RESEARCH ARTICLE

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Hydrobiological Factors Related With Augmentation for Fish Production of Certain Selected Sites of Gandak River

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ABSTRACT

The hydrobiological parameters influencing indirectly to the trophic composition in any water reservoirs. A hydrobiological study conducted in three different selected site of Gandak River near shyampur ghat in Siwan district of Bihar showed that the concentrations of chemical parameters like dissolved oxygen, free carbon dioxide, pH, conductivity, alkalinity, nitrate, phosphate, calcium, magnesium, copper and zinc are within the permissible level in water quality standard for fishery. Hydrogen ion concentration and conductivity were measured by a pH and conductivity meter, respectively, while free carbon dioxide, dissolved oxygen and total alkalinity were estimated by standard methods. The micronutrients were also determined. However, iron content was higher in most of the ponds. A clear indirect relationship between iron concentration and euglenoids has been observed. Major phytoplankton taxa present in the River sites are Chlorophyceae, Cyanophyceae and Euglenophyceae. The study reveals that River sites can be a very good source of water for fishery and should be conserved at any cost.
Key words: *Hydrobiology, chemical factors, phytoplanktons, zooplanktons*

INTRODUCTION

The world's water resources are under pressure and must be managed for human survival. It is, therefore, necessary to have most relevant information for arriving at rational decisions that will result in the maximum benefit to most people. Accurate and reliable information on the water resource system can, therefore, be a vital aid to strategic management of the resources.

The small Rivers have been also used since time immemorial as a traditional source of water supply in India. However, the water of the ponds, lakes and River are polluted mainly due to discharged waste water from residential areas, sewage outlets, solid wastes, detergents, automobile oil wastes, fishing facilities and agricultural pesticides from farmlands (Usha, *et al.,* 2006; Hasan, *et al.,* 2007). In recent years, their importance has somewhat declined due to technological advancements leading to more centralized water supply systems. There is a relationship among ecologists and micro-planners about the importance of conservation to such River as sustainable source of water for rural communities (Park and Park, 2005). The present study is an attempt to assess the water quality of selected sites in Gandak River so that they may be sustainably exploited for multiple uses like rural water supply, fisheries and even recreation.

METHODS AND MATERIALS

The study was carried out in three different selected sites of Gandak River in Siwan district. Water samples were collected fortnightly from February to April, 2013 from the sub-surface layer of the sites in PVC and BOD bottles (for estimating dissolved oxygen). Hydrogen ion concentration and conductivity were measured by a pH and conductivity meter, respectively, while free carbon dioxide, dissolved oxygen and total alkalinity were estimated by standard methods (Ramesh and Anbu, 1996). Nitrate content was measured

by Ion Meter with Ion Selective electrode (Eutech, Germany) while phosphate content was estimated by Ammonium Molybdate-Stannous Chloride method.

Ca, Mg, Fe, Cu and Zn contents were estimated (Gupta, 1996) by Perkin-Elmer 2380 flame atomic absorption spectro-photometer. The readings were checked with those of standard solutions and procedural blanks, acid washed glassware, analytical grade reagents and double distilled de-ionized water were used to minimize contamination errors. The detection limits for Ca, Mg, Fe, Cu and Zn were 1.0, 0.1, 3.0, 1.0 and 0.8 gl^{-1} respectively. Quantitative sampling of plankton was done by filtering a known volume of water through plankton net. After fixation in 6 percent formalin and pre-concentration, cell counts were made in a sedgewick rafter. Statistical analysis was done by using window based statistical package.

RESULTS AND OBSERVATIONS

Table 1: Variation of chemical parameters in selected sites of Gandak River

Variables	Site 1	Site 2	Site 3
DO	6.37(1.01)	8.19(1.07)	5.91(2.38)
Free CO_2	12.47(3.36)	13.27(4.68)	23.47(16.66)
TA	20.00(3.60)	11.00 (3.6)	47.87(56.23)
pH	7.40 (0.34)	7.47(0.25)	7.5(0.21)
Cnd.	123.8 (8.26)	29.63(1.7)	114.3(36.96)
TDS	56.30 (3.79)	14.00(1.0)	52.67(16.56)
Nitrate	0.720 (0.38)	0.210(0.11)	0.38(0.32)
Phosphate	0.850 (0.01)	0.00	2.56(0.25)
Calcium	0.013 (0.01)	0.03(0.01)	0.14(0.001)
Magnesium	5.15 (0.05)	2.05(0.05)	3.37 (0.01)
Iron	1.13 (0.01)	0.71(0.045)	0.49 (0.01)
Copper	0.081 (0.01)	0.07(0.01)	0.09 (0.02)
Zinc	0.820 (0.03)	0.39	0.30 (0.01)

Table 2: Significant correlations among chemical variables

Variables	r	p	Variables	r	p
DO vs. CO_2	-0.365	<0.01	Ca vs. TA	0.321	< 0.02
DO vs. NO_3	0.561	<0.001	PO4 vs. TA	0.350	< 0.01
Cnd.vs. PO_4	0.510	<0.001	pH vs. NO_3	-0.336	< 0.02
Cnd. vs. Mg	0.289	<0.05	Fe vs. Cu	0.683	< 0.001
Ca vs. Mg	0.350	<0.01	Fe vs. Zn	0.445	< 0.001

Fig. 1: Dominant Phytoplankton groups in studied sites of Gandak River

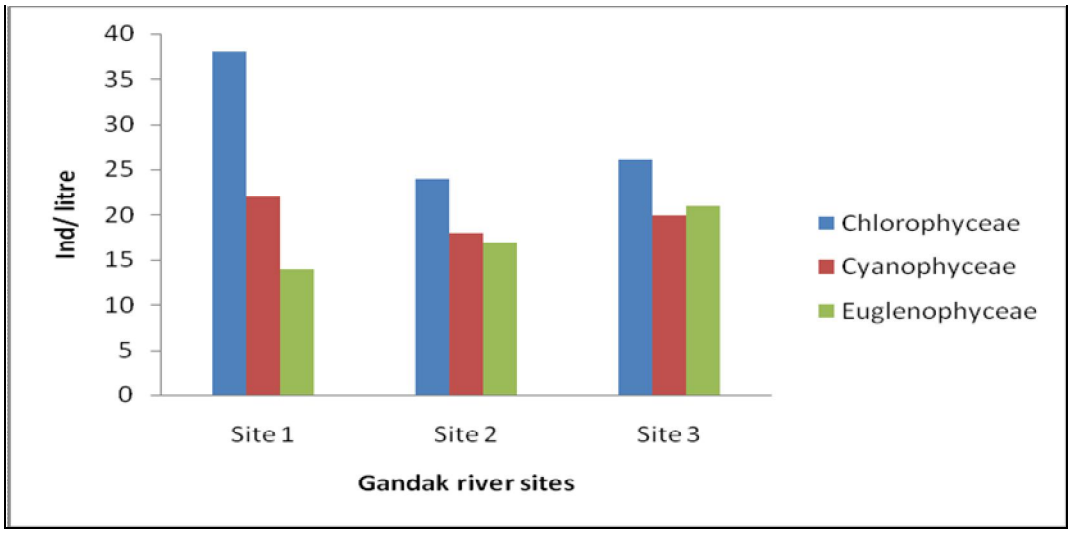

Table 1 depicts the chemical variables of the water of nine different ponds selected for the present study. Variations in percentage occurrence of major phytoplankton taxa in ponds 1 to 4 are shown in Fig. 1. Major taxa present are Chlorophyceae, Cyanophyceae, Baci llarophyceae and Euglenophyceae. Correlation coefficients computed among the chemical parameters of nine ponds showed a number of significant relationships (Table 2).

DISCUSSIONS

Quality of an aquatic ecosystem is dependent on the physicochemical qualities of water as also on the biological diversity of the system (Tiwari and Chauhan, 2006). Cairns and Dickson (1971) stated that analysis of biological materials along with chemical factors of water forms a valid method of water quality assessment.

The River sites are used only for washing and bathing with entry of sewage and domestic waste. Hence the two groups, *Cyanophyceae* and *Euglenophyceae* which are generally seen to appear near sewage outfall (Pandit, 2002) are also encountered during the study.

The solubility and availability of nutrients is affected by oxygen content of water and therefore the productivity of aquatic ecosystems (Wetzel, 1984). The highest dissolved oxygen value and nearly neutral pH in pond 8 can be attributed to the diversified nature of the plankton population of the River site where family, *Euglenophyceae* was the most dominant group followed by *Chlorophyceae*. As chlorophyll-b is possessed by these two groups only besides possessing chlorophyll-a, they must have transferred an additional amount of light energy to chlorophyll-a for primary photo chemical reactions (Wetzel, 1984).

In lake ecosystems beside the input of nitrate through runoff, decomposition of nitrogenous matter and its further oxidation plays a significant role. All River sites have been found to be favorable for fish productivity as nitrate value of these sites ranged between 0.1-2.56 mgl^{-1} (Verma, 2002). The low range of phosphate value in all the sites is due to the fact that at high temperature, phosphate is rapidly assimilated by plankton and microorganisms (Manna and Das, 2004).

In this study, we find that concentration of iron is beyond the permissible level of water quality standard in site 1 and 3 while other parameters are within the limits in all the River sites. In our study, it has been observed that it is totally absent in the ponds where iron level is quite high whereas in site 2 comparatively lower iron value is associated with moderate abundance of *Euglenophyceae*. This confirms that magnesium also has a great role in stimulating and maintaining Euglena blooms (Dutta Gupta, *et al.,* 2004). This is possible because calcium increases the availability of other ions and magnesium acts as a carrier of phosphorus (Wetzel, 1984). Lake Manasbal of Kashmir valley of India which is infested by *Euglena pedunculata* also has calcium rich water (Khan and Bhat, 2000). The concentration of copper in all the sites have been found to be very low compared to other elements and concentration of zinc also has not shown much fluctuation.

The classical inverse relationship between dissolved oxygen and carbon dioxide was found to be significant as dissolved oxygen is mainly regulated by photosynthetic activity of algal flora when free carbon dioxide is utilized (Wetzel, 1984). In contrast, positive relationship between dissolved oxygen and nitrate may be explained by the fact that nitrate concentrations in all the sites were not very high.

The moderate nitrate concentration is likely to have enhanced the growth of phytoplankton which in turn produced more dissolved oxygen. Significant positive correlations of conductivity with phosphate and magnesium indicate that they are the key factors governing the conductivity regimes of the ponds investigated.

Phosphate is essential for the growth of organisms and can limit primary productivity (Wetzel, 1984). Again magnesium is required by the chlorophyllous plants as it acts as a micronutrient in enzymatic trans-phosphorylation by algae. It was also shown that low available magnesium can influence the phytoplankton productivity in oligotrophic Alaskan lakes (Goldman, 1960). Calcium and magnesium are significantly correlated which can be attributed to the fact that both are integral part of plant tissue and

contribute to the hardness of water (Wetzel, 1984). Further they play an important role in neutralizing the excess acid produced in the system (Das, 2002). This also justifies the significant positive relationship of calcium with alkalinity. Inverse relationship of pH with nitrate as recorded in the present study agrees well with the study made in the Maheshkhali Channel, Bay of Bengal, Bangladesh (Ali, *et al.,* 1985). Iron showed significant positive correlation with copper and zinc. These are essential micronutrients for plants and many animals, required in trace amounts, and thus vital in the molecular architecture of various proteins, enzymes and vitamins.

CONCLUSIONS

The present findings indicate that water quality of all the River sites has good potential for fishery. Thus Gandak sites in Siwan district are useful for generating income from fishery which can be augmented with scientific management as small reservoirs are more manageable and high yielding than larger ones. Hence, it is necessary to protect and conserve these sites for fish productivity.

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