**Research Article**

# Evaluation of water quality index for drinking purposes of river Subernarekha in Singhbhum District

Kavita Parmar[1] &Vineeta Parmar[2]
1. Senior research fellow National Metallurgical laboratory, CSIR, Jamshedpur
2.WOS-B Directorate of weed science research , ICAR, Jabalpur
parmar_vineeta@yahoo.co.in
kavitanitj@gmail.com

## ABSTRACT

An attempt has been made to develop water quality index (WQI), using six water quality parameters Dissolved oxygen (DO), Biochemical oxygen Demand (BOD), Most Probable Number (MPN), Turbidity, Total Dissolved Solids (TDS) and pH measured at five different stations along the river basin from November 2006 to November 2007 . Rating curves were drawn based on the tolerance limits of inland waters and health point of view. Bhargava WQI method was used to find overall WQI along the stretch of the river basin. Five point rating scale was used to classify water quality in each of the study areas. It was found that the water quality of Subernarekha varied from Excellent to Marginal range by Bhargava WQI method. It was observed that the impact of human activity was severe on most of the parameters. The MPN values exceeded the tolerable limits at almost all the stations. It was observed that the main cause of deterioration in water quality was due to the lack of proper sanitation, unprotected river sites ,high anthropogenic activities and and direct discharge of industrial effluent.

**Keywords**: Water quality index, Bhargava's WQI, Subernarekha Water, Water quality

## 1. Introduction

The Subernarekha is a medium basin of the Indian subcontinent. The riverbed of Subernarekha is believed to contain traces of gold and hence the name. It originates in the Chhotanagpur hills of Jharkhand and subsequently passes through West Bengal and Orrisa.Throughout its course, several small rivers meet like Kharkai at Jamshedpur, and Gara Nallah at Jadugoda etc. Iron ore, bauxite, copper and uranium, minerals are found along its stretch. The bedrock of the basin is is a pre-Cambrian hard rock comprising mica-schist, Quartzite, soda granites and dhanjori volcanic. The water quality index is a dimensionless number with values ranking between 0 and 100. A higher index value represents a good water quality (Cude, 2001; Pandey and Sundaram, 2002). This numerical index can be used as a management tool in water quality assessment.

## 2. Materials and methods

In order to determine the water quality index, four stations were chosen for sample collection in the study area along the stretch of the river, as described in Fig.1.Sampling stations 40km long stretch of river Subernarekha situated in the West and East Singhbhum district of India has beenn selected for the present study. Four stations were selected at (1) Manikui,Station A (22_52¢N, 86_05¢E), (2) Kapali, Station B (22_50¢N, 86_10¢E), (3) Asonboni, Station C

(22_44¢N,86_20¢E) and (4) Galudih, Station D (22_40¢N, 86_25¢E).Station A is situated upstream on river Subernarekha,about 15 km from the industrial city of Jamshedpur and just touching the southern demarcation line of the basic igneous rock layer. Station B, before river Kharkhai meets with river Subernarekha, is also upstream at a distance of 5 km. Similarly, stations C and D are situated downstream and at a distance of 5 and 15 km,respectively, after the city of Jamshedpur. A small seasonalrivulet, the Gurmanala creek, joins river Subernarekha between stations C and D.

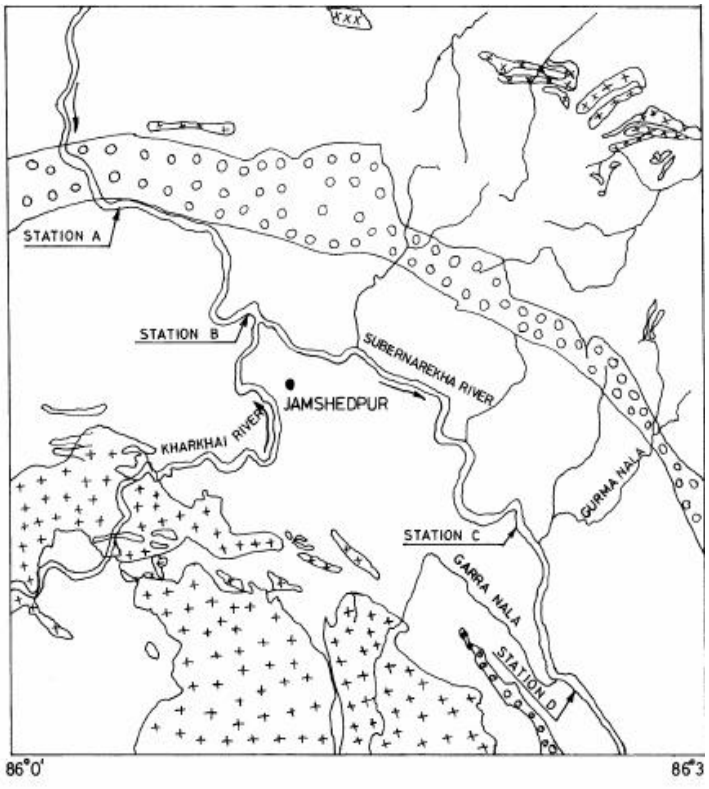


**Figure 1.** A map of the study area showing the different sampling stations

To determine the WQI, the following six water quality parameters are measured:
pH: The pH level is a measure of the acid content of the water. Most forms of aquatic life tend to be very sensitive to pH. Since most of the human body consists of (50-60%) water, the pH level has profound effect on all body chemistry, health and disease.

## 2.1 Dissolved Oxygen

The dissolved oxygen test measures the amount of life-sustaining oxygen dissolved in the water. Natural waters in equilibrium with the atmosphere will contain dissolved oxygen concentrations ranging from about 5 to 14.5 mg O2 per liter depending on the water temperature, salinity, and altitude. The dissolved oxygen (DO) concentration present in water reflects atmospheric dissolution, as well as autotrophic and heterotrophic processes that respectively, produce and consume oxygen. DO is the factor that determines whether

biological changes are brought by aerobic or anaerobic organisms. Thus, dissolved-oxygen measurement is vital for maintaining aerobic treatment processes intended to purify domestic and industrial wastewaters. The optimum value for good water quality is 4 to 6 mg/L of DO, which ensures healthy aquatic life in a water body.

### 2.2 Biochemical Oxygen Demand

The Biochemical Oxygen Demand (or BOD) is a measure of the amount of food for bacteria that is found in water. It determines the strength in terms of oxygen required to stabilize domestic and industrial wastes. For the degradation of oxidizable organic matter to take place minimum of 2 to 7 mg/L of DO level is to be maintained at laboratory experimentation or should be available in the natural waters (De, 2003).

### 2.3 Micro-organisms

In drinking water microorganisms can cause sensory defects (odor, color, taste). Micro-organisms are an important cause of the corrosion of steel pipes. Various health related problems due to contaminated waters are diarrhea, abdominal cramps and vomiting due to salmonella, cholera is due to vibro cholerae, infection of lungs due to mycobacterium (Adarsh and Mahantesh, 2006; Nollet, 2000).

### 2.4 Total Dissolved Solids

This is a measure of the solid materials dissolved in the river water. This includes salts, some organic materials, and a wide range of other things from nutrients to toxic materials. The amount and nature of dissolved and undissolved matter occurring in liquid materials vary greatly. Waters with higher solids content have laxative and sometimes the reverse effect upon people whose bodies are not adjusted to them. TDS consists of oxygen-demanding wastes, disease-causing agents, which can cause immense harm to public health .Organo-chlorinated pesticides such as DDT, is a very toxic compound. Exposure to high doses can affect the central nervous system, provoking paralysis of the tongue, lips, and, face, irritability, dizziness. The presence of synthetic organic chemicals (fuels, detergents, paints, solvents etc.) imparts objectionable and offensive tastes, odors and colors to fish and aquatic plants even when they are present in low concentrations (Sawyer et al., 1994; Nollet, 2000).
Temperature: The water temperature of river is very important, as many of the physical,biological, and chemical characteristics of a river are directly affected by temperature.The water quality index (WQI) was determined according to Bhargava method (Bhargava,1983; Bhargava, 1998; Bhargava, 2006) and Harmonic Mean WQI method (Shree Kumar, 2006).

## 3. Analysis of samples

The water samples were collected from each of the five selected stations according to the standard sampling methods (IS: 2488, 1966; APHA, 1998).Samples for estimating dissolved oxygen (DO) and biochemical oxygen demand (BOD) were collected separately in BOD (glass) bottles. Water temperature was recorded on the spot using thermometers.

### 3.1 Water Quality Index determination

In this study the water quality index (WQI) was determined according to Bhargava method. The Bhargava method was adopted because of its simplicity involved in handling small to large data for various beneficial uses. The simplified model for WQI for a beneficial use is given by equation

$$WQI^{n}_{i=1} = [\pi \text{ fi (pi)}]^{1/n} \text{ x } 100 \text{ ------- } 1$$

Where n is the number of variables is considered more relevant to the use and (f i) P i is the sensitivity function of the i th variable which includes the effect of weighting of the i th variable in the use.

## 4. Result and discussion

Turbidity is a measure of cloudiness in water. The higher the turbidity, the cloudier the water appears. The water was found to be more turbid during the monsoon 2006 at various sampling stations. This can be caused by soil erosion, waste discharge, urban runoff, algal growth etc. The DO level was the lowest at the station 4 in the month of August compared to the previous seasons. Total Dissolved solids or filterable residue includes salts and organic residue. Sampling station 4 marked the least fluctuations in the present study. This may be due to the forest, semi-green catchments area thereby less soil erosion of the top soil. It is noticed that the stations of downstream region have higher TDS values compared to the upstream ones.

**Table: 1** Water quality values at various sampling stations (During Nov2006-Nov 2007)

| Parameter | pH | DO mg/l | BOD mg/l | Turbidity NTU | TDS mg/l | MPN/100ml |
|---|---|---|---|---|---|---|
| Station 1 | 6.8 | 6.87 | 1.2 | 6.8 | 256 | 1200 |
| Station 2 | 7.4 | 7.2 | 0.8 | 5.7 | 240 | 800 |
| Station 3 | 6.9 | 7.4 | 2.9 | 4.2 | 178 | 670 |
| Station 4 | 6.6 | 6.2 | 1.57 | 3.8 | 308 | 950 |

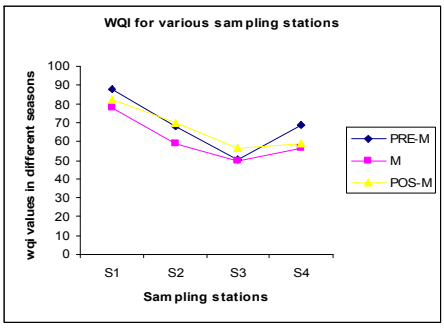


**Figure 2**: Water quality values at various sampling stations (During Nov2006-Nov 2007)

According to above WQI values at various sampling stations there is general progressive decline in WQI values along the downstream indicated that an increase in pollution is due to effluent discharge. Thus, a general progressive decline in WQI values along the downstream indicated as increase in pollution due to the discharge by various industries along the stretch. The poorer water quality index at S4 Sampling station is due to anthropogenic activities.

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