Narmada river water quality assessment using benthic macro-invertebrates at Barwani, Rajghat Madhya Pradesh

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ABSTRACT

River Narmada is one of the 13 prominent rivers of India, which covers 98,797 sq km of total water-shed area. Narmada is considered to be the lifeline of Madhya Pradesh and is one of the most important west flowing rivers of India. The monitoring of water quality of Narmada river was carried out for one year August 2011 to July 2012. Barwani sampling stations were selected at downstream of Narmada River. The water samples collected were analyzed, as per standard methods parameters such as pH, Turbidity were measured in-situ. Raised values of physico-chemical parameters indicate the pollution of riverine ecosystem due to domestic wastes, municipal sewage, industrial effluent from Security Paper Mill (SPM) and agricultural run-off that influence the water quality directly or indirectly. Statistical analysis carried out through correlation method and also evaluates Average values (AV), Standard Deviation (SD), Standard Variance (SV), Standard Error (SE) and 95% Confidence Limit (CL) to assess the pollution load assessment. The results revealed that most of the water samples were below or out of limited; according to the WHO, BIS standards.

KEY WORDS: STATISTICAL ANALYSIS, NARMADA RIVER, WATER POLLUTION, RIVER WATER QUALITY, BARWANI, PHYSICO-CHEMICAL ANALYSIS

INTRODUCTION

Macro-invertebrates are most frequently used in bio-monitoring studies because the responses of macro-invertebrates to organic and inorganic pollution have been extensively documented (Thorne and Williams., 1997; Kazanci. and Dugal., 2000). They have sensitive life stages

that respond to stress and integrate effects of both short-term and long-term environmental stressors (EPA., 1998) and they are important areas for maintaining biodiversity (Meyer et al., 2007 Richardson and Danehy 2007). The study of benthic macro-invertebrates provides a method to determine the water quality of a stream based on collection and identification of stream-bottom (benthic)

ARTICLE INFORMATION:

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Received 27th Dec, 2017

Accepted after revision 17th March, 2018

BBRC Print ISSN: 0974-6455

Online ISSN: 2321-4007 CODEN: USA BBRCBA

Thomson Reuters ISI ESC / Clarivate Analytics USA and Crossref Indexed Journal

NAAS Journal Score 2017: 4.38 SJIF 2017: 4.196

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Online Contents Available at: <http://www.bbrc.in/>

DOI: 10.21786/bbrc/11.1/22

macro-invertebrates. This study has been done to find out the diversity of benthic macro-invertebrates. Benthic study in Malwa region of Madhya Pradesh is scarce except that of Varshney et al., 1976, Rao et al., 1985, Sunny and Diwan., 1991 Sharma 2016, Sharma et al., 2007, Khichi et al., 2017).

MATERIAL AND METHODS

Description of Study Area The Narmada river is considered as the life line of Madhya Pradesh. The catchment area of the river exists in the States of Madhya Pradesh (86.18%), Gujarat (11.6%), Maharashtra (1.5%), and Chhattisgarh (0.72%). During its course, the river drops from an elevation of 1051 m to sea level, and flows through narrow gorges in the head reaches. The basin is bounded on the north by the Vindhya ranges, on the east by the Maikal range, on the south by the Satpura ranges and on the west by the Arabian Sea. Deep black soil covers the major portion of the basin. The river has 41 tributaries, of which 22 are on the left bank and 19 are on the right bank. The Barna, Tawa, Kolar, and Sukta dams have been constructed on the tributaries. The Bargi is constructed on the mainstream, while the Indirasagar, Omkareshwar, Maheshwar and Sardar Sarovar dams are under construction.

SAMPLING STATIONS BARWANI

Barwani, also known as Siddh Nagar, is an important city and a municipality in Barwani district in the state

of Madhya Pradesh, India. The place is also famous for chool giri, Jain pilgrimage center of Bawangaja. The town is situated near the left bank of the Narmada river. Latitude (DMS) 22° 10', 60"N and Longitude (DMS) 74° 54', 0 " E.

PHYSICO CHEMICAL ANALYSIS OF WATER

The water samples were collected from the sampling station Barwani, for the period of 12 months from August 2011 to July 2012. In the analysis of the Physico-chemical properties of water, standard methods prescribed in limnological literature were used. Parameters like Temperature, pH and Turbidity were determined at the site, while other parameters like Biochemical oxygen demand, Chloride, Alkalinity, total Solids were determined in the laboratory. The Physico- Chemical parameters of water were determined as per standard methods of APHA (2005), Welch (1998), Golterman (1991).

RESULTS AND DISCUSSION

WATER TEMPERATURE

The oxidation of organic matter is highly influenced by the temperature of water. Temperature of river water depends upon the season, climatic zone, where river is flowing, time of sampling and also upon the temperature of the effluents, which are being added in the river. Temperature fluctuation during August 2011 to July 2012 was as follows.

FIGURE 1. Map of Narmada river showing Sampling Stations

Table 1. Monthly fluctuation in water temperature (°C) of narmada river from August 2011 to July 2012 at barwani.

Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Avr.	Standered Ddeviation
30	28.8	31.5	28	26.2	27.5	28.5	28.8	31.5	32.6	30.9	27.10	27.85	1.91

The minimum water temperature was 26.2°C in December 2012 and the maximum was reported 32.6°C in May 2012 at Barwani. The same observation were also reported by. Bhutaiani et al. (2016), Sharma et al

(2011) and Shraddha et al (2008) in Narmada river, while studying the hydrological parameters of Narmada river at Hoshangabad recorded water temperature between 27.6°C to 38.4°C.

PH RANGE

pH is an important parameter which is important in evaluation the acid base balance of water. Natural waters generally have been found to range from 5.5 to

8.6 because of the presence of bicarbonates and carbonates of alkaline earth metals. Drinking water with a pH range from 6.5 to 8.3 has been necessary. During August 2011 to July 2012 the pH was fluctuated as follows.

Table 2. Monthly fluctuation in water pH of narmada river from August 2011 to July 2012 at barwani.

aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Avr.	Standered Ddeviation
8.2	8	8.4	8.5	8.7	8.26	8.4	7.8	9	8.8	8.5	7.9	8.37	0.34

The minimum in March 2012 and the maximum in May 2012 at Barwani. Sharma et al (2011) observed pH fluctuation between 7.6 to 9.9 in Hoshangabad area of

Narmada river. Prasanna and Ranjan (2010) observed pH value between 7.5 to 8.5 in Dharma estuary.

TRANSPARENCY

Transparency has been long known to hinder disinfection by shielding microbes, some of them perhaps pathogens. This is most important significance of transpar-

ency monitoring and therefore it has been an indication of effectiveness of filtration of water supplies (Hauser 2001). During August 2011 to July 2012 transparency was fluctuated as follows.

Table 3. Monthly fluctuation in water transparency mg/l of narmada river from August 2011 to July 2012 at barwani.

Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Avr.	Standered Ddeviation
22	21	37	33	39	53	48	39	27	31	29	20	33.16	10.56

The minimum in July 2012 and maximum in January 2012 at Barwani. These observations were also supported by Prasanna and Panda (2010), Shraddha et al (2008) Tiwari, M and Dwivedi, A (2016) and Trivedi et al (2009).

TOTAL DISSOLVED SOLIDS

The total solids are the total amount of chemical substance present in the water. The total dissolved solids and total suspended solids together make the total sol-

ids in the water. The presence of solids in water vary greatly at different times and affect the density of water and there by the quality of aquatic environment. During August 2011 to July 2012 the value of total solids varied as follows.

Table 4. Monthly fluctuation in water total dissolved solid mg/l of narmada river from August 2011 to July 2012 at barwani.

Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Avr.	Standered Ddeviation
160	145	136	124	109	180	185	156	135	152	159	119	146.6	22.31

The minimum value was recorded in December 2011 and maximum in February 2012 at Barwani. Nduka et al (2008) also recorded total solids between 100 to 220 mg/l in Niger delta of Nigeria and Khanna, D.R, and Rawat, S., Bhutiani, R., (2014).

ALKALINITY

Alkalinity measures the buffering capacity of water and content of CO2 in its various forms are involved in this

carbonate-bicarbonate carbonic acid buffering system. In the present study the value of Alkalinity varied as follows.

Table 5. Monthly fluctuation in water alkalinity of narmada river from August 2011 to July 2012 at barwani.

aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Avr.	Standered Ddeviation
132	155	175	280	293	255	230	240	190	170	150	135	146.6	22.31

The minimum value in August 2011 and maximum in December 2011 at Barwani. Trivedi et al (2009) also observed the same value in Ganga river India.

BIOCHEMICAL OXYGEN DEMAND

Biochemical oxygen demand is the amount of oxygen utilized by microorganism in stabilizing the organic matter in aerobic condition. DO measurement forms

the basis of BOD analysis. It gives an indication of load of biodegradable organic material present in the water body. During the present study the BOD was fluctuated as follows.

Table 6. Monthly fluctuation in water biochemical oxygen demand mg/l of narmada river from August 2011 to July 2012 at barwani.

Aug.	Sep.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Avr.	Standered Ddeviation
4.9	5.9	5.7	4.6	4.3	3.9	3.5	5.6	6.6	4.4	5.2	5.4	5	0.86

The minimum BOD was recorded February 2012 and maximum in April 2012 at Barwani. Same observations

were also recorded by Nnaji et al (2010) Katakwar, M (2014) and Mary et al (2008).

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