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DETERMINANT ROLE OF PHYTOPLANKTON- DIATOMS IN WATER QUALITY ASSESSMENT OF PONDS

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Abstract: Diatoms are unicellular autotrophic organisms, play key role as primary producers in aquatic ecosystem. Diatoms are very sensitive to subtle changes in the environmental conditions. Due to which they are used as bio-monitors for water quality assessment. Diatom population directly or indirectly depends upon the physicochemical parameters like water and air temperature, pH, nitrate, phosphate, silicate, DO and BOD etc. For proper management of a particular water body, investigation of physicochemical parameters along with the diatom or phytoplankton population should be studied .Seasonal variations in population dynamics and parameters should be recorded to generate basic information about the ecology of the pond. Tolerant species should be identified and implemented as tool to make the environment feasible for organisms living in that water body.

Keywords: Diatoms, Phytoplankton, Physicochemical Parameters, Pond ecosystem.

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INTRODUCTION

Ponds are generally small and shallow bodies of standing water. Provides water for domestic, industrial and agricultural uses. Some ponds in India are religious, used to take holy dips or for immersion of idols. Ecology of pond is very important to assess the water quality. Population Dynamics of each pond is somewhat different as it is influenced by physical and chemical factors. Physico-chemical parameters of a water body provide a good indication about the water chemistry and quality, but unable to depict the clear picture of ecological condition of the water body. This is due to lack of proper integration with ecological factors Karr *et al* (2000). In this situation bio-monitoring, is useful to assess changes in the environment, which is due to tremendous pressure from human population and developmental activities around the water bodies.

Biomonitering involves the use of indicators. Generally benthic macro invertebrates, fish or algae are used. Certain aquatic plants have also been used as indicator species for pollutants including nutrient enrichment Batiuk *et al.,* (1992). Lot of work has been done on using algae as bioindicators of pollution Mohanty(1983), Reddy and Venkateswarlu (1986) Tripathy (1989), Mohapatra and Mohanty (1992).

Algal growth is dependent on sunlight and nutrient concentrations. An abundance of algae is indicative of nutrient pollution De Lange (1994). Moreover algae are sensitive to some pollutants at levels which may not visibly affect other organisms in the short term or may affect other communities at higher concentration .Algae is used as indicator organisms because of the following advantages, it has short life cycles and rapid reproduction, directly affected by physical and chemical environmental factors, Sampling is easy and inexpensive and Standard methods exist.Plafkin *et al* (1989).

Being one of the pioneer workers in algal biomonitoring, Palmer (1969) listed 60 genera and 80 species of algae tolerant to organic pollution and accordingly, proposed a pollution index scale based on algal genus to be used in rating water sample of high to low organically polluted water bodies. The scored pollution index of 20 or more indicate high organic pollution, 19 to 15 indicate probable organic pollution and less than 15 indicate less organic pollution Palmer (1969).

Out of algae diatoms play important role in assessing the water quality as are sensitive to very subtle changes in environmental conditions. The importance of diatoms must not be overlooked. These tiny organisms have been around for billions of years and play major roles in chemical and biological processes. Diatoms are estimated to be responsible for 30% to40% of the entire organic carbon fixation, are major sources of atmospheric oxygen, and are a major food source for aquatic ecosystem. According to Tiffany (1968) marine diatoms have great

importance and have been called as "grass of the sea". This is because diatoms are major contributors to primary productivity in the oceans and create a beginning to the food chain. Another important use of diatoms in the biological realm is in water quality testing.Many researchers has done work in this field. Research by singh (1961), (1962) and (1963),Prasad and singh (1996), Dixit *et al*. (1999) Nautiyal *et al*. (2004), Rai, S K (2005)and (2006), Dubey and Boswal (2009), Agarwal and Rajwar (2010),Karthick *et al.* (2010) Singh *et al* (2010), Venkatachalapathy and Karthikeyan (2014), Venkatachalapathy *et al.* (2014a and 2014 b).

Studies indicate that physicochemical parameters of water bodies play important role in the distribution, density and abundance of diatom population. Kamat (1965) mentioned that the diatoms are usually abundant in the alkaline water. Wetzel (1975) reported that the value of pH ranges from 8 to 9 units in Indian waters. Alkaline nature of water was also reported in Greater Zab River, Iraq Ali (2010). Alkalinity is common in most of the fresh water ecosystems Ishaq and Khan (2013). High pH favored the high number of diatoms Patrick(1948). Patrick (1971) observed that acidic pH do not support the abundance of diatoms, while alkaline waters with pH above 8.0 showed higher density of diatoms. Singh and Swarup (1979) stated that, higher temperature promotes the growth of diatoms. The maximum temperature was observed during pre-monsoon season while the minimum was found during winter season. Kannan and Job (1980), Yadav *et al.* (2013), Niroula *et al*. (2010) also recorded similar observations in urban ponds of India. Calcium rich water bodies have high number of diatoms. Chloride is one of the important factors for controlling the growth of diatoms. Murugesan and Sivasubramanian (2008). Regular supply of nitrate encouraged the augmentation and periodicity of diatoms Munawar M (1970). Hegde and Bharati (1986), Vaishya and Adoni (1992). reported higher density of diatoms in phosphorous rich waters It appeared that the presence of pH, Phosphate, Nitrate, Silicate and Calcium favored the growth of diatoms. Similar finding is supported by many workers Thomas *et al* (2000) Bordoloi and Baruah (2014)**,**Ansari *et al* (2015).

In research papers diatom population is correlated with physicochemical parameters. Ramakrishnan (2003) reported negative correlation of phytoplankton population and nutrients like nitrate and phosphate.This is supported by results of Singh (1993), Mishra and Yadav (1978). In studies correlation coefficient between parameter and diatom population was showing significant positive correlation with the air temperature and water temperature Reddy and Venkateshwaralu (1992), Murulidhar and Murthy (2015).

Some researchers observed that pre-monsoon and monsoon rain play key role in seasonal dynamics of physicochemical properties of the water samples.

The rain water carries large amount of organic matter by which excessive phytoplankton growth occurs.Radhika *et al*(2004), Pathak and Limaye (2012) and Dhanalakshmi *et al.*(2013).

The maximum concentration of phosphate and nitrate was also observed during monsoon season. Runoff from the surrounding human settlement consisting domestic sewage rich in organic matters was the main cause of phosphate and nitrate enrichment of the ponds Khurshid *et al* (1997), Verma *et al*(2012). In a study pollution tolerant genera of diatoms were identified, *Nitzschia, Navicula, Synedra, Melosira* and *Gomphonema* were dominant throughout the year in all the four seasons which in conformity with the study of Goel *et al.* (1986) who reported similar finding in few polluted fresh water bodies of Maharastra,India. From the basic biological data various pollution indices like saprobic index, Nygaard's index, Nygaard (1949), Palmer's algal pollution species index, Palmer (1969), biological index and Shannon-Wearner index ,Shannon andWearver(1949) were calculated to qualify the water quality of the water bodies.

Review of literature

Pond ecology has been well studied long back by various workers in India with special reference to phytoplanktons including diatoms as biomoniters.Palmer in(1969 and1980) depicts about significance of algae and algae tolerating organic pollution In (1970) Munawar studied unicellular and colonial phytoplankton in polluted and unpolluted environment of fresh water ponds of Hyderabad. Mohanty(1983) suggested Algae as indicators of pollution. Trivedi and Goel(1986) suggested the Chemical and Biological Methods for water pollution studies. Venkataraman *et al* (1994) suggested Algae as tool for biomonitoring and abatemnent of pesticide pollution in aquatic system.

Many researchers studied about the phykoplankton diversity including diatoms of fresh water ponds. Vyas and Kumar (1968) worked on Indrasagar tank,Udaipur, Seenayya (1971)on fresh water ponds of Hydrabad, Hegade and Bharati in (1984) compares the diversity of ponds and lakes of Dharwar, Karnataka State. Goel *et al* (1992) studied phytoplankton of freshwater polluted pond in relation with the diurnal variation of physicochemical characteristics. Kanna (1992) worked on Blue green algal flora of Muthupet, Tamil Nadu. Kanshik *et al* (1993) observed the planktonic algae of sewage fed Vivek Nagar pond at Gowalior. Kumar and Singh (2000) carried out research on pond at Deogha. Ramakrishan *et al* (2000) studied three different fresh water bodies of Tamil Nadu. Prameela *et al* (2001) on temple tanks of four coastal districts of Kerala. Maya *et al* (2000 and2002) carried a preliminary study on the algal flora of temple tanks and harvesting water in temple tanks through people's participation of southern Kerala. Khanna and Bhutiani (2003) studied the Ecological status of Sitapur pond at Haridwar (Uttaranchal). Ravikumar *et al* (2006) worked on Phytoplankton periodicity in relation to abiotic. factors in Kulahalli tank near Harapanahalli, Karnataka. Tiwari and Shukla (2007) studied Algal biodiversity and trophic status of some temporary water bodies of Kanpur. Senthilkumar and Das (2008) studied freshwater reservoirs of Karnataka.

Bera *et al* (2014) studied Phytoplankton density in relation to physico-chemical parameters of Kangsabati Reservoir, West Bengal. Murulidhar and Murthy (2015) studied the Teetha Wetland in Tumakuru District, Karnataka.

Workers also observed seasonal changes in physicochemical parameters of various ponds Kannan and Job (1980)observed it on Sathio reservoir. Prasad *et al* (1985) worked on Periodicity and interrelationships of physicochemical factors of pond.Jain, Sharma and Thakur (1996) on Halali reservoir of Vidisha district. Islam (2007) observed Physico-chemical Condition and Occurrence of Some zooplankton in a Pond of Rajshahi University. Niroula *et al* (2010) on Betana Pond, Eastern Nepal. Hulyal and Kaliwal (2011) Almatti Reservoir of Bijapur district, Karnataka State. Pathak *et al* (2012) Sagar city under anthropogenic Influences. Dhanalakshmi *et al* (2013) on Eutrophic pond in Pollachi town, Tamilnadu.Yadav *et al* (2013) studied Physico-Chemical Characteristics of a Fresh Water Pond of Orai, Uattar Pradesh.

Work is also done in the field of water quality assessment by certain workers on ponds Ramakrishnan in 1990 and1991on two drinking water ponds and on primary production of two manmade reservoirs using algae as indicators. Mohapatra and Mohanty (1992) Used algal bioassay method .Garg, Saksena and Rao (2006and 2009) assessed the water quality of Harsi reservoir and also worked on conservation management of Ramasagar reservoir Gwalior Madhya Pradesh.

Many researchers focused on limnology of water bodies Goel *et al* (1986) studied limnology of few freshwater bodies in southwestern Maharasthra with special reference to their chemistry and pollution.Das (2000) studied Limnochemistry of Some Andhra Pradesh Reservoirs. Dubey *et al* (2012) studied Limnology on Khop Niwari Tank with special reference to phytoplanktons.

CONCLUSION

There are many ponds and reservoirs in India which are polluted due to pressure of population or human activities. There is an urgent need for the assessment of water quality and pollution level. Physical and chemical parameters of pond do not provide the complete information about the ecological status of the water body. It requires the integration and interaction of biotic community with abiotic environment. Thus the biotic community of a particular water body provides a tool for assessing its status.

Algae specially phytoplanktons including diatoms have long been used for the purpose. It is evident from the literature that algae have been used as biomoniters. With reference to several studies it may be concluded that the diversity of diatoms is dependent on different abiotic factors directly or indirectly. The basic information of its distribution and abundance would form a useful tool for further ecological assessment and monitoring of pond.

In India there is an immense constraint to extend measures for improving the water quality of ponds. For this purpose a database preparation of diatoms and regular monitoring of water body is required. It could also be suggested to develop particular diatom indices for the study of a particular water body. Some genera of Diatoms are pollution tolerant and could be used for natural cleaning of water along with aerobic bacterias.Diatoms are autotrophic and primary producer of food chain. It liberates lot of oxygen which increases the DO level of pond and promotes the activity of oxidation of organic waste in ponds by aerobic bacteria.

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