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A study of physico-chemical parameters of Narmada river in Dindori city, MP, India

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Abstract

Narmada River is the holy river of the state Madhya Pradesh. A study was considered for the development of water quality index using fifteen physicochemical parameters like pH, temperature, TDS, turbidity, total alkalinity, Nitrate, Phosphate, Sulphate, Chloride, Fluoride, Total hardness, Calcium hardness, BOD, COD and DO measure at four different sites (S1, S2, S3 and S4) along the river Narmada at Dindori city. The investigation period was divided in to three seasons' rainy, winter and summer. The physicochemical parameters were estimated by standard method of APHA (2012) [1]. The various physico chemical parameters were taken into consideration to assess the Narmada river water quality. The study finds out the water quality of river Narmada through the analysis of some selected physicochemical parameters and compares with BIS (Bureau of Indian Standards) permissible limit (BIS 10500 2012) [2]. On the basis of various parameters, it can be concluded that water of the study indicates the river water of Narmada River is not completely pollution free. Narmada River can serve as a good habitat for many aquatic organisms. The river water is used for domestic and irrigation but not for drinking.

Keywords: Narmada river, physico-chemical study, pollution, water quality, physico-chemical parameter

Introduction

Narmada River is one of the most essential rivers in Madhya Pradesh. It provides clean water for irrigation and domestic purposes to Madhya Pradesh. Narmada River is the fifth largest river in India and the largest West flowing river of Indian peninsula. It is also known as the life line of Madhya Pradesh for its huge contribution to Madhya Pradesh. Narmada River originated from Amarkantak in Anuppur District of Madhya Pradesh, travelling a distance of 1312 kms, prior to flowing through Arabian Sea situated in Gulf of Cambay in Gujarat. It runs through State of Madhya Pradesh (1077 Kms) covering the districts Anuppur, Mandla, Dindori, Jabalpur, Narmadapuram, Harda, Khandwa, Barwani, Khargone, Dhar and Jhabua. The research paper deals with a study of physico-chemical characteristics of eastern zone of Narmada River to assess the quality of water. Physico-chemical in India and many environmental scientists performed research on evaluation of water (Trivedy & Goel, 1986 and Anjum *et al.*, 2013) [3, 4]. Many studies were done on Narmada River Sharma *et al.*, 2011., Soni *et al.*, 2013, Kumari *et al.*, 2013, Piplode and Barde 2015, Kushram 2016, Rajsekharan and Raja., 2017, Gupta *et al.*, 2017, Saluja 2018, Solanki and Saraswat., 2021) [5, 6, 7, 8, 9, 10, 11, 12, 13] and many more.

Study Area

Dindori is a central Indian district of Madhya Pradesh. Dindori is the district headquarter. The district is a part of Jabalpur Division. Dindori is situated near Narmada River. Narmada river rises from Amarkantak plateau in Anuppur district of Madhya Pradesh. The source of the Narmada is a small reservoir known as the Narmada Kund. The river descends from Sonmuda, then falls over a cliff as Kapildhara waterfall and meanders in the hills. Narmada River flows through Chandan Ghat to Shahpura block in Dindori district and then the river flows to Mandla district. Total area of the district is 6128 square kms. It is located on the eastern part of Madhya Pradesh, bordering the state of Chhattisgarh. It is surrounded by Anuppur in the East, Mandla in the West, Umaria in the North and Mungeli district in the South.

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Material and Methods

The sample site selected was Dindori city (M.P.). The Narmada River water samples were collected in glass bottle for physicochemical studies and the bottles were labeled with location and date of collection. The water sample were collected from four selected locations, i.e., S1 (Satighat dharamshala), S2 (Dam Ghat near stop dam), S3 (Jogi tikariya ghat) and S4 (Shiv ghat near model college) for a period of one year, i.e., Jan 2021 to Dec 2021. The river water samples were collected in different sampling bottles as per standard method APHA. The pH and temperature were estimated at sampling site at the time of sample collection. The other parameters were measured by the procedure given by APHA in the laboratory. The investigation period was divided into three seasons rainy, winter and summer. The physicochemical parameters were estimated by standard method of APHA (2012) [1].

The physicochemical properties of water standard methods prescribed in literature were used. Temperature, pH, conductivity, total dissolved solid, total alkalinity, total hardness, Calcium hardness, Chloride, Fluoride, Nitrate, Sulphate, Dissolved Oxygen, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were

measured. The pH of water sample was measured by digital pH meter at the sample collection site. Temperature was measured by digital thermometer direct to river. Conductivity is measured by conductivity meter. Turbidity of water sample was measured by Turbidity meter. Total dissolved solids were measured by TDS meter. Total alkalinity is determined by Acid-Base titration method. Total hardness and Calcium hardness were determined by EDTA method. Chloride was measured by titration method. Fluoride was determined by Zirconium Xylenol range reagent. The fluoride content in water can be evaluate by comparing generate colour with colour chart. Nitrate measured by Spectrophotometer. Dissolved oxygen determined by Winkler's method and BOD analyzed using BOD incubator.

Result and Discussion

This study shows seasonal variation for the different physicochemical parameters at various stations (S1, S2, S3 and S4) with their ranges which have tabulated and shown in Table 1, Table 2 and Table 3. To assess the quality of river water, Indian drinking water quality standard BIS 10500 (2012) [2] has acquired. The data presented the seasonal variation of all the parameters during the study period.

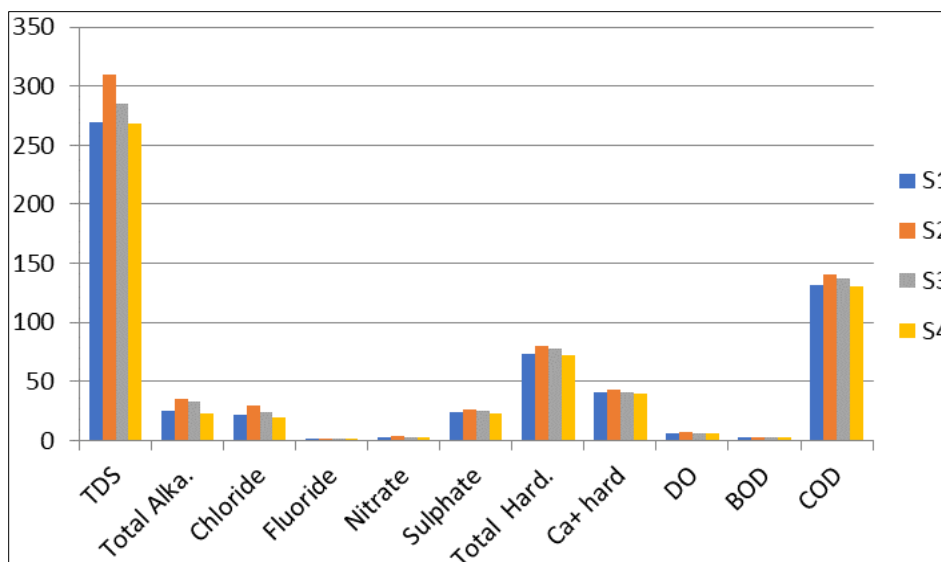


Fig 1: Graph showing Rainy season physicochemical parameters in mg/let different sites (S1-S4)

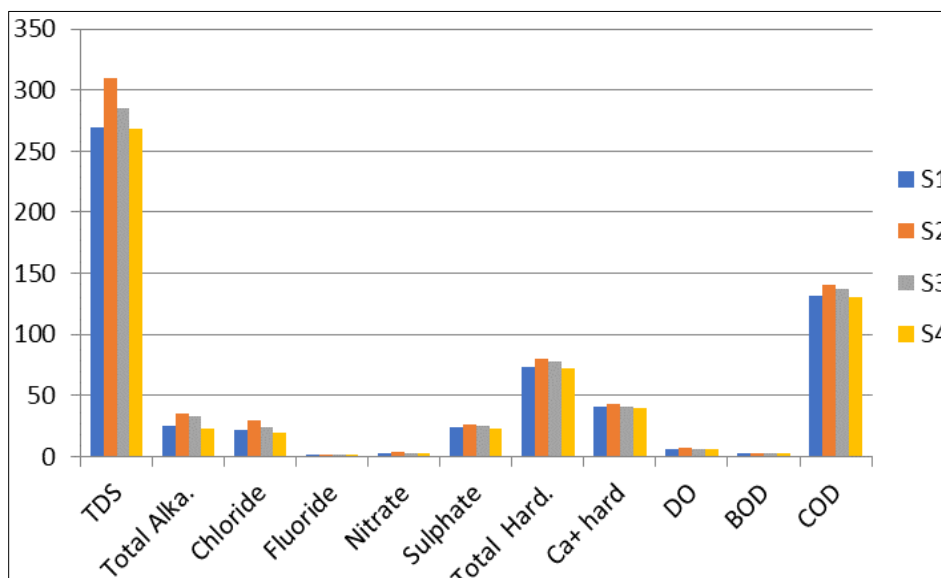


Fig 2: Graph showing winter season physicochemical parameters at different sites (S1-S4)

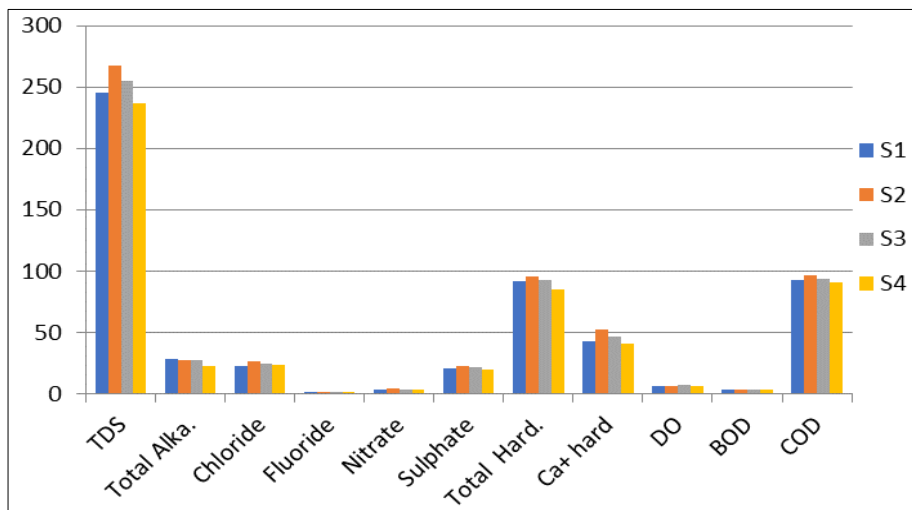


Fig 3: Graph showing summer season physicochemical parameters at different sites (S1-S4)

Table 1: Physicochemical properties of Narmada River in rainy season at different site (S1-S4)

Parameters	BIS value	S1	S2	S3	S4	Mean value
Temperature	°C	20.1	20.3	20.6	22.3	20.82
Turbidity (NTU)	1-5	3.6	4.1	3.8	3.9	3.7
TDS mg/l	500-2000	270	310	285	268	283.25
pH	6.5-8.5	7.2	8	7.4	7.1	7.4
Conductivity (µs/cm)	400	440	438	462	470	452.5
Total Alkalinity mg/l	20-200	24.6	34.9	32.6	23	28.7
Chloride mg/l	250-1000	22	30	24	20	24
Fluoride mg/l	1.0-1.5	0.12	0.18	0.16	0.12	0.14
Nitrate mg/l	45	2.8	3.6	3.1	2.6	3.0
Sulphate mg/l	200-400 mg/l	24	26.3	25.4	23.3	24.75
Total Hardness mg/l	200-600	73	80	78	72	75.7
Calcium Hardness mg/l	75-200	41.3	43.2	40.4	39.2	41.02
DO mg/l	6.5-8	6.5	7.4	6.2	5.8	6.4
BOD mg/l	3	2.6	3.2	2.8	2.5	2.8
COD mg/l	250	132	140.8	136.7	130	134.87

Table 2: Physicochemical properties of Narmada River in winter season at different site (S1-S4)

Parameters	BIS value	S1	S2	S3	S4	Mean value
Temperature	°C	16.2	16.3	16.5	16.2	16.3
Turbidity (ntu)	1-5	2.1	3.2	2.8	2.2	2.5
TDS mg/l	500-2000	220.9	261.8	240.6	220.8	236
pH	6.5-8.5	7.3	7.8	7.4	7.3	7.4
Conductivity (µs/cm)	400	336.2	349.2	342.5	330	339.47
Total Alkalinity mg/l	20-200	24	24.8	24.6	24	24.3
Chloride mg/l	250-1000	20	29.3	25.4	20.6	23.82
Fluoride mg/l	1.0-1.5	0.09	0.2	0.19	0.06	0.13
Nitrate mg/l	45	2.6	2.9	2.4	2.2	2.5
Sulphate mg/l	200-400	18.6	20.5	19.1	17.8	19
Total Hardness mg/l	200-600	86	89	82	80	84.25
Calcium Hardness mg/l	75-200	46	45	41	40	43
DO mg/l	6.5-8	6.9	7.3	7.2	6.8	7.05
BOD mg/l	3	2.4	2.8	2.5	2.3	2.5
COD mg/l	250	84	89	86	80	84.75

Table 3: Physicochemical properties of Narmada River in summer season at different sites (S1-S4)

Parameters	BIS value	S1	S2	S3	S4	Mean value
Temperature	°C	30	32	31	29.8	30.7
Turbidity (ntu)	1-5	2.3	3.2	2.9	2.6	2.7
TDS mg/l	500-2000	245	267	255	237	251
pH	6.5-8.5	7.5	7.9	7.3	7.4	7.5
Conductivity (µs/cm)	400	348	347	338	323	339
Total Alkalinity mg/l	20-200	28	27	27.2	23	26.5
Chloride mg/l	250-1000	23	26	24.2	23.5	24.17
Fluoride mg/l	1.0-1.5	0.08	0.6	0.09	0.08	0.21
Nitrate mg/l	45	3.2	3.8	3.1	3.0	3.3

Sulphate mg/l	200-400	20.4	22.5	21.4	19.8	21.02
Total Hardness mg/l	200-600	92	96	93	85	92.75
Calcium Hardness mg/l	75-200	43	52	47	41	45.75
DO mg/l	6.5-8	6.2	6.1	6.8	6.4	6.3
BOD mg/l	3	3	3.4	3.2	2.9	3.1
COD mg/l	250	93	96.4	93.5	90.3	93.3

In the present study temperature varied from 16 °C to 30 °C. The minimum temperature was recorded in winter 16 °C and maximum in summer 30 °C. The pH of the Narmada River water ranges between 7.4 to 7.5 and the pH was highest in rainy season at site 2. BIS proposed a maximum range of water at 5 NTU. The mean value of turbidity was maximum at 3.7 NTU during rainy season and minimum at 2.7 NTU in winter days, but turbidity was highest at site 2 in rainy season standing at 4.1 NTU near to permissible limit of turbidity according to BIS (Verma *et al.*, 1984) ^[14]. Total dissolved solids ranged between min 220.8 mg/l to max 283.25 mg/l. The maximum seasonal value is observed in rainy season 310 mg/l at site 2 and minimum value in winter season 220.8 mg/l at site 4. Present study reveals that the water is considered to be fit for human consumption in terms of dissolved solids. Total alkalinity of river water ranges from 24.3 to 28.7 mg/l. During rainy days, the mean value of total alkalinity was maximum at 28.7 mg/l and minimum in winter at 24.3 mg/l (Pratibha, *et al* 2005) ^[15]. With respect to stations, the highest value of total alkalinity at site 2 was 34.9 mg/l and lowest at site 4. Chloride value was derived moderate in all seasons between 23-24 m /l. Fluoride value ranges from 0.13 to 0.21 mg/l. Nitrate values ranged between 2.5 mg/l to 3.3 mg/l and maximum of nitrate values were reported during rainy and summer season while minimum during winter at 2.5 mg/l (Gohram, 1961) ^[16]

The value of sulphate lies between 19 mg/l to 25 mg/l. Minimum concentration of Sulphate was in winter at 19 mg/l and maximum in rainy season at 24.75 mg/l. Total hardness reveals seasonal variation in water sample of Narmada River ranged between 75 mg/l to 93 mg/l with minimum in the rainy season and maximum in summer season. Calcium value range between 41 mg/l to 46 mg/l. It was found maximum in summer 45.75 mg/l and minimum in rainy season 41.02 mg/l. The range of DO lies between 6.5 to 8 mg/l for better aquatic life in the water body. (Cox, 2003) ^[17]. The maximum B.O.D. was 3.1mg/l in summer season and minimum in winter 2.5 mg/l. The maximum seasonal value of B.O.D. was reported at site 2 in summer season 3.4 mg/l. According to BIS drinking water standard, BOD should not exceed 6 mg/l (Handerson & Tarzwell 1957) ^[18]. The COD value observed between 85 – 135 mg /l maximum range in rainy season and minimum in winter season.

Conclusion

Narmada River is major source of water in Dindori city so it should be free from pollution. People consuming water directly from river without any treatment in the rural and tribal areas of Dindori city. Narmada River is mainly rain filled, hence water level is moderate in all the season .In rainy season level became rise up and depth of river was increase and in summer Season River became shallow. The water quality of Narmada River is moderate due to domestic waste water discharge in to the river without any treatment and various human activities like bathing, washing clothes and many religious activity along the banks of the river .Different parameters are considered for the water quality determination of Narmada River at four stations (S1–S4). Fifteen water

quality parameters as Nitrate, pH, Dissolved Oxygen, Biological Oxygen Demand, Turbidity, Total Dissolved Solid and Temperature etc considered to assess the quality of river water. Physico- chemical characteristics of River Narmada are compared with Indian standards BIS 10500 and it was revealed that all parameters are well within the permissible limits. On the basis of various parameters, it can be concluded that water study indicates that water of Narmada River is pollution free and can serve as a good habitat for many aquatic organisms. The river water can be used for domestic and irrigation but not for drinking directly.

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