Indian Journal of Environmental Sciences 22(1) 2018, pp.16-20. ISSN 0971-8958
Green Earth Foundation

ASSESSMENT OF PHYSICO-CHEMICAL PARAMETERS OF DIHING RIVER-TRIBUTARY OF ALMIGHTY BRAHMAPUTRA, ASSAM, NE INDIA

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Abstract

Water quality of Dihing river, a tributary of the Brahmaputra, was assessed for fish production. In spite of various human activities such as disposal of sewage and input of fertilizers from paddy fields, less eutrophication was noticed in the Dihing river. Water qualities parameters were found almost within the desirable limits of standard indexes of BIS (1983). Fish culture was also observed during the study period by different fisherman folks and self-help groups.

Key words: Dihing river, abiotic parameter, fish culture

INTRODUCTION

A suitable environment is necessary for any organism since life depends upon the continuous exchange of necessary components with the surrounding environment (Chetia 2014). A wide array of physical and chemical factors affect lentic and lotic freshwater (Sharma and Biswas 2014), which alter number and diversity of their fauna. Physico-chemical factors of the aquatic habitat not only affect health of fishes but also their maturity and breeding cycle.

This study was aimed to assess physico-chemical parameters of Dihing river for fish culture and domestic use purpose. The main aim of the present work is to develop a structure for the better growth and management of fish production.

MATERIALS AND METHODS

Study area: Dihing river is the largest south-bank tributary of the Brahmaputra. It originates from the Patkai hills in Nagaland (close to Indo- -Myanmar border) and flows through Tinsukia and Dibrugarh district of Assam to its confluence with the Brahmaputra at Dihingmukh. The catchment area of the river is about 6000 km^2 and runs through the plains of Assam valley for about 300 km before joining the Brahmaputra river (Sarma et al. 1986).

Water Sampling: Regular sampling of water was done from three sites of the river. In all the stations, human activities especially, fishing was observed. A total of 11 abiotic parameters like total alkalinity (TA), dissolved oxygen (DO), free carbon-dioxide (FCO_2), total suspended solid (TSS), total dissolved solids, air and water temperature, water current, pH and transparency were measured following standard protocols of APHA (1998), Trivedy et al. (1987) and digital gadgets. All the analysis was done in the laboratory of Fish & Fisheries in Dibrugarh University, Assam, India.

Statistical analysis: Statistical analysis of data was done using SPSS (2008) and MS excel (2010) and significance of correlation was recorded at 0.01 & 0.05 level.

RESULTS

The water temperature of river fluctuated seasonally. Since no significance difference was found between stations and so, all the data were combined and considered the average value (Fig. 1). The mean atmospheric temperature (AT) was found maximum (28.7±0.98^{o}C) in August and minimum (12.5±1.41^{o}C) in January. Incidentally maximum (27±1.41^{o}C) and minimum (14.9±2.54^{o}C) water temperatures (WT) were also recorded in August and January respectively.

In the present study water current flow was found between 0.43 and 1.51 m/sec with a mean maximum value (1.47± 0.03 m/sec) in July and minimum (0.55± 0.12 m/sec) in January (Fig 2). The current flow rate increased from pre monsoon (March – May) to monsoon (June- August) and reached its minimum in winter (Dec. - Feb.) months. The transparency was found minimum (11.5 ± 3.04 cm) in August and maximum in February (70.3 ± 3.74 cm) (Fig. 3).

As far as pH of river water is concerned, monthly minimum (7.23±0.19) and maximum (7.85± 0.21) values of pH were recorded in December and March respectively. Minimum dissolved oxygen (DO) was recorded (8.2 ±0.72 mg/L) in January (Fig. 4). Thereafter, its value increased steadily and was maximum in August (11.1 ± 0.96 mg/L). Free CO_2 value was having an increasing trend from winter and reached its peak in pre-monsoon (March-May). Its maximum value (5.07 ± 0.3) was recorded in June and minimum (1.67±0.13 mg/L) in October (Fig.5). The monthly mean value of total alkalinity of the river varied from 28.3 ± 7.15 mg/L (January) to 75 ± 5.29 mg/L (August) (Fig. 6).

The monthly (mean) variations in TDS and TSS followed similar trend (Fig. 7, 8). TDS increased from January towards monsoon and was maximum in July and later again dropped down.

Multiple correlations between abiotic factors are presented in Table 1. Air and water temperatures were found to be positively correlated with all the parameters except transparency and pH; both the variables showed inverse relationship with temperature. DO was negatively correlated with transparency (r = -0.892) and pH (r = -0.186); but positively correlated with other parameters. Similarly, FCO_2 was positively correlated with all the studied parameters except transparency (r = -0.241). Water velocity was positively correlated with most of the abiotic parameters except transparency (r = -0.871) and pH (r = -0.83). Again, pH was positively correlated with transparency, free CO_2 and TSS but negatively correlated with alkalinity, TDS, DO, water current and temperature. Total alkalinity was found positively correlated with DO (r = 0.906), free CO_2 (r = 0.319), TDS (r = 0.942), TSS (r = 0.849), water current (r = 0.873) and both atmospheric temperature (r = 0.983) and water temperature (r = 0.9381) while negatively correlated with pH (r = -0.055) and transparency (r = -0.944) (Table 1). Further TDS and TSS showed positive correlation with air and water temperature and negatively correlated with transparency. Due to presence of minimal quantities of suspended matter, transparency was maximum in February (70.3 ± 3.74 cm) and minimum (11.5 ± 3.04 cm) in August (Fig.3). The transparency was found to be negatively correlated with all studied parameters except pH (r = -0.1742).

Table 1. Multiple correlations of abiotic parameters

	WT	AT	Trans	WC	DO	Free CO_2	pH	Alk	TDS	TSS
WT	1									
AT	0.971**	1								
Trans	-0.897**	-0.949**	1							
WC	0.842**	0.874**	-0.871**	1						
DO	0.795**	0.874**	-0.892**	0.893**	1					
FCO_2	0.331	0.283	-0.241	0.558	0.318	1				
pH	-0.223	-0.137	0.174	-0.083	-0.186	0.436	1			
Alk	0.938**	0.983**	-0.944**	0.873**	0.906**	0.319	-0.056	1		
TDS	0.945**	0.966**	-0.967**	0.905**	0.882**	0.259**	-0.263	0.942**	1	
TSS	0.743**	0.797**	-0.819**	0.911**	0.868**	0.621*	0.138	0.849**	0.786**	1

** Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

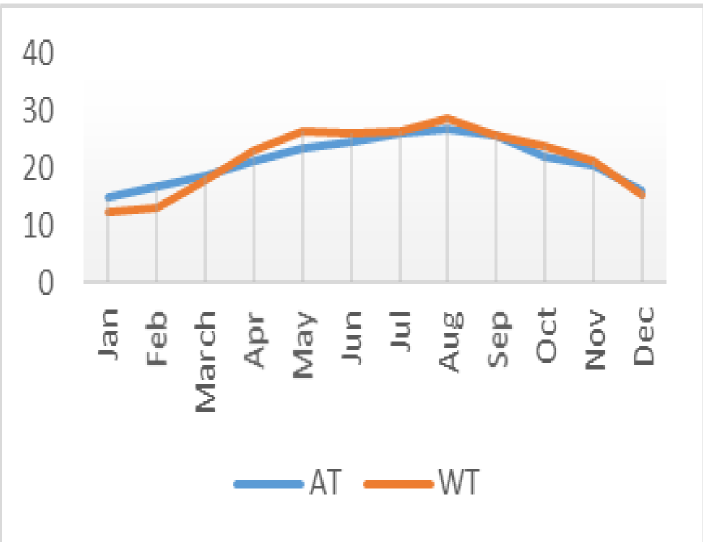

Fig. 1. Mean variation of air & water temperature

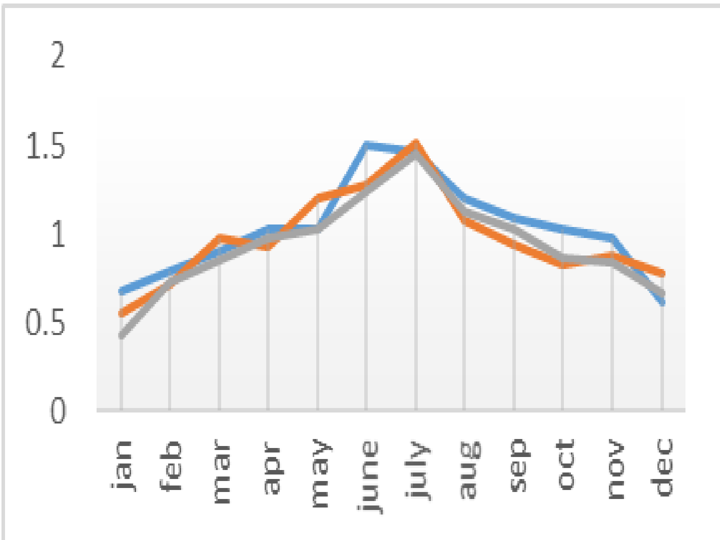

Fig. 2. Mean variation of water current

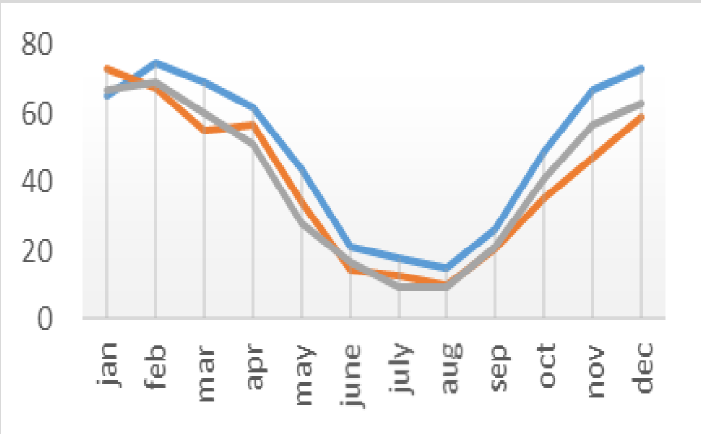

Fig.3. Mean variation of transparency

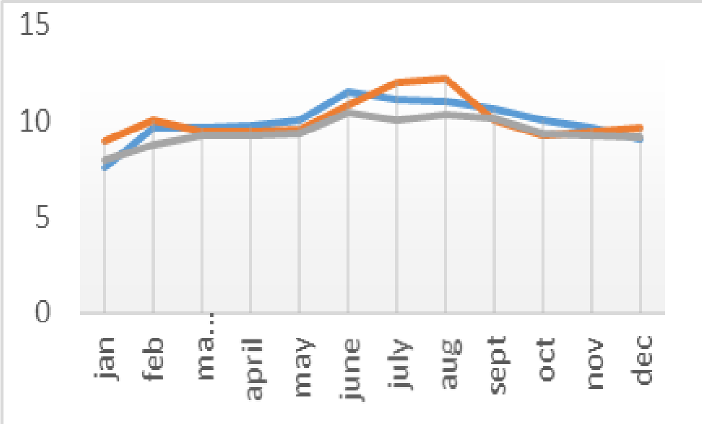

Fig. 4. Mean variation of DO

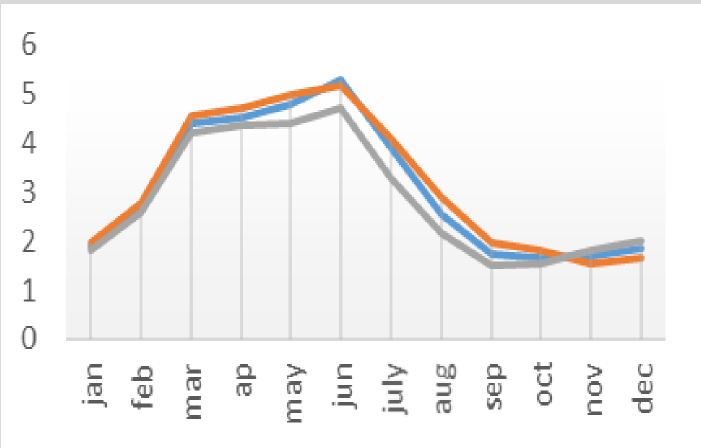

Fig. 5. Mean variation of Free CO_2

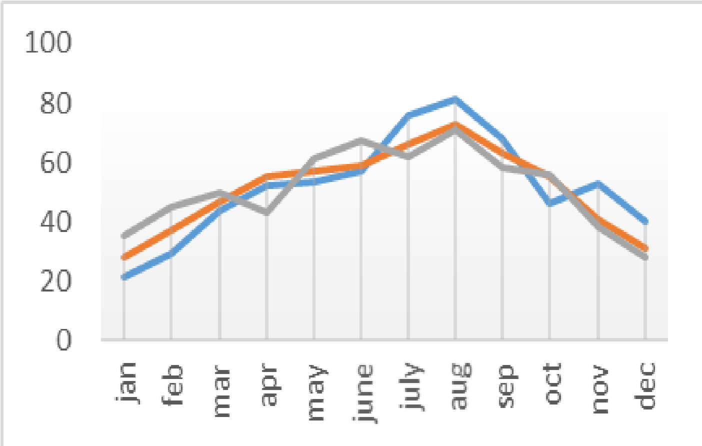

Fig. 6. Mean variation of alkalinity

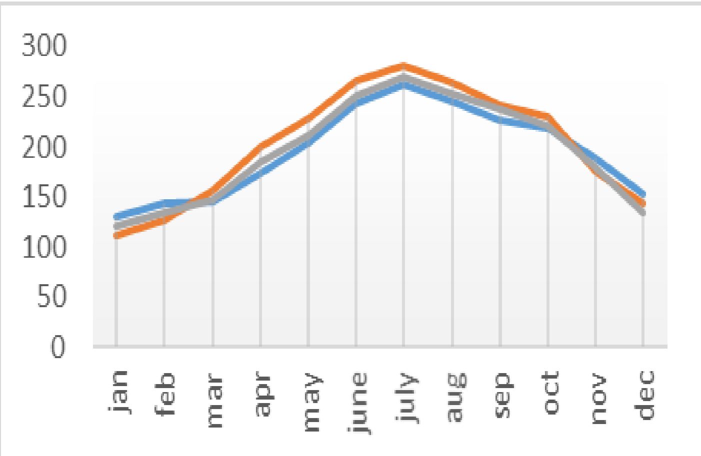

Fig. 7. Mean variation of TDS

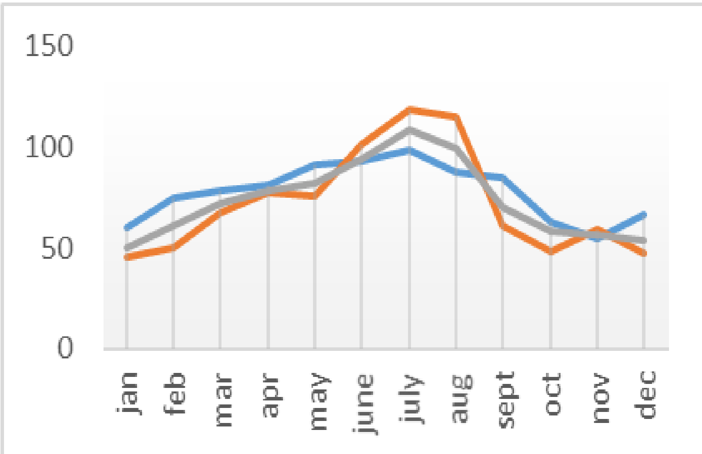

Fig. 8. Mean variation of TSS

DISCUSSION

Aquatic ecosystem is not only source of water and resources such as fish and crop for household and agro- industrial uses, but also a vital part of natural environment for our own survival (Singh et al. 2010). Abiotic parameters influence structuring assemblages of fish (Mathew et al. 1994) and therefore, limnological knowledge and its proper applications is an important tool for better fish yield and management of the aquatic ecosystems.

In the present study January was found to be the coldest month. Similar trends of air temperature were also recorded by Bordoloi et al. (2012), Dutta et al. (2014) and Laishram and Dey (2014) in their studies. Higher air temperature in monsoon may be due to high solar radiation whereas low temperature in winter may be due to shorter day length in the Indian sub-continent. Air and water temperature showed a very characteristic annual cycle, with higher during summer and lower during winter (Fig. 1). Similar fluctuation pattern of water temperature was reported by several workers in recent years elsewhere in N.E. India (Abujam et al. 2009, Singh et al. 2010, Dutta et al. 2014). Changes in the air temperature naturally affect the water temperature (Kumar 1997, Singh and Mathur 2005). Photoperiod is directly related to temperature (Odum 1971). The summer temperature was always found above the winter temperature due to abundant sunlight (Sinha and Biswas 2011).

Alkalinity of water is the capacity to neutralize the acid and maintained homeostasis in animals. It is usually taken as an index of productive potential of the water (Datar and Vashistha 1992). Seasonally it was found maximum in monsoon and minimum in winter during study period. Hujare (2008) also reported similar results and attributed maximum value in monsoon to high photosynthetic rate. Larger quantities of bicarbonates during summer may be due to the liberation of free carbon-di-oxide in the process of decomposition of bottom sediments and domestic waste (Yerel 2009) which probably resulted in conversion of insoluble carbonates to soluble bicarbonates (Sahni 2012). Total alkalinity ranging between 20 and 100 mg/L is optimal for primary and secondary production in aquatic ecosystems (Stickney 1979). Thus the river might be a good habitat for ichthyofaunas.

Dissolved oxygen is an important parameter which has a direct impact on the survival and distribution of flora and fauna in an ecosystem. In the present study, DO was found to be lowest in January but increased steadily and reached its maximum in August (Fig. 4). Das et al. (2014) reported that long day period accelerate photosynthesis that increase DO in summer. Moreover, bright sunlight in summer influences the percentage of soluble gases in water. Dissolved oxygen (DO) concentration is directly related to flow velocity (Marques et al. 2003). During non-rainy months, especially in winter, flow rate became feeble and consequently DO level dropped down. The high values in the rainy season might be due to aeration with continuous disturbance of the water from wind storms usually occurring in rainy months. In the present study too, DO values altered by changing pattern of the current velocity in the river.

High values of TDS and TSS during monsoon were due to increase in sediment load from catchment such as agricultural fields and mixing of effluents released from nearby collieries with the river water. With rising temperature, organic matter mineralized faster and increase TDS and TSS. The acceptable limit of TDS in drinking water is 500 mg/L (EPA 1976, WHO 1997). The range of TDS (112 to 281 mg/L) fell within the permissible limit. Thus, water is potable and may be utilized for human and animal consumption.

Transparency was found low during rainy seasons. This may be due to number of reasons like excess sediments carried by runoff from the catchment areas, high water current eroded the bank of the river, suspended matter and dissolved particles. Moreover Dihing river has many sub tributaries. The higher transparency during winter (dry season) might be due to settling of particles at the bottom.

pH of an aquatic ecosystem is important because it is closely linked to biological productivity (Baruah et al. 2011). pH range of water determines fish survivability and its use as drinking water. pH remained alkaline throughout the study period and its range (7.04 to 8.14) fell within the desirable limits of drinking water and fish culture as it did not exceed 6.5-8.5 (BIS 1983). pH variations were due to the seasonal fluctuations of free CO_2 and carbonate which were higher in the pre-monsoon and monsoon but lower in the post-monsoon (Fig. 5).

The free CO_2 content found between 1.52 and 5.79 mg/L were well below the permissible limit and is an indicator of good water quality. It increased along with ambient temperature from winter to monsoon (Fig.5). The higher values of free CO_2 in pre-monsoon and monsoon might have been due to deoxygenation (Talling 1957) as well as higher rate of decomposition of organic matters by the microbes (Sinha 1986). Natural acidity in rainwater is caused by the dissolution of atmospheric CO_2 (Carr and Neary 2008). The high CO_2 value is due to the entry of organic and inorganic nutrients from the surrounding areas.

The velocity of river was found to be directly proportional to the 'flood pulse' and also with gradient of the river stretch. The seasonal flooding in the tropical river was due to extreme rainfall during monsoon (Baruah et al. 2012). It determines both food supply rates and energetic costs for ûshes, affecting their behavior, position choice, and intra- and interspeciûc interactions (Hughes and Dill 1990, Beecher et al. 1993).

The range of abiotic parameters of Dihing river water was compared with the standard indexes and found within the desirable limit recognized by BIS (1983), WHO (1997), APHA (1998) for drinking water purpose and fish production. Despite of human activity, less eutrophication was observed in the river. However, excessive fishing in the river may threat ichthyofauna and therefore, it has to be stopped.

REFERENCES

Abujam, S., S. Dakua and S.P. Biswas. 2009. Physico-chemical parameters and fish enumeration of Maijan beel (wetland) of upper Assam. Geobios 36: 184-188.

A.P.H.A. 1998. Standard methods for estimation of water and waste and water, 20th edition, American Public Health Association, Washington D.C., USA: 1193.

Baruah, D., R. Dutta, L.R. Hazarika and S.K. Sarmah. 2011. A critical analysis of the environment impact assessment report of the 2000 MW Lower Subansiri Hydroelectric project with special reference to the down-stream ecology and people's livelihood. Journal of Environmental Science and Engineering Technology 53(4): 499-506.

Baruah, D., L.P. Hazarika, B. Bakalial, R. Dutta and S.P. Biswas. 2012. A grave danger for the Ganges dolphin (*Platanista gangetica* Roxburgh) in the Subansiri River due to a large hydroelectric project. The Environmentalist 32: 85-90.

Beecher, H. A., T.H. Johnson and J.P. Carleton. 1993. Predicting micro distributions of steelhead (*Oncorhynchus mykiss*) from depth and velocity preference criteria: test of an assumption of the in stream flow incremental methodology. Canadian Journal of Fisheries and Aquatic Science 50: 2380-2387.

BIS. 1983. Tolerance limits for inland surface waters subject to pollution, 2296.

Bordoloi, R., S. Abujam and G. Paswan. 2012. Limnological study of a closed wetland-Patisola from Jorhat district, Assam. Journal of Bio Innovation 1(5):132-141.

Carr, G.M. and J.P. Neary. 2008. Water Quality for Ecosystem and Human Health. 2nd Eds. United Nations Environment Programme Global Environment Monitoring System (GEMS)/ Water Programme, Canada, 120.

Chetia, P. 2014. Hydrobiological studies on Burhi Dihing River in Margherita subdivision. Journal of International Academic Research for Multidisciplinary 2(3): 624-637.

Das, B. K., P. Boruah and D. Kar. 2014. Study of seasonal variation of water quality of River Siang in Arunachal Pradesh, India. Journal of Environmental Science, Toxicology and Food Technology 8(2): 11-20.

Datar, M.O. and R.P. Vasishtha. 1992. Physico-chemical aspects of pollution in river Betwa. Indian Journal of Environmental Protection 12(8): 577-580.

Environmental Protection Agency. 1976. Quality criteria for water by United States. E.P.A office of water planning and standards, Washington, 20460.

Ganapati, S.V. 1956. Hydrobiological investigations of the Hope reservoirs and of Thambaraparni River at Papanasam Tirunaveli Dt. Madras state, India. Geography Journal 31: 1-2.

Hughes, N. F. and L.M. Dill. 1990. Position choice by drift-feeding salmonids: model and test for Arctic grayling (*Thymallus arcticus*) in subarctic mountain streams, interior Alaska. Canadian Journal of Fisheries and Aquatic Science 47: 2039-2048.

Hujare, M. S. 2008. Seasonal variation of physico-chemical parameters in the perennial tank of Talsande, Maharashtra. Journal of Ecotoxicology and Environmental Monitoring 18(3): 233-242.

Kumar, N. 1997. A view on freshwater environment. Ecology, Environment and Conservation 3: 3-4.

Laishram, J. and M. Dey. 2014. Water quality status of Loktak lake, Manipur, Northeast India and need for conservation measure: A study on five selected village. International Journal of Scientific and Research Publications 4 (6): 1-6.

Marques, P. H. C., H. T. D. Oliveira and E. D. C. Machado. 2003. Limnological study of Piraquara river (Upper Iguacu Basin): Spatiotemporal variation of physical and chemical variables and watershed zoning. Brazilian Archives of Biology and Technology 46(3): 383-394.

Matthews, W.J., B.C. Harvey and M.E. Power. 1994. Spatial and temporal patterns in the ûsh assemblages of individual pools in a mid-western stream (USA). Environmental Biology of Fishes 39: 381–397.

Munawar, M. 1970. Limnological studies on fresh water ponds of Hyderabad, (India) The Biocoenose: The distribution of unicellular and colonial phytoplankton in the polluted and the unpolluted environments. Hydrobiologia 36: 105-128.

Sahni, K. and S. Yadav. 2012. Seasonal variation in physico-chemical parameters of Bharawas Pond, Haryana. Asian Journal of Experimental Science 26(1): 61-64.

Sarma, J. N. 1986. Sediment transport in Burhi Dihing river, India. In: R. F. Hadley (Ed.) ,Drainage Basin Sediment Delivery. Proceeding of Albuquerque Symposium: 159.

Sarmah, A. and S. P. Biswas. 2014. Fish diversity and anthropogenic stress on Gela beel in Golaghat district, Assam. International Research Journal of Humanities, Engineering and Pharmaceutical Sciences 2(8): 6-9.

Singh, K. K., B. M. Sharma and K. Usha 2010. Ecology of Kharungpat lake, Thoubal, Manipur, India: Part-I Water quality status. The Ecoscan 4 (2 & 3): 241-245.

Singh, R.P. and P. Mathur. 2005. Investigation of variations in physicochemical characteristics of a fresh water reservoir of Ajmer city, Rajasthan. Indian Journal of Environmental Science 9: 57-61.

Sinha, M.P. 1986. Limnobiotic study on trophic status of a polluted freshwater reservoir of coal field area. Pollution Research 5(1): 13-17.

Sinha, S.N. and M. Biswas. 2011. Analysis of Physico-Chemical Characteristics to Study the Water Quality of a Lake in Kalyani, West Bengal. Asian Journal of Experimental Biological Sciences 2(1):18-22.

Stickney, R. R. 1979. Principles of warm water aquaculture. Interscience Publication, John Wiley and Sons, New York, USA: 375.

Talling, J.F. 1957. The longitudinal succession of the water characteristics in white Nile. Hydrobiologia 90: 73-89.

Trivedy, R.K., P.K. Goel and C. L. Trisal. 1987. Practical Methods in Ecology and Environmental Science. Environmental Media Publications, Karad, India: 340.

Yerel, S. 2009. Investigation of water quality characteristics by using factor and multidimensional scaling analysis in Porsuk River (Turkey). Asian Journal of Chemistry 21(9): 7234-7240.

World Health Organization (WHO). 1997. Guidelines for drinking water quality 2nd edition. World Health Organization. Geneva: 249.