation.Minimum48% and Maximum90 % value were recorded in May 2025 and January 2025 in Tedhi Nadi at Balpur of district Gonda,(U.P.), India.

Review of literature

In India, the observation of Prasad (1916), on the seasonal conditions governing the pond life in Punjab, appears to be the first hydrobiological study. Since then such studies have progressed in different parts of the country and several notable contributation have been made so far.Since then such studies progressed in different parts of the country and several notable contribution have been made so far. Since then such studies progressed and noteworthy contribution were made by several worker like Allen (1920), Atkins (1932) Hasler (1949), Singh (1955) and Srivastava (1956), Trivedi (1986).

The cycling of nutrients through decomposition of dead organic matter is an essential ecological process controlled by temperature of the biotic environment. The biotic component of the ecosystem comprises of the producers, consumers and decomposers. The consumers include plankton, periphyton, benthos and nektons etc. Zooplankton organisms are not only the important food items for the planktonivorous fishes but also for the young ones of the herbivorous, carnivorous and predatory fishes. Benthos comprises of bottom dwelling organisms. Their important lies in the fact that they helped in recycling by reducing organic debris through mineralization. Benthos also assuming important and initiating steps of deterus based fisheries. Benthic communities are regarded as the best indicators of organic pollution because of their constant presence and relatively longer life. Comparatively large sized of animals as compared to their other inhabitants of the lake except nektons and their capacity for varying tolerance of stresses or dysfunction caused by pollution in the ecosystem (Chaturvedi, 1999).

Sharma (1999) has studied limnology and distributional pattern of Zooplankton of Ban Ganga Jammu (India). Similar results other wetland have also been noted by Mohanty(1999), Chaturvedi(1999), Bhattacharya (2000), Khan And Ghosh (2001), Nath(2001), Baba (2002), Clarke (2002), Gupta (2002), Kumar (2002), Kumar and Asija(2002), Saunders (2002), Sharma (2002), Verma and Sharma (2002), Ismail and Dorgham (2003), Prasad and Singh (2003), Singh (2004), Suchi Tewari(2004), Pani and Mishra (2005), Nautiyal(2005).

Tripathiet.al. (2006) have studied distribution of crustaceans Zooplankton in Seetadwar lake of Shravasti (U.P.),India. Crustacean occur in variety of aquatic habitat. In Seetadwar lake, studies pertaining to species diversity and seasonal distribution were conducted for two years from August 2004 to July 2006 and total of 14 crustacean were recorded. The study influence of abiotic features on the crustacean fauna, water temperature, dissolved oxygen, pH, conductivity, calcium, total alkalinity, chloride, nitrate, nitrogen and total phosphorus were also studied.

Pandey et.al. (2007) have studied on the plankton diversity of a water body of Chittaurgarhdam in district Balrampur (U.P.), India. Subsequent contribution on this aspect were made by Tripathi (2006) Latha and Thanga (2008), Kumar (2009), Kabir (2010), Mola (2011), Singh (2012), Ahmad (2012), Sharma (2013), Singh (2013).

Tripathi et.al. (2015 & 2016) studies on Zoobenthos in relation to water parameters of Seetadwarlake of Shravasti district, Uttar Pradesh, India. Afshan and Tripathi (2021) have studied Zooplankton in relation to water parameters of Tedhi nadi near Katahaghat of district Gonda (U.P.), India, according to this studies, physico-chemical parameters such as temperature, pH, DO, FCO_2, total alkanity, bicarbonate all salinity, carbonate alkanity, phosphate, chloride, calcium, total nitrogen and total organic matter were studied.The author also recorded 15 genera of Zooplankton and contains taxa protozoan, rotifers, crustaceans and mero-planktonic organisms.

Materials and Methods

The present work was carried out for a period of 9months from September2024to May 2025for completion of exhaustive work and the standard methods described for the purpose have been used, certain permissible modification and according to the local condition have also been incorporated. A short description of materials and methods applied during the present investigation has been presented below.

A. Sampling and preservation:-

(a) Sampling: The study of hydrobiological (physico-chemical and biological) condition of the water body and to assess the actual position of zooplankton diversity, the entire area in Tedh Nadi at Balpur of district Gonda has been taken into account. For the purpose three sampling station namely littoral, pelagic and polluted were setout, depending upon the degree of inflow and water turbidity. At a glance station littoral and pelagic were marked non polluted. The sampling station were marked by means of a weighted plastic float.

All the sample for abiotic and biotic component (ex-water and zooplankton) in Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh were collected during the first week of each month between 08.00A.M. to 11.30 A.M. They were taken from different sampling station fixed up in littoral, pelagic and polluted region and were transported to the laboratory of Department of Zoology, D.A.V.P.G.College, Azamgarh (U.P.) at the earlier for qualitative and quantitative estimations. Water samples were collected in three replicates from each of the site in clean plastic containers, using standard method of collection (APHA 2005).

(b)Preservation: The samples collected in sample containers of polyethylene. Labels on different bottles clearly indicated the name and locations of sampling station, date and time of Sampling, station number and depth.

The samples tightly cappped containers were brought to the laboratory in an ice box and kept in freezer to check the biological activity and preserve them. The physico-chemical analysis used standard method **(APHA-AWWA, WPCF 2005).**

B. Water sample analysis: The procedures described by Michael (1984), Trivedi (1986) have been adopted in the analysis. A brief description of the methods employed are given here.

(a) Physical Parameter

Temperature (°C): For determination of temperature, soon after the collection of sample in the polyethylene bottle, a mercury thermometer of (0.0 – 60°C)

(b) Chemical Parameters:

pH: pH of water was determined using pH meter (HANN, model no. -H19)

DO, FCo2, Carbonate, alkalinity, bicarbonate alkalinity, total alkalinity, nitrate, calcium, chloride, phosphate, total organic matter and total nitrogen. Rest of the parameters will be analysed using the method of Michael (1984), **APHA, AWWA and WPCF (2005)**.

Pankton Sampling and Preservation:

Plankton Fauna were sampled with Mushroom shaped bottom sampler which collected a sample of about 10 cm ×10 cm. The entire collections were brought to the laboratory for further investigation as per the method applied by singhet.al.(1998).A sample of 200 ml was taken out and passed through guarded sieve and washed with plenty of water. The organisms collected in sieve and were transferred to a bottle filled with water. The Phytoplankton and Zooplankton were first identified in living condition and then preserved in 5% formaldehyde solution. For the identification of Phytoplankton and Zooplankton using standard taxonomic literatures (Ward and Whipple,1959). Zoobonthos fauna and diversity worked out according to Mishra(1968).

Results and Discussion

Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh on which ecological studies has been carried out represents a special type of habitat. It is a shallow, eutrophic and supports a rich aquatic Plankton. The monthly changes of different physico-chemical and Plankton condition of Tedhi Nadi at Balpur of district Gonda has been described in preceding work. The salient features of findings of all parameters have been discussed here.

A. Hydrology in Tedhi Nadi at Balpur of district Gonda

The various physico-chemical characteristics of water sample in Tedhi Nadi at Balpur of district Gonda in relation to periodic changes have been described in (Table-3).

Water conditions:-

Aquatic habitat in Tedhi Nadi at Balpur of district Gonda Uttar Pradesh discussed the environmental factors include various physico-chemical properties of water such as solubility, Temperature, pH, phosphate and nitrates are very important for growth and density of phytoplankton on which zooplankton and some higher consumer depend on their existence (Table 3).

The fluctuation of the water temperature in any aquatic habitat has little to do with the distribution of species but it does influence the physico-chemical characteristics of the habitat. The high temperature from March onwards initiates rapid decomposition of the organic matter in the substrate and consequently the mineral content rises in the water during the following month (Table-3).

Bose and lakra (1994) has pointed out the pH expresses the acidity or alkalinity of water which is determined by means of hydrogen ion (H+) and hydroxyl ion (OH-) in water. Higher concentration of H+ ions gives lower score on the pH scale and lower concentration of H+ion gives

higher scores on the pH scale. Water of around pH-7 are called neutral. During daylight, aquatic plants usually remove the Co2 from the water quickly and pH increases. At night Co2 accumulates and pH declines. The magnitude of daily fluctuation pH depends on the buffering. In the present study pH shown in (Table-3). The water with pH values ranging 7.0-7.9 at day break is most suitable for fish production. This observation is in concurrence with those of Singh (1992), Shukla (1996) and Tripathi (2006).

Further an inverse correlation was found between pH and the temperature which is contrary to the observations of Kaushik and Saksena (1999), Tripathi (2006), Pandey (2007), Parveen (2010), Singh and Tripathi (2012).

The dissolved oxygen (Table-3) in the present investigation is plentiful during winter months when submerged macrophytes were luxuriant and mansoon months, when there was rich micro-planktonic vegetation and addition of excess oxygen from intensive rainfall. The oxygen production during these period exceeded many time the oxygen consumed by the organisms, have also been observed by Tripathi (2006), Pandey (2007), Singh (2012), Singh (2013) and Tripathi (2015).

The free carbon dioxide (Table-3) was detected mainly from the polluted region during the winter and monsoon months. Its absence from the littoral and pelagic waters of the Tedhi Nadi suggested that probably all the carbon dioxide produced during the respiration of living oraganisms was either utilized in photosynthesis of the autotrophs or converted in the bound forms of mono and bicarbonates, a features reported by Ganai (2010) and Tripathi (2015).

Tripathi (2016) has pointed out the amount of acid required titration the bases in a measures of alkalinity of water or it is the ability of water to neutralize of acids. The minerals, which dissolves in water from soil, atmosphere and waste discharge, provide the source of alkalinity. Carbonate and bicarbonates are the major constituent in Tedhi Nadi at Balpur of district Gonda Uttar Pradesh as total alkalinity. Calcareous water with alkalinity more than 50ppm is most productive. Water, alkalinity less than 10ppm rarely produces large crops. Water intermediate between 10ppm – 50ppm may give useful results. In highly productive water, the alkalinity is thought to be over 1000ppm. However, the range of alkalinity as 0.00-20ppm for low production, 20-90ppm for medium production and 90-299ppm for high production are considered. Since in the present total alkalinity Tedhi Nadi at Balpur of district Gonda ranges total alkalinity 114.0-185.0ppm is obtained during September 2024 & December 2024, hence it is could classified as nutrient rich in Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh (Table-3). Similar result obtained by Singh (2012), Tripathi (2015 & 2021).

(Table.3) A direct link was observed between chloride content and the water temperature, Since both of them fluctuated identically. Further increase in the chloride content, the nitrate and phosphate contents also increased which agreement with the findings of Tripathi (2006), Pandey (2007) and Singh (2012) have pointed out that the quantity of available nitrogen and phosphorus in any water is indicative of its productivity. The amount of nitrate and phosphate in the present water is relatively medium(Table-3).

The result of physico-chemical properties in Tedhi Nadi at Balpur of district Gonda include pH value ranged varied from 7.0in the month of September to 7.8 in the month of April at site, temperature (°C) of water ranged from 12.5in the month of Januaryto20.5in the month of April 2025, DO (ppm) ranged from9.2 in the month of April to 16.0 in the month of October, FCo2(ppm) ranged from 2.0ppm in the month of November to 4.5 ppm in the month of April 2025,Carbonate alkalinity (ppm) ranged from 69.0 in the month of April 2025to 95.0 in the month of February 2025, Bicarbonate alkalinity (ppm) ranged from105.0 in the month of January to 184in the month of September, Total alkalinity (ppm) ranged from 114 in the month of September to 185 in the month of December. Nitrate (ppm) ranged from

0.18in the month of October to 0.50 in the month of March, Calcium (ppm) ranged from 97.0 in the month of October to 144.0 in the month of March, Chloride (ppm) ranged from 18.5 in the month of October to 47.0 in the month of March, Phosphate (ppm) ranged from 0.030in the month of October to 0.082 in the month of April, Total organic matter (ppm) ranged from5.5 in the month of September to 12.5 in the month of April and Total nitrogen (ppm) ranged from 1.20in the month of February to 2.51in the month of November.

Table-3: Monthly Variation of Water Parameters in Tedhi Nadi at Balpur of district Gonda (U.P.), India

(Data of September 2024 to May 2025)

S.No.	Parameters	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
1	Water Temperature(0°C)	18.0	17.9	16.5	15.2	12.5	15.5	17.5	20.5	18.5
2	pH	7.0	6.9	7.3	7.5	7.7	7.4	7.5	7.8	7.7
3	DO (ppm)	14.0	16.0	14.0	13.0	12.0	9.8	9.5	9.2	9.9
4	FCO_2 (ppm)	-	-	2.0	3.0	3.2	2.8	4.0	4.5	4.3
5	Carbonate alkalinity (ppm)	86.0	70.0	76.0	75.0	72.5	95.0	70.0	69.0	72.6
6	Bicarbonate alkalinity (ppm)	184.0	137 .0	130.0	135.0	105.0	125.0	130.0	136.0	132.4
7	Total alkalinity (ppm)	114.0	150.0	170.0	185.0	170.0	172.0	165.0	155.0	175.0
8	Nitrate (ppm)	0.20	0.18	0.21	0.30	0.36	0.40	0.50	0.48	0.46
9	Calcium(ppm)	118.0	97.0	125.0	135.0	138.0	110.0	144.0	134.0	139.0
10	Chloride(ppm)	19.0	18.5	30.0	25.2	28.0	30.0	47.0	38.0	40.2
11	Phosphate (ppm)	0.038	0.030	0.047	0.036	0.039	0.059	0.074	0.082	0.070
12	Total organic matter (ppm)	5.5	6.2	6.2	6.5	6.8	12.0	11.0	12.5	11.8
13	Total nitrogen	2.05	1.48	2.51	1.60	1.49	1.20	1.27	1.90	1.85

B-Plankton population in Tedhi Nadi at Balpur of district Gonda Uttar Pradesh

In the present work reported that presence of 04 genera of Phytoplankton contains-*Lemna minor, Oryza sativa, Eichhornia crassipes, Ipomea aquatica* and 04 genera of Zooplankton contains-Euglena sp., Amoeba sp., Eristalis larvae and Ptychoptera larvae were identified and recorded in Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh (Table-4). The result is quite clear that Zooplankton were the most dominating and maximum in the month of May and Minimum in the month of February. Similar results were observed earlier Tripathi (2006), Pandey. (2007), Singh(2013), Tripathi(2015),Tripathi & Shukla (2021) and Tripathi(2021).

During the investigation presence of zoobenthos was maximum in the summer month and minimum in the spring month (February). This is not conformity to the finding of Eggleton (1931) and Devey (1945) who observed the maximum zooplankton in April and minimum in September in American lake, while Srivastava (1956) and Tripathi (2006) observed maximum in the month of May and June and minimum in the month of February from a lake of Lucknow and Seetadwar lake of Shravasti district (U.P.), India. Michael (1969) concluded the peak period in the month of January and April but Mandal and Moitra (1975), Singh (2013), found maximum peak during summer months which is quite in conformity to the finding of this investigation. The differences

in the occurrence of peak in zoobenthos might be due to the different nature of the water bodies, different in nature of the abiotic factors of water and soil and variation in the productivity of different water bodies. Some worker such as Tripathi (2006), Pandey (2007),Singh(2012) and Tripathi (2015) correlated bottom community with the fish productivity and accordingly this water body is most suitable for the Fish Culture.

Table-4: Plankton Population in Tedhi Nadi at Balpur of district Gonda (U.P.), India (Data of September 2024 to May 2025)

S.N.	Plankton	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
	Genera									
	Phytoplankton									
1	*Lemna minor*	++	+	++	+	+	++	++	++++	++++
2	*Oryza sativa*	+	+	+	+	-	++	+++	+++	++++
3	*Eichhornia crassipes*	+	+	+	+	-	++	+++	++++	++++
4	*Ipomea aquatica*	-	+	-	++	-	+	++++	++++	++++
	Zooplankton									
1	Euglena sp.	+	+	+	-	-	++	+++	+++	++++
2	Amoeba sp.	+	+	+	-	-	++	+++	+++	++++
3	Eristalis larvae	-	-	+	-	-	++	++	++	++++
4	Ptychoptera larvae	++	++	+	,-	-	++	+++	+++	++++

Note :-
++++ = Abundant (51-100%)
+++ = Common (26-50%)
++ = Frequent (11-25%)
+ = Rare (0-10%)
- = Absent (Nil)

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DOI:10.22192/ijamr.2026.13.04.001	

How to cite this article:
Karunesh Singh. (2026). Study on Physico-chemical Parameters and Plankton Fauna in Tedhi Nadi at Balpur of district Gonda, Uttar Pradesh, India. Int. J. Adv. Multidiscip. Res. 13(4): 1-14.
DOI: http://dx.doi.org/10.22192/ijamr.2026.13.04.001