Original Research Paper

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Microbiology

STUDY THE ANTHROPOGENIC PRESSURE IN AN AROUND THE WATER OF SHILABITI RIVER NEAR GHATAL, PASCHIM MIDNAPUR, WEST BENGAL, INDIA.

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ABSTRACT The Shilabiti River near Ghatal, Paschim Midnapur, acts as an important role in local society, as a source of irrigation, drinking water and domestic utility. Present study was intended to ascertain the quality of river water for public consumption, recreation and other purposes. To keeping the importance of utility of river water, we determine the spatial and temporal variation of different physicochemical parameters like Dissolved oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand (COD), Total Alkalinity (TA),, Hardness, temperature, pH, Electrical Conductivity (EC), heavy metals and coliform, fecal coliform at five sampling sites from March-2017 to March- 2018. Present result indicate that water quality of all studied area are good and can use directly in domestic purpose but not good for directly drinking purpose because of presence of fecal coliform in all sampling stations. So, this result informed that proper treatment is required before water consumption otherwise may also trigger outbreaks of waterborne disease.

KEYWORDS : Shilabiti River, Biochemical oxygen demand, Coliform, fecal coliform Chemical oxygen demand

Introduction

The Silabati River is situated at the south-western part of Bengal basin, at the outskirts of the Chhotonagpur plateau. The River Silabati or Silai was originated near La para village of Puncha Block of Purulia district, West Bengal and flows southeasterly before it meets Dwarakeswar River near Ghatal of West Midnapore District, West Bengal. The Silabati River has flows in an almost southeasterly direction through the districts of Bankura and West Midnapore. The total watershed of Silabati River were covers approximately 4249 sq km. area between 22°32' N to 23°15' N latitude and 86°40' E to 87°46' E longitude. Purulia, Bankura and West Midnapore districts of West Bengal and block Headquarters like Taldangra, Simlapal of Bankura district, and Garbeta, Salboni, Chandrokona of West Midnapore district are the main towns within the Silabati basin area. Both the districts climatologically face very hot summer and cold winter. The temperature at the winter season is 6 to 10°C (December-January) and 40 to 50°C in the summer month (May-June). The area suffers rainfall during the period of the monsoon (June-September). The average rainfall in that area is 150cm/year. In other season, weather is mainly dry with average relative humidity 60 to 65%. The topography of the area is undulating with occurrence of isolated hillocks at the higher altitude. The height of such hillocks ranges within 150 metre from the mean sea level (msl). In the lower altitude of the basin, the hillock is gradually replaced by isolated highland with maximum height 40 to 50 metre and at the lowest altitude, the topography is peneplained. The general slope of the basin is towards southeast. The soil properties of the area are lateritic in nature and red colour of the soil which have higher percentage of iron in the upper and middle part i.e. Bankura districts of the river basin. In the lower part, the soil is represented by recent alluvial soil which is carried and deposited by the principal river system and its tributaries. The soil nature, particularly in the upper reaches of the basin does not permit the flourish of agriculture, but there are some sporadic paddy fields and some agricultural land to harvest seasonal vegetables like cabbage, cauliflower and mustard. In the lower part of the river especially in the Ghatal region are suitable for agriculture like different crops and also suitable for vegetables. With increase the growth of population and gradual urbanization in this agriculture based region, the demand for utilization of subsurface ground water is gradually increases. Such rising trend of utilization of groundwater is intimately related to the future planning of socio-economic development of the agriculture based area. To cope up with the ongoing demands of surface water, it is essential to study the proper evaluation of present surface water resources and future planning of surface water exploitation, development and management of the study area. According to WHO (1984), the occurrence of pathogens or indicator organisms in ground or surface water mainly depends on the range of human activities and animal sources that release pathogens to the environment. In this context, the present study is an approach to find out the quality of hydrogeological parameters and microbial load of the Silabati river water.

Materials and Methods

Study area: The present study was conducted around the Ghatal area which is situated in the Paschim Midnapur district of West Bengal. It is located at 22°32' N to 23°15' N latitude and 86°40' E to 87°46' E longitude. We have taken five water samples for our present study. The distance between intra sample points was near about 3 km (Fig.1 and 2).

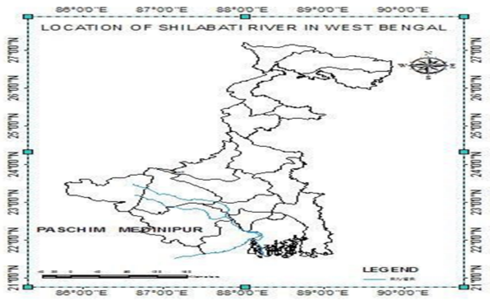


Fig.1 Location of Shilabati River in West Bengal

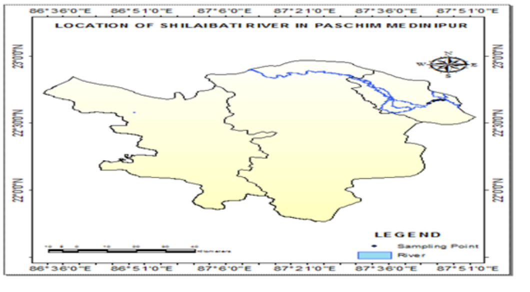


Fig.2 Location of Shilabati River in Paschim Medinipur

Sampling

The water sample was collected from different area of the Silabati River around the Ghatal region. The water samples were collected from all the five selected stations between 8 a.m to 10 a.m of 10 cm below the water surface during March-2017 to March- 2018. Samples were collected in plastic bottles for physico-chemical analysis. Temperature and pH of the water were measured at the sampling sites. The anthropogenic stress of the selected station are tabulated below –

Table 1: The anthropogenic pressure at the different selected station

Sample Point	Name of Place	Latitude & Longitude	General Characteristics
1	Pratappur	22 °40 ′03 ″N 87 °46 ′32 ″E	This river side place has been used as a ferry ghat for long time. People are mainly using this place for communication purpose. Human intervention is high of that place. This station is agriculture area.

2	Harisnghpur	22 °39′45″N 87 °47′02″E	Local people are using this place for water, bathing, cleaning etc. During bathing and cleaning, they have used different kinds detergent and soap. This kind of anthropogenic activity may be harmful for maintain water quality. Source of income from agriculture.
3	Nischintapur	22 °39′04″N 87 °47′40″E	Local people are using this place for water, bathing, cleaning etc. During bathing and cleaning, they have used different kinds detergent and soap. Population density high.
4	Gomvirnagar	22 °38′30″N 87 °43′19″E	This place is famous for burning ghat. It is one of the most important burning ghat in Ghatal town. Anthropogenic activity may be fatal for river water quality. Population high.
5	Kushpata	22 °37′52″N 87 °43′10″E	Anthropogenic activity is too much low. Population relatively low.

Methods for analysis of physico-chemical and microbial parameters

Determination of pH

The pH of the surface water was measured with a potable digital pH meter (Model BST-BT-BT65; sensitivity =±0.01). Three readings were recorded from each site and the mean value was considered for statistical analysis.

Determination of Total Alkalinity (TA), Electrical Conductivity (EC) and Total Hardness of water

Alkalinity in water can be determined by titrating the sample using a strong alkali and phenolpthalein used as an indicator (Trivedy and Goel, 1986). Alkalinity (mg/lit) = Volume of 0.1 NHCl solution used as titrant × 1000/ Vol of water sample. Conductance of water was measured by standard conductometer. The hardness of water was measured by titriometric methods using EDTA (Trivedy and Goel, 1986). Hardness as mg/lit or ppm = (V × 20) ppm, Where V= mean volume of EDTA.

Determination of DO, BOD, and COD of water sample

For chemical variables of water like Dissolved Oxygen (DO) Biochemical oxygen Demand (BOD) and Chemical Oxygen Demand (COD) was analyzed by the standard method of APHA (2005) and Trivedy and Goel(1986).

Analysis of microbial load in water sample

Determination of total coliform and fecal coliform in water

Fecal coli forms do not pose a health threat but serve as an indicator for bacteria that can cause illness in humans and aquatic life. The total coliform and fecal coliform of water sample was determined Multiple fermentation Technique by (APHA, 1998).

Graphical analysis

Graphical presentation was completed using MS- excel

Determination of heavy metals present in water sample

For heavy metal analysis, water samples were filtered through Nuclepore filters (0.4 µm pore diameter) and aliquots of the filters were acidified with sub-boiling distilled nitric acid to a pH of about 2 and stored in cleaned low-density polyethylene bottles. Dissolved heavy metals were separated and pre-concentrated from the seawater using dithiocarbamate complexation and subsequent extraction into Freon TF, followed by back extraction into HNO_3(Lindsay et al , 1978). Extracts were analyzed for Zn, Cu, Mn and Fe by Atomic Absorption Spectrophotometer (Perkin Elmer: Model 3030).

Result and discussion:

Water temperature

The surface water temperature at all the five sampling stations showed a more or less parallel trend of variation throughout the season. The monthly variation of surface water temperature during pre-monsoon period (March to June) was characterized by a mean around 34ºC, in monsoon period (July to October) shows around 29ºC and during the post monsoon period (November to Februarary), the mean surface water temperature was 20ºC (Fig. 3). Present results showed that monthly variation of water temperature did not changed drastically between pre monsoon and monsoon season, but the strong changes was noted during post monsoon period as this period belongs to winter season and characterized by cold weather.

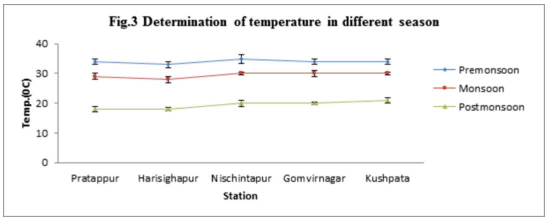


Fig.3 Determination of temperature in different season

Water pH

The water pH of all the stations showed slightly alkaline and remained almost constant. Alkaline pH of each water bodies was due to the dissolved the domestic waste and agriculture runoff. A minor lowering of water pH was recorded during the monsoon period due to discharge of freshwater run-off from the adjacent village. The monsoonal cycle has some pronounced effect on the physico-chemical parameters of aquatic environment, particularly on temperature and pH of the water bodies. The decrease in pH in monsoon period was mainly to the massive rainfall that causes a considerable increasing in freshwater runoff from the land runoff of the river adjacent village. The highest pH was observed during the pre-monsoon period because of excessive evaporation (Fig.4). Comparatively high pH of the water at Nischintapur may be attributed to discharge of huge domestic waste in to the river. According to Boyd (1990), the pH can also affect fish health. For most freshwater species, a pH range between 6.5 - 9.0 is ideal, the observed pH is usually between pH 6.8 and 7.6. Therefore, the observed pH of water in different stations indicates good water quality as it falls within the normal range for aquaculture.

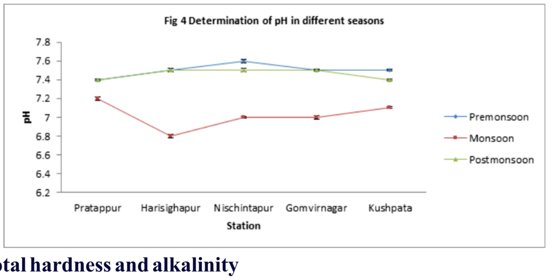


Fig 4 Determination of pH in different seasons

Total hardness and alkalinity

Hardness in water is due to the natural accumulation of salts of mainly Calcium and Magnesium. According to Kannan (1991), water with the hardness having values more than 180 mg/L is very hard. The acceptable limit of total hardness is 500mg/L (WHO, 1984). Based on the total hardness, Sawyer and McCarty (1966) have classified the water into four classes such as soft (less than 75mg/L), moderately hard (75-150mg/L), hard (150- 300mg/L) and very hard (more than 300mg/L). The standard unit for the total hardness specified is 300mg/L and is considered potable; beyond this limit it produces gastrointestinal irritation (ICMR, 1975). Accordind to Lawson (1995), the permissible level of alkalinity in water for fish culture is less than 20ppm. In the present study, total hardness ranged from 38±0.1 mg/L to 68±5.5 mg/L (Fig.6) and the alkalinity of the water fluctuated from 6.0±1.2 mg/L to 20±2.0 mg/ L (Fig .5). Therefore, water quality for all the sampling station is potable for domestic purpose and not adverse for fish.

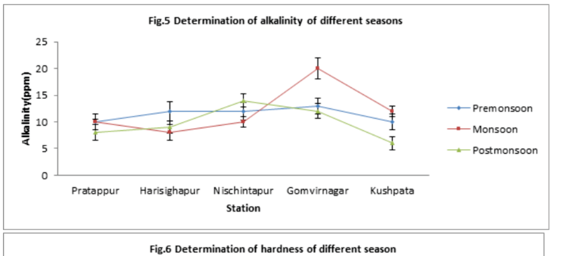


Fig.5 Determination of alkalinity of different seasons

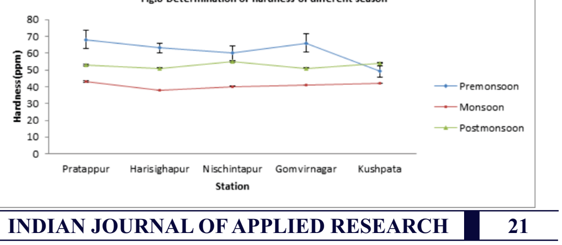
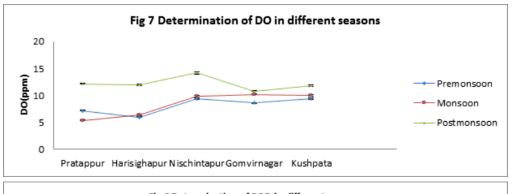
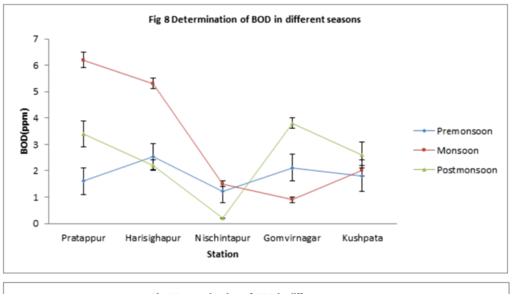


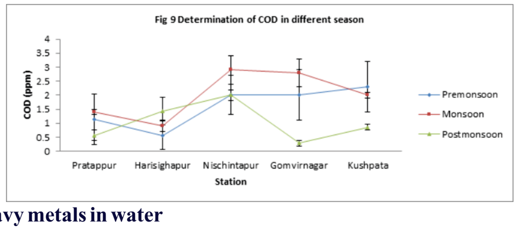
Fig.6 Determination of hardness of different season

Dissolved oxygen, Biochemical oxygen demand and Chemical oxygen demand (COD)

The dissolved oxygen (DO) is one of the most important parameters of water quality assessment. It plays an important role on the biotic life of an aquatic system and this can be used as an index of water quality for pollution studies (Thirumala et al., 2011). Maximum values of DO observed were 14.2±0.2 mg/lit at Nischintapur and minimum values observed were 5.4±0.1 mg/ lit at Pratappur station during the study period (Fig.7). High values of DO at Nischintapur could be due to better domestic sanitation, good hygienic and greater macro vegetation which is absent in other stations. In general, a saturation level of at least 5 mg/lit is required (Lioyd, 1992) for aquatic animal. Values lower than this can put undue stress on the fish, and levels reaching less than 2 mg/L may result to death (but 3 mg/L to some species). Therefore, present investigation indicates that Silabati river water is considered as suitable site for aquaculture and also suitable for domestic purpose. Biochemical Oxygen Demand (BOD) detects only the destructible proportion of organic substances and as a general principle is therefore lower than the COD value, which also includes inorganic materials and those materials which cannot be biologically, oxidized. For domestic and some industrial wastewater COD is about 2.5 times BOD. This is important parameter to assess the pollution of surface waters and ground waters where contamination occurred due to disposal of domestic and industrial effluents. Drinking water usually has a BOD of less than 1 mg/l. But, when BOD value reaches 5 mg/l, the water is doubtful in purity (WHO, 2011). The BOD of water sample varied from 0.2± 0.01 to 6.2±0.3 ppm throughout the sampling stations (Fig.8) which is within the permissible level compared to the acceptable limit for drinking purpose by WHO. The standard value of COD by WHO (2011) and Bangladesh standard is 4 mg/L (GoB, 1997). The COD of water sample varied from 0.29±0.1 to 2.9±1.5 ppm throughout the sampling stations (Fig.9) which is within the permissible level compared to the acceptable limit for drinking purpose by WHO. Present result also shows that the high value of BOD and COD was observed at monsoon period because of land runoff which contain different household organic and inorganic wastes, drainage effluent, fish feed, detergent, etc.







Heavy metals in water

The aquatic environment with its water quality is considered the main factor controlling the state of health and disease in both man and animal. Nowadays, the increasing use of the waste chemical and agricultural drainage systems represents the most dangerous chemical pollution. The most important heavy metals from the point of view of water pollution are Zn, Cu, Pb, Cd, Hg, Ni and Cr. Some of these metals (e.g. Cu, Ni, Cr and Zn) are essential trace metals to living organisms, but become toxic at higher concentrations. Others, such as Pb and Cd have no known biological function but are toxic elements. The permissible level of studied metal for animal are-

Permissible level*	Cu	Zn	Fe	Mn
Water (ppm)	1	20	0.01	0.2

** Permissible level as recommended by Egyptian Organization for Standardization (1993)*

The same is true for certain elements with respect to drinking water. Selenium, for example, is essential for humans but becomes harmful or even toxic when its concentration exceeds a certain level. Metal concentrations in water at different water sample are illustrated in Table -2, 3 and 4. Present study revel that the concentration of heavy metal in water is belongs to permissible label but slightly high value of Fe was observed at all stations during pre monsoon because of land run off from upper area of silabati river which can create adverse effect on aquatic animal.

Table 2: Determination of heavy metals in in water from Shilabiti River (Premonsoon)

River water	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)
Pratappur	0.140±0.012	0.004±0.001	0.018±0.010	0.338±0.015
Harisighapur	0.077±0.010	T	0.016±0.012	0.267±0.012
Nischintapur	0.150±0.015	0.003±0.001	0.052±0.010	0.263±0.012
Gomvirnagar	0.091±0.010	T	0.035±0.010	0.284±0.012
Kushpata	0.082±0.010	0.001±0.001	0.037±0.012	0.313±0.010

Table 3: Determination of heavy metals in in water from Shilabiti River (monsoon)

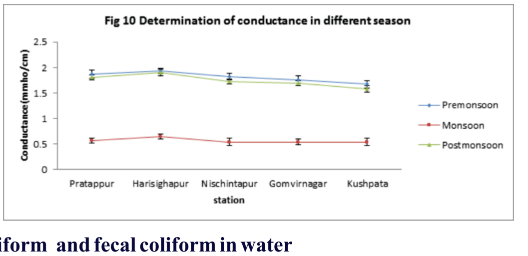
River water	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)
Pratappur	0.089±0.012	T	0.024±0.016	0.124±0.016
Harisighapur	0.98±0.012	T	0.029±0.015	0.054±0.010
Nischintapur	0.199±0.015	T	0.033±0.017	0.129±0.017
Gomvirnagar	0.079±0.015	T	0.020±0.017	0.083±0.015
Kushpata	0.086±0.012	T	0.034±0.015	0.180±0.015

Table 4: Determination of heavy metals in in water from Shilabiti River (Post monsoon)

River water	Zn (ppm)	Cu (ppm)	Mn (ppm)	Fe (ppm)
Pratappur	T	T	0.030±0.015	ND
Harisighapur	T	T	0.044±0.012	ND
Nischintapur	T	T	0.031±0.015	ND
Gomvirnagar	T	T	0.032±0.013	ND
Kushpata	T	T	0.049±0.012	ND

Conductance

Electrical conductivity of water at different stations was recorded to be 540 to 1900 µmhos/cm (Fig.10). Freshwater, fish ponds, in general, exhibit low EC values which may be expressed as µmoles cm^{-1}. Sharma et al (2011) stated that natural waters usually have EC values of 20 to1500 µmhos/cm. But, present result indicates that the EC value is slightly higher during the pre and post monsoon in all stations which are not suitable for aquatic animal. An increase in electrical conductivity is regarded as pollution indicator in water bodies (Das et al., 2006).



Coliform and fecal coliform in water

Coliform and fecal coliform is found mostly in feces and intestinal tracts of humans and other warm blooded animals. It does not cause disease but are used as an indicator of disease causing pathogens in the aquatic environment. High levels of fecal coliform in the water may cause typhoid fever, hepatitis, gastroenteritis, dysentery and eat infection. In recent times increased attention is given to the possibility of cultured fish as vector of human pathogenic bacteria (Islam et al., 2000). Fish living in natural environment are known to harbor pathogenic Enterobacteriaceae (pillay, 1990). The State of California Water Pollution Control Board recommends concentrations of coliform in water is less than 5 colonies per 100 ml of sample for shellfish culture. Present result indicate that the maximum density of total coliform (TC) and fecal coliform in the water was recorded during premonsoon and monsoon in all stations and low at post monsoon (Fig.11 and 12) but amount exceed the permissible level at all station in three season which is restricted for aquaculture an drinking purpose.

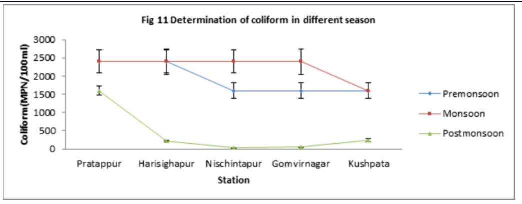


Fig 11 Determination of coliform in different season

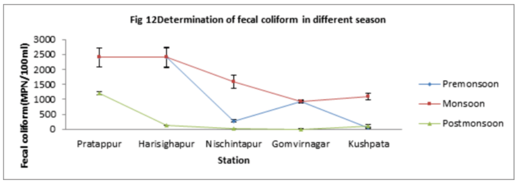


Fig 12Determination of fecal coliform in different season

CONCLUSION

Present result indicate that water quality of all studied area are good with respect to physiochemical value of water and can use directly in domestic purpose but not good for directly drinking purpose because of presence of high level of coliform and fecal coliform in all sampling stations. So, this result informed that high bacteria levels can limit the uses of water for domestic .

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