Limnological Studies of Khanwari Pond of Kaushambi District (U.P.) In Relation To Planktons

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Abstract- ***Limnological study is one of the most important parameter to assess the water quality of a water body. In this study authors tried to assess the seasonal variations in physico-chemical properties of water and plankton diversity during one year (July, 2018 - June, 2019) of a perennial pond of Khanwari village of Kaushambi district of Uttar Pradesh. A significant level of variation was found in respect to these parameters throughout the study period. The planktonic populations in the pond indicates that the water of this pond is not yet seriously polluted since it contains freshwater algae Chara and Nitella and phytoplankton Volvex in the central region of pond. During the present study, presence of Chlorella, Oscillatoria, Anacystis, Scenedesmus, Branchionus, Keratella and Cyclops is considered as indicator of organic pollution, because all these genera were collected from polluted marginal water.***

Indexed Terms- Water quality, Plankton, Khanwari pond.

I. INTRODUCTION

The lentic water resources such as ponds, tanks and lakes, situated near human settlements, are getting polluted as they constantly receive solid and liquid wastes. Limnological studies of such water bodies reveal interaction of parameters influencing the productivity of the aquatic ecosystems (Alam, 2001). Because, all living organisms can tolerate certain range of physico-chemical parameters hence any major deviations can affect seriously on body function of aquatic organism.

Phytoplankton forms the vital source of energy in the aquatic environment. They initiate the food chain, by serving as food to primary consumers, which include zooplankton, fish and others. Phytoplankton is the primary producers and constitutes the first level in aquatic food chain for all aquatic animals. Aquatic ecosystem harbours a variety of communities, which constitute the functioning of the ecosystem in terms of maintaining production and food chain. The density and diversity of phytoplankton also help to determine the trophic status and water quality of a fresh water body. The seasonal variation of phytoplankton in water body has been studied by different scientists including Prakash *et al.,* (2015a) and Verma *et al.,* (2016a). Numbers of studies have been carried out on limnological condition of freshwater bodies in various regions of India including Prakash *et al.,* (2015b), Singh *et al.,* (2016) and Verma (2016a and 2019a).

Aquatic macrophytes not only play an important role in maintenance of aquatic ecosystem (Ranjan and Prakash, 2019), but also they absorb different dissolved nutrients, nitrogen and phosphorus from polluted water in maintaining the resilience of ecosystem (Singh *et al.,* 2020). The study of the macrophytes gives us valuable information and also maintains healthy aquatic environment. But on the other hand, when the macrophytes are present in surplus amount, they not only reduce productivity of aquatic system, accumulate silts but also produce huge amount of nutrients causing death, pollute water and produce foul odour and smell.

The fishes are not only used as good source of food for mankind, having economic importance from medicinal point of view but also play a crucial role in the second tropic level of the aquatic ecosystem. Prakash *et al.,* (2015c and 2016) and Verma *et al.,* (2016b) performed the ichthyological studies of Alwara Lake of Kaushambi (U.P.) while Verma *et al.,* (2017a, 2017b and 2018) and Prakash *et al.,* (2017, 2019a and 2019b) studied the fresh water bodies for distribution and conservation of fishes, other chordates

and other properties. Verma (2016c, 2016d, 2016e, 2017d, 2017e, 2018c, 2019b, 2019c and 2020), and Prakash (2020a and 2020b) and Prakash *et al.*, (2020) studied the biodiversity and conservation status of fishes in the various lentic and lotic fresh water bodies of Uttar Pradesh.

Pond water is beneficial for agriculture since but the unsustainable farming has multiple effects (Verma 2017a) and disturbs the ecological balance (Verma 2018a). Aquatic ecosystem maintains the ecological, social and economic functions that interconnect the organisms including humans. It is helpful in maintaining the biodiversity. The biodiversity has values (Verma 2016b) and explored at three levels *namely*: ecosystem diversity, species diversity and genetic diversity**.** The genetic diversity acts as a buffer for biodiversity (Verma, 2017b). The biodiversity helps to maintain the ecological balance. There is a necessity of ecological balance for widespread biodiversity (Verma 2017c) and the biodiversity loss has ecological impact (Kumar Ajay *et al.,* 2017). The ecological balance is must for human survival (Verma 2018b). The climate change has a huge impact on biodiversity (Prakash *et al.,* 2019) and farmers' practices (Mandal *et al.,* 2020).

The present study is an effective attempt to assess the seasonal variations in physico-chemical properties of water and plankton diversity during one year (July, 2018 - June, 2019) of a perennial pond of Khanwari village of Kaushambi district of Uttar Pradesh.

II. MATERIALS AND METHODS

Monthly sampling of water of the pond was done from July, 2018 to June, 2019. Observations were made for water temperature and pH at the site, while for rest of the parameters analysis was made in the laboratory as per standard procedures of APHA (2005). Planktonic flora and fauna were collected from marginal and center of pond using plankton net following standard procedures, and later identified in the laboratory. Plankton were identified with the help of a book entitled "A guide to the study of fresh water biology" written by Needham & Needham (1962) and other standard literature.

III. RESULTS AND DISCUSSION

The results of the study are given in table 1 and 2**.** It is a well-known fact that physico-chemical characteristics of the water play an important role in determining the status of the aquatic ecosystems. Climatic conditions of the area also influence these parameters to great extent.

Table 1. Seasonal Variation of physico- chemical parameters of Pond water and comparison with acceptable range of BD (Bhatnagar and Devi, 2013).

Parameters	Summer	Rainy	Winter	Acceptable rangeBD
Temperature (^{0}C)	29.2-35.4	33.5-28.4	19.6 – 23.5	15-35
pH	7.7-8.1	7.2-7.7	7.5-7.9	7.0-9.5
Dissolved Oxygen (mg/l)	2.5-4.9.	3.8-6.4	3.8-5.7	3.0-5.0
Free CO_2 (mg/l)	40.2-52.4	35.4-40.0	33.2-34.4	-
Total Alkalinity (mg/l)	125-155	120-150	122-175	50-200
Chloride (mg/l)	75-150	58-105	54-95	0-100
Phosphate (mg/l)	3.0-4.0	2..5-3.9	2.5-3.8	0.03- 2.0
Nitrate (mg/l)	1.8-3.0	1.7-3.2	1.8-2.8	0-100

The water temperature varied from 19.6 to 35.4^{0}C, showing maximum range in summer and minimum in winter. This variation of water temperature was directly related to atmospheric temperature having more effect directly or indirectly on all life processes (Welch, 1952). The pH of the water ranged from 7.2 to 8.6, showing alkaline nature. The alkaline pH is a usual feature of productive water bodies as reported earlier by Ayappaan and Gupta (1981).

Dissolved oxygen of any water body is an important parameter because it is an indicator biological productivity of taal. The oxygen concentration in

water body is a function of the temperature as well as the photosynthesis and community respiration. Dissolved oxygen concentration showed variation between 2.5 mg/L and 6.4mg/L, the higher values being noted in post winter months due to high photosynthetic activity (Alam, 2001).

Free carbon dioxide in a water body is generally derived from the atmospheric sources, biotic respiration and decomposition of organic matter by saprophytes. The free carbon dioxide was ranged from 33.2-52.4 mg/L with maximum value in summer and minimum in winter season. The present finding is similar to that of Kumar *et al*., (2015).

Carbonate alkalinity of the pond was absent throughout the study period. The total alkalinity was mainly due to bicarbonates which varied from 120.0mg/L to 175.0mg/L, showing minimum range in post monsoon and maximum in summer months. The present finding of high alkalinity value is due to influx of domestic sewage rich in alkalinity causing chemicals such as soap and detergents and also due to presence of bicarbonate system and high value of pH in alkaline side (David *et al.,* 1969) showing that the pond is of productive nature.

The level of chlorides varied from 54.0-150.0 mg/L. As reported by Bhaskaran (1977) this chloride level is harmful to aquatic life. Singh (1983) suggested that high chloride content of water is an indication of pollution of animal origin.

Phosphate is considered as the most critical nutrient substance in the maintenance of aquatic productivity. They are essential for the growth of organisms and a nutrient that limits the primary productivity of the water body. The level of phosphate varied from 2.5-4.0 mg/L with maximum value in summer and minimum in winter season. Low phosphate contents during winter months and high during summer or post monsoon months may be due to low decomposition of organic matters during summer seasons (Prakash, 2001)

The most chemically stable available form of nitrogen is nitrate. High nitrate concentration is responsible for algal blooms in water body. Surface runoff, decayed vegetations and animal matter are the main sources of nitrates in water body. The level of nitrate varied from 1.7-3.2 mg/L with maximum value in summer and minimum in winter season. The result is supported by the findings of Khan *et al*. (1986). In the present study except chloride, all the physico-chemical parameters were optimum for fish productivity as reported by Bhatnagar and Devi (2013).

Table 2. Seasonal Variation of Phytoplankton in the Pond studied.

S.N.	Phytoplankton	Summer	Rainy	Winter
A	Chlorophyceae .			
1	*Chlamydomonas* sp.	-	-	+
2	*Pandoria* sp.	+	+	+
3	*Gonium* sp.	+	+	+
4	*Volvox* sp.	+	+	+
5	*Oedogonium* sp.	+	+	+
6	*Chlorococcum* sp.	+	+	-
7	*Sirogyra* sp.	-	-	+
8	*Closterium* sp.	+	+	+
9	*Chara* sp.	+	-	+
10	*Nitella* sp	+	-	+
B	Cyanophyceae			
11	*Microcystis* sp.	+	+	_
12	*Scytonems* sp.	+	+	+
13	*Oscillatoria* sp.	+	+	+
14.	*Spirulina* sp.	+	-	-
15.	*Gloecapsa* sp.	-	+	-
16	*Anacystis* sp.	+	+	-
C	Euglenophyceae			
17	*Euglena* sp.	+	-	+
18	*Phacus* sp.	+	-	+
D	Bacillariophyceae			
19	*Diatoma* sp.	+	+	-
20	*Cymbella* sp.	-	-	+
21	*Frustulia* sp.	-	-	+
22	*Navicula* sp.	-	-	+
23	*Nitzschiasp*.sp.	+	-	+
24	*Fragilaria* sp.	-	-	+
25.	*Synedra ulna*	+	-	+

In the present study, twenty five genera of phytoplankton were found. Of these 10 belong to

Chlorophyceae (*Chlamydomonas, Pandoria, Gonium, Volvox,, Oedogonium Chlorococcum, Sirogyra, Closterium, Chara* and *Nitella* sp); 6 to Cyanophyceae (*Microcystis, Scytonems, Oscillatoria, Spirulina, Gloecapsa* and *Anacystis* sp); 2 to Euglenophyceae (*Euglena* and *Phacus*) and 7 to Bacillariophyceae (*Diatoma, Cymbella, Frustulia, Navicula, Nitzschiasp, Fragilaria* and *Synedra*,) and Apart from this 18 genera of zooplankton were found. Of these 7 species belong to Rotifers (*Brachinous, Keratella, Notholca, Rotaria Polyarthra, Asplanchna* and *Lecane*); 6 to Cladocerans (*Diaphnosoma, Ceriodaphria, Daphnia, Simocephalus, Macrothrix* and *Chydorus*); 3 to Copepods (*Cyclops, Diaptomus,* and *Nauplius* larva) and 2 Ciliates (*Paramecium* and *Vorticella*). Most of these species were present in fresh waterbodies of eastern Uttar Pradesh (Prakash, 2001, Prakash *et al*., 2002 and Sinha *et al*., 2002). Presence of 23species of phytoplankton and 20 species of zooplankton shows that the taal is rich in planktonic diversity.

Table 3. Seasonal Variation of Zooplankton in the Pond studied.

S.N.	Zooplankton	Summer	Rainy	Winter
A	Rotifera			
1	*Brachionus sp.*	-	-	+
2	*Keratella sp.*	+	+	+
3	*Notholca sp.*	+	+	+
4	*Rotaria sp.*	+	+	+
5	*Polyarthra sp.*	+	+	+
6	*Asplanchna sp.*	+	+	-
7	*Lecane sp.*	-	-	+
B	Cladocera			
8	*Diaphnosoma sp.*	+	+	_
9	*Ceriodaphria sp.*	+	+	+
10	*Daphnia sp.*	+	+	+
11	*Simocephalus sp.*	+	-	-
12	*Macrothrix sp.*	-	+	-
13	*Chydorus sp.*	+	+	-
C	Copepods			
14	*Cyclops sp.*	+	-	+
15	*Diaptomus sp.*	+	-	+
16	*Nauplius* larvae			
D	Clliates			
17	*Paramecium sp.*	+	+	-
18	*Vorticella sp.*	-	-	+

The results for phytoplankton and zooplankton populations in the pond indicates that the water of this pond is not yet seriously polluted since it contains freshwater algae *Chara* and *Nitella* and phytoplankton *Volvex* in the central region of pond. Most other plankton also comprised of non-indicator organisms. During the present study, presence of *Chlorella, Oscillatoria, Anacystis, Scenedesmus, Branchionus, Keratella* and *Cyclops* is considered as indicator of organic pollution, because all these genera were collected from polluted marginal water.

During the field survey various type of macrophytes, e.g. emergent (*Ipomoea* sp.), rooted submerged (*Hydrilla* sp.), free submerged (*Ceratophylum* sp.) and free floating (*Eichhornia* sp., *Lemna* sp., *Pistia* sp., and *Azolla* sp.), have been observed. Maximum macrophytes were found in the margin of the pond due to efficient and adequate nutrients coming from different sources. The presence of *Lemna* sp. and *Eichhornia* sp. also indicates the pollution load in Pond.

REFERENCES

[1] Alam M. N. (2001). Studies on variations in the physic-chemical parameters of a pond at Hathwa (Bihar). *Journal of Environment & Pollution.* 8(2):179-181.

[2] APHA (2005). Standard methods for Examination of water and waste water. American Public Health Association 21st Ed. APHA, New York.

[3] Ayappan S. and Gupta T.R.C. (1981). Limnology of Ramasamudra Tank-Hydrograph, Mysore. *J. Aqric. Sc.* 15:305-312.

[4] Bhaskaran R. R. (1977). Treatment and disposal of tannery effluents. Geo Miller and Co. Pvt Ltd. New Delhi.

[5] Bhatnagar A. and Devi P. (2013). Water quality Guidance for the management of Pond fish culture. *Int. J. Environ. Sci*. 3(6):1980-1993.

[6] David A., Rao G.N.S. and Rahman F.A. (1969). Limnology and Fisheries of Tungbhadra Reservoir. Bull. Central Inland Fisheries Research Institute, Barrakpore, Mimeo.13:188.

[7] Needham J. J. and Needham P. R. (1962). A Guide to the study of freshwater Biology, Charles Cthomas Publisher, USA.

[8] Prakash S. (2001). Seasonal dynamic of plankton in a fresh water body at Balrampur. *GEOBIOS*. 28(1):29-32.

[9] Khan E., Kaiser U. M., Habib M. A .B. and Hasan M.R. (1986). Interrelations and interrelations and intrarelations of some water characteristics of a farm pond and meterologiacl factor. *Bangladesh, J. Agric*. 11 (4): 35-40.

[10] Kumar Ajay and Verma A. K. (2017). Biodiversity loss and its Ecological impact in India. *International Journal on Biological Sciences*. 8(2): 156-160.

[11] Kumar U., Choudhary S., Kumar M. and Paswan R. (2015): Physico-chemical Prameters of Gamhi water body of the Kaula Chaur (Wetland) Of Begusarai District (Bihar). *Proc. Zool. Soc. India*. 14(1): 1-6.

[12] Mandal A.C. and Singh O.P. (2020). Climate Change and Practices of Farmers' to maintain rice yield: A case study. *International Journal of Biological Innovations*. 2(1): 42-51. DOI: https://doi.org/10.46505/IJBI.2020.2107

[13] Prakash S. (2020a). Fish diversity of Semara Taal, a wetland of district Siddharthnagar (U.P.), India. *International Journal of Fisheries and Aquatic Research*. 5(2):07-09.

[14] Prakash S. (2020b). Conservation status of fishes reported from Semara Taal of District Siddharthnagar (U.P.). India. *Internal Journal of Fauna and Biological Studies*. 7(3): 21-24.

[15] Prakash S., Ansari K. K. and Sinha M. (2002). Seasonal dynamics of zooplankton in a fresh water pond developed from the wasteland of brick-kiln. *Poll. Res*. 21 (1): 81-83.

[16] Prakash S., Verma A.K. and Prakash S. (2015a). Seasonal variation of Zooplankton and Zoobenthos Population in Alwara lake of District Kaushambi (UP) India. *The Journal of Zoology Studies*. 2(5):13-16.

[17] Prakash S., Verma A.K., and Prakash S. (2015b). Limnological Studies of Alwara Lake of Kaushambi (U.P.). *International Journal on Biological Sciences.* 6 (2): 141-144.

[18] Prakash S. and Verma A.K. (2015c). Studies on different fish genera in Alwara lake of Kaushambi. *Bioherald: An International Journal of Biodiversity & Environment.* 5(1-2): 60-62.

[19] Prakash S. and Verma A.K. (2016). Conservation status of fresh water fishes reported in Alwara Lake of District Kaushambi (U.P.). *International Journal of Zoology Studies*. 1(5): 32-35.

[20] Prakash S. and Verma A.K. (2017). IUCN Conservation Status of Fishes of Khanwari Pond of District Kaushambi (U.P.) *Proceedings of The Zoological Society of India*. 16 (1): 81-84.

[21] Prakash S. and Verma A.K. (2019a). Biodiversity Assessment of Khanwari Pond of District Kaushambi (U.P.). *International Journal on Environmental Sciences*. 10(1): 24-28.

[22] Prakash S. and Verma A.K. (2019b). Length-Weight Relationships and Condition Factors of Fresh Water Fishes of Baghel Taal of Bahraich (U.P.). *Journal of Experimental Zoology, India*. 22 (1): 343-345.

[23] Prakash S. and Srivastava S**.** (2019). Impact of Climate Change on Biodiversity: An Overview. *International Journal of Biological Innovations*. 1(2): 60-65. DOI: https://doi.org/10.46505/IJBI.2019.1205

[24] Prakash S., Kumar A., Prakash S. and Mishra B.K. (2020). A Survey of Fish Fauna of Rapti River, Balrampur (U.P.), India. *International Journal of Biological Innovations.* 2(1): 76-81. DOI: https://doi.org/10.46505/IJBI.2020.2110

[25] Ranjan, R. and Prakash, S. (2019). Seasonal Variation in Primary Productivity and Macrophytes of Baghel Taal. *Iconic Research and Engineering Journal*. 3 (6):210-215.

[26] Singh S. and Singh S. (2020). Macrophytes as Bioindicator in Bichhiya River, Rewa (M.P.), India. *International Journal of Biological Innovations.* 2(1): 25-30. DOI: https://doi.org/10.46505/IJBI.2020.2104

[27] Singh S.R. (1983). Observations on the seasonal variation in the water quality of Dah Lake (Ballia). *Proc. Nat. Acad. Sci. India*, 53(B), II: 142-149.

[28] Singh P.R. and Verma A.K. (2016). Observations on Hydrobiological Conditions of River Ganga at Daraganj, Allahabad. *The Journal of Zoology Studies*. 3(4):81-82.

[29] Sinha M., Prakash S. and Ansari K.K. (2002). Seasonal dynamics of phytoplankton population in relation to abiotic factors of a fresh water pond developed from wasteland of brick-kiln. *Asian Jr. of Microbiol. Biotech. Env. Sc.* 4(1):43-45.

[30] Verma A.K. (2016a). Hydrobiological Studies of Muntjibpur Pond of Allahabad (U.P.). *International Journal on Agricultural Sciences.* 7 (2): 164-166.

[31] Verma A.K. (2016b). Biodiversity: Its Different Levels and Values. *International Journal on Environmental Sciences.* 7(2): 143-145.

[32] Verma A.K. (2016c). Dominancy of Cypriniformes fishes in Alwara Lake of District Kaushambi (U.P.). *International Journal on Agricultural Sciences.* 7 (1): 89-91.

[33] Verma A.K. (2016d). Distribution and Conservation Status of Catfishes in Alwara lake of District Kaushambi (U.P.). *International Journal on Environmental Sciences.* 7 (1):72-75.

[34] Verma A.K. (2016e). A Preliminary Survey of Fresh Water Fishes in Muntjibpur Pond of Allahabad (U.P.). *Indian Journal of Biology.* 3(2): 99-101.

[35] Verma A.K. (2017a). Multiple effects of Unsustainable Agriculture. *International Journal on Agricultural Sciences.* 8(1): 24-26.

[36] Verma A.K**.** (2017b). Genetic Diversity as Buffer in Biodiversity**.** *Indian Journal of Biology.* 4(1): 61-63. DOI: http://dx.doi.org/10.21088/ijb.2394.1391.4117.9

[37] Verma A.K. (2017c). Necessity of Ecological Balance for Widespread Biodiversity. *Indian Journal of Biology*. 4(2): 158-160.

[38] Verma A.K**.** (2017d). A study on ichthyo-diversity of Muntjibpur Pond of Allahabad (U.P.). *Flora and Fauna.* 23(1): 220-224.

[39] Verma A.K. (2017e). Distribution and Conservation Status of Fishes reported from Muntjibpur Pond of Allahabad (U.P.): *International Journal of Scientific World*. 5(1): 50-53.

[40] Verma A.K. (2018a). Unsustainable Agriculture, Environmental Ethics and Ecological Balance. *HortFlora Research Spectrum.* 7 (3): 239-241.

[41] Verma A.K. (2018b). Ecological Balance: An Indispensable Need for Human Survival. *Journal of Experimental Zoology India*. 21 (1): 407-409.

[42] Verma A.K. (2018c). A Biodiversity Survey of Muntjibpur Pond of District Allahabad (U.P.). *International Journal on Environmental Sciences.* 9(1): 56-59.

[43] Verma A.K. (2019a). Studies of Hydrobiological Properties of Balapur Pond of Prayagraj (U.P.). *Hortflora Research Spectrum.* 8(1): 9-11.

[44] Verma A.K. (2019b). Biodiversity of Higher Chordates at Khanwari village of Kaushambi (U.P.). *International Journal of Fauna and Biological Studies.* 6(3): 48-50.

[45] Verma A.K. (2019c). A Study of Fish Distribution in Balapur Pond of Prayagraj (U.P.). *International Journal on Biological Sciences*. 10(1): 7-10.

[46] Verma A.K. (2020). Conservation status of Anamniotes reported from Balapur Pond of District Prayagraj (U.P.). *Uttar Pradesh Journal of Zoology*. 61(6):42-46.

[47] Verma A. K., Kumar S. and Prakash S. (2016a). Seasonal Correlation between physico chemical factors and phytoplankton density in Alwara taal of

Kaushambi, U. P., India. *International Research Journal of Biological Sciences*. 5(3):40-45.

[48] Verma A.K. and Prakash S. (2016b). Fish biodiversity of Alwara Lake of District Kaushambi, Uttar Pradesh, India. *Research Journal of Animal, Veterinary and Fishery Sciences*. 4(4): 5-9.

[49] Verma A.K. and Prakash S. (2017a). Fish Biodiversity of Khanwari Pond of district Kaushambi (U. P.), India. *The Journal of Zoology Studies*. 4(1): 37-40.

[50] Verma A.K. and Prakash S. (2017b). Dominancy of Cat fishes in Khanwari Pond of District Kaushambi (U. P.). *Life Science Bulletin*. 14(1): 85-87.

[51] Verma A.K. and Prakash S. (2018). Qualitative and Quantitive Analysis of Macrozoobenthos of Baghel Taal, A Wetland of U.P. *Indian Journal of Biology***.** 5(2): 127-130. DOI: http://dx.doi.org/10.21088/ijb.2394.1391.5218.3

[52] Welch P.S. (1952). Limnology. McGraw Hill Book Co., N.Y. 538.