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Research Article

Comparative study on the hydrographical status in the lentic and lotic ecosystems

Abstract

The objective of this study is to assess the hydrography in the lentic and lotic ecosystems. According to this study, the Water Quality Index of lentic ecosystem is highest in the Kukkarahalli lake (106.32), followed by Karanji lake (97.42), Varuna lake (95.73) and lowest in the Kamana lake (94.62). The Water Quality Index of lotic ecosystem (Kavery river) is highest in the Sangama (99.33), followed by Snanghat (96.40), Chandravana (93.05) and lowest in the Paschimavahini (90.48). So, the Water Quality Index of lentic ecosystem is higher than the lotic ecosystem in general. This indicates that, the water quality of standing water is deteriorated more than the running water.

Introduction

Water is essential for the survival of any forms of life. For confirming the good quality of water resources large number of physico-chemical or biological parameters studied in detail and must be found in normal range. In any rational formulation and deciding quality of water, an adequate knowledge of existing nature of physico-chemical parameters, magnitude and source of pollutants must be known, for which monitoring of hydrographical parameters and pollutants is essential. In recent years, rivers are the amongst the most vulnerable water bodies to pollution as a consequence of unprecedented development. Thus the water quality of these water resources is a subject of ongoing concern and has resulted in an increasing demand for monitoring river water quality. The quality of water is described by its physical, chemical and microbiological characteristics. Therefore a regular monitoring of fresh water bodies not only prevents outbreak of disease and checks water from further deterioration, but also provides a scope to assess the current investments for pollution prevention and control.

A lotic ecosystem is the ecosystem of a river, stream or spring. Included in the environment are the biotic interactions (amongst plants, animals and micro-organisms) as well as the abiotic interactions (physical and chemical). Lotic ecosystems can be contrasted with lentic ecosystems, which involve relatively still terrestrial waters such as lakes and ponds. Together, these two fields form the more general study area of freshwater or aquatic ecology. Lotic waters can be diverse in their form, ranging from a spring that is only a few centimeters wide to a major river that is kilometers in width. Despite these differences, the following unifying characteristics make the ecology of running waters unique from that of other aquatic habitats. Flow is unidirectional. There is a state of continuous physical change. There is a high degree of spatial and temporal heterogeneity at all scales (microhabitats). Variability between lotic systems is quite high.

Physico-Chemical analysis of water sample gives a picture of the physical and chemical constituents which would give us only certain numerical value but for estimating exact quality of water an indexing system has been developed known as "Water Quality Index (WQI)". WQI gives us an idea regarding the quality of entire aquatic system. Water quality index is defined as "a rating of water quality, which reflects the composite influence of different water quality parameters on the overall quality of water". Large amount of water quality data is reduced in to single numerical value to formulate water quality index. The water quality index of lotic ecosystems studies were carried out by few researchers [1,2]. Few limnologists formulated the Water quality Index in the lotic ecosystems to know the water quality status [3-6]. Some other hydrologists assessed the physico-chemical parameters and computed water quality index in the ground water [7-9]. The comparative study was carried out on water quality index in the lakes of Mysore [10]. The water quality parameters of Kavery river was quantified and water quality index was computed [11,12]. The surface water quality was assessed and compared by employing water quality indices [13]. Water Quality Assessment was carried out in terms of Water Quality Index [14].

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The Kaveri is a large Indian river. The origin of the river is at Talakaveri, Kodagu in Karnataka, flows through Karnataka and Tamil Nadu and across the southern Deccan plateau. The water from this river is used as potable water in the river basins of Karnataka and Tamilnadu. The river water is supplied to cities like Mysuru, Mandya, Bangalore etc., for drinking purpose. The four lakes namely Kamana, Varuna, Karanji and kukkarahally lakes are water feeding source to human utility and agriculture. The present study is carried out to evaluate the suitability of Kavery river water to human consumption and the water quality of lotic ecosystem is compared with lentic ecosystems.

Materials and Methods

The surface water samples collected in each month from January 2011 to December 2013 & subjected to hydrographical analysis. The methodology followed as per standard specifications [15-19], for the investigation of water quality parameters. In this study few hydrographical parameter are estimated in four sites (Sangama, Snanghat, Chandravana and Paschimavahini) of the Kavery river and four lakes (Kamana, Varuna, karanji and Kukkarahally lakes) in the Mysuru. Few physicochemical parameters like pH, Dissolved oxygen, total alkalinity, chloride, hardness, carbondioxde, were estimated at spot immediately after collection of the sample and other chemical analysis for total solids, calcium, magnesium, B.O.D. carried out in laboratory.

Water Quality Index (WQI) computation

For the computation of the Water Quality Index, 9 Water Quality parameters are considered [20,21]. The recorded Water Quality Parameter values are compared with the ICMR and WHO recommended standards [22-24], for water quality parameters to compute Water Quality Index. Water quality parameters are studied from the point of view to know the status of water quality.

Water Quality Index (WQI) = Σqiwi,. Where qi = quality rating, wi = unit weight

1. Quality rating qi =100(Va-Vi) / (Vs-Vi) or

Where Va-Actual amount of nth water quality parameter, Vi = The ideal value of water quality parameter, Vi = 0 except for pH and D.O, (Vi= 7.0 mg/ lit for pH and Vs = 14.6 mg/ lit for D.O.)

Vs- Standard Value

2. Unit Weight (wi) for various parameters is inversely proportional to the recommend standard (Sn) for the corresponding parameter

$$Wi = K/Sn, \text{Where } K\,(\text{constant}) = \frac{1}{1/Vs1 + 1/Vs2 + 1/Vs3 + 1/Vs4 - - - - - 1/Vsn}$$

VSn = 'n' number of standard values (9 parameters).

Results and Discussion

According to the results, the quality rating of Biochemical Oxygen Demand is more than 100 in the Chandravana (108) and Sangama (126) of Kavery river. All other hydrographical parameters are within 100, which indicates that all these water quality parameters are within the prescribed standards. In comparison, in the lotic ecosystem the highest Water Quality Index is recorded in the Sangama (99.40) of Kaveri river followed by Snanghat (96.40), Chandravana (93.05) and lowest in the Paschimavahini (90.48) (Table 1).

According to the results, In Kamara lake only magnesium (123.33) quality rating was more than 100, whereas other parameters were within 100 indicates that these were within the prescribed ICMR and WHO standards. In Karanji lake the quality rating of dissolved oxygen (100) and magnesium (150) was more than 100. In Kukkarahally lake the quality rating of pH (153), total dissolved solids (132), dissolved oxygen (112.5), total hardness (120) and magnesium (250) was more than 100. All other parameters are within the prescribed standards. In the lentic ecosystem the highest value of WQI is documented in the Kukkarahalli Lake (106.32), followed by Karanji Lake (97.42), Varuna Lake (95.73) and lowest in the Kamana Lake (94.62).

As per the results in the table 1 & 2, the highest Water Quality Index is recorded in the Lentic ecosystem (Kukkarahalli

Table1: Water quality rating and Sub index (qiwi) of four sites in the Kavery river.

Parameter	Water Quality rating (qi)				unit weight (wi)	Sub index (qiwi)			
	Paschima vahini	Chandravana	Snanaghat	Sangama		Paschima vahini	Chandravana	Snanaghat	Sangama
pH	71	53	80	73	0.20	14.2	10.6	16	14.6
TDS	55	50	14	43	0.004	0.165	0.2	0.05	0.17
Dissolved Oxygen	81	79	84	69	0.35	28.35	27.65	29.4	24.15
Biochemical Oxygen Demand	88	108	97	126	0.35	30.8	37.6	34.2	44.1
Chloride	15.04	10.4	18	17.8	0.007	0.10	0.0728	0.12	0.12
Total Alkalinity	41	49	38	50	0.01	0.41	0.49	0.38	0.5
Total Hardness	50	49	49	32.4	0.005	0.25	0.245	0.24	1.62
Calcium	62	65	64	53	0.2	12.4	13	12.8	10.6
Magnesium	76	80	80	86.6	0.04	3.8	3.2	3.2	3.46
	Water Quality Index (∑qi wi)					**90.48**	**93.05**	**96.40**	**99.33**
	Average WQI of lotic ecosystem					**94.8**			

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Table 2: Water quality rating and Sub index (qiwi) of four lakes.

Parameter	Water Quality rating (qi)				unit weight (wi)	Sub index (qiwi)			
	Kamana lake	Varuna lake	Karanji lake	Kukkarahally lake		Kamana lake	Varuna lake	Karanji lake	Kukkarahally lake
pH	46.6	93.33	73	153	0.20	9.32	18.66	14.6	30.6
TDS	76.6	50.6	80.6	132	0.004	0.3064	0.20	0.32	0.528
Dissolved Oxygen	97	97.91	100	112.5	0.35	33.95	34.26	35	39.375
Biochemical Oxygen Demand	88	90	76	32	0.35	30.8	31.5	26.6	11.2
Chloride	32.4	16	16.8	38.4	0.007	0.22	0.11	0.1176	0.2688
Total Alkalinity	73.33	28.33	33	15.8	0.01	0.73	0.28	0.33	0.158
Total Hardness	45.2	25.2	90	120	0.005	0.22	0.126	0.45	0.6
Calcium	70	39	70	68	0.2	14	7.8	14	13.6
Magnesium	123.33	70	150	250	0.04	4.9	2.8	6	10
	Water Quality Index (∑qi wi)					**94.62**	**95.73**	**97.42**	**106.32**
	Average WQI of lentic ecosystem					**98.5**			

Lake- 106.32) & lowest in the Lotic ecosystem (Paschimavahini 90.48). The average WQI was more in lentic ecosystem (98.5) than lotic ecosystem (94.8).

Kukkarahalli lake is highly polluted due to sewage and excessive land encroachments and blockage of water flow source almost lead to the eutrophication of the lake so the pollution is high in Kukkarahalli lake. In Karanji lake disposals of sewage from the nearby residential areas are let into lake. This pollution leads to the destruction of aquatic life in the lake. In order to prevent the destruction of aquatic life in the lake and to renovate it, restoration activities are undertaken by zoo authority of Karnataka. The restoration activities includes removal of polluted silt, de-weeding of the entire lake surface, removing 30 cm of silt from the lake, restoration of feeder channels. Kamana lake and Varuna lake are comparably less polluted than other two lakes. Due to anthropogenic activities such as washing, bathing, disposal of wastes, agricultural runoff and domestic sewage water is excessively polluted.

In lotic ecosystem, among four sites the high WQI recorded in the Sangama (99.33), followed by Snanghat (96.40), Chandravana (93.05) and lowest in the Paschimavahini (90.48). Increase in the WQI reflects higher pollution load so, Sangama is highly polluted site than other 3 sites along Kaveri river due to anthropogenic activities. In the Kavery river, Sangama has higher pollution than snanghat. Here human activities are more such as bathing, washing and disposal of wastes and also it is one of the most attractive tourist spot where Large number of peoples visited to this site this leads to very high floating population. Because of this reason there is more pollution. In Chandravana WQI recorded is (93.04). The main polluters in this sites are agricultural runoff, industrial and domestic sewage. Huge quantities of fertilizers and pesticides are discharged into the river as agricultural runoff this leads to the pollution. Similar observation was made by aquatic researchers in the Kavery river at tamilnadu [25]. In other other lotic ecosystems also the water quality deteriorated in the increasing order from the upstream to the downstream [26-29].

When 0>WQI< 100 indicates that the water is considered as good for human consumption. If WQI>100 reflects its unsuitability for human use. It has been accepted that if WQI < 50 (0–50) – fit for human consumption, WQI<80 (51–80) – moderately polluted, WQI<100 (80-100) – Excessively polluted and WQI > 100 – severely polluted [1,5,10]. In lotic ecosystem the WQI of all the 4 sites are within 100. So, in future the water quality may be deteriorate further and it may even hamper the agricultural yield. So some necessary preventive measures to control the pollution level increase. In the Lentic ecosystem the Water Quality Index of Kukkarahalli lake is above 100. So, it is highly polluted and the Water Quality of other 3 lakes are below 100 and their pollution level increases significantly. In conclusion, the higher water quality index indicated that lentic ecosystems water quality deteriorated significantly when compared with lotic ecosystem.

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