Research Paper Zoology

A Physico-Chemical Assessment of the Naljhara River, A Split Channel of River Manas, in Barpeta District of Assam, India

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ABSTRACT

The present study was planned to show the seasonal variations of physico-chemical parameters of Naljhara River, a split channel of river Manas, considering the importance of its coldwater fisheries and to ascertain the status of a freshwater river in an agricultural catchment. The study was carried out for a period of twelve months, from March, 2010 to February, 2011. Water samples were analyzed seasonally at four different sampling sites to monitor the characteristics of various important water parameters such as water temperature, depth, water velocity, turbidity, conductance, pH, total dissolved solids, dissolved oxygen, free CO^2, alkalinity, hardness and chloride. The physico-chemical parameters of the river water were found within the safe limits for different fisheries particularly in the monsoon season in comparison to the other seasons.

KEYWORDS Physico-chemical parameters; River Naljhara; Seasonal variations.

INTRODUCTION

With the growing realization of the importance of drinking water quality to public health and raw water quality to aquatic life, assessment of surface water quality has become very important. The recognized sources of contaminants responsible for surface water quality degradation are the surface runoff drained from urban, rural, and agricultural lands, groundwater seepage from malfunctioning septic tank systems, discharge from ditches and creeks, chemicals used for aquatic weed control and naturally occurring inorganic inputs; and atmospheric deposition. With the increased level of pollution, amount of usable water have decreased throughout the world. The primary sources of contaminants are from the leaching of fertilizers and pesticides used in agricultural fields, industrial waste, and municipal waste. The present scenario depicts adverse affect on majority of world's freshwater resources and only about one-third of these freshwater resources can be used for human needs (WHO, 2004). Impact of human activities at the agricultural landscape especially on aquatic ecosystems is currently a topic of increasing concern. Deterioration of surface water and especially river water quality has recently been observed in many countries. In India major rivers are polluted (Sharma, K. D. and Pathak, P. D., 1981) (Somasekhar, R. K., 1984) (Sengupta, B., Lasker, S.,Das, A.K., and Das, J., 1988) (Trivedy, R. K., 1990) (Kudesia, V.P., 1990). The North Eastern region of India is one the most important freshwater zone of India. The region is blessed with diversified freshwater resources with 1, 43,740 ha. wetland and lakes, 19,150 km. stretch of rivers, 23,792 ha. reservoirs, 40,809 ha. ponds and mini barrage, 2,780 ha.wet paddy fields, 56 notable rivers and tributaries and several rivulets/hill streams (Goswami M. M., 2010).The major rivers of this region are Brahmaputra and Barak along with their tributaries. The North Eastern region of India is rich in freshwater fish biodiversity. A total of 276 species belonging to 114 genera under 38 families and 10 orders have been reported from this region (Sen, N., 2000). The increase in the growth of human population coupled with over exploitation of natural resources and unsustainable developmental activities aroused general concern regarding the health of the river ecosystems within the agricultural catchments of North East India. The present study is an attempt to throw light on water characteristics of river Naljhara, within Barpeta district of Assam, India. It is a split channel of river Manas, an established coldwater fisheries resource of Assam. A better understanding of the hydrology and water quality of the Naljhara River will help to develop and manage the river in a sustainable manner.

MATERIALS AND METHODS

Study area: The River Naljhara is situated at a distance of 35 km in the northwestern side of the district head quarter, Barpeta town. The river lies within a watershed of total geographical area of 4773 hector and extends between $26^0 31' 28.97''$ North to $26^0 33' 9.57''$ North latitude and $90^0 53' 3.34''$ East to $90^0 54' 41.90''$ East longitude. The river is a part of northern tributary of river Brahmaputra and forms a major connecting network between the river Manas and the river Beki. The river Manas is situated in the foothills of outer Himalaya and near the Indian border within the Manas national park; it splits into three perennial rivers and many other smaller and shallower tributaries and then joins the Brahmaputra River further south. The river Beki, Hakua and Naljhara are the important rivers of this area. The Climate of the area is warm and humid with hot summer followed by monsoon of heavy rainfall and relatively cool and dry winter. Periodic dry spells occur during October to March. The area receives annual rainfall of 1800 to 2000 mm. with heaviest precipitation during May to July. The total number of rainy days per year varies from 118 days to 141 days. The minimum temperature is about 12^0 C. during December, January and maximum temperature is 33^0 to 38^0. Relative Humidity is minimum 72% and maximum 75%. The land used pattern comprises of Built-up area -250 hector, Kharif crop area -2215 hector, Rabi crop area -300 hector, Zaid crop area -150 hector, Double crop area- Nil, Agricultural Plantation area- 223 hector, Scrub area-202 hector and Marshy area- 60 hector (Source: Detailed Project Report, Naljhara IWMP, Department of Soil conservation, government of Assam).

Sampling for determination of Physico-chemical properties: The survey of the river was done from March, 2010 to February, 2011 in four sampling sites covering entire length of river Naljhara within Barpeta district of Assam. Four sampling sits were selected on random selection, covering the areas at upper (Serial number of sampling site-S4), middle (Serial number of sampling site-S3 and S2), and lower reaches (Serial number of sampling site-S1), of the river Naljhara starting from the boundary of the district Baksa and Barpeta to the confluence point with the Beki River. Sampling was undertaken in four different seasons in a year (Borthakur M, 1986).The

seasons are pre-monsoon (March-May), monsoon (June-September), retreating monsoon (October-November) and winter (December-February). Water samples were collected from the surface zone at random, covering different spots of the river at the respective sampling sites. Physico-chemical parameters ware analyzed following the standard methods (Welch, P. S., 1952; Wetzel, R. G. and Likens, G. E., 1991; Welcher, F. J., 1963) (APHA, 1998). Water temperature was measured with a mercury in-glass thermometer graduated 0^0 to 100^0c, turbidity was measured with a digital turbidity meter (Model-Decibel – DB-1126), pH was measured with a digital pH meter (Elico pH-Meter, Model LI 120; Electrode type-CL-51B) and conductivity was measured with a digital conductivity bridge (Simtronics, Model-SE 976) and a conductivity cell of cell constant 1.0.

RESULTS

Water temperature: In sampling site- S1, the minimum and the maximum mean value of water temperature ranged between 21.72^0C ± 0.09 in the winter season and 28.22^0C ± 0.09 in the pre-monsoon season. In sampling site- S2, the minimum and the maximum mean value of water temperature ranged between 20.02^0C±0.20 in the winter season and 28.3^0C± 0.14 in the pre-monsoon season. In sampling site- S3, the minimum and the maximum mean value of water temperature ranged between 19.6^0C±0.21 in the winter season and as 28.05^0C±0.12 in the pre-monsoon season. In sampling site- S4, the minimum and the maximum mean value of water temperature ranged between 18.82^0C±0.56 in the winter season and 28.07^0C±0.25 in the pre-monsoon season.

Depth: In sampling site- S1, the minimum and the maximum mean value of depth ranged between 0.95m ± 0.35 in the winter season and 2.92m ± 0.18 in the monsoon season. In sampling site- S2, the minimum and the maximum mean value of depth ranged between 0.85 m ± 0.23 in the winter season and 2.75 m ± 0.17 in the monsoon season. In sampling site- S3, the minimum and the maximum mean value of depth ranged between 0.82 m ± 0.26 in the winter season and 2.475 m ± 0.15 in the monsoon season. In sampling site- S4, the minimum and the maximum mean value of depth ranged between 0.9 m ± 0.29 in the winter season and 2.55 m ± 0.20 in the monsoon season.

Water velocity: In sampling site- S1, the minimum and the maximum mean value of water velocity ranged between 0.37msec^{-1} ± 0.01 in the retreating monsoon season and 1.32 msec^{-1} ± 0.26 in the monsoon season. In sampling site- S2, the minimum and the maximum mean value of water velocity ranged between 0.34 msec^{-1} ± 0.03 in the winter season and 1.3 msec^{-1} ± 0.25 in the monsoon season. In sampling site- S3, the minimum and the maximum mean value of water velocity ranged between 0.32msec^{-1} ± 0.02 in the winter season and 1.3 msec^{-1} ± 0.21 in the monsoon season. In sampling site- S4, the minimum and the maximum mean value of water velocity ranged between 0.29 msec^{-1} ± 0.01 in the winter season and 1.45 msec^{-1} ± 0.12 in the monsoon season.

Water turbidity: In sampling site- S1, the minimum and the maximum mean value of water turbidity ranged between 5.75 ntu ± 0.5 in the winter season and 62 ntu ± 0.81 in the monsoon season. In sampling site- S2, the minimum and the maximum mean value of water turbidity ranged between 5 ntu ± 0.81 in the winter season and 59.75 ntu ± 0.5 in the monsoon season. In sampling site- S3, the minimum and the maximum mean value of water turbidity ranged between 5 ntu ± 0.81 in the winter season and 66 ntu ± 0.81 in the monsoon season. In sampling site- S4, the minimum and the maximum mean value of water turbidity ranged between 5.5 ntu ± 0.57 in the winter season and 66.5 ntu ± 1.29 in the monsoon season.

Conductivity: In sampling site- S1, the minimum and the maximum mean value of water conductivity ranged between 0.21mScm^{-1} ± 0.01 in the monsoon season and 0.72 mScm^{-1} ± 0.001 in the winter season. In sampling site- S2, the minimum and the maximum mean value of water conductivity ranged between 0.2 mScm^{-1} ± 0.001 in the monsoon season and 0.81 mScm^{-1} ± 0.001 in the winter season. In sampling site- S3 the minimum and the maximum mean value of water conductivity ranged between 0.19 mScm^{-1} ± 0.002 in the monsoon season and 0.77 mScm^{-1} ± 0.007 in the winter season. In sampling site- S4, the minimum and the maximum mean value of water conductivity ranged between 0.22 mScm^{-1} ± 0.006 in the monsoon season and 0.75 mScm^{-1} ± 0.001 in the winter season.

pH: In sampling site- S1, the minimum and the maximum mean value of pH ranged between 6.8 ± 0.05 in the monsoon season and 7.5 ± 0.01 in the retreating monsoon season. In sampling site- S2, the minimum and the maximum mean value of pH ranged between 6.8 ± 0.01 in the monsoon season and 7.5 ± 0.01 in the winter season. In sampling site- S3 the minimum and the maximum mean value of pH ranged between 7 ± 0.01 in the monsoon season and 7.4 ± 0.009 , 7.4 ± 0.008 in the retreating monsoon and winter seasons respectively. In sampling site- S4, the minimum and the maximum mean value of pH ranged between 7.1 ± 0.01 in the monsoon season and 7.6 ± 0.01 in the retreating monsoon season.

Total dissolved solids (TDS): In sampling site- S1, the minimum and the maximum mean value of TDS ranged between 119 mgl^{-1} ± 1.82 in the monsoon season and 214.75 mgl^{-1} ± 0.95 in the winter season. In sampling site- S2, the minimum and the maximum mean value of TDS ranged between 112.75 mgl^{-1} ± 2.21 in the monsoon season and 216 mgl^{-1} ± 1.15 in the winter season. In sampling site- S3 the minimum and the maximum mean value of TDS ranged between 105.75 mgl^{-1} ± 2.62 in the monsoon season and 213.5 mgl^{-1} ± 1.29 in the winter season. In sampling site- S4, the minimum and the maximum mean value of TDS ranged between 96.25 mgl^{-1} ± 0.95 in the monsoon season and 213.25 mgl^{-1} ± 0.95 in the winter season.

Dissolved oxygen (DO): In sampling site- S1, the minimum and the maximum mean value of DO ranged between 6.45 mgl^{-1} ± 0.12 in the pre- monsoon season and 8.5 mgl^{-1} ± 0.25 in the winter season. In sampling site- S2, the minimum and the maximum mean value of DO ranged between 6.22 mgl^{-1} ± 0.29 in the pre- monsoon season and 8.5 mgl^{-1} ± 0.21 in the winter season. In sampling site- S3 the minimum and the maximum mean value of DO ranged between 6.32 mgl^{-1} ± 0.17 in the pre- monsoon season and 8.8 mgl^{-1} ± 0.18 in the winter season. In sampling site- S4, the minimum and the maximum mean value of DO ranged between 6.32 mgl^{-1} ± 0.17 in the pre- monsoon season and 8.27 mgl^{-1} ± 0.22 in the winter season.

Free Carbon dioxide (FCO_2): In sampling site- S1, the minimum and the maximum mean value of FCO_2 ranged between 3.07 mgl^{-1} ± 0.09 in the winter season and 7.3 mgl^{-1} ± 0.2 in the monsoon season. In sampling site- S2, the minimum and the maximum mean value of FCO_2 ranged between 3.05 mgl^{-1} ± 0.05 in the winter season and 7.17 mgl^{-1} ± 0.17 in the monsoon season. In sampling site- S3 the minimum and the maximum mean value of FCO_2 ranged between 2.85 mgl^{-1} ± 0.19 in the winter season and 7.46 mgl^{-1} ± 0.15 in the monsoon season. In sampling site- S4, the minimum and the maximum mean value of FCO_2 ranged between 3.1 mgl^{-1} ± 0.08 in the winter season and 7.12 mgl^{-1} ± 0.09 in the monsoon season.

Hardness: In sampling site- S1, the minimum and the maximum mean value of hardness ranged between 74.5 mgl^{-1} ± 1.29 in the monsoon season and 223.5 mgl^{-1} ± 1.91 in the winter season. In sampling site- S2, the minimum and the maximum mean value of hardness ranged between 69.5 mgl^{-1} ± 1.29 in the monsoon season and 219 mgl^{-1} ± 1.82 in the winter season. In sampling site- S3 the minimum and the maximum mean value of hardness ranged between 72.5 mgl^{-1} ± 1.29 in the monsoon season and 224 mgl^{-1} ± 0.81 in the winter season. In sampling site- S4, the minimum and the

maximum mean value of hardness ranged between 73.5 mgl^{-1} ± 2.08 in the monsoon season and 219.75 mgl^{-1} ± 0.05 in the winter season.

Alkalinity: In sampling site- S1, the minimum and the maximum mean value of alkalinity ranged between 48.75 mgl^{-1} ± 2.62 in the monsoon season and 69.25 mgl^{-1} ± 1.7 in the winter season. In sampling site- S2, the minimum and the maximum mean value of alkalinity ranged between 47.75 mgl^{-1} ± 0.95 in the monsoon season and 64.75 mgl^{-1} ± 2.62 in the winter season. In sampling site- S3 the minimum and the maximum mean value of alkalinity ranged between 45.5 mgl^{-1} ± 1.29 in the monsoon season and 71.25 mgl^{-1} ± 0.95 in the winter season. In sampling site- S4, the minimum and the maximum mean value of alkalinity ranged between 47 mgl^{-1} ± 1.63 in the monsoon season and 70.5mgl^{-1} ± 1.29 in the winter season.

Chloride: In sampling site- S1, the minimum and the maximum mean value of chloride ranged between as 9.19 mgl^{-1} ± 0.17 in the monsoon season and 22.05 mgl^{-1} ± 0.09 in the winter season. In sampling site- S2, the minimum and the maximum mean value of chloride ranged between 9.75 mgl^{-1} ± 0.12 in the monsoon season and 20.01 mgl^{-1} ± 0.08 in the winter season. In sampling site- S3 the minimum and the maximum mean value of chloride ranged between 10.02 mgl^{-1} ± 0.26 in the monsoon season and 21.07 mgl^{-1} ± 0.13 in the winter season. In sampling site- S4, the minimum and the maximum mean value of chloride ranged between 8.05 mgl^{-1} ± 0.20 in the retreating monsoon season and 19.98 mgl^{-1} ± 0.15 in the winter season.

DISCUSSION AND CONCLUSION

The present investigation on physico-chemical parameters of Naljhara River demonstrates the existence of favorable environmental conditions for the healthy growth of different fisheries, particularly in the breeding seasons. The river Naljhara was studied considering the importance of river Manas which is an established coldwater fisheries resource of Assam and as reported the important fish species of the river Manas at the Mathanguri site of Assam are *Tor putitora, Schizothorax richardsonii, Schizothoraichthys progastus, N. hexagonolepis, C. latius latius, Garra sp., Barilius spp. and Lepidocephalus sp.* (Bhattacharjya B. K., 2005).The observed water temperature of the Naljhara river was found between the range of 18.82^{0}C to 28.22^{0}C, which is within the desirable range for the growth of coldwater fishery. The water temperature range between 20.0-25.0^{0}C and marginally higher during the rearing phase is desirable for breeding and rearing of *Tor putitora* (Sarma Debajit,Sanwal Suman,Haldar R.S., Das Partha, Mahanta P.C., 2010). The present investigation shows that the environmental conditions of the Naljhara River are favorable for breeding of different coldwater fisheries. The minimum observed value of DO was 6.22 mgl,$^{-1}$ the pH value ranged between 6.8-7.6, the total alkalinity value ranged between 45.5 mgl^{-1}to71.25 mgl^{-1} and hardness value ranged between 69.5 mgl^{-1} to 224 mgl^{-1}. Most of the values of water parameters were well within the safe water quality standards (Boyd, C.E. and Tucker, C.S. , 1998)**.** However the presence of low value of water depth and water velocity except the monsoon season indicates existence of low fish diversity during the other seasons. A survey on potentialities of various fisheries of Naljhara River is vital to formulate best management practices for conservation of its aquatic resources.

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