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Review Article

A Critical Review of Phytoplankton Studies of Lentic Water Bodies of India

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ABSTRACT

Phytoplankton is microscopic organisms that lie in watery environment and make their own food from sunlight through photosynthesis. Phytoplankton's are the primary producers and play important role in the food web. Many physico-chemical were affecting the phytoplankton. In the present paper an effort has been made to give broad review of literature on phytoplankton. This review clearly indicates that such research is necessary and emphasis the urgency of present work. According to present condition it is very important to investigate with fresh approaches in this field for diversity, abundance and variation in the biotic factors in the aquatic system.

Introduction
Phytoplanktons are producers of aquatic ecosystem. These are autotrophic components of the plankton community and a key part of oceans, seas and freshwater ecosystem. Also are very important organisms from ecological point of view. Most of the aquatic food chains begin with them. Therefore, these remained popular subjects for research during last couple of centuries. The literature of such studies is available and while collecting most of the research the difficulties are faced by most of the researchers. A systematic review of such references is a need of the time. Present paper is trying to fulfill this need and reviews various aspects of phytoplankton research presented in the research articles.

Review Methodology and Review details
The various aspects studied by the researchers are their diversity, analysis of the attributes of their surrounding medium, seasonal variations and their role/functions in their habitats etc.

Studies from abroad Periodic environmental changes in temperature, water movement, light, soil and other biological factors lead to changes in species composition and food chain of marine ecosystem (Gray,1974, 1981). Phytoplankton, the most important biological phenomenon in nature on which the entire array of life depends is the integral component of riverine ecosystem which determines the primary productivity of the system. It is the bio-indicators of water pollution. Its appearance,

disappearance, density and pattern of distribution depends on biotic and abiotic factors (Lewitus *et al*., 1998; Escaravage *et al*., 1999; Escaravage *et al*., 2002; Kauppila *et al*., 2004; Gupta *et al*. 2005; LeQuere *et al*., 2005; Komala *et al*., 2013). Phytoplankton is the major primary producers in many aquatic ecosystems (Kensa, 2011).

Winder and Sommer (2012) studied the effect of climate change on phytoplankton. Climate affects phytoplankton directly through physiology and indirectly by changing water column stratification and resource availability, mainly nutrients and light. Climate also effects phytoplankton species composition and size structure and favors' species trait.

Veronica *et al*.(2014) studied the effect of water quality on phytoplankton abundance in Hampalam river and fish pond of Batanjung village. In these 60 genera of phytoplankton phyla were found in the river and pond with the highest abundance of Pluerosigma belonging to Chrysophyra in the river and euglena species belonging to euglenophyta in the pond.

Palh*et al*.(2016) studied the phytoplankton of Chakhan Lake district Dadu, sindh Pakistan. Phytoplankton algal species belonging to genera Anabaenospsis, Anabaena, Nostoc of family Nostocaceae were reported. Zebek and Szymanska(2017) assessed the differences in phytoplankton abundance, biomass,

structure and the environment requirement of dominant species of pond of Warmia Mazury region of north-east Poland.

Giripunje *et al.* (2013) studied a comprehensive review of phytoplankton ecology in freshwater lakes of India. In this the relations of phytoplankton with factors like lake temperature, sunlight exposure period, sunlight penetration, water pH, wind, transparency, seasonal variations, water characteristics, nutrient enrichment and prey-predator relation in the lakes of India were discussed.

Hosmani (2014) assessed phytoplankton influenced climatic changes and by variation in the physico-chemical constituents of the water and the uncontrolled conditions lead to pollution.

Kumar *et al.,* (2008) evaluate the physico-chemical characteristics and diatom as indicators of trophic status of wetland namely Kishore Sagar Lake of Kota Rajasthan. The Diatom community comprised of 42 species representing 8 centric forms and 34 pennate forms. *Melosira granulata, Cocconies placentula, Diatoma elongatum, Fragilara crotoneinsis, Ghomphonema olivacium, Ghomphoneis herculum, Nitzchia sp. Navicula radios* and *Synendra ulna* were the most dominant species from this wetland. Highest population density of diatoms was observed in winter season. The abundance of diatoms in cold months is probably due to the fact that they are able to grow under the condition of weak light and low temperature. The dominance and abundance of diatoms the wetland is indicative of eutrophic nature of the water body. The water quality of the lake has deteriorated and is potential threat to human health as well as aquatic flora and fauna.

The study includes various aspects of lotic and lentic fresh water ecosystems, such as quality of water its physical, chemical and biological characteristics (phytoplankton, zooplanktons, macrophytes and animal of different taxonomic categories which has been reviewed and included in many research papers, dissertations, theses, monographs and books (Dube*, 2002 and Basavarajappa et al., 2014)*. Periodical ecological study of an urban pond near Vadodara Gujarat was studied by Soni and Bhatt (2008) with the physic-chemical, biological and microbiological parameters. The physic-chemical parameters show N max up to 3.4 mg/l, total phosphates 1.45 mg/land BOD 33 mg/l. The pond is full of algal growth. Microbiological analysis show positive result for *E. coli*, *Vibrio species* and many other pathogenic bacteria. These in water increase pollutants in terms of nutrients, organic matter and toxic substance in water bodies and disturb its ecosystem.

The primary productivity of phytoplanktons of Kolayat Lake, Bikaner. The monthly primary productivity in the lake revealed a seasonal cycle in the values for gross and net primary production (Barupal and Gehlot 2014).

Bhupender and Kumar (2015) studied the phytoplankton diversity of desert village pond in Bikaner Rajasthan. The reported species of phytoplankton were the members of three algal groups namely Cholorophyceae, Cynophyceae, and Bacillariophyceae were observed. The species cladocera, crucigenia,murospora, chara , spirogyra (5 green), Navicula , Nitzchia , Synedra, diatoma ,coscrnodiscus (5 diatoms),

Spirulina, Nostoc, Anabaena, Oscillatoria (4 blue green algae) were recorded from pond.

Physico-chemical parameters and plankton diversity of Konda (open pond) pond of Bharatpur is studied by Singh (2015). Physico-chemical parameters of pond are water temperature 24-25.6 ˙c ,transparency 0.2-0.4 m , pH 7.3-7.4 ,total dissolved solids 143.8-159.5 mg/L, conductivity 290.8-391.5 µmhos, salinity 0.11-0.19 %,dissolved oxygen 0.7-1.8 mg/L, and alkalinity 0.8-1.7 mg $CaCO_3$/L, five families of phytoplankton are identified at the time of study Cyanophyceae, Cholorophyceae, Euglenophyceae, Bacillirophyceae and Dinophyceae. Three groups of zooplanktons are also identified namely Copepods, Cladocerons and Rotifers. Pond is likely polluted as some pollution indicator species are present such as Microcystis, Phacus, Oscillatoria, Anabeana, and Euglena.

Seasonal changes of phytoplankton community of Lake Ramgarh was studied by Maheshwari *et al*. 2015correlation between various physico-chemical parameters , productivity and plankton groups were calculated according to Karl Pearson's formula. During summer gross and net primary production were high and low during the winter season. Bacillareophyceae (43.58%) > Chlorophyceae (33.41 %) > Cyanophyceae (23 %) were three major groups according to their density. Nitzchia, synedra and Navicula were the main contributors of bacillariophyceae, Closterium and Chlorella were from the group Cholorophyceae, Cynophyceae was dominated by *Spirullina ,Anabaena, Microcystis*.

Kumar*et al.* (2015) studied the phytoplankton diversity in relation of primary productivity of Lake Udai Sagar Udaipur. The mean primary productivity (GPP) was to be 0.50 gcmh¯1 in surface.

Mishra *et a*l. (2017) assessed the seasonal diversity of phytoplankton by Palmer's Index. In Pichola Lake 36 genera were repoted among them 12 from Cyanophyceae, 9 from Bacillariophyceae, 12 from Chlorophyceae and 3 from Desmidiaceae. Chlorophyceae were dominant among phytoplankton.

The phytoplankton study is a very useful tool for the assessment of water quality and productivity of any type of water body and also contributes to understanding of lentic water bodies Pawar*et al*., 2006.

Ansari*et al*. (2015) assessed the diversity of phytoplankton and physico- chemical parameters of ONGC pond Hazira. During the time period of study 73 genera belonged to 4 classes' viz. Euglenophyceae, Cholorophyceae, Bacillariophyceae and Cyanophycea were identified. Among the four classes cholrophyceae group was dominating class. Level of various physico-chemical parameters are as follow oxygen (5.678±0.218 mg/L, nitrate (4.089±0.926mg/L), phosphate (0.257±56.786mg/L) and silicate (0.218±0.029 mg/L). Physico-chemical parameters show direct relationship.

Joseph (2017) studied the diversity and distribution of phytoplankton in an artificial pond, Phytoplankton species cyanophyceae (39%) was the dominating group followed by

Cholrophyceae (34%), Bacillariophyceae (235%) and Euglenophyceae (4%).

Triest and Stier (2017) studied the impact of naon native plant species on phytoplankton and zooplankton communities in temperate pond. We investigated the relationship between the three aquatic nonnative invasive species (Hydrocotyle ranunculoides, Ludwigia, randiflora and Myriophyllum aquaticum), zooplankton and phytoplankton density.

Saidu *et al*. (2016) studied the species distribution of phytoplankton in Balanga Dam. 21 species were identified belonging to about 7 taxa. Cholorophyceae were dominating about 28.6%, followed by Bacillariophyceae 19%, Cyanophyceae (19%), Desmidiaceae (14.3%) and Chrysophyceae (9.5%) respectively.

Pandiammal *et al.* (2017) assessed on the diversity of phytoplankton and seasonal fluctuation in temple pond at Thiruvottiyur Chennai. Totally 5 groups of phytoplankton taxa were identified which were chlorophyceae 10, Bacilliariophyceae 11, Cyanophyceae 6, Euglenophyceae 3, Dinophyceae 2.

Phytoplankton diversity is influenced by physical and chemical parameter of pond water was studied by Devi and Antal (2013). Phytoplankton showed significant correlation with certain abiotic parameters such as water and air temperature, phosphate, carbonates and chlorides. Margalef's index, Menhink's index, Simpson index, Shannon Wiener index and Equitability index were used for phytoplankton population.

Sharma *et al*. 1985 studied relationship of phytoplankton and physico chemical parameters which shows that increase in concentration of physico-chemical parameters has an adverse effect on phytoplankton density.

Roy et al. (2015) studied plankton diversity of urban and rural ponds of Raipur. Total 67 algal genera were reported belonging to classes Chlorophyceae (29), Bacillariophyceae (18), Cyanophyceae (15), Chrysophyceae (2), Euglenophyceae (2) and Dynophyceae (1) while among zooplankton 24 genera were stated belonging to classes Rotifera (11), Copepoda (7), Protozoa (3), Cladocera (2) and Ostracoda (1). These ponds have high plankton diversity.

Verma *et al.* (2016) assessed phytoplankton diversity. Phytoplankton diversity is important for evaluation of suitability of water for irrigation and drinking purpose.

Bordolol and Baruah (2014) studied correlation between phytoplankton and physico- chemical parameters of water. There is positive relationship with surface water temperature, electric conductivity, turbidity, BOD, potassium, phosphate ad nitrate with the total density values of Palmer's genera.

Das and Sayantan (2016) assessed the physicochemical parameters and biological parameters as plankton of different ponds. Sharma *et al*., (2018) critically reviewed the literature on diversity and seasonal variation of phytoplankton. The important components of phytoplankton are Diatoms (Bacillariphyceae), Dinoflagellates (Xanthophyceae, Chrysophyceae, Haptophyceae, Cryptophyceae) and Nanoplankters (*Chlorella, Nannochlorpsis*, etc.). In addition to these, two other classes namely Silicoflagellates and Coccolithophores also belong to the category of phytoplankton.

Karra *et al*., (2018) reviewed the studies of Phytoplankton in Lotic Water of India. Phytoplanktons are microscopic creatures mainly algae contain chlorophyll and live near the surface of water where there is sufficient light, producing their own food and thus providing meals for countless other aquatic dwellers. They play important role in maintaining the equilibrium between living organism and abiotic factors. The density and diversity of phytoplankton and their association as biological indicator is significant in the assessment of water quality.

Conclusion

This review clearly indicates that the pocket of such research is necessary and emphasis the urgency of present work. According to present condition it is very important to investigate with fresh approaches in this field for diversity, abundance and variation in the biotic factors in the aquatic system.

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