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Ecology of Sirsa Tributary of River Sutlej in Foothill of Himachal Pradesh, India

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ABSTRACT: Ecological studies on riverine tributary system need to be addressed as a mark of niche relationship for sustainability of aquatic resources. The nature of hydrobiological factors in the river ecosystem act as a tool for limnologists to study the synergy among different water bodies flowing in lotic and lentic landscape. Such studies were done on Sirsa tributary of river Sutlej in the lap of foothill for restoration purpose. It includes hydrobiological analysis of water sample collected from selected study area in Baddi region to provide baseline ecological data to preserve aquatic life in the long run. Variation in DO ranged (9.6-12.2 mg/L) due to rapid water current at S_1; pH (7.2-9.4) also changes due to muddy or silty water flow with more turbidity. Water analysis of wastewater generated by industrial units at Baddi near CETP (S_2) showed that the value of chemical oxygen demand was very high (78.5-672.6 mg/L) with very low value of dissolved oxygen (1.2-3.5 mg/L) and BOD ranged between (62.3-328.5 mg/L). Self-purification of water quality reported at S_3 with polysaprobic status showing richness of pollution bio-indicators and also have traces of elements (Cr, Co, Ni, As, Cd, Pb, Hg) in ppb. Water is not potable along this stretch due to ruthless discharge of industrial effluents. Prevention is only the key to restore this ecotone of river basin in the near future.

Keywords: Niche**,** Pollutants, Sirsa Tributary**,** Biomonitoring, Ecology and Restoration.

INTRODUCTION

The intricate relation that exist in biosphere was well referred by learners across the globe. Studies on some aspects of ecology has resulted in the emergence of today's world to explore more about degraded aquatic ecosystem. The riverine system has no boundaries, so also have no limits for Limnologists to know the nature of water resources around the freshwater ecosystem. The foothill area of river is consider to be consist of various zones showing change in hydrology and biology. The relationship among the water body of such habitat in shivalik region can be studied for sustainability of biological cycle (Chauhan *et al.,* 2013; Bhardwaj *et al.,* 2019). The load of pollutants in water system has to be underlined to know the impact of organic and inorganic waste discharges on water ecology and material. The fundamental perspective of present ecological idea may be significant to provide overall water quality in this stretch of tributary.

Study Area: Indus freshwater system is considered to be most significant due to flow of River Sutlej in criss-cross belly regions and enters into plan of Punjab near Bhakra Nangal reservoir. During its downward course in lentic zone it confluences with Sirsa tributary and receives polluted waste water generated by industrial units of Baddi region. Sirsanadi lies in transit with respect to geographical domain, originated in lower Kasauli hills, travelling 20 km in Haryana, 28 km in Himachal Pradesh and 6 km in Punjab. The study area include three observation sites (S_1, S_2 and S_3) as demarcated in (Fig. 1). Brief description of the collection sites includes; S_1: River Sirsa 2 km D/S Barotiwala; S_2: It is situated on Effluent Nallah near CETP after receiving wastewater from Baddi Industrial hub; S_3: River Sirsa after confluence withEffluent Nallah near Jagatkhana Bridge.

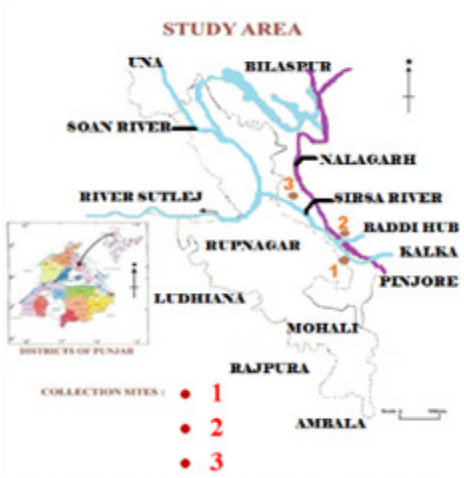

Fig. 1. Borderline map showing collection sites.

MATERIAL AND METHODS

For hydrobiological studies water samples were collected from Effluent Nallah of Baddi (S_2) and Sirsariver (S_1 and S_3). Further analysis was done as per methods given in APHA (2002) ; Trivedy and Goel (1986). The collection of biota includes a metal ring having terricot cloth fitted with a wide mouthed plastic bottle and preservation was done on spot with 5% formalin solution. Counting of plankton was done with the help of Sedgwick Rafter counting cell as per the procedure laid down by Wetzel (2001); Palmer (1969). For the identification of the phytoplankton, benthos, zooplankton and fishes, books consulted were; Ward and Whipple (1959); Pennak (1979); Kudo (1986); Talwar and Jhingran (1991); Jayaram (1999); Johal (1998); Negi and Johal (2005); Brraich *et al.* (2003).

RESULTS AND DISCUSSION

The change in physico-chemical parameters have been shown in Table 1 and reported that the geography of Sirsa Nadi at selected sites may be the factor in the variation of hydrology. The flow of water in this foot hill region was observed to be very fast and criss-cross with more dissolved oxygen (8.2-9.5 mg/L) at S_1 as well as rapid changes in turbidity. The pH recorded at S_3 was (4.2-6.7) more than S_2 (1.2-1.7) near CETP. The pH of water is geochemical balance operating in the waterbody (Krishnamurthy and Bharati 1996). It was due to black color waste water discharged by industrial units of Baddi and can also be co-related with findings of Gurumayum *et al.* (2002; Sharma *et al.* (2018) on riverine ecosystem.

Table 1: The values of pollutant reported at S_1, S_2 & S_3 and their permissible limits as specified by WHO (2008) and BIS (2012).

Sr. No.	Elements	S_1 (Lotic Zone) mg L^{-1}	S_2 (Pollutant Nallah) mg L^{-1}	S_3 (Lentic Zone) mg L^{-1}	Permissible limits WHO (2008) mg L^{-1}	Permissible limits BIS (2012) mg L^{-1}
1.	Temperature (°C)	10.2-21.4	29.7-57.5	17.2-36.5	40	40
2.	P^H	7.5-9	1.2-1.7	4.2-6.7	7-8.5	6.5-8.5
3.	DO	8.2-9.5	1.2-2.8	4.5-6.2	4-6	6
4.	Turbidity (NTU)	5.5-9	274.7-1165	125.5-542.5	5	5
5.	TDS	155-235.2	2835-3515	465-1442	300-600	500
6.	BOD	1.5-2.0	155-295	35-115	2	2
7.	COD	5.5-8.5	272-1123.4	96-248.2	20	20
8.	Nitrate	18.2-30.4	192.5-275	45.6-88.2	45	45
9.	Phosphate (µg L^{-1})	2.5-3.7	7.2-48.7	6.9-42.5	0.1	NA
10.	Sulphate	3.4-4.2	165-338.2	118.4-195	200	200

The amount of DO near to CETP at S_2 was very low (1.2-2.8mg/L) may be due to high organic or inorganic load but at S_1 (near to foot's of Kausauli hills) the value of DO was very high (8.2-9.5 mg L^{-1}) during the study period with some seasonal variations. The concentration of oxygen at S_3 was declined (4.5-6.2 mg/L) after confluence with Baddi effluent nallah near Jagatkhana bridge may be due to presence of nutrients and eutrophic belt. The oxidation of organic matter has resulted in the decrease or increase of oxygen content with the change of water temperature and showed a positive co-relation with dissolved oxygen and pH in water quality estimation (Verma 1998; Jindal and Sharma 2011). Water temperature recorded (°C) was (10.2-21.4) at S_1, (29.7-57.5) at S_2 and (17.2-36.5) at S_3 as recorded by (Khadse *et al.,* 2016) while worked on river Chenab. The turbid nature of water was (274.7-1165 NTU) at S_2, (125.5-542.5 NTU) at S_3 while at S_1 it was (5.5-9.0 NTU). It was similar with results of Narayan and Chauhan (2000) on river Panchnanda. The site S_2 was found to be more turbid due to presence of substances discarded by industrial units. The chemical factor such as TDS of water may induce undesirable metabolic changes in an aquatic ecosystem (Boyed, 2000). The reported values of TDS at S_2 (2835-3515 mg/L) was much more than permissible limits of WHO and BIS for industrial plant but site S_3 (465-1442 mg/L) showed less TDS may be due to self-purification capacity of Sirsa river water in down-stream area and dilution by crystal clear water from site S_1. It was also in conformity with pollution status of river Beas in Punjab (Jindal and Vasisht 1980).

Studies on Biochemical Oxygen Demand at S_3 revealed that the presence of algal blooms, rotifers, protozoans, dipterans larvae with high values of BOD (35-115mg/L) as it receives pollutants of Baddi industrial hub via site S_2 near not properly working CETP at the edge of Sirsa tributary. BOD value was more at S_2 (155-295mg/L) and can be co-related with works of (Singh and Rai 2003) on river Ganga; (Singh *et al.,* 2019) on river Sutlej in Punjab.The industrial pollution determinant include COD, which was found to be (272-1123.4 mg/L) at S_2 and (96-248.2 mg/L) at S_3 may be due to discharge of pharmaceutical effluents and municipal waste water into Sirsa river basin as same result was reported by Singh and Singh (2003) on river Ami near Sultanpur area. Present studies on nutrients include nitrate, phosphate and sulphate at sites S_2 and S_3 showed very high values at site S_2

(192.5-275 mg/L); (7.2-48.7 mg/L) and (165-338.2 mg/L) respectively. It was found to be related with findings of Gill *et al.* (1993; Ghavazan *et al.* (2006) on river Beas near Ludhiana and river Muthaat Pune with respect to nutrients and eutrophication. It was also reported that concentration of sulphate, nitrate, alkalinity, phosphate and bicarbonate were directly proportional to planktonic density as done by Hazarika and Dutta (1998). The value of sulphate at S_3 was ranged (118.4-195 mg/L) and nitrate at S_3 was (45.6-88.2 mg/L) near Jagatkhana bridge with dominance of pollutant's tolerant species of cat fishes and zooplankton. The site S_2 have traces of some elements (Cr, Co, Ni, As, Cd, Pb, Hg) in ppb (Singh *et al.,* 2023), but site S_3 shown to be polysaprobic in term of organic pollutant load. It was co-related with work of and Sampoorani *et al.* (2002) on river Cauvery. It was noticed that nature of biotic and abiotic factors in this region of investigation were changing throughout the whole period of study because of man power activities and industrial developments in the vicinity of Sirsa river basin.

CONCLUSIONS

The rate of discharge of inorganic pollutants were more at S_2 due to chemical dissolution of raw materials used in pharmaceutical industries near common effluent treatment plant of Baddi area. This has resulted in biogeochemical recycling of elements (toxic and non-toxic) at the mercy of Sirsa river water flowing down stream area near Jagatkhana bridge with continuous eutrophication and self-purification (Heerojeet *et al.,* 2017; Sharma *et al.,* 2018). Studies on river tributary has reflected light on ecological imbalance in the aquatic food chain that also changed the state of main riverine system. The uncontrolled discharge of pollutants in the lotic zone of Sirsa river bed may be use as a remark for sustainability and restoration. Biological monitoring and chemical nature of polluted water will pave the way of river ecology in both direction (upstream and downstream) of study area in Baddi region.

FUTURE SCOPE

Further scope of present study is, to restore the water quality of riverine tributaries for sustainable development of aquatic resources to the cater needs of local public and can be explore more on scientific lines in the area of elemental load and their toxicity.

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Conflict of Interest. None.

REFERENCES:

APHA (2002). Standard methods for the examination of water and wastewater (20th ed.). Washington D.C, New York, USA: American Public and Health Association.

Bhardwaj, S. K., Sharma, R. and Aggarwal, R. K. (2019). Suitability Assessment of Sirsa River Water for Irrigation in Shiwalik Foothills of North Western Himalaya. *Curr World Environ 14*(1), 159-169.

Boyed, R. J. (2000). The relation of the palnkton to the physico-chemical and biological features of Stanford Lough Co., Dawn. *Proc. R. in. Acad Sect. B*., *73*(20), 317-353

Brraich, O. S., Ladhar, S. S. and Johal, M. S. (2003). New record from Harike wetland, Punjab, Ramsar site. *Punjab Fisheries bulletin, 23,* pp. 35–36.

Chauhan, B. S. and Sagar, S. K. (2013). Impact of Pollutants on Water Quality of River Sutlej in Nangal Area of Punjab, India. *Biological Forum – An International Journal, 5*(1), 113-123.

Ghavazan, N. J., Gunale, V. R. and Trivedy, R. K. (2006). Limnological evaluation of an urban fresh water river with special reference to phytoplankton. *Poll. Res., 25*(2), 259-268.

Gill, S. K., Sahota, G. P. S., Sahota, B. K. and Sahota, H. S. (1993). Physico-chemical characteristics and phytoplankton occurrence frequency of Beas water at Shah Nehar Barrage. *IJEP*, *13*(7), 528-532.

Gurumayum, S. D., Daimari, P., Goswami, B.S.J., Sarkar, A. and Chaudhury, M. (2002). Physico-chemical qualities of water and plankton of selected rivers in Meghalaya. *J. Inland Fish Soc. India, 34*(2), 36-42.

Hazarika, A.K. and Dutta, A. (1998). Inter-relationship of certain physico-chemical parameters and plankton community of Tasek lake (Meghalaya). *Environ. and Ecol., 16*(3), 561-567.

Herojeet, R., Rishi, M.S. and Lata, R. (2017). Quality characterization and pollution source identification of surface water using multivariate statistical techniques, Nalagarh Valley, Himachal Pradesh, India. *Appl Water Sci.*, *7***,** 2137–2156.

Jayaram, K. C. (1999). The Freshwater Fishes of the Indian region. Narendra Publishing House, Delhi; *27,* 509 pp. 26.

Jindal, R. and Vasisht, H.S. (1980). Potamological survey of North India. *Pb. Fish. Bull., 4* (2), 7–16.

Jindal, R. and Sharma, C. (2011). Studies on water quality of Sutlej River around Ludhiana with reference to physicochemical parameters. *Environ Monit Assess 17*(4), 417–425.

Johal, M. S. (1998). Fishes of Himachal Pradesh (India). Proceedings of Indo-U.S. workshop on conservation and development of natural fishery resources of western Himalayas (December, 7–8), pp. 22 – 35. 28.

Khadse, G.K., Patni, P.M. andLabhasetwar, P.K. (2016). Water quality assessment of Chenab river and its tributaries in Jammu Kashmir (India) based on WQI. *Sustain. Water Resour. Manag, 2***,** 121–126.

Krishnamurthy, S. R. and Bharati, S. G. (1996). A study of distribution of diatoms in the river Kali around Dandeli (North district), Karnataka, India. *Poll.*

Res., 15(4), 321-324.
Kudo, R. R. (1986). Protozoology. 1st Indian ed. Books and Periodical corporation (India), New Delhi. 1174.
Narayan, S. and Chauhan, R. (2000). Water quality status of river complex Yamuna at Panchnada (Distt. Etawah, U.P., India). I: An integrated management approach. *Poll. Res.,19*(3), 357-364.
Negi, R. K. and Johal, M. S. (2005). Ichthyofaunal diversity of Pong dam reservoir in H.P. India. Him. *Journal of Environmental Zoology, 19*(2), 219-222.
Palmer, C.M. (1969). A composite rating of algae tolerating organic pollution. *J. Phycol., 5*, 78–82.
Pennak, R.W. (1978). *Freshwater invertebrates of United States,* John Wiley and Sons, New York. 803 pp.
Sampoorani, V., Dhanapakiam, P., Kavitha, R., Eswari, S. and Rajalakshmi, R. (2002). Assessment of biota in the river Cauvery. *Poll. Res., 21*(3), 333-340.
Sharma, C., Jindal, R., Singh, U. B. (2018). Assessment of water quality of river Sutlej, Punjab (India). *Sustain. Water Resour. Manag., 4*, 809–822
Singh, A.P. and Singh, J. (2003). Physico-chemical characteristics of river Ami in relation to discharge of paper mill effluent. *Indian J. Environ. Hlth., 45*(2), 93-96.
Singh, B., Singh, H. and Kumar, S. (2019). Ecological Study of Sirsa Tributary of River Sutlej Around Ghanauli Area of Punjab, India. *Adv. Biores., 10*(5), 100-105.
Singh, B., Arora, R. and Mehra N. (2023). Persistence of Heavy Metals in River Sirsa Around Industrial Hub Baddi, India. *Curr World Environ, 18*(1), 289-296.
Singh, S. K. and Rai, J. P. N. (2003). Pollution studies on river Ganga in Allahabad district. *Poll. Res., 22*(4), 469-472.
Talwar, P. K. and Jhingran, A. G. (1991). *Inland fishes of India and adjacent countries* (Vol. 2). CRC press.
Trivedy, R. K. and Goel, P. K. (1986). *Chemical and biological methods for water pollution studies.* Environmental Publications, Karad. India.
Verma, C.M. (1998). Chemical and biological evaluation of an industrially polluted river Subernarekha near Ranchi. *Journal of Environment and Pollution, 5*(2),181-187
Ward, G. B. and Whipple, G. C. (1959). *Freshwater biology*. John Willey and Sons, New York, 1248 pp.
Wetzel, Robert G. (2001). *Limnology: Lakes and Rivers Ecosystem,* 3rd ed. San Diego: Academic Press, California, USA. 772 pp.

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