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Research Paper

Study on Abiotic Features of a Freshwater Wetland of Nadia District, West Bengal, India

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A B S T R A C T

The study was conducted in a freshwater closed wetland, known as beel in Nadia district of West Bengal. The investigation covers the hydro-chemical aspects of the beel (Khalsi beel), focusing on the scope of pisciculture therein with healthy ecological condition. During the study period values of different pysico-chemical parameters of this water sheet have been recorded round the year, recording the annual value of water temperature: 29.25° ± 2.6° C depth: 93.77 ± 45.7 cm, transparency: 61.05 ± 30.9 cm, as the physical parameters. Recorded values for the chemical aspect are pH: 7.8 ± 0.39, DO: 5.0 ± 0.92 ppm, free CO_2: 8.0 ± 4.9 ppm, total alkalinity: 216.4 ± 80.22 ppm, NO_3-N: 0.18 ± 0.12 ppm, PO_4-P: 0.21 ± 0.04 ppm and silicate: 8.74 ± 4.7 ppm. Month wise study shows a variation in most of the parameters probably due to typical character of the beel, especially for the presence of different aquatic weeds, largely infested round the year and water abstraction. Monthly variation of values of different parameters has been discussed and presented graphically in the present communication along with physiography of the studied beel.

***Key words*:** Beel, Hydro-chemical, Pisciculture, Abstraction, Physiography

Wetlands are unique ecosystem as it supports different food chain, food webs, regulate hydrological cycle, recharge groundwater, trapping of energy and shelter to large numbers of flora and fauna. Ecologically wetlands are of great significant for an area supporting the livelihood too [1]. Wetland resource has an estimated expansion of 5.6-8.6 million Km^2 accounting 4-6% of the total global water [2]. Estimation reveals that the flood plain wetlands in West Bengal cover a total area of 42,500 hectare (ha). Though these water resources have enormous potential for fish production but due to lack of proper and meaningful management these biotopes are under develop, causing negligible fish production [3]. A hydro-chemical and biological study of water is the prime factor to focus on the water quality. Flood plains based on the water flow can be broadly divided into two groups viz. lotic (flowing water) and lentic (stagnant water). The aim of the present study includes some limnochemical characters of the beel with the objective to offer reliable indication of water quality to enumerate the possibility of fish culture with sustainable healthy water quality in such wetland.

MATERIALS AND METHODS

The beel is located at geographical location of Latitude 22.58°N and Longitude 88.26°E, nearer to Kalyani city of Nadia district in West Bengal and existed about 80.0 km away from east of Kolkata.

Sampling and analysis procedure

Water samples were collected monthly from different selected spots during morning hours between 6.00 -8.00 AM. Physical parameters like temperature, transparency and depth were recorded in-situ. Transparency was observed with the help of Secchi disc whereas chemical parameters viz. pH, DO, free CO_2, total alkalinity, NO_3-N, PO_4-P and silicate were studied employing usual analytic methods of [4]. Water samples were collected in separate polythene bottles and brought to laboratory for chemical analysis keeping in icebox.

Physiography and water abstraction

The beel shows a total area of 62 hectare (ha) and infested largely with various types of aquatic macrophytes covering rooted, floating, emergent and submerged weeds throughout the year. Of these, *Eichhornia sp*. is found to be the predominant ones. Water level of the beel recedes considerably during maximum period of the year estimating about 50-55%, except in monsoon leaving a limited effective water area in regard to fish culture therein. During summer it goes down further. Run off from the surrounding agricultural field is another menace besides diversion of water from this beel for irrigation and other purpose causing abstraction of water greatly which frequently exerts the negative impact on biological process.

RESULTS AND DISCUSSION

Physical parameters

Water temperature

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Temperature is an important factor which influences the rate of chemical reaction together with biological process of aqua-ecosystem as a whole. The present study depicts the annual average temperature of 26.3° ± 2.6°C with the minimum of 24.9°C in January and maximum as 32.6°C in July (Fig 1). A voluminous literature on the water temperature is available. The abiotic parameters of a tropical freshwater lake in Thiruvanthapuram district of Kerala, recorded lake temperature as 25.83°C [5]. Critical analysis on the present study shows the occurrence of increasing trend from February and declining trend from May, lowest being in January.

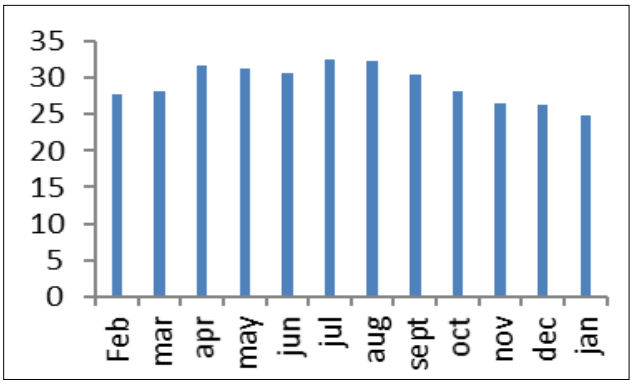


Fig 1 Monthly variation of water temperature

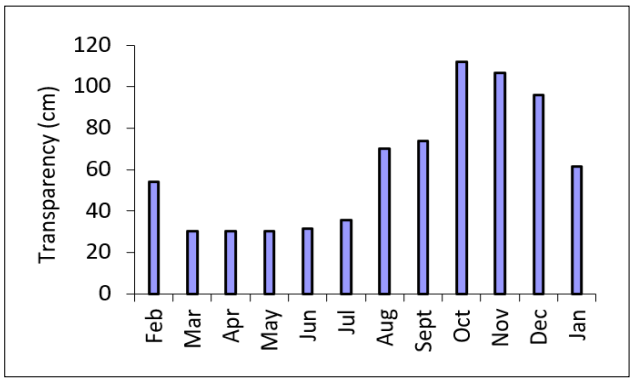


Fig 2 Monthly fluctuation of water transparency

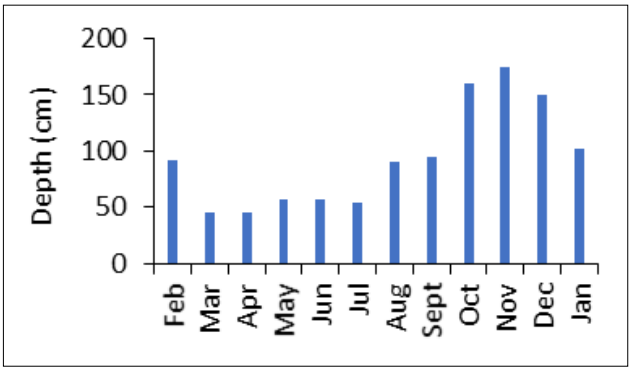


Fig 3 Month wise fluctuation of water depth

Transparency

Water transparency depends on many factors like presence of suspended solids, plankton population, water colour, wave action, water depth and many more. This aspect is also related with the occurrence of plankton indicating productivity of water. The present study recorded the maximum transparency in October (112.0 cm) while minimum during monsoon months (Fig 2), annual average being 61.05 ± 30.9 cm. The seasonal variation of water transparency is due to differential amount of suspended solids, algae and illumination [6], [7]. That suspension of bottom deposits into water by wind action, accumulation of turbid water the causes to lower down the transparency in lentic ecosystem which also support the present work [8], [9]. On the contrary, during winter the more water transparency of this beel was noticed as observed by the previous workers, assessing such phenomena is due to lack of run off and minimum disturbance of water body.

Depth

Water table of the beel varied widely, ranging from 44.95 cm (April) to 174.3 cm (November), yearly average being 93.8 ± 45.7 cm (Fig 3). The variation of water depth in beels of West Bengal shows the similar trend of value as documented by [10] through extensive survey.

Chemical parameters

pH

Water pH being a critical aspect in aquaculture field needs alkaline environments. The extensive study made by [11] on seven beels in West Bengal depicts the water pH ranges from 6.05-9.7 which supports the present observation, registering the annual average of 7.8 ± 0.39 with the range of 7.0-8.5 (Fig 4). Santosh and Singh (2007) reported. The suitable pH of 6.7 to 9.5 is the conducive for fish culture [12] whereas [13] opined that pH between 7.2 and 8.5 is the favourable range for the natural growth of plankton which is in accordance with the present observation.

Dissolved oxygen (DO)

It is needless to mention about the vital role of DO in all biosphere including aquatic biotopes. The present study has registered the annual average DO of 5.09 ± 0.92 ppm with the range of 3.2 (March) to 6.2 (January) ppm (Fig 5). Limnological study in Surha Lake (Bihar) by [14] documented the identical trend of fluctuation as recorded in the present work.

Free carbon-dioxide (CO_2)

It is an important item of far-reaching biological significance but from the fisheries point of view this parameter is an important component in water phase. The present study denotes the annual range of 4.0-22.0 ppm (Fig 6) with the average of 8.0 ± 4.9 ppm. An unprecedented increased value of 22.0 ppm was recorded in September of the study period immediately after heavy shower which remained for about 3.0 hrs and started to decline to 8.0 ppm after rain. Such phenomena were perhaps due to influx of run off from the surrounding catchment area and crop field. In general, the free CO_2 exhibited yearly range of 4.0-8.2 ppm in the beel, with the average of 6.7 mg/l±1.4 ppm. Assam beel infested with *Eichhornia* sp. indicated a positive impact of free CO_2. The free CO_2 in beels of West Bengal ranging between nil and 16.0 ppm [10]. In Harwa Jibbar Jheel in Katihar (Bihar) recorded higher CO_2 during monsoon months [15]. While studying the water quality in the lakes of Nagpur city [16] recorded the similar trend as registered in the present study.

Total alkalinity

Month wise study of total alkalinity shows the maximum value of 290 ppm in the month of June and minimum of 68 ppm in July (Fig 7), annual average being 216.4 ± 80.22 ppm. On Chennai wetland registered the maximum value in June and minimum in August which in accordance with the present study [17].

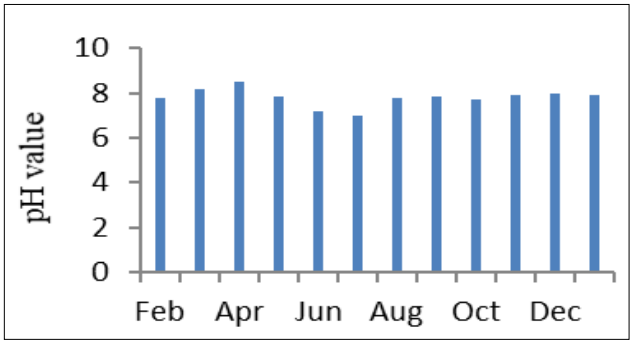


Fig 4 Month wise pH

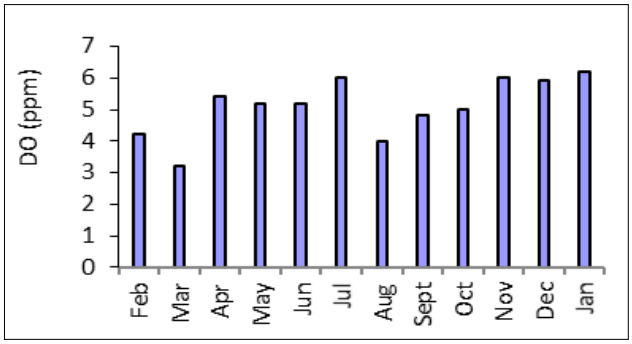
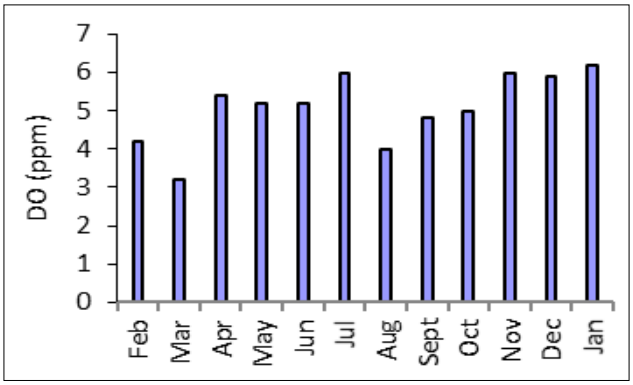


Fig 5 Monthly variation of D.O



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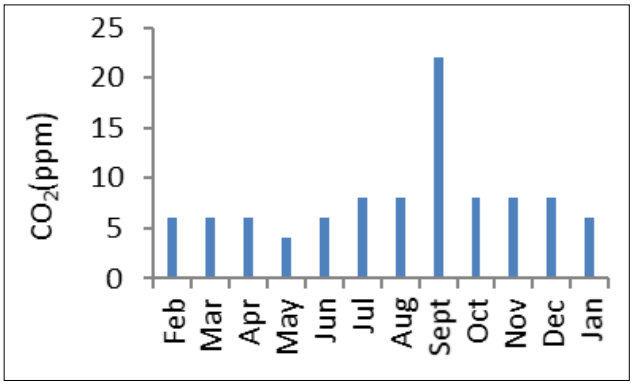

Fig 6 Monthly variation of carbon-di-oxide

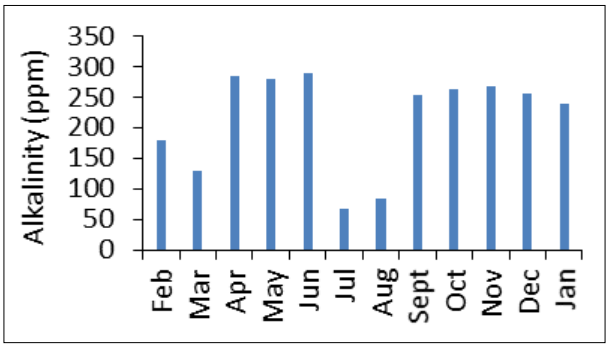

Fig 7 Month wise variation of alkalinity

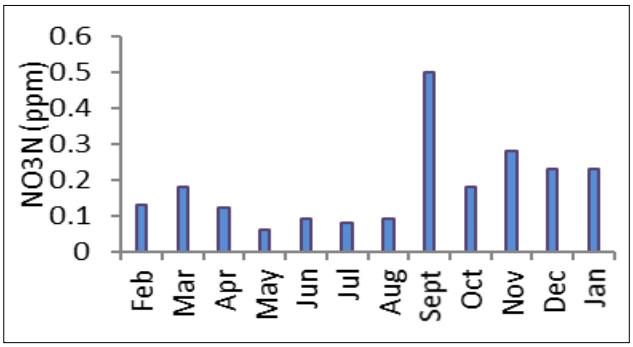

Fig 8 Monthly variation of NO_3-N

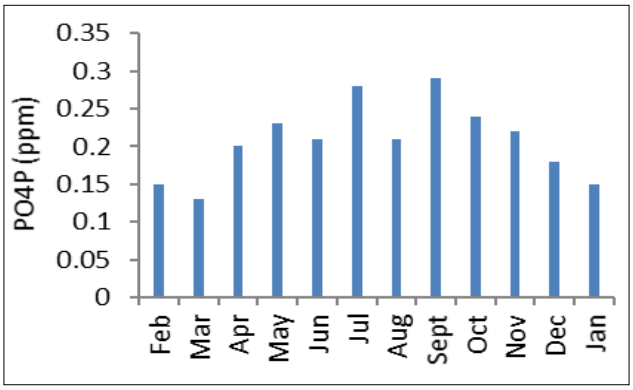

Fig 9 Monthly variation of PO_4-P

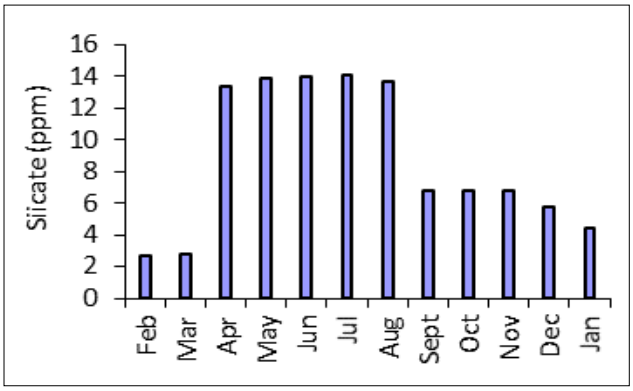

Fig 10 Monthly variation of silicate

Nitrate-nitrogen (NO_3-N)

Chemically stable form of nitrogen is nitrate which influences the growth of algal bloom. While studying in Rudrasagar wetland recorded minimum value during summer months which supports the present observation [18]. In this study the annual range of nitrate-nitrogen is noted as 0.06-0.5 ppm, maximizing in September (Fig 8), yearly average being 0.18 ± 0.12 ppm. Sudden increase of NO_3-N from two water bodies of Kalyani (WB) after heavy rain [19].

PO_4-P

Phosphorus is one of the limiting nutrients for growth of plants in freshwater bodies [20]. The deficiency of phosphorus is more likely affect the productivity of water sheets [21]. The phosphorus level below 0.05 ppm is considered as poor production [22]. The present study encountered the annual range of 0.13 ppm (April) to 0.29 ppm (September) with an average of 0.21± 0.04 ppm (Fig 9).

Silicate

This element in water bodies exists in several forms like ortho silicate in dissolved form, sistonic mineral particles and clay particles in clay. Silicon can be consumed during the

active growth of specific algae [23]. The present study registers the annual average of 8.74 ± 4.7 ppm with the range of 2.76 (March) – 14.02 (July) ppm (Fig 10). The maximum value of silicon in monsoon season which is supported by the present study [24]. The such phenomena is due to rain washings from surroundings which present authors also hold the similar opinion.

CONCLUSIONS

The ox-bow lake like this beel shows the varying degree of precipitation and the nature, becoming a highly complex ecosystem and posing contrasting pictures of its area and depth within a year. It is concluded from the present study that water abstraction and macrophytes infestation largely round the year are the major constraints for low productivity as a whole which adversely affect the fish production. Adding to these, the observation further indicates that it is more management crisis than resource crisis. Some of the recorded values of hydro-chemical show more or less conducive which can be improved the productivity of the ecological niche vis-à-vis augmenting fish yield. The study may throw the base line information for researchers for future study and planers to formulate strategy for improving productivity as a whole with holistic approach.

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LITERATURE CITED

1. Narayan RK, Saxena K, Chauhan S. 2007. Limnological investigations of Texi temple pond in district Etawah (U.P.). *J. Environ. Biol.* **28**(1): 155-157.
2. Acharjee B, Choudhury M, Dutta A, Goswami UC. 1998. Productivity and fish yield in the beels of lower Brahmaputra basin. *Indian J. Fish.* 45(4): 419-427.
3. Khanna DR, Bhutiani R, Ruhela M. 2013. Fish diversity and their limnological status of Ganga river system in foothills of Garhwal Himalaya, Uttarakhand, India. *J. Environ. Res. Develop*. **7**(4): 1374-1380.
4. APHA. 1995. Standard methods of examination of water and waste water. 19th Edition. American Public Health Association, Washington D.C.
5. Radhika CG, Mini I, Gangadevi T. 2004. Studies on abiotic parameters of a tropical freshwater lake-Vellayani Lake, Trivandrum, Kerala. *Pollution Research* 23(1): 43-63.
6. Sharma AP. 2000. Manual on fishery limnology. G.B. Pant University of Agriculture and Technology, Pantnagar. pp 1-115.
7. Salim M, Ahmed Z. 1985. Environmental factors and planktonic communities of Baigul and Nanaksagar reservoirs, Nainital. *J. Bombay Nat. Hist. Soc.* 82: 13-23.
8. Swarup K, Singh SR. 1979. Limnological studies of Surha lake (Ballia). *J. Inl. Fish Soc. India* 2(1): 22-33.
9. Sharma AP. 1980. Phytoplankton, primary production and nutrient relations in the Nainital lake. *Ph. D. Thesis*, Kumaon University, Nainital. pp 317.
10. CIFRI. 2000. In environmental assessment impact assessment of inland waters for sustainable fisheries management and conservation of biodiversity. (Eds) M. Sinha, B. C. Jah and M. A. Khan. *CIFRI Bull* No. 101: 210.
11. CIFRI. 2002. In ecology and fisheries of beels in West Bengal. Prepared by V. V. Sugunan, G. K. Vinci, B. K. Bhattachariya. and M. A. Hassan. *CIFRI Bull.* No. 103: 53.
12. Santosh B, Singh NP. 2007. Guideline for water quality management for fish culture in Tripura. ICAR Research Complex for NEH Region, Tripura Centre, Publication No.29.
13. Mishra A, Srivastava A, Singh UP. 2003. Limnological studies of fish ponds in Tarai region of Uttar Pradesh. *Environment and Ecology* 21(3): 623-627.
14. Kumar SR, Kumar SD. 2013. Aqua status of Surha Tal, located in district Ballia, Uttar Pradesh, India. *J. Environ. Res. Development* 7(4A): 1577-1585.
15. Mahalakshmi K, Anwar M R, Azmi N. 2014. Seasonal variation in physico-chemical parameters of Harwa Jabbar Jheel of Katihar, Bihar. *Octa Journal of Environmental Research* 2(4): 381-384.
16. Kumari P, Dadse S, Chaudhari PR, Wate SR. 2008. A biomonitoring of plankton to assess quality of water in the lakes of Nagpur city. (Eds) Sengupta M. and Dalwani R. *In The 12th World Lake Conference*. pp 160-164.
17. Sulekh C, Singh A, Tomar PK. 2012. Assessment of water quality values in Porur Lake Chennai, Hussain Sagar Hyderabad and Vihar Lake Mumbai, India. *Chem. Sci. Trans* **1**(2): 508-515.
18. Abir S. 2014. Seasonal variations in physico-chemical characteristics of Rudrasagar wetland - A Ramsar site, Tripura, North East, India. *Res. J. Chem. Sci.* 4(1): 31-40.
19. Paul A, Das B, Das SK. 2007. Interrelationship between primary productivity and environmental nutrients of two water bodies in Kalyani, West Bengl. *Indian. J. Fish*. 54(3): 259-265.
20. Stickney RR. 2005. *Aquaculture: An Introductory Text*. CABI Publishing, UK. pp 265.
21. Hutchinson GE. 2004. *A Treatise on Limnology*. Vol. 1 (Part-2), John Wiley & Sons Publ. (Asia).
22. Banerjea SM. 1967. Water quality and soil condition of fish ponds in some states of India in relation to fish production. *Indian J. Fish.* 14(1/2): 115-144.
23. Paramasivan M, Sreenivasan A. 1981. Changes in algal flora due to pollution in Cauvery River. *Indian J. Environ. Health* 23: 222-238.
24. Pathak AK. 1990. Waste water-fed aquaculture. (Eds) P. Edwards and R. S. V. Pullin. *Proc. International Sem. Waste Wat. Reclaim. & Reuse for Aquaculture*, Calcutta, India. pp 223-235.