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Research Article

A STUDY ON PHYSICO-CHEMICAL WATER QUALITY AND BIODIVERSITY LOSS OF A RIVER IN A SMALL TOWN OF WEST BENGAL.

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Abstract

The physico chemical parameters such as water temperature, turbidity, pH, total dissolved solid, total suspended solid , total solid conductivity (µs/cm), dissolved oxygen, free CO_2,salinity, BOD, nitrate , phosphate ,silicate , chloride , total alkalinity were measured at three sites of Shutunga river, a tributary of Jaldhaka river traversing through Coochbehar district of West Bengal, India to study the seasonal variation of physico-chemical factors .The study was executed in pre-monsoon, monsoon and post-monsoon period from January,2016 to May,2017.

Agricultural field uses the river water for plantation and drain off the used excess water with variety of pesticides and fertilizers to the river .The fisherman make the most of the downstream market, drainage materials from hospital, leaching of fertilizers & pesticides from agriculture land, use of ichthyotoxic substances for fish capture and also ashes of cremation directly mix up with Shutunga river.of this river for fish capture. Slum-dwellers uses water resource for bathing, washing of cloths etc. Sewage from municipality, garbage from market openly mixed with the river. As a result the physical, chemical and biological characteristics of the river water are regularly changing and creating the unsafe effect on aquatic biota and also human beings.

Keywords: Shutunga river , turbidity, pH, total dissolved solid, total suspended solid , total solid,conductivity (µs/cm), dissolved oxygen ,BOD.

Introduction:

The Coochbehar district is situated in the northeastern part of West Bengal. Mathabhanga subdivision is a subdivision of the Coochbehar district in the state of West Bengal,India. The Mathabhanga sub division town lies on the bank of the Shutunga River which is tributary of Mansai river. The small river Shutunga flows through the middle of the town bisecting the town into two halves.

The shutanga is a small stream which takes its rise in the Western Duars and enters the Coochbehar district from the north at the north-west corner of Changrabandha area where it is joined by the Chebas from the north. Its course lies through a tract of district rich in paddy, tobacco and jute.

Farmers consume the water resource for agricultural land and drain off the utilized excess water which carries varieties of pesticides and fertilizers and other pollutants to the river Shutunga. The fisherman utilizes the downstream of this river for fish capture. Slum-dwellers exploit the water resource for bathing, washing and other domestic purposes. Sewage from municipality and hospital, garbage from market and ash of cremation directly disposes to this river. As a result the physical, chemical and biological characteristic of the river water is gradually changing and producing alarming harmful effect on aquatic biota and thereby the health of human beings. Water pollution is a major problem in all the major rivers of India [1-4].The good quality of river water as determined by its physical and chemical constituents is of great value in determining its fitness for a certain use such as public water supply, irrigation, industrial application etc and also to maintain good Biodiversity profile [5].

Northern part of West Bengal, sometimes mentioned as North Bengal is gifted with numerous fresh water rivers. River "Shutunga" is one of them. Shutunga river which takes its rise in the western Duars and flows down to the river Mansai near Manabari at Mathabhanga subdivision town. Tea industries consume the water resource for tea plantation and drain off the utilized excess water

which carries variety of pesticides and fertilizers to that river. As a result the physical, chemical and biological characteristics of the river water are gradually changing and producing the harmful effect on aquatic biota and thereby human beings. Research has been carried out on the physicochemical parameters of river water and their impact on aquatic biota in India [6-10].

Experimental Section:

MATERIALS AND METHODS

Study area

Three different locations were chosen in that river for sampling of water The area-QI is near the Jamaldah, upperstream of the river. Its latitude, longitude, and elevation (from Mean Sea Level) are 26°26'15" N, 89°01'58" E, and 212 ft. correspondingly. The area-QII (Near College More, ward no-9) is situated in the heart of subdivision town . Its latitude, longitude, and elevation (from Mean Sea Level) are 26°20'27" N, 89°12'32" E, and 163 ft. respectively. The area-QIII (Near Manabari) is located at the intersection of Mansai and shutunga. Its latitude, longitude, and elevation (from Mean Sea Level) are 26°19'38"N, 89°13'47"E, and 159 ft. respectively [11]

Collection of Samples

Water samples were collected once in pre monsoon, monsoon & post monsoon seasons during, Janauary, 2016 to May, 2017 from three selected sites of the River Shutunga. Samples were collected from a three places of each sampling site, randomly and mixed thoroughly. Water samples were stored in the ice box. Collection of samples took place between the hours of 5.30 am to 7.30 am. The samples were analyzed as per standard methods mentioned in (APHA, 1995). The standards reagents used in analysis were prepared using double distilled water.

Fortnightly the water samples were collected at the depth of 1.5 ft. All fifteen days samples were brought together as monthly average. All water sample were collected in duplicate form by two glass DO (Dissolved Oxygen) bottles with the capacity of 150 ml each and one large PVC (1 litter capacity) bottle. The water samples were transferred to the laboratory for all physicochemical studies except the water temperature, pH, conductivity and total dissolved solid (TDS).Physicochemical parameters were analyzed in the laboratory in the same day as early as possible except BOD.

Methodology

The aim of this study is to describe the trend and variations of the selected water quality parameters of the river. The study also aims to ascertain the levels of the quality parameters and in the absence of any detectable impact from any source, may serve as baseline values [17a] The water quality test methods are shown in Table 1. The range values of the River Shutunga water quality parameters of the present study are presented in Table 2, 3, 4 and discussed on the basis of pre monsoon, monsoon and post monsoon seasons inbrief. The odour was unobjectionable and taste agreeable at the selected sites except the QII station where odour of the water is objectionable specially at pre-monsoon and post monsoon period.

RESULTS AND DISCUSSION

Temparature

The air temperature was calculated with the aid of ordinary mercury thermometer at 2 ft. above surface water and the water temperature was measured with the same thermometer by placing it inside the water at the depth of 2 ft. on the sampling stations at QI, QII and QIII. Temperature is one of the most important physical parameters that control the physiological activities. The water temperature at QI and QII found in the range 29.1-29.4°C during pre-monsoon which was greater than the air temperature but at QIII it was 25.1°C and was lower than the air temperature. The explanation can be suggested behind this observation is the thermal properties, depth and mixing of cold water from the hilly region. Throughout the monsoon at QI the water temperature was 27.5°C, at QII 28.4°C and at QIII 28.3°C. For the period of post-monsoon it was 16.8 °C at QI, 18.5°C at QII and 17.5°C at QIII.

pH

One of the significant factor that serve as an indicator of pollution of water body is pH. The oscillation of pH in the present system may be due to the buffering capacity. The pH is one of the most significant factor which influences aquatic life of any water body. At the period of study, the average pH on QI and QIII during pre and post monsoon was acidic. During early monsoon it was neutral to alkaline. The QII which is located at the centre of the town showed acidic pH during all the seasons. The

acidic pH may be due to the high organic load and decomposition. The rain water is accountable for neutralization and finally make it to alkaline.

Turbidity

For the full period of study, monsoon showed the maximum turbidity range whereas the pre and post monsoon showed the least range. Turbidity may be caused when light is blocked by major amounts of silt, microorganisms, plant fibers, wood ashes, chemicals. Any substance which makes water cloudy will cause turbidity. At the meeting point of Mansai and shutunga the water was more turbid than QI and QII. As the turbidity depends upon the TSS, it may be due to the soil erosion.

Electrical conductivity **(EC)**

The electrical conductivity represents the total concentration of soluble salts/mineral salts in water (Trivedy and Goyal, 1986), so making it sour and inappropriate for drinking. In the present study the EC values of water samples ranged from 31 to 39 (µs/cm) at QI, 65 to 79 (µs/cm) at QII and 43 to 51(µs/cm) at QIII. It was observed that QII showed maximum EC. The EC depends upon the concentration of ions and nutrients and difference of dissolved solids. Dilution water during rain depletes the EC value of water. The disparity of conductivity shows the uneven happening of un-ionized chemical substances and due to poor irrigation supervision, minerals from rain water runoff, or other discharges.

Table 1: Water Quality Test Methods

S. No	Parameters	Units	Test Method
1	pH	-	Deluxe water and soil analysis kit (Model-171 of Electronics India).
2	Electrical Conductivity	µs/cm	Deluxe water and soil analysis kit (Model-171 of Electronics India).
3	Total dissoved Solids	Ppt	Deluxe water and soil analysis kit (Model-171 of Electronics India).
4	Alkalinity	mg/l	Titration and Electrometric
5	Chloride	Ppm	Titration
6	Dissolved Oxygen	Ppm	Winkler method with Azide Modification
7	Biological Oxygen Demand	Ppm	5 days incubation
8	Turbidity	Nephelometric Turbidity Units (NTUs)	Turbidity meter
9	Total suspended Solids	Ppt	evaporation method
10	Air and water emparature	^{0}C	ordinary mercury thermometer
11	Total solid	Ppt	Sum of TDS and TSS values.
12	Free CO_2	Ppm	In accordance with APHA (1995)
13	Salinity	Ppt	In accordance with APHA (1995)
14	Nitrate	Ppm	In accordance with APHA (1995)
15	Phosphate	Ppm	In accordance with APHA (1995)
16	Silicate	Ppm	In accordance with APHA (1995)
17	Total alkalinity	Ppm	In accordance with APHA (1995)

Table 2.Physico-chemical parameters of water at QI of Shutunga river.

	Seasons

Water quality (Physico-chemical) Water quality	Pre-monsoon Mean value	Monsoon Mean value	Post-monsoon Mean value
Air temperature (°C)	26.4	27.3	13.5
Water temperature (°C)	29.4	27.5	16.8
Dissolved oxygen (ppm)	5.7	6.9	4.2
Free CO2 (ppm)	6.60	5.98	6.65
TDS (ppt)	0.032	0.025	0.033
TSS (ppt)	0.0627	0.0874	0.0374
Total solid (ppt)	0.1025	0.1123	0.06
Turbidity (NTU)	19.75	31	8.73
pH	6.8	7.13	6.83
Conductivity (µs/cm)	39.25	31.25	35
Nitrate (ppm)	0.47	0.15	0.19
Phosphate (ppm)	0.1928	0.074	0.073
Silicate (ppm)	0.545	0.16	0.236
Chloride (ppm)	3.3	4.44	6.025
Total alkalinity (ppm)	30.35	28.68	29.93
Salinity (ppt)	0.042	0.035	0.034
BOD (ppm)	1.35	0.47	0.95

Table 3.Physico-chemical parameters of water at QII of Shutunga river.

Water quality (Physico-chemical) Water quality	Seasons		
	Pre-monsoon Mean value	Monsoon Mean value	Post-monsoon Mean value
Air temperature (°C)	26.5	26.2	15.2
Water temperature (°C)	29.1	28.4	18.5
Dissolved oxygen (ppm)	4.94	5.02	3.38
Free CO2 (ppm)	7.58	5.14	6.15
TDS (ppt)	0.0875	0.045	0.0725
TSS (ppt)	0.08	0.2125	0.0424
Total solid (ppt)	0.1675	0.2575	0.113
Turbidity (NTU)	19.24	48	8.7
pH	6.44	6.9	6.5
Conductivity (µs/cm)	79.75	65.5	68.5
Nitrate (ppm)	0.583	0.22	0.273
Phosphate (ppm)	0.282	0.075	0.1075
Silicate (ppm)	0.533	0.16	0.2375
Chloride (ppm)	13.093	7.273	9.374
Total alkalinity (ppm)	33.25	31.38	32.7
Salinity (ppt)	0.054	0.044	0.044
BOD (ppm)	2.74	0.95	1.75

Table 4.Physico-chemical parameters of water at QIII of Shutunga river.

Water quality (Physico-chemical) Water quality	Seasons		
	Pre-monsoon Mean value	Monsoon Mean value	Post-monsoon Mean value
Air temperature (°C)	27.5	26.2	15.2
Water temperature (°C)	25.1	28.3	17.5
Dissolved oxygen (ppm)	4.9	5.6	3.5
Free CO2 (ppm)	9.2	5.4	6.83
TDS (ppt)	0.057	0.043	0.05
TSS (ppt)	0.35	0.65	0.1224
Total solid (ppt)	0.438	0.693	0.1725
Turbidity (NTU)	24.2	52	10.5
P^H	6.7	7.03	6.54
Conductivity (µs/cm)	51.74	44	46.5
Nitrate (ppm)	0.333	0.285	0.274
Phosphate (ppm)	0.157	0.063	0.078
Silicate (ppm)	0.5575	0.16	0.2375
Chloride (ppm)	11.5	5.97	9.02
Total alkalinity (ppm)	29.5	27.8	28.6
Salinity (ppt)	0.052	0.044	0.046
BOD (ppm)	1.8	0.83	1.36

Total solid (TS), TDS and TSS

Total solid (TS) of water is calculated by the sum total of TDS and TSS. The TSS values of water ranged from 0.03-0.08 ppt at QI, 0.08-0.2 ppt at QII and 0.12-0.35 ppt at QIII. Comparatively QIII station showed maximum TSS. The TDS values of water ranged from 0.02 to 0.03 ppt at QI, 0.04 to 0.08 ppt at QII and 0.04 to 0.05 ppt at QIII. In our study reveals that QII station showed maximum TDS concentration. The TDS and TSS were irreversibly related. This may be due to the addition of solids from runoff water.

Alkalinity

Alkalinity is not a pollutant. It is a total measure of the substances in water that have "acid-neutralizing" ability.Alkalinity is an indicator for a solution's capacity to react with acid and "buffer" its pH. In the present study, total alkalinity (TA) represents to bicarbonate alkalinity only. Increase dilution of river water may be responsible for lower values of alkalinity in rainy seasons [11].

Dissolved oxygen

Dissolved oxygen in water is an indicator for water quality and diversity of living things. The concentrations ranged from 5.7 to 6.7 ppm at QI, 3.4 to 5.0 ppm at QII and 3.5 to 5.6 ppm at QIII. The highest values of DO were calculated from the end of pre monsoon to mid monsoon at all the three points. The explanation behind the information is the turbulence and oxygenation consequential from rain falls and addition up of polished aerated water. Mixing of domestic sewage, municipalities wastes, waste from market and hospital etc. promote the growth of micro organisms which utilize the dissolved oxygen for decomposition and as a result the concentration gradually decreases. [12].

Free carbon dioxide

The existence of carbonic acid in water may be good or bad depending on the water's pH and alkalinity. In the present work, the free carbon dioxide concentration varies from 5.7-6.7 ppm at QI, 5.14-7.58 ppm at QII and 5.3-9.2 ppm at QIII respectively. The result of carbon dioxide shows high organic load in two down stream locations i.e., QII and QIII.

The biological oxygen demand (BOD)

The biological oxygen demand (BOD) gives a measure of the quantity of biodegradable organic matter present in an aquatic system that is subjected to aerobic decomposition by microbes which

gives a direct dimension of the state of pollution. The concentration of BOD ranged from 0.47 to 1.4 ppm at QI, 0.95 to 2.7 at QII and 0.83-1.8 at QIII. The BOD level shows that QII is more polluted than other two points.

Salinity

If salinity concentration is more than 1 ppt, it is marked as saline water. In the present investigation, the

salinity of water was very poor and always less than 1 ppt. It ranged from 0.035-0.040 ppt at QI, 0.044-0.054 ppt at QII and 0.044-0.052 ppt at QIII. Organic wastes openly mixed with water body and increasing the chloride concentration which finally increases the salinity during pre-monsoon. During monsoon rain fall dilutes the concentration of chloride and eventually the decrease of Salinity is noticed.

Chloride concentration

Chloride concentration is one of the indicators of water pollution. It is also related with the concentration of salinity. In the present study, the average chloride concentration showed an increase from QI to QII and subsequently decreased at QIII at premonsoon, monsoon and postmonsoon seasons. Minimum concentrations were noticed during monsoon and maximum were recorded during pre-monsoon at both the stations due to the organic waste load particularly sewage pollution.

Phosphate (orthophosphate or total reactive phosphorus [TRP])

Phosphorous is an essential nutrient to living organisms. Inorganic phosphate ranged from 0.074-0.1928 ppm at QI, 0.075- 0.282 ppm at QII and 0.063-0.157 ppm at QIII. At all the three defined locations, TRP concentration was maximum during pre-monsoon and the least during rainy season.

Nitrate (NO3-)

To study water quality of Shutunga River, three nutrient factors were selected. Nitrate (NO_3 -) is one of the vital nutrients in water body which is the common form of nitrogen in natural water. In the present investigation, the nitrate concentration ranged from 0.15 to 0.47 ppm at QI, 0.22 to 0.58 ppm at QII and 0.27 to 0.33 ppm at QIII. Maximum concentration was calculated during premonsoon at all the three stations. The average values were low at QI in contrast to QII and QIII. The possible cause behind the fact is the mixing of nitrogenous fertilizer from tea gardens, sewage, etc.

Silicate (soluble)

Silicate (soluble) is another nutrient of fresh water body system. In the present study the silicate concentration varied from 0.16 to 0.56 ppm in the river and more or less uniformly distributed. Concentration was higher at pre-monsoon in comparison to other two seasons.[12]

CONCLUSIONS

It may accomplished that the general characteristics of water from the congested town area (QII) is alkaline in quality at rainy season. The parameters chlorides are good within the permissible limits of drinking water quality standards at QI and QII. Some selected parameters are slightly higher limits prescribed by (WHO,1993) at QII and not tolerable for domestic and also commercial purposes mainly in premonsoon period. The QII appears to be more troubled by external influences compared to the QI and QIII. The domestic sewage, garbage from market, drainage materials from hospital, discharge of fertilizers & pesticides from agricultural land , use of ichthyotoxic substances for fish capture and also ashes of cremation directly mix up with Shutunga river are clearly revealed in these results. The deterioration of water quality and biodiversity loss is related with above causes. The QI appears to be the least polluted. The results obtained from the present investigation shall be usefull tool in future management of the river Shutunga Slightly higher value of DO, BOD values in Shutunga river water is unsuitable for drinking purpose at QII mainly in premonsoon time. High pH, TS, Hardness, DO, BOD values suggests purification is needed for domestic consumption. Strong legal action should be taken against those who pollute the Shutunga river by waste discharges of local effluents. Till date it is regrettable that the Shutunga river, life line of Mathabhanga subdivision has not received any right methodical awareness from the authority. This report gains significance as the Shutunga river has been described as one of the most important tributary of Mansai.

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