# Baseline study of water and sediment of Bhatsa river (Vasind, MS)

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**Abstract:** India is a blessed country when water sources come into question which is available in the form of numerous rivers and lakes. It has 14 major, 55 minor and numerous small rivers to fulfil its freshwater needs. The Bhatsa river of Maharashtra descends from Bhatsa River Valley located at Igatpuri town (part of Western Ghats) and from Ambivli onwards meets Kalu river, Ulhas river, and three together develop typical estuarine environments before meeting the Arabian Sea at Vasai and Thane Creeks. 50% of the freshwater provided to Mumbai city comes from Bhatsa river. The present investigation of Bhatsa river deals with the study of physio-chemical characteristics of its water and sediment. The study was conducted for three seasons. The water and sediment sampling were done at three different sampling stations. The results obtained from the undertaken parameters provide a basic water and sediment quality data of the river with seasonal variation which can be further utilized for assessing future water and sediment quality checks of the river.

**Key Words:** Bhatsa river, Vasind, water analysis, sediment analysis

## I. INTRODUCTION

Rivers are important resources for human civilizations as they meet water demand for various uses apart from supporting flora and fauna, improving aesthetic and landscape quality, moderating climate and providing resource for hydropower. River ecosystems are most vulnerable habitats and likely to be altered by the anthropogenic inputs (Lavaniya et al, 2015). The Bhatsa river originates from Igatpuri Town's Bhatsa River Valley. An earthfill and gravity dam is constructed at the Bhatsa village which provides water for drinking to Mumbai city, water for irrigation as well as for production of hydroelectric energy.

Due to its importance as a source of freshwater and a source of economy for the fishermen, the Bhatsa river's water and sediment quality needs to be monitored on a regular basis. The water quality data obtained can be used as a tool for keeping a check on river's water pollution and for planning pollution control of the river.

## II. MATERIALS AND METHODS

### 2.1 Site Selection

The Bhatsa river passes through 16 villages before meeting the Kalu river at Ambivli town. The site selected for sampling was Vasind town belt of Bhatsa river. Based on various activities such as fishing, Ganesh visarjan, washing and cleaning of clothes and utensils in river; three stations for water sampling and one station for sediment sampling were decided. This was to check for variation in water quality due to the variation in activities.

### 2.2 Sample Collection

The water sampling was done at three stations for three seasons (monsoon, post-monsoon and pre-monsoon). The water sampling was done from a feet and a half's river depth. The water was collected, labelled and were transported to the lab for analysis within 2 hours.

Sediment was collected at a depth of four and a half feet with the help of a scoop. The sediment was collected in a plastic jar, then air dried and transported to the lab for analysis.

### 2.3 River Characteristics

a. River Flow Rate: River flow rate was measured by Bucket method.

b. River Width: River width was measured using Google Maps (Fig. 1) and Google Earth.

c. River Temperature: The temperature was measured with the help of thermometer.

### 2.4 Physicochemical analyses of water

The physico-chemical analyses of river water provide a good indicator of the physical as well as chemical state of the river ecosystem. Therefore, qualitative and quantitative analyses of different types of water quality parameters can be used to assess the pollution status. Attention has also been paid on the monitoring of Indian rivers. (Rout et al, 2015a; Lavaniya et al, 2015; Rout and Bhatia. 2015b; Mishra et al, 2014; Gupta et al, 2014; Rani et al, 2012; Patra et al, 2009). The physicochemical parameters assessed for Bhatsa river water were pH, Total Dissolved Solids (TDS), Turbidity, Electrical Conductivity (EC), Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD). The biological parameter for water's coliform analysis was Most Probable Number for Coliforms (MPN).

### 2.5 The physicochemical analyses of sediment

For sediment the physicochemical parameters were Sediment's colour, texture, pH, Moisture content, Water holding capacity, Organic matter and Electrical Conductivity (EC).

The collection, preservation and analysis of various parameters of water samples from different sampling locations were carried out, by following the standard methods (APHA, 1998). The results obtained were compared with each other on the basis of the sampling season to check seasonal variation. The water quality data was also compared with Central Pollution Control Board's (http://cpcb.nic.in) and WHO (https://www.lenntech.com) drinking and stream water standards.

## III. RESULTS AND DISCUSSION

Bhatsa river flow rate was estimated by bucket method and was found to be 63.0252 Litres/minute. The location selected for the flow rate estimation was the check dam on the river. Bhatsa river width was measured by using 'line measurement method' on river map in Google Earth (Fig. 1) and was found to be 236.61 feet. River's temperature was checked on each sampling station for each season which ranged from $18^0$ C – $23^0$ C.

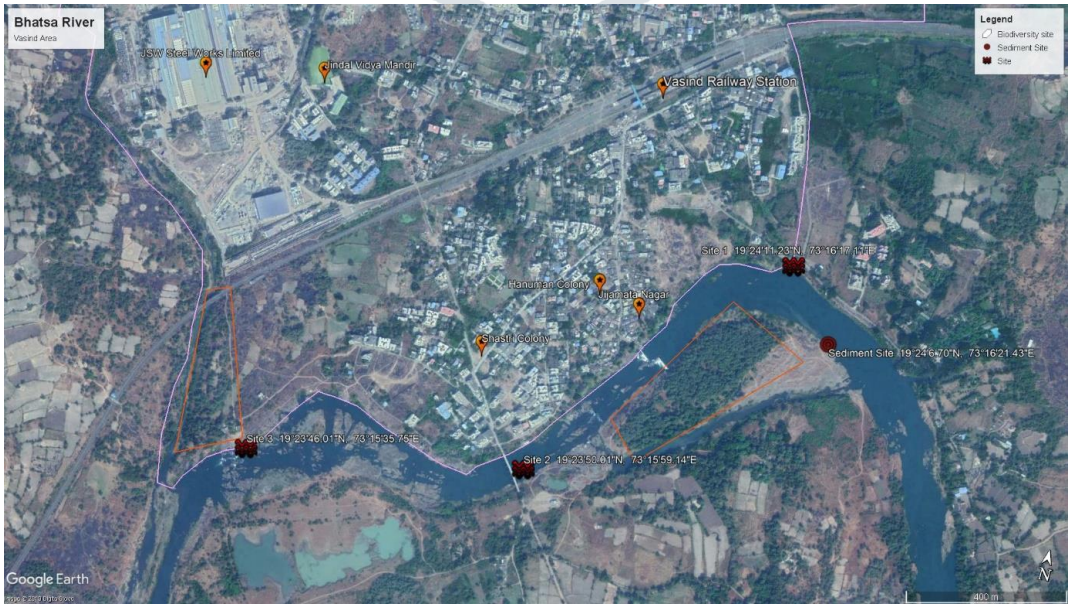


Figure 1: Google Map of River Bhatsa

The results obtained (Table 1) in all three seasons indicate that the water pH remained neutral and within limits all the time. According to Fakayode, 2005, the pH of a water body is very important in determination of water quality since it affects other chemical reactions such as solubility and metal toxicity.

Other parameters can be seen showing seasonal variation, highly in monsoon due to the natural pollution of the river.

Table 1: Bhatsa river water quality across three stations with seasonal variation

| Station | Season | pH | TDS (mg/L) | Turbidity (NTU) | Electrical Conductivity (EC) (mS/cm) | Dissolved Oxygen (DO) (mg/L) | Biological Oxygen Demand (BOD) (mg/L) | MPN (MPN /100ml) |
|---|---|---|---|---|---|---|---|---|
| Station I | Pre-Monsoon | 7.0 | 51 | 15.1 | 60 | 4 | 1.3 | 3.6 |
| | Monsoon | 7.0 | 80 | 34.8 | 140 | 5.8 | 1.7 | 1100 |
| | Post-Monsoon | 7.2 | 45 | 14.3 | 90 | 3.8 | 1.3 | 53 |
| Station II | Pre-Monsoon | 7.0 | 49 | 15.5 | 50 | 6.3 | 1.1 | 11 |
| | Monsoon | 7.2 | 220 | 63.8 | 160 | 8 | 2.7 | 460 |
| | Post-Monsoon | 7.2 | 38 | 14 | 110 | 5.1 | 0.4 | 53 |
| Station III | Pre-Monsoon | 7.0 | 36 | 12.2 | 60 | 5.3 | 1.2 | 3 |
| | Monsoon | 7.0 | 60 | 31.1 | 170 | 7.4 | 1 | >1100 |
| | Post-Monsoon | 7.0 | 27 | 10 | 170 | 3.8 | 0.7 | 23 |

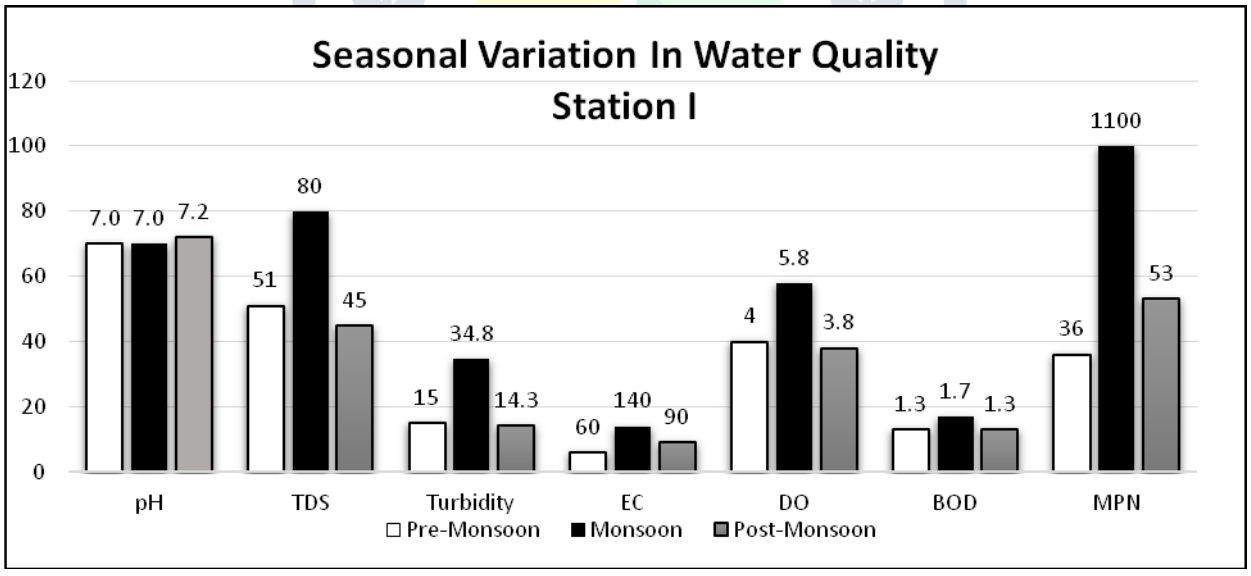


Figure 2: Seasonal variation in water quality at Station I

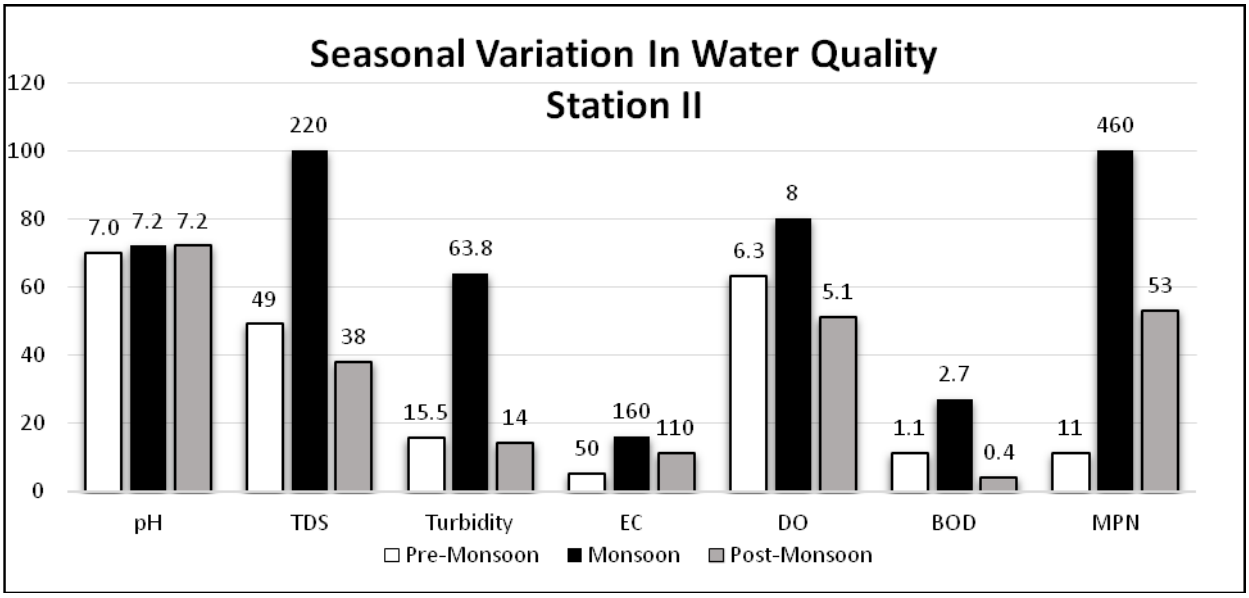


Figure 3: Seasonal variation in water quality at Station II

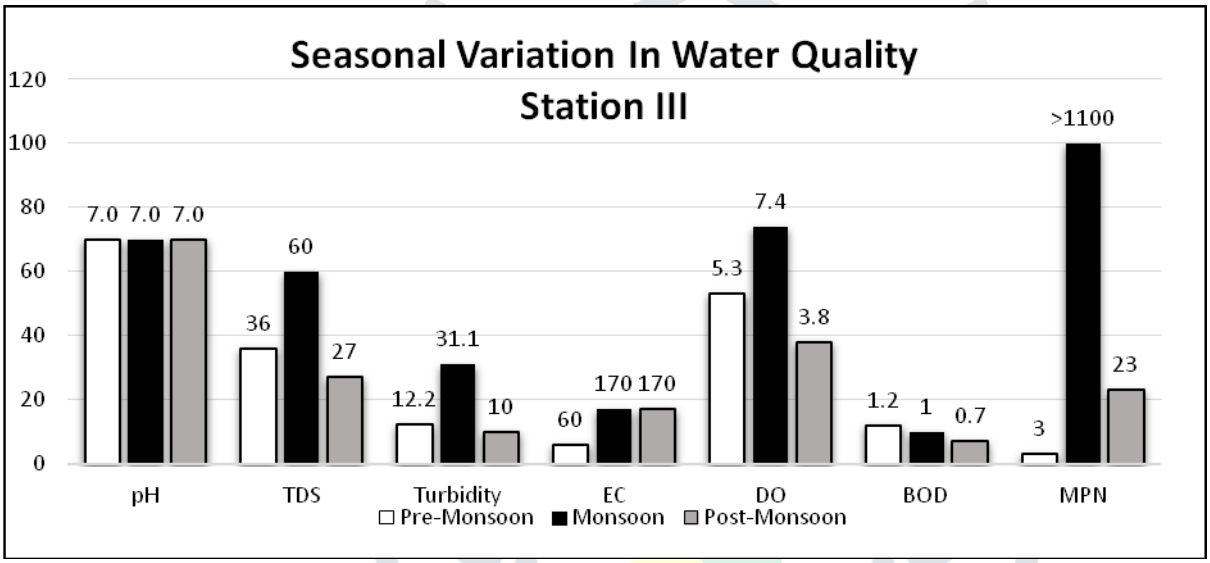


Figure 4: Seasonal variation in water quality at Station III

Total dissolved solids (TDS) describe the inorganic salts and small amounts of organic matter present in solution in water. The presence of dissolved solids in water may affect its taste. TDS levels low than 300mg/litre indicate excellent drinking water by WHO (https://www.lenntech.com) standards. Turbidity is the measure of relative clarity of a liquid. In streams, increased sedimentation and siltation can occur, which can result in harm to habitat areas for fish and other aquatic life. Excessive turbidity, or cloudiness, in drinking water is aesthetically unappealing and may also represent a health concern by promoting pathogenic growth and resulting in waterborne disease outbreak. CPCB (http://cpcb.nic.in) turbidity permissible limit for drinking water in 10 NTU. Both the TDS and turbidity levels were in a similar range for pre-monsoon and post-monsoon but showed a rise in monsoon due to heavy rainfall.

Conductivity is a good and rapid method to measure the total dissolved ions and is directly related to total solids. Higher the value of dissolved solids, greater the amount of ions in water (Bhatt et al, 1999). The water conductivity decreased in pre-monsoon while remained in a close range for monsoon and post monsoon.

Seasonal variation in Dissolved Oxygen content is related to temperature and biological activities (Chapman and Kimstach, 1992). Rainfall in monsoon caused rise organic content resulting in rise of DO. It remained within the range of 3.8 mg/l - 8 mg/l. By CPCB standards (http://cpcb.nic.in), water with a DO of more than 4mg/l is ideal for drinking and for healthy growth of fish populations. Moderately polluted rivers show a BOD value of more than 3mg/l to 8mg/l. Bhatsa river BOD remained below the CPCB (http://cpcb.nic.in) BOD permissible limit 2mg/l across all the stations for all seasons except for Station II in monsoon.

All the physical parameters remained within limits for all the seasons which indicates safe quality for drinking the water as well as for survival of aquatic life.

The permissible limit for Total Coliforms is 10 MPN/100ml. The coliform presence in river water was not under CPCB (http://cpcb.nic.in) permissible limits in any season, the reason can be open defecation, livestock watering and flow and introduction of sewage lines along and in the river. The coliform content increased drastically in monsoon due to the natural river pollution. According to the ministry's norms, river water can be considered fit for bathing if the faecal coliform count is between the desirable limit of 500 and maximum permissible limit of 2,500 MPN (most probable number) per 100 ml. (https://www.downtoearth.org.in)

For the sediment (Table 2), the soil sediment was brown coloured and showed a clay texture. The pH of the sediment was neutral 7.5. Being river sediment, the soil showed a greater water holding capacity, which is good for agriculture. Soil organic matter is low therefore it cannot be classified as an organic soil. The estimated Electrical Conductivity of soil was in optimal fertility limit and indicated a fertile soil. The physicochemical parameters of sediment indicated a healthy soil quality.

Table 2: Sediment quality of Bhatsa river

| Color | Texture | pH | Moisture Content (%) | Water Holding Capacity (%) | Organic Matter (%) | Electrical Conductivity (EC) (mS/cm) |
|---|---|---|---|---|---|---|
| Brown | Clay | 7.5 | 3.3342 | 56.7060 | 0.1947 | 180 |

## IV. CONCLUSION

With the present study, the baseline data of Bhatsa river water and sediment quality was obtained. The study also indicated seasonal variations for water quality across all the parameters. For water, the pH is remains mostly neutral for all the seasons. The physical characters such as Total Dissolved Solids, Turbidity and Electrical Conductivity increased in monsoon due to increased solids in water. The biological parameters i.e. Dissolved Oxygen and Most Probable Number for Coliforms increased in monsoon due to the same reason stated above. The Biological Oxygen Demand remained consistent across all the seasons. When compared with the CPCB (http://cpcb.nic.in) permissible limits for stream water, the Bhatsa river presents itself as a healthy water body for drinking water and for the survival of the aquatic life. The only parameter which exceeded the permissible limit is Most Probable Number for Coliforms, which can be due to the presence of open defecation and sewage discharge along and in the river. The sediment quality is also within the standards set by CPCB (http://cpcb.nic.in). Even though the data obtained indicates a healthy river, further heavy metal analysis of Bhatsa river water and sediment needs to be done for a comprehensive conclusion. The obtained baseline data can be used as a primary data for further evaluation and monitoring of the Bhatsa River.

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