

# Water quality modeling for seasonal fluctuation of Ichamati river, West Bengal, India

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**Abstract** The study was carried out to assess some physico-chemical water quality parameters and pollution scenario of the Ichamati river. Water samples were collected from nine different selected stations at origin of the river Majhdia to Taki end portion of the Ichamati river during the pre-monsoon, monsoon and post-monsoon periods. A seasonal variation in these parameters was observed throughout the study period and monthly comparisons were made as monsoon, pre-monsoon and post-monsoon. The results of the present investigation was undertaken to assess seasonal and spatial variation in pH, Electrical Conductivity, Turbidity, Salinity, Chlorophyll, DO and Water Temperature are compared with literature values and investigation reveals that there is a fluctuation in the physico-chemical characters of the water, this will be due to ebb and flow and change in the temperature and salinity as season changes. All parameters except turbidity and conductivity have shown high concentration in pre-monsoon-monsoon and post-monsoon, overall the concentration of water quality parameters were governed by flushing of rainfall, river water flow, sea water intrusion runoff from agricultural fields. Turbidity content in the study area was higher because the Ichamati river is dynamic zone of lower stretch. This river only depends on upper stretch rainy season rain water; no tidal fluctuation but lower stretch of the river is high tidal fluctuation the salinity is must high then upper stretch the value of Salinity 3–8.5 ppm that the

parallelly fluctuation the huge amount of sediment continuing; the turbidity is very high 600–700 NTU.

**Keywords** Seasonal variation · Pre-monsoon · Pollution · Water quality parameters and post-season

## Introduction

In the eastern side of the Bhagirathi/Hooghly River the only major river is the Ichamati river which is a link between the ‘Nadia group of rivers’ (viz. Jalangi, Mathabhanga, Churni etc.) in the north and Sundarban in the south (Chakravarti 1938; Mondal and Bandyopadhyay 2014a, b). The Ichamati river, a spill channel of Mathabhanaga river, originating from Majdia (krishnaganj Block) Nadia district, India and Bangladesh (for a short distance) enters into the 24 Parganas (north) district at Bagdah block. Subsequently, the Ichamati river flowing through eastern part of the 24 Parganas (north & south) districts ultimately debouches in the Raimangal river vis-a-vis the bay of Bengal. The Ichamati river could be subdivided into two segments on the basis of the river morphology:

*Upper stretch* Brand off point from Mathabhanaga River at Majdia, Krishnaganj Block, Nadia District and beri/Swarupnagar, 24 Parganas (N) district. In this stretch the river is moribund in nature with high sinuosity and serpentine meanders exhibiting numerous abandoned scrolls/oxbow lakes. In this part, the river is practically not receiving any upland flow excepting in rainy season (Mondal and Bandyopadhyay 2014a, b; Mondal and Satpati 2012).

*Lower segment* From Beri/Swarupnagar to Bay of Bengal. In this portion, the channel width gradually

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increases as semidiurnal tidal flow exists. In this stretch, Jamuna river is a tributary to the Ichamati river and joins at Tipi, 24 Parganas (N). The lower most part of the river is funnel shaped (Chakravarti 1938; Mondal and Bandyopadhyay 2014a, b).

River banks areas are the upper parts in any of its cross-section and it may or may not consist of manmade structures to have influences on the natural morphodynamic system of the channel. After the bed, bank is the second most important component of the river channel and it is a transverse vector of the channel. The river banks gradually descend up to the river bed and the cross-profile may consist of different slop elements. The nature of put significant influences on the morphological equilibrium of the channel in relation its ambient environmental set up. The bank area of a deltaic river channel is highly influence by tidal conditions. When the river is in low tidal level, the bank of river channel is further exposed, (Mondal and Satpati 2012) but a high tide situation, when the river is full to its brim, much of its bank area is inundated. The present study attempted to study the morphodynamics setting and erosion status of the river banks of the Ichamati, a decaying river located in the eastern part of Ganga delta region of West Bengal (Chakravarti 1938; Mondal and Bandyopadhyay 2014a, b; Mondal and Satpati 2012).

## Background of the study

According to the reference in the Mahabharata, the Raghubansa and some of the Puranas, the delta lay on the boundary between two powerful kingdoms, namely Suhma, corresponding to western Bengal, and Vanga, or Eastern Bengal, and its probable that the Nadia District was under the control of the kingdom Vanga in the time of Raghubansa, i.e., about the fifth century A.D. When the Chinese traveler Hiuen Tsiang visited Bangal in the seventh century, he found two large kingdoms in the lower delta, namely, Samatata and tamralipti. From the general description which he gives of the former, it seems clear that it must have included what is now known as the Nadia district. Samatata appears to be another name for Vanga, given to it on account of its flat and level aspect. In the tenth eleventh centuries the northern delta seems to have formed part of the empire of the Pal kings, and it is certain that it was included in the kingdom of the Sen Rajas, who are masters of both Vanga and Radha. The town of the Nabadwip is said have to be founded by Lakshman Sen, son of Ballal Sen, and Ballal Sen himself used to visit the locality, as his name is still connected with a mound and a tank in the village of Bamanpukur which is close by Nabadwip (Garrett 1910).

## Objectives of the study

- Physical measurements of Ichamati river during the Pre-monsoon, Monsoon and Post-Monsoon season of Water Temperature, pH, DO, Electric Conductivity, Turbidity, Salinity and Chlorophyll Concentration etc.
- The trends of changes in water quality with activities in the catchment area.
- Evaluation of the effectiveness of a water quality management intervention of the Ichamati river catchment area.
- We performed an exploratory data analysis of Water Quality Analyzer Instrument consisting mainly comparing the distributions for each multi season and calculating linear trends.

## Location

The Ganga–Brahmaputra Meghna river system constitutes one of the largest river systems of the world in terms of its water resources its extends to 21°30 to 23°30N and 88°30 and 89°E. The distributaries of the Padma River like Bhairab, Jalangi, Mathabhanga river and their tributaries enters West Bengal and joins the Bhagirathi on its left bank. The Bhairab and the Jalangi meet and their joined course known as Jalangi falls into Bhagirathi. The Mathabhanga divides into branches namely; Churni and Ichamati, The river Churni meets the Bhagirathi while the other flows southwards and joins the Kalindi. The Sundarbans region is covered by numerous estuaries and streams, mainly distributaries of main rivers. The rivers are interconnected and are fed by tidal waters. The major rivers of the area are Hooghly, Matla, Gosaba, Saptamukhi, Haribhanga, Piyali, Thakuran/Jamira, Raimangal, Kalindi and Ichamati.

It has an area mainly consists of a wide alluvial plain, bounded on the west by the Bhagirathi, and intersected by the Jalangi which flows past the head-quarters station and, eight or nine miles further on, joins the Bhagirathi opposite Nabadwip and lower part Santipur of Ichamati river catchment area. In this area are Bhagirathi-Hooghly River is the western most major distributry channel of the Ganga delta. In the east other distributaries are Bhairab, Sialmari, Jalangi, Mathabhanga-Churni-Ichamati rivers (commonly known as “Nadia Group of Rivers”) up to Bangladesh border. In consequence of this area communication lines-Eastern Railway and National Highway 34 and 31 (Fig. 1).

## Water quality analysis of Ichamati river

Water quality testing is an important part of environmental monitoring. When water quality is poor, it affects not only aquatic life but the surrounding ecosystem as well.

Fig. 1 Location map

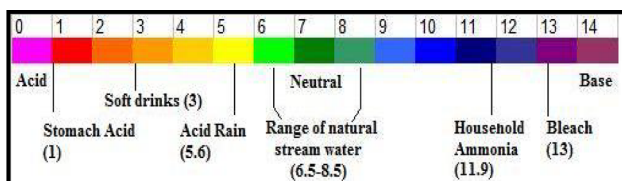
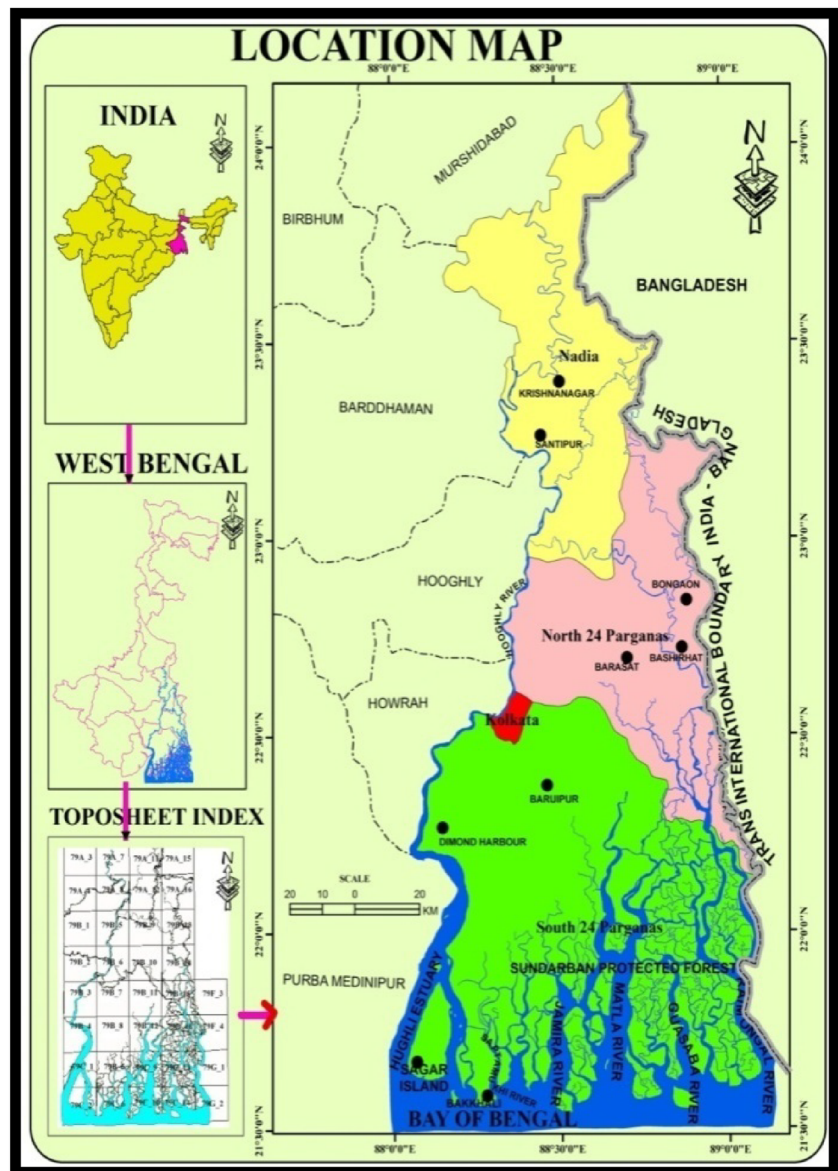


Fig. 2 Range of PH

These sections detail all of the parameters that affect the quality of water in the environment. These properties can be physical, chemical or biological factors. Physical properties of water quality include temperature and turbidity. Chemical characteristics involve parameters such as pH and dissolved oxygen. Biological indicators of water

quality include algae and phytoplankton. These parameters are relevant not only to surface water studies of the ocean, lakes and rivers, but to groundwater and industrial processes as well.

### pH

The pH of river water is the measure of how acidic or basic the water is on a scale of 0–14. It is a measure of hydrogen ion concentration. US natural water falls between 6.5 and 8.5 on this scale with 7.0 being neutral. The optimum pH for river water is around 7.4 (Fig. 2). Water’s acidity can be increased by acid rain but is kept in check by the buffer limestone. Extremes in pH can make a river inhospitable to life. Low pH is especially harmful to immature fish and

insects. Acidic water also speeds the leaching of heavy metals harmful to fish.

The Ichamati River had a measured pre-monsoon, monsoon and post-monsoon pH ranging from 6.9 to 8.9 in three time tests of a range of locations in 2014 (Fig. 3; Table 1). The lower values present a problem for most organisms with the exception of bacteria, which can survive pH's as low as 2.0. A pH of 8.0 should be sufficient to support most river life with the possible exception of snails, clams, and mussels, which usually prefer a slightly higher pH. The average pH in the study was 7.5, a value that is only sufficiently basic for bacteria, carp, suckers, catfish, and some insects.

During rain water is naturally acidic at about 5.6. Stream water usually ranges from a pH of 7.5 to a pH of 8.9; this range is considered to be an optimal range for most aquatic life. The natural pH of the river will vary from river to river but the pH range of a river will generally remain stable.

The natural pH range of Ichamati river is largely determined by the geology and soils of the area, for example muddy areas will result in rivers and streams having naturally higher pH levels and peat areas will have naturally low pH levels. Carbon dioxide from the atmosphere can also affect the pH of a river; when it mixes with the water it increases its soil fertility.

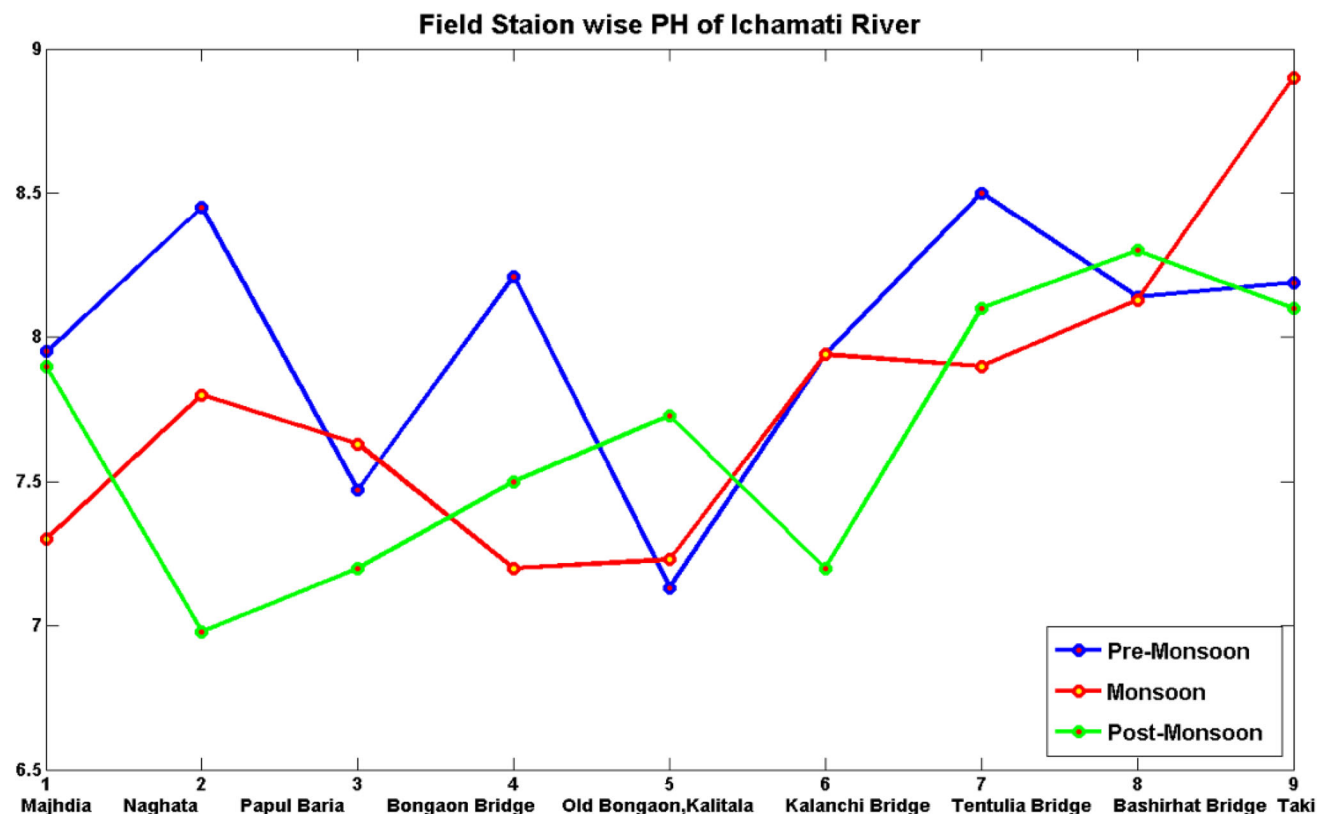
The pH of the river affects the organisms living there. Large fluctuations in pH outside of a rivers natural pH range can lead to stresses on aquatic life in that river.

Low pH levels (below optimal) can result in fish kills by stressing their systems causing physical damage, which in turn can make them more vulnerable to disease, similarly high pH particularly in combination with high water temperature, can increase the amount of unionized ammonia which is highly toxic to fish of the Ichamati river.

### Dissolved oxygen

An adequate supply of dissolved oxygen gas is essential for the survival of aquatic organisms. A deficiency in this area is a sign of an unhealthy river. There are a variety of factors affecting levels of dissolved oxygen. The atmosphere is a major source of dissolved oxygen in river water. Waves and tumbling water mix atmospheric oxygen with river water. Oxygen is also produced by rooted aquatic plants and algae as a product of photosynthesis.

There are physical factors that can lessen the amount of oxygen dissolved in the Ichamati river. High temperatures, which may result from high turbidity, from the return of industrially used water to the river (the phenomenon of thermal pollution), or from dry periods, decrease the



**Fig. 3** Variations in pH of surface water

**Table 1** Location-wise sampling stations and water quality parameters

Sampling station	pH	DO	Conductivity	Turbidity	Temperature	Salinity	Chlorophyll
(Pre-monsoon April 2014)							
Orgin of Ichamati River Majdia	7.95	6.23	5.3	8.9	33.3	0.1	4.3
Naghata	8.45	6.49	5.2	2.8	33.5	0.2	18.7
Pipul Baria	7.47	5.2	6.4	12.6	34.4	0.1	5.1
Bongaon Bridge	8.21	9.52	8.8	3.3	33.8	0.3	32.6
Old Bongaon Kalitala	7.13	3.83	6.7	8.9	34.5	0.3	2.5
Kalanchi Bridge	7.94	4.62	5.15	26.3	33.1	0.7	2.5
Tentulia Bridge	8.5	5.23	7.3	500.6	34.2	5.6	1.9
Bashirhat Bridge	8.14	6.45	9.96	709.9	34.4	5.5	1.6
Taki	8.19	7.29	11.55	700.2	34.5	8.7	8.5
(Monsoon July 2014)							
Orgin of Ichamati River Majdia	7.3	5.7	2.14	5.6	30.2	0.1	5.4
Naghata	7.8	5.69	2.62	8.5	31.5	0.2	7.9
Pipul Baria	7.63	5.8	2.81	9.2	31.2	0.3	8.9
Bongaon Bridge	7.2	5.6	3.2	10.7	30.8	0.1	6.9
Old Bongaon Kalitala	7.23	5.35	3.1	8.6	30.9	0.1	11.1
Kalanchi Bridge	7.94	5.74	5.6	20.4	31.7	1.2	7.7
Tentulia Bridge	7.9	5.28	8.7	201.6	31.2	2.1	2.4
Bashirhat Bridge	8.13	5.31	9.7	618.3	30.6	5.4	15.4
Taki	8.9	5.9	10.43	680.2	30.2	3.4	13.1
(Post-monsoon October 2014)							
Orgin of Ichamati River Majdia	7.9	5.6	4.3	5.3	28.2	0.1	5.9
Naghata	6.98	6.2	3.4	6.5	27.3	0.2	6.87
Pipul Baria	7.2	7.52	5.6	7.9	26.6	0.1	7.6
Bongaon Bridge	7.5	6.79	6.2	4.7	27.8	0.2	6.9
Old Bongaon Kalitala	7.73	5.9	7.1	8.6	27.9	0.3	10.1
Kalanchi Bridge	7.2	4.74	8.6	2.4	28.1	1.5	8.7
Tentulia Bridge	8.1	6.28	9.7	160.6	28.2	6.1	3.4
Bashirhat Bridge	8.3	7.31	10.7	518.3	29.3	6.4	14.4
Taki	8.1	6.9	11.43	610.2	29.5	7.4	15.1

amount of gases that can be dissolved in water. Dry periods also decrease flow which reduces the amount of oxygen churned into the water.

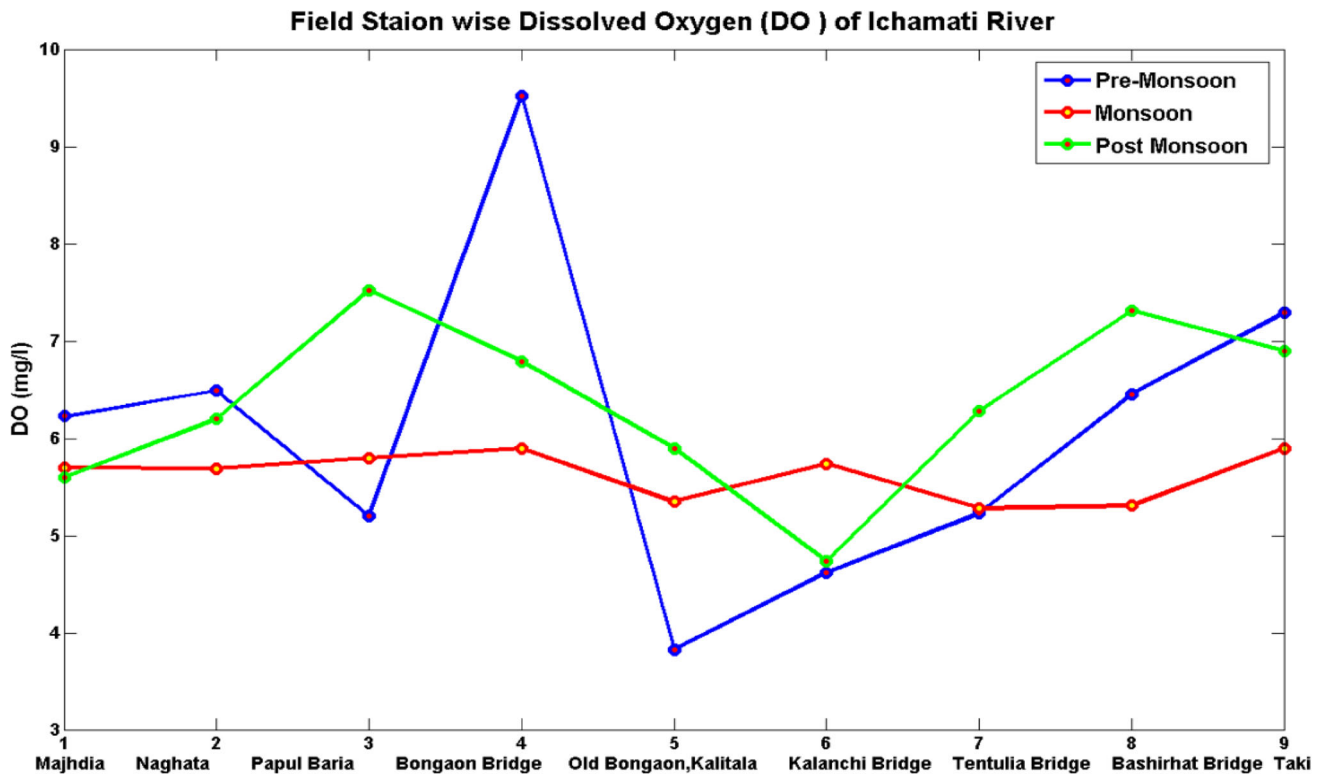
In the navigation channel near the mouth of the Raimangal River, the river is dredged regularly to maintain sufficient depth for boats. This extra depth slows the river which hampers its mixing action. The navigation channel has particularly low dissolved oxygen levels.

DO is the most important sensitive parameter for assessing the water quality and reflects the physical and biological process. Dissolved oxygen is needed for living organism to maintain biological process. From the DO profile it can be seen that the DO level is maximum near the water surface due to the proper mixing of surface water with the open atmosphere. As we go deep down the DO level decreases accordingly but it is still sufficient for the aquatic life to survive. The percentage of dissolved oxygen saturation also remains constant along the entire stretch of

the river under study (Fig. 4). The Dissolved oxygen was classified during the pre-monsoon, monsoon and post monsoon average ranges of 3.5–7.5 mg/l for pre monsoon Bongaon location place is high fluctuation DO because this area huge amount of water hyacinth value of DO 9.8 mg/l. The Ichamati river based on the ranges the spatial variation graph of Dissolved oxygen has been prepared and presented (Fig. 4; Table 1). In the present study the Ichamati river catchment area of water having acceptable range of DO.

**Chlorophyll concentration of Ichamati river**

Chlorophyll gives plants their green colour and is produced by microscopic plants called algae in lakes and rivers. The amount of chlorophyll in water is usually highest in summer and lowest in winter because of course it is not easy for plants to grow in winter. There are many human activities



**Fig. 4** Variations in DO of surface water

that affect chlorophyll in water, such as sewage inputs and destruction of lake and river shorelines (Horne and Goldman 1994).

Chlorophyll concentrations can act as an indicator of phytoplankton abundance and biomass in the Ichamati river waters. It is natural for levels of chlorophyll to fluctuate over the different seasons Jamshidi and Bakar (2011) (Fig. 5; Table 1). Here at the time of measurements in pre-monsoon, monsoon and post-monsoon the concentrations of chlorophyll increased with depth. Concentrations at the Ichamati river mainly varied between 5 and 35 g/l. Different nine places to sample collect along the river catchment the maximum value of chlorophyll was recorded around 5–15 g/l. Then during the monsoon and post-monsoon season average chlorophyll concentration of the river 5.1–10.8 g/l. So the high fluctuation during the pre-monsoon time 4.9–34 g/l, but there are two places Bongaon and Naghata location places are high fluctuation chlorophyll because this area has a huge amount of water hyacinth highest value 35 g/l (Fig. 5; Table 1).

### Water hyacinth of Ichamati river

This Ichamati river is now considered a major weed species. A huge amount of water hyacinth is showing at Bongaon and Naghata. Ichamati river water-hyacinth is a floating plant that has clusters of leaves with spongy stalks arising from a base

of dark purple feathery roots (Fig. 6). The leaf clusters are often linked by smooth horizontal stems (called stolons). Linked plants form dense rafts in the water and mud. Water-hyacinth blocks waterways and limits boat traffic, recreation, flood control and wildlife use. By producing a dense canopy at the water surface, this exotic pest plant shades out native submersed plant species and can uproot native emergent species that are important to wildlife.

### Environmental damage caused by water-hyacinth populations of Ichamati river

- Water-hyacinth mats lower dissolved oxygen concentrations, damaging fish populations.
- Water-hyacinth mats can increase flooding in rivers and canals by forming dams.
- Water-hyacinth mats provide ideal breeding environments for mosquitoes.
- Water-hyacinth populations decrease biodiversity in Ichamati river catchment area.

### Turbidity

Turbidity is the condition resulting from suspended solids in the water, including silts, clays, industrial wastes, sewage and plankton. Such particles absorb heat in the sunlight, thus raising water temperature, which in turn lowers

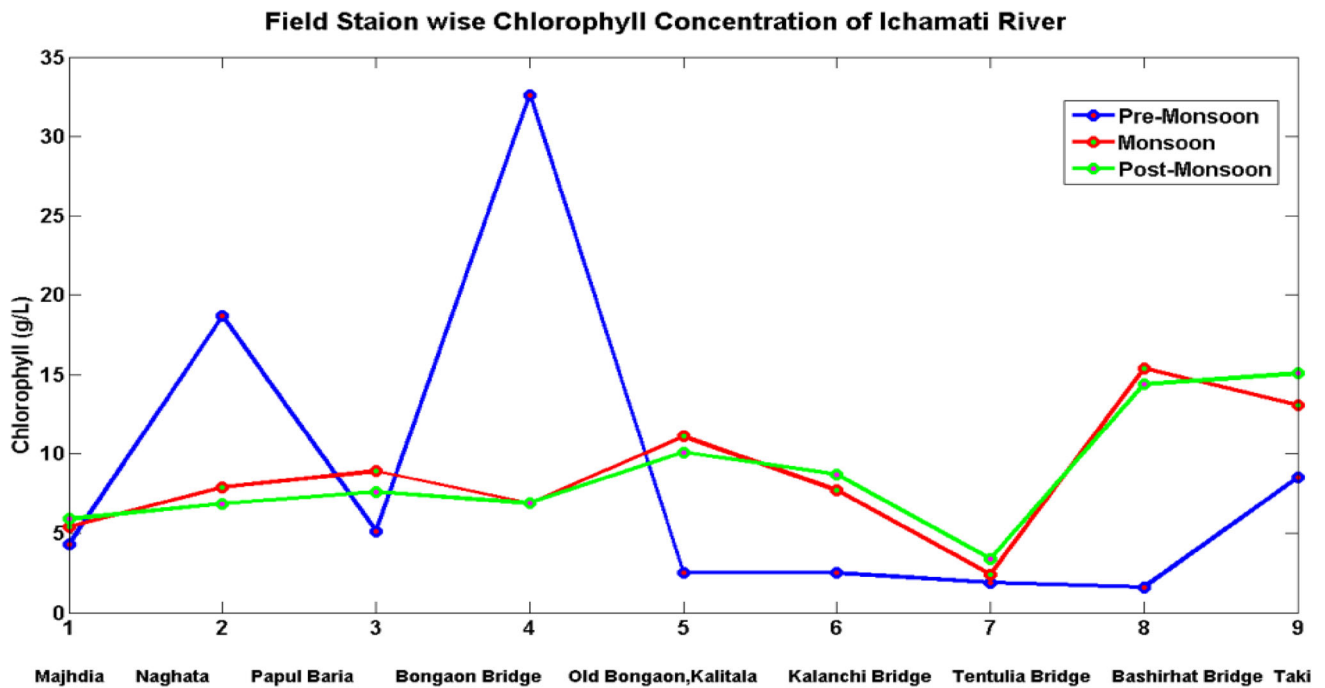


Fig. 5 Variations in chlorophyll concentration of surface water

Fig. 6 Water hyacinth of Ichamati river Bongoan



dissolved oxygen levels. They also prevent sunlight from reaching plants below the surface. This decreases the rate of photosynthesis, so less oxygen is produced by plants. Turbidity may harm fish and their larvae. It is caused by soil erosion, excess nutrients, various wastes and pollutants, and the action of bottom feeding organisms which stir sediments up into the water.

In the Ichamati river catchment area average turbidity from a study of nine sites was Pre-Monsoon, Monsoon and Post-Monsoon water quality analyzer Turbidity Units (NTU), with a range of average

Majhdia to Kalanchi 10 units of upper stretch this area influence of fresh water turbidity range low but in lower stretch the Ichamati river depends on tidal fluctuations huge amount of turbidity continuing and the riverside of the river lots of brick fields industry are growing the huge amount sediment accumulate of the river. So our field study collect the sample of turbidity by water quality analyzer instruments maximum high turbidity of suspended sediment load are shown of the lower stretch average value 600–700 NTU (Fig. 7; Table 1).

## Water temperature of Ichamati river

Temperature impacts the rates of metabolism and growth of aquatic organisms, rate of plants' photosynthesis, solubility of oxygen in river water, and organisms' sensitivity to disease, parasites, and toxic materials. At a higher temperature, plants grow and die faster, leaving behind matter that requires oxygen for decomposition. The temperature of the Ichamati river as tested in Pre-Monsoon, Monsoon and Post-Monsoon by water quality analyzer. The temperature of the river water fluctuates between multi seasonal variations 25.5–34.5 °C along the entire stretch from Ichamati river. In the Ichamati river, temperature changes radically in the spring and autumn.

Figure 8 and Table 1 shows the temperature at different Stations in pre-monsoon, monsoon and post-monsoon. Among different stations, in pre-monsoon, the highest temperature was observed at Taki (34.5 °C) and lowest at Majhdia (33.2 °C), whereas in post-monsoon season, the highest value was observed at Taki (28.7 °C) and lowest at Papul Baria (26.5 °C) station and during the monsoon season, the highest value was observed at Kalanchi Bridge (31.5 °C) and lowest at Taki (29.9 °C) station. The fluctuation in river water usually depends on the season, geographic location, sampling time and temperature of effluents entering the stream (Ahipathi and Puttaiah 2006). The standard value of temperature of river water is 20–30 °C (ECR 1997).

## Why the temperature of water is important of Ichamati river

Temperature is an important factor to consider when assessing water quality. In addition to its own effects, temperature influences several other parameters and can alter the physical and chemical properties of water. In this regard, water temperature should be accounted for when determining (Wilde 2006).

- Metabolic rates and photosynthesis production.
- Compound toxicity.
- Dissolved oxygen and other dissolved gas concentrations.
- Conductivity and salinity.
- Oxidation reduction potential (ORP).
- pH.
- Water density (Fig. 9).

## Electric conductivity of water level

The conductivity of water due to water level fluctuations is often directly connected to water flow. Conductivity and salinity fluctuations due to water level changes are most noticeable in the lower stretch of Ichamati river. As tides rise, saltwater from the Bay of Bengal is pushed into the river, raising salinity and conductivity values. When the

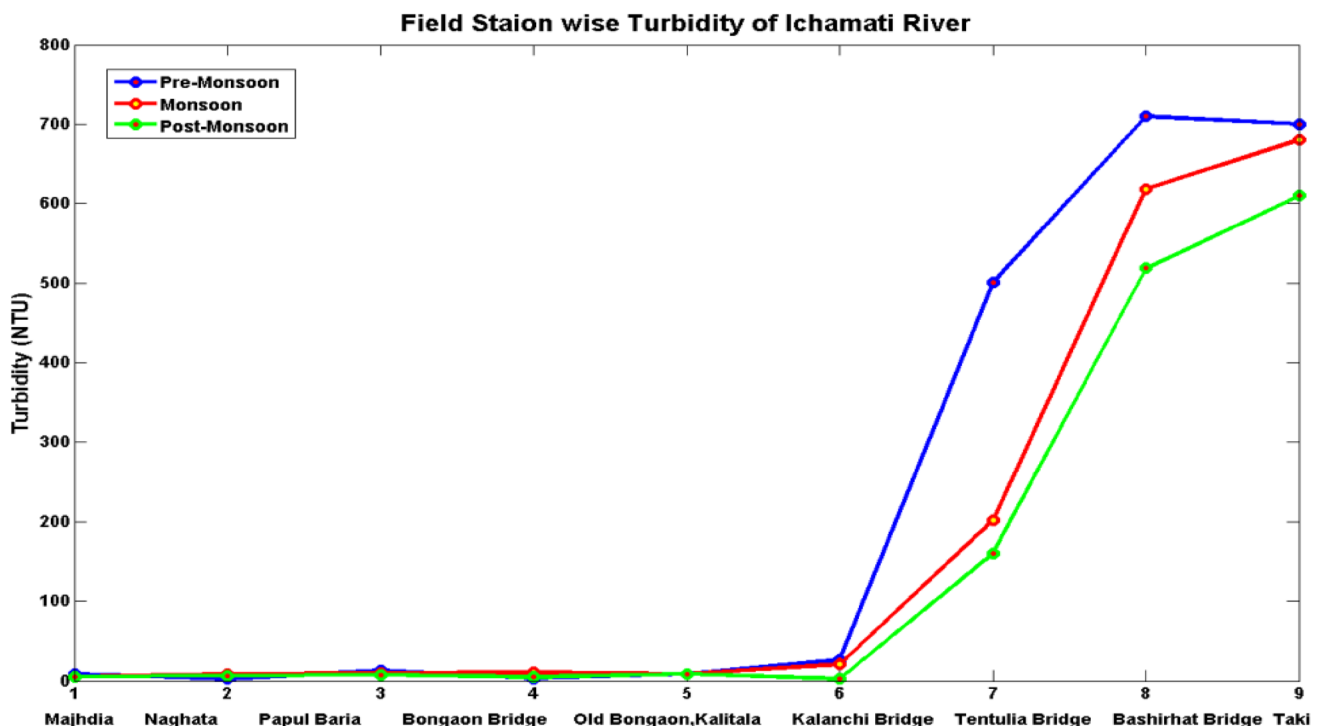


Fig. 7 Variations in turbidity of surface water



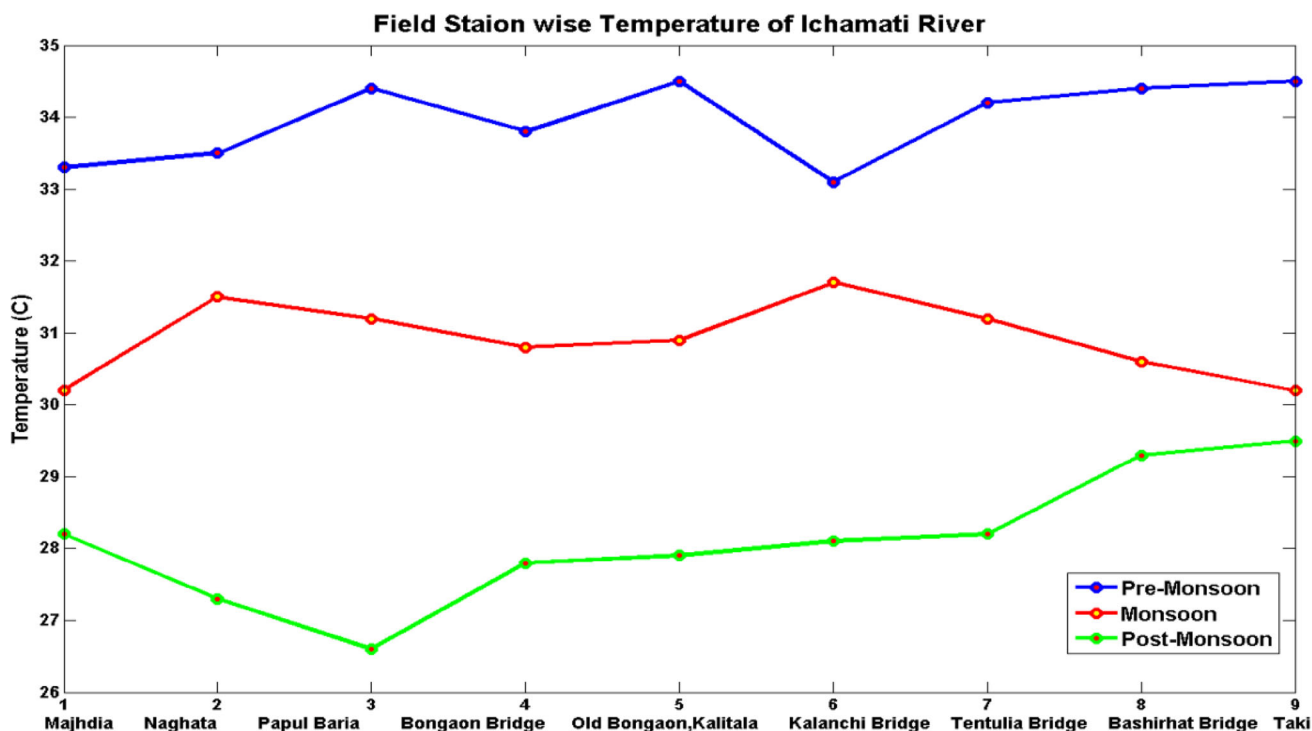


Fig. 8 Variations in water temperature of surface water

tide falls, the saltwater is pulled back toward the ocean, lowering conductivity and salinity.

Evaporation can cause salinity concentrations to rise. As the water level lowers, the ions present become concentrated, contributing to higher conductivity levels (LCRA 2014). This is why conductivity and salinity values often increase in summer due to lower flow volume and evaporation (Virginia Institute of Marine Science 2005). On the other side of the scale, rain can increase water volume and level, lowering conductivity of the river.

In streams and rivers, normal conductivity levels come from the surrounding geology (EPA 2012). Clay soils will contribute to conductivity, while granite bedrock will not (EPA 2012). The minerals in clay will ionize as they dissolve, while granite remains inert. Likewise, groundwater inflows will contribute to the conductivity of the stream or river depending on the geology that the groundwater flows through. Groundwater that is heavily ionized from dissolved minerals will increase the conductivity of the water into which it flows.

Electrical conductivity usually used for indicating the total concentration of ionized constituents of water (Huq and Alam 2005). The standard value of electrical conductivity is 300  $\mu\text{S}/\text{cm}$  (De 2007). The highest EC (11.5  $\text{mS}/\text{cm}$ ) lower stretch of Ichamati river of pre-monsoon, monsoon and post-monsoon was found at Bahirhat and Taki. The values of EC at different stations are shown in (Fig. 10; Table 1). The average value of EC in pre-monsoon season was 6.5  $\text{mS}/\text{cm}$  and monsoon season are found that 6.5  $\text{mS}/\text{cm}$  and post-monsoon season 8  $\text{mS}/\text{cm}$ . These values exceeded the standard value which indicates the pollution of Ichamati river.

*Salinity frequency change of Ichamati River* Salinity is an ambiguous term. As a basic definition, salinity is the total concentration of all dissolved salts in water (Wetzel 2001).

These electrolytes form ionic particles as they dissolve, each with a positive and negative charge. As such, salinity

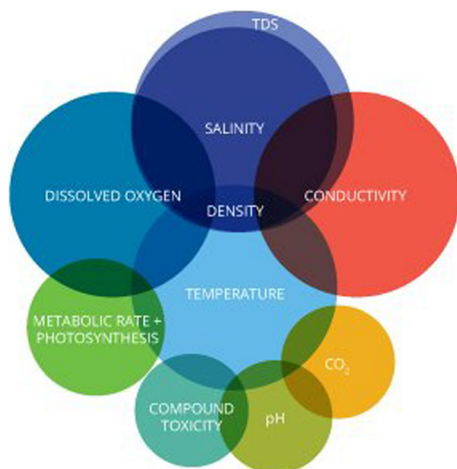


Fig. 9 Water temperature affects nearly every other water quality parameter

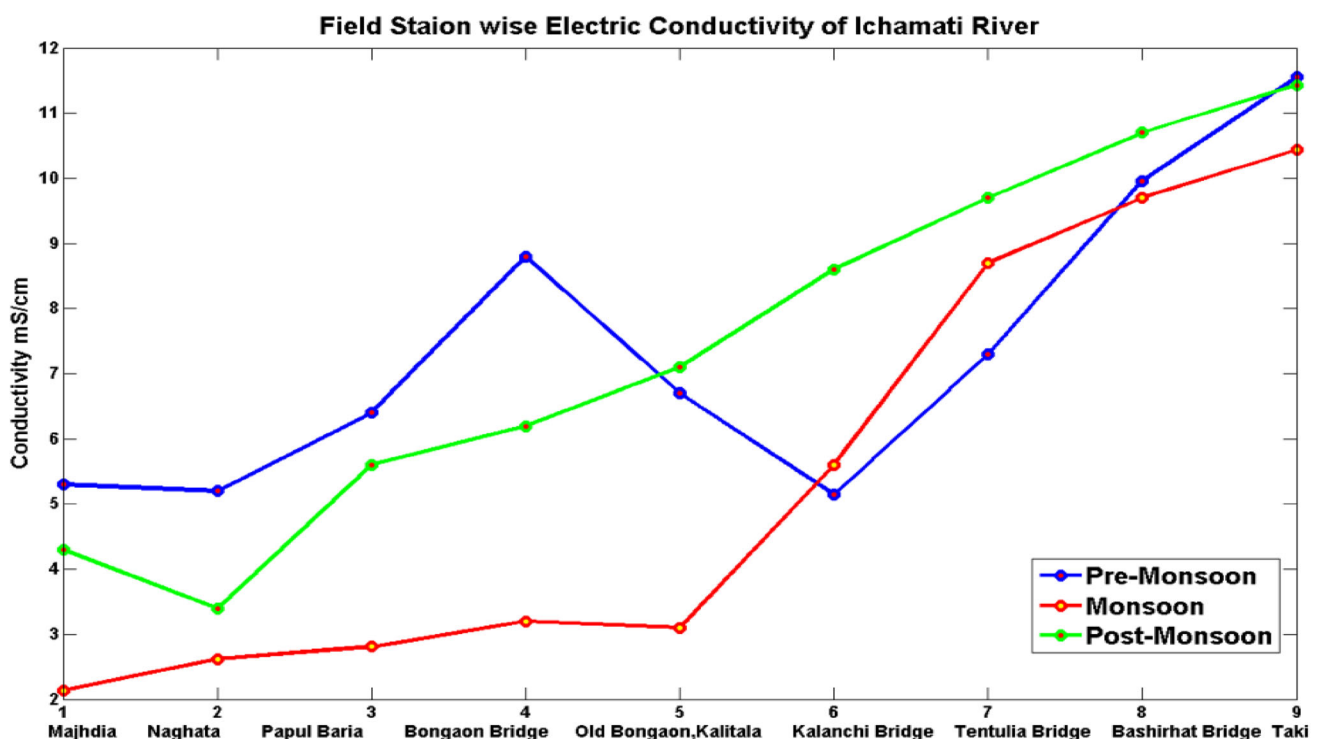
is a strong contributor to conductivity. While salinity can be measured by a complete chemical analysis, this method is difficult and time consuming (Water Environment Federation 1999). Seawater cannot simply be evaporated to a dry salt mass measurement as chlorides are lost during the process (Stewart 2004).

The salinity of the river water increases progressively as we move from upstream towards downstream as observed from the results (Fig. 11). In the Ichamati river catchment area average salinity from a study of nine sites was Pre-Monsoon, Monsoon and Post-Monsoon water quality analyzer salinity Units (PPM), with a range of average Majhdia to Old Bongaon 0–1.5 ppm of upper stretch this area influence of fresh water salinity range low but in lower stretch the Ichamati river depends on tidal fluctuations huge amount of salinity from the high tide of Bay of Bengal. So our filed study collect the sample of salinity by water quality analyzer instruments maximum high salinity are shown of the lower stretch of the river average value 3–8.5 ppm (Figs. 11, 12; Table 1).

## Conclusion

The present investigation summarizes various water and soil quality parameters of the samples collected from nine sites of the Ichamati river. The results of the Parameters significantly fluctuated over different seasons.

- In the respect, the applied Geomorphological studies using satellite image (of different seasons) supported with ground truthing unravel the following major issues.
- Increase of upland flow for rejuvenating the river because siltation is obvious in such a river where semidiurnal tidal effect is present.
- Need to study the difference in R.L. of river bed between the upper and the lower stretches of the river (especially between Beri-Swarupnagar to Tipi, North 24 Parganas) where tidal flow exists. It may so happen that due to siltation caused by tidal flow, the river bed level in the lower stretch i.e. after Bei-Swarupnagar is higher than the upstream side. For the reason, even in the low tide time the river is incapable of clearing the flood water and long lasting inundation is prevailing in the area.
- In the lower reaches where tidal effect is present, the brick kilns situated in the riverside are accused for ‘water logging’ in the upper reaches-it may be termed as ‘apparent visualization’. Actually, the brick kilns are acting as ‘silt trapper zone’ or ‘siltation tank’ of tide water and thereby minimizing the deposition of silt in the river bed. However, modernization of the “inlet system” is required, as the existing “bamboo sluice with mud lining” are not that much effective should be converted with modern engineering techniques.



**Fig. 10** Variations in electric conductivity of surface water

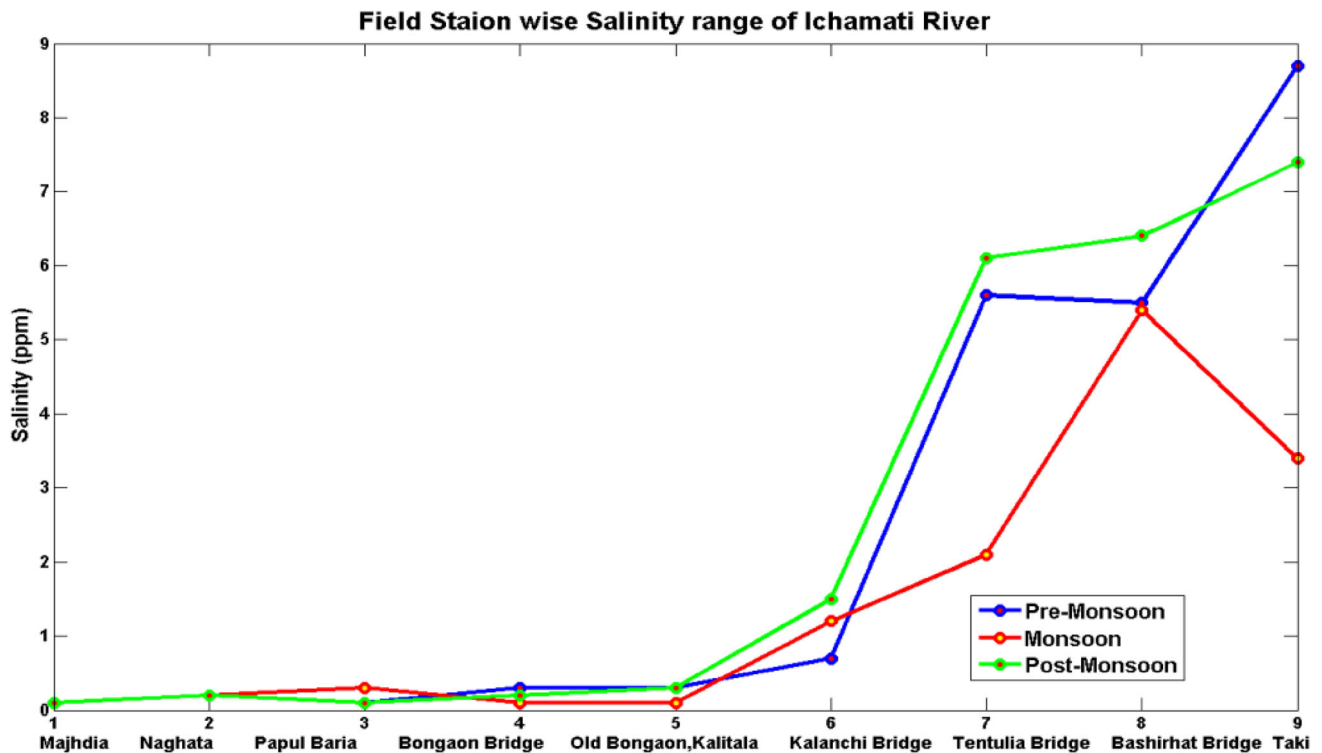


Fig. 11 Variations in salinity of surface water



Fig. 12 Data sampling collection of Ichamati river of WQP instrument

- As the season changes there is a fluctuation in the physicochemical characters of the water, this will be due to ebb and flow, change in the temperature and salinity as during the pre-monsoon, monsoon-and post-monsoon changes.

- The present water quality of Ichamati catchment area reveals that salinity plays a dominant role in controlling the water quality.
- The Ichamati river catchment are the lower stretch mud content was higher because high organic matter in soil while higher water holding capacity directs that the soil was clays in texture.
- The present day information of Ichamati river physicochemical characteristics of water would form a useful tool or further ecological assessment and monitoring of these Ichamati catchment ecosystem.
- Presented data in this manuscript provide a preliminary knowledge on the distributions of chlorophyll-*a* in the Ichamati river catchment area. The results showed that the maximum concentrations of chlorophyll-*a* were observed in pre-monsoon time of Bongaon.

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