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Physico-Chemical Study of River Narmada with Special Reference to Eastern Zone

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ABSTRACT

The Physico-chemical characteristics of Eastern zone of river Narmada were studied during 2014-15. The Eastern Zone spread out from Amarkantak origin point of River Narmada to Berman Ghat of Narsingpur. Seasonal variations were also recorded. The various physic-chemicals parameters such as pH, turbidity, temperature, alkalinity, chloride, fluoride, DO, BOD, COD, total solid, nitrate and sulphate were taken in to consideration to assess the Nermada River water quality. The results of analysis were compared with the BIS: 2296. The results showed that most of the physico-chemical parameters were in the normal range and indicates healthy quality of water and provide good habitat for aquatic and endangered species.

Keywords: *Narmada River, Physico-chemical study, Pollution, Eastern zone, Aquatic organism.*

INTRODUCTION

Narmada River is one of the most essential rivers in Madhya Pradesh. . It provides the clean water for irrigation purposes and domestic to Madhya Pradesh (NCA 2013 & Sharma et al., 2011). 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. Originating from Amarkantak (situated at 20040' N, 80045'E), in District Anuppur of Madhya Pradesh, the river travels a distance of 1312 km, prior to flowing through Arabian sea situated at 21043'N, 72057'E. in gulf of Cambay in Gujarat. It runs through State of Madhya Pradesh (1077 km) covering the districts of Anuppur, Mandla, Dindori, Mandla, Jabalpur, Hoshangabad, Harda, Khandwa, Barwani, Khargone, Dhar and Jhabua. Narmada River is an inter-state river, 32 kms in common boundary between Madhya Pradesh, Maharashtra and another 40 kms between the border of Gujarat and Maharashtra. The river flows through Gujarat state for a length of 161 kms. The eastern zone extends from origin point to Berman Ghat, Narsingpur.

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The present communication deals with a study of physico-chemical characteristics of eastern zone of Narmada River to asses the quality of water. Physico-chemical and biological study In India and many environmental scientist have done work on evaluation of water (Trivedy & Goel, 1986) and Anjum et al., 2013).). Many studies were done in Narmada River (Sony et al., 2013 & Kumari et al., 2013).

MATERIALS AND METHODS

2.1 Study Area

Surface water samples were collected from thirteen sites of Eastern zone of Narmada river (M.P.) as depicted in table 1. Samplings were done in three quarters, Aug-Oct 2014 was considered as first quarter, Nov-Jan 2014 as second quarter and Jan-Mar 2015 as third quarter. Monitoring locations of River Narmada given in the table 1.

Table 1: Selected sampaling location for Narmada River Monitoring

S.N.	**Monitoring Locations**	Latitude and Longitude
1.	Amarkantak[Ramghat]	22°40'28.2"N 81°45'27.3"E
2.	Kapilvan	22°42'03.2"N 81°42'20.2"E
3.	Kapildhara	22°42'03.2"N 81°42'20.2"E
4.	Dindori ghat	20°20'3131" N 73°82'8682"E
5	Jogitakaria	22°58'07.2"N 81°02'47.2"E
6	Raptapul	22°586600" N 80°356200" E
7	Chrrighat	22°77'07.2"N 81°04'47.2"E
8	Bargi U/S	22°94'10"N 79°92'31" E
9	Bargi D/S	22°94'10" N 79°92'31" E
10	Graveyard	29°38'8531"N 79°43'3617"E
11	Saraswati ghat	23°13'38°" N 79°80'06" E
12	Jhansi ghat	23°11'63" N 79°57'44" E
13	Barman ghat	23°02'99" N 79°01'94" E

2.2. Analysis

Physico-chemical parameters such color, odor, pH and temperature were recorded at sampling sites, while remaining for parameters sample were transported to the laboratory and analysed at the earliest as per standard (APHA 2017 and Trivedy & Goel 1986). The physico-chemical characteristics determines water quality at any water body. According to Surface Water Quality Standards (BIS: 2296), various classes of water are classified as follows-

RESULTS AND DISCUSSION

The results of Physico-chemical parameters of river Narmada are presented in fig. 1-11. The obtained data reveals that the water parameters under study are well within the limit of Indian Standard (BIS: 2296), which indicate river water is suitable for domestic purpose. According to Ellis (1937) pH range of 6.7 to 8.4 is suitable for the growth of aquatic biota (Ellis 1937) . The water of whole fourteen sampling locations of eastern zone was observed alkaline throughout the period of study as shown in table 1. The pH ranges from 7.2-8.1 which is within the limits of BIS: 2296(6.5-8.5).Therefore, it can be concluded that water of eastern zone is suitable for the growth of aquatic biota. Variation of pH at various sampling locations is depicted in fig. 1.

In stream water, suspended solids comprise of silt and clay particles, plankton, algae, fine organic debris, and other particulate matter. High levels of total solids will reduce the clarity of the water. This reduces the amount of sunlight reaching the water, thereby decreasing the photosynthetic rate. Suspended particles in the water absorb the sunlight which, in turn, warms the surrounding water. This causes other problems associated with increased temperature levels. In the present study suspended solid observed in the range of 0-98 mg/l. It was minimum [0 mg/l]at Raptapul ghat during first quarter and maximum (98 mg/l) at Bargi dam D/S (Downstream) during third quarter. Dissolved solid in eastern zone lies between 44-216 mg/l. Maximum dissolved solid was at Raptapul ghat during third quarter. According to BIS: 2296, dissolved solid levels exceed 1000mg/l water is generally considered unfit for human consumption. Present studyreveals that the water of eastern zone is considered to be fit for human consumption in terms of dissolved solids.

BOD is measure of the amount of dissolved oxygen demanded by aerobic biological organisms in water body to break down organic material present in a given water sample at certain temperature over a specific time period. BOD is an indicator of organic pollution. The range of BOD was 0.1-5.5 mg/l. Maximum BOD (6.2 mg/l) was found in Kapildhara in third quarter, however, in first and second quarter. it was under the limite as prescribed by BIS: 2296. Thus, water of Kapildhara belongs to class C. The present study indicates moderate pollution of Kapildhara as depicted in fig. 5

Saksena (2008) reported that metabolic activities of organisms are regulated by Dissolved oxygen and also acts as an indicator of trophic status of the water body (Saksena et al., 2008). Tarzwell (1957) investigated that inorganic reducing agents such as hydrogen sulphide, ammonia, nitrite, ferrous iron and certain oxidizable substances also tend to decrease dissolved oxygen in water has suggested that a minimum of 3 mg /l dissolved oxygen is necessary for healthy fish and other aquatic life (Tarzwell (1957). In the present study the value of dissolved oxygen was recorded as 5.2 mg/l at Ramghat in month of Aug-Sep2014 indicating water class B and maximum was (9.9 mg/l) at Barman ghat in month of Jan-Feb 2015 indicating water class A. This level of oxygen in the river should be able to support good fauna and flora. Thus, the study shows good oxygen saturation at eastern zone of river Narmada. Variation in DO at various sampling locations is depicted in fig. 6.

Higher value of nitrate in water is an indication of pollution in the river and will cause eutrophication, hence, deteriorating water quality. Aldefer reported that inorganic nitrogen above 0.03 mg/l stimulates algal growth to such an extent that water may not be suitable for human consumption (Aldefer, & Lovelace, 1977). Excessive use of fertilizers in agriculture, decayed vegetable, animal matter, domestic effluents, sewage or sludge disposal, industrial discharges, leachable from refuse dumps, atmospheric washout and precipitation are the main reasons for high level of nitrate in drinking water. In the present study the value of nitrate was recorded as 5.2 mg/l at Ramghat in month of March-May 2015 and maximum was 2.2 mg/l at Barman ghat in month of Aug-

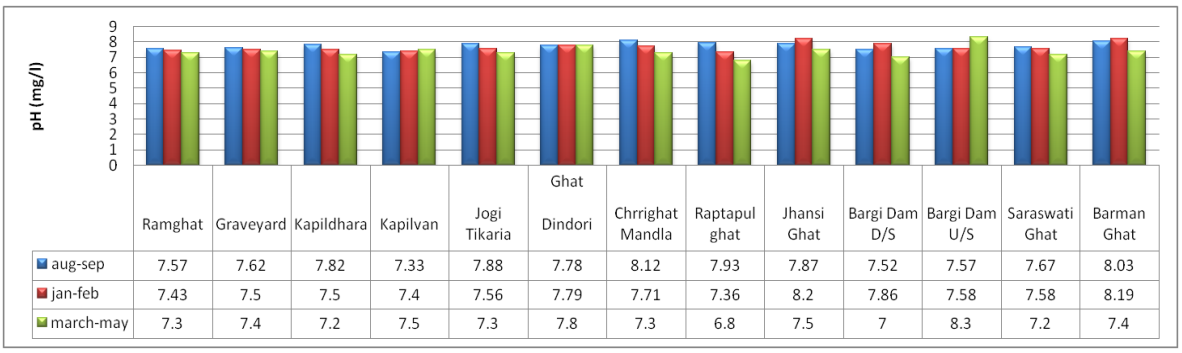
Sep 2014. Thus it shows thate nitrate concentration was under permissible limit as per BIS 2296 i.e. less than 20 mg /l for class A. Variation in nitrate at sampling locations is depicted in fig. 7

Chemical Oxygen Demand (COD) measures the extent of pollution in water (Srivastava, & Patil 2002). COD is the measure of the oxygen required for chemical oxidation of organic matter. In the present study maximum COD (60 mg/l) was found in Saraswati ghat area in second quarter. This also provides a direct measure of state of pollution in water bodies as shown in fig. 8.

Major source of phosphate in water are domestic sewage, agriculture effluents and industrial waste waters. The high concentration of phosphate is, therefore, indicative of pollution (Thresh et al., 1949). The range of phosphate in eastern zone was 0.066-0.264 mg/l. Variation in phosphate at sampling locations is depicted in fig. 9.

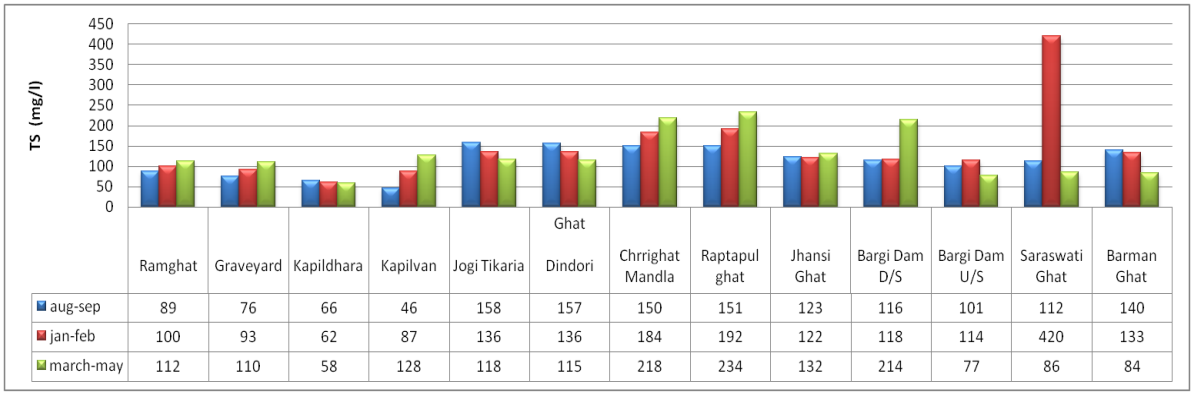
Chloride concentration in water marks the presence of organic waste in water, primarily of animal origin (BRN 2015).It increases with ammonical nitrogen which also owes itself mostly to animal excreta. The range of chloride in eastern zone was 0.99-14.9 mg/l. The chloride concentration was quite low in the river as prescribed by BIS: 2296, indicating class A, which reflects that there is very less amount of organic waste of animal origin and practically no discharge of municipal and industrial wastes. Variation in chloride at sampling locations is depicted in fig. 10.

In eastern zone maximum turbidity was found in Ramghat in March-May 2015 (41 NTU). In present investigation turbidity was higher during monsoon because of heavy rain which brings sediments and fly ash particle by point and nonpoint sources. The value of turbidity was highest in March-May 2015 in eastern zone because in this months the flow of water become slow and water start condensing and accumulating at the place which leads to formation of algae that ultimately sediments. [fig. 11]



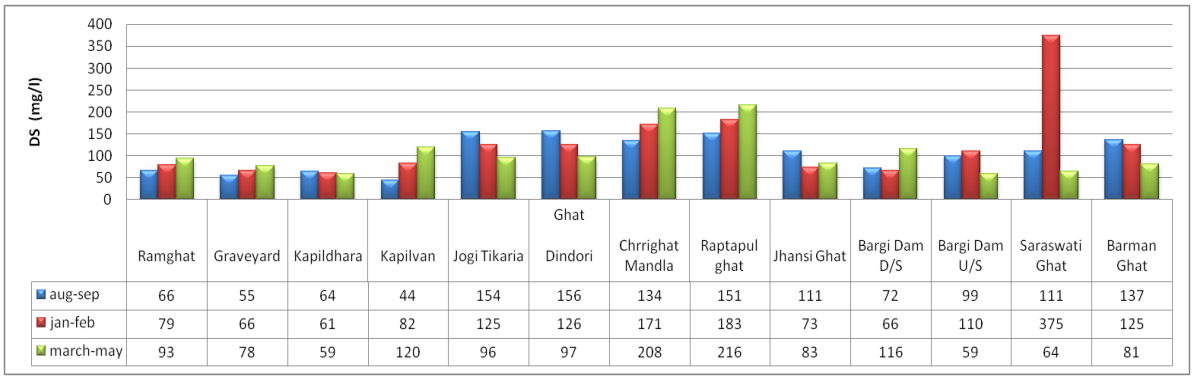
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	7.57	7.62	7.82	7.33	7.88	7.78	8.12	7.93	7.87	7.52	7.57	7.67	8.03
jan-feb	7.43	7.5	7.5	7.4	7.56	7.79	7.71	7.36	8.2	7.86	7.58	7.58	8.19
march-may	7.3	7.4	7.2	7.5	7.3	7.8	7.3	6.8	7.5	7	8.3	7.2	7.4

Fig. 1: Variation of pH in eastern region of River Narmada



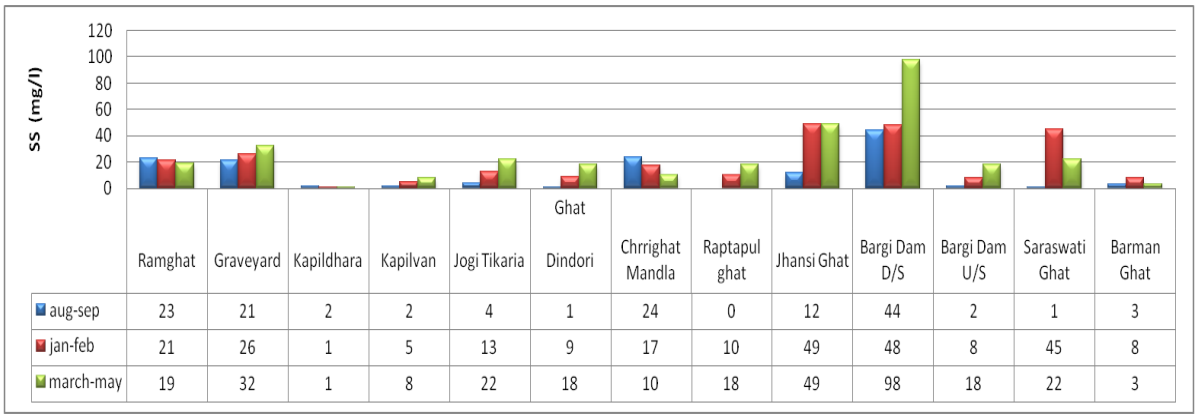
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	89	76	66	46	158	157	150	151	123	116	101	112	140
jan-feb	100	93	62	87	136	136	184	192	122	118	114	420	133
march-may	112	110	58	128	118	115	218	234	132	214	77	86	84

Fig. 2: Variation of TS in eastern region of River Narmada



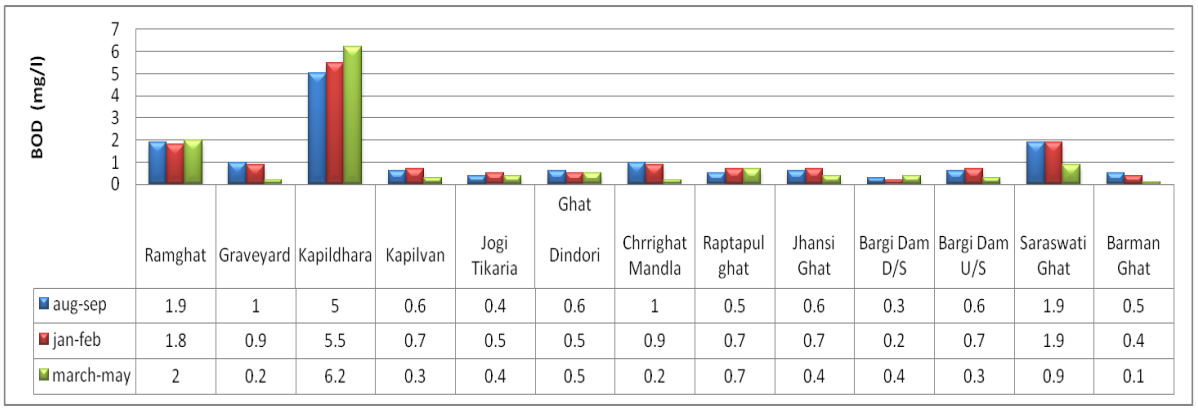
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	66	55	64	44	154	156	134	151	111	72	99	111	137
jan-feb	79	66	61	82	125	126	171	183	73	66	110	375	125
march-may	93	78	59	120	96	97	208	216	83	116	59	64	81

Fig. 3: variation of DS in eastern region of River Narmada



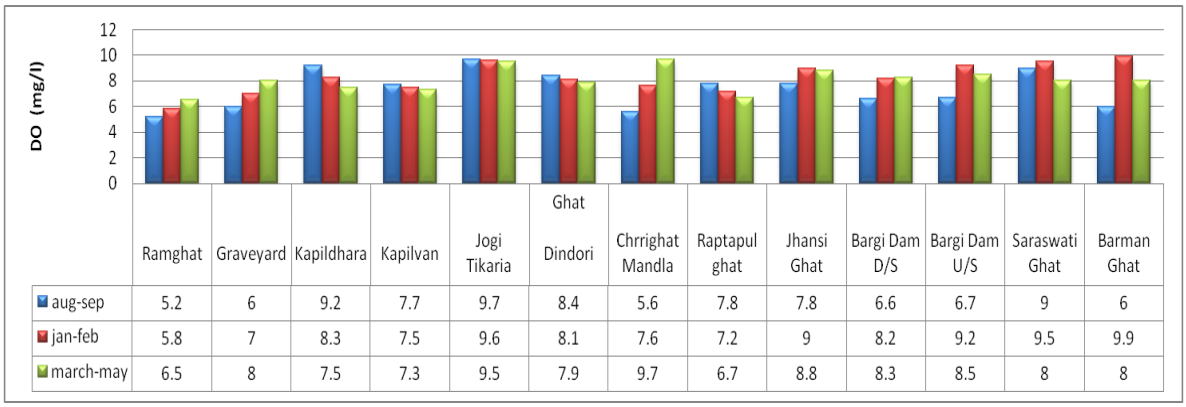
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	23	21	2	2	4	1	24	0	12	44	2	1	3
jan-feb	21	26	1	5	13	9	17	10	49	48	8	45	8
march-may	19	32	1	8	22	18	10	18	49	98	18	22	3

Fig. 4: Variation of SS in eastern region of River Narmada



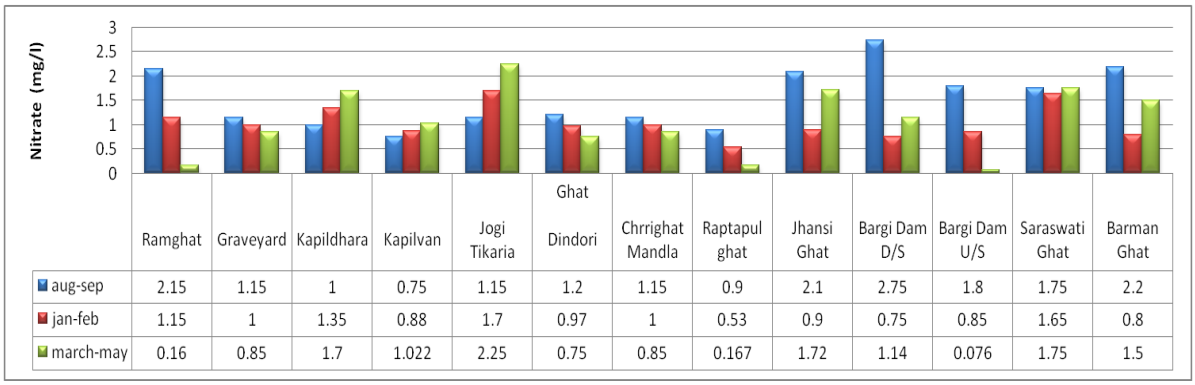
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	1.9	1	5	0.6	0.4	0.6	1	0.5	0.6	0.3	0.6	1.9	0.5
jan-feb	1.8	0.9	5.5	0.7	0.5	0.5	0.9	0.7	0.7	0.2	0.7	1.9	0.4
march-may	2	0.2	6.2	0.3	0.4	0.5	0.2	0.7	0.4	0.4	0.3	0.9	0.1

Fig. 5: Variation of BOD in eastern region of River Narmada



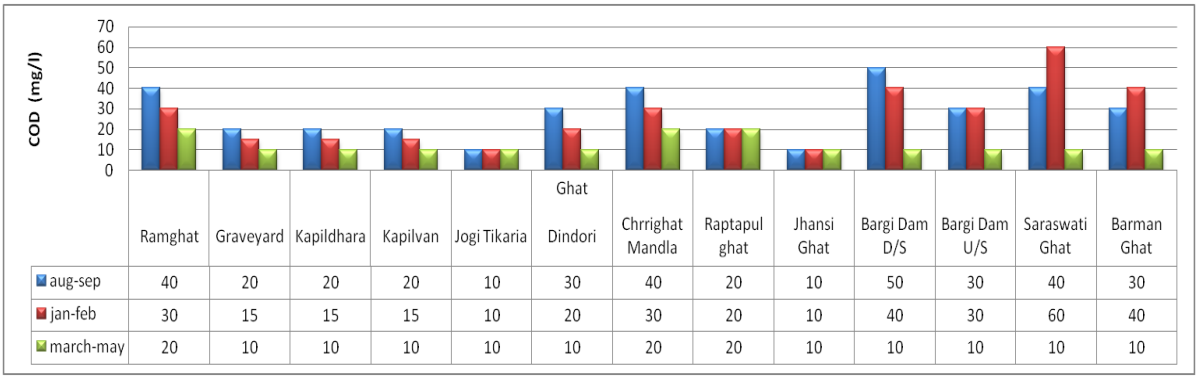
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	5.2	6	9.2	7.7	9.7	8.4	5.6	7.8	7.8	6.6	6.7	9	6
jan-feb	5.8	7	8.3	7.5	9.6	8.1	7.6	7.2	9	8.2	9.2	9.5	9.9
march-may	6.5	8	7.5	7.3	9.5	7.9	9.7	6.7	8.8	8.3	8.5	8	8

Fig. 6: Variation of DO in eastern region of River Narmada



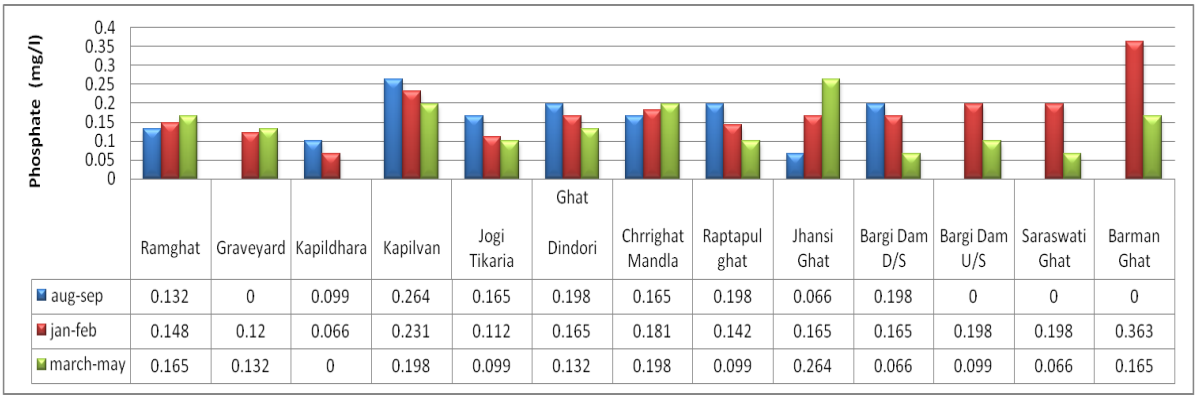
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	2.15	1.15	1	0.75	1.15	1.2	1.15	0.9	2.1	2.75	1.8	1.75	2.2
jan-feb	1.15	1	1.35	0.88	1.7	0.97	1	0.53	0.9	0.75	0.85	1.65	0.8
march-may	0.16	0.85	1.7	1.022	2.25	0.75	0.85	0.167	1.72	1.14	0.076	1.75	1.5

Fig. 7: variation of Nitrate in eastern region of River Narmada



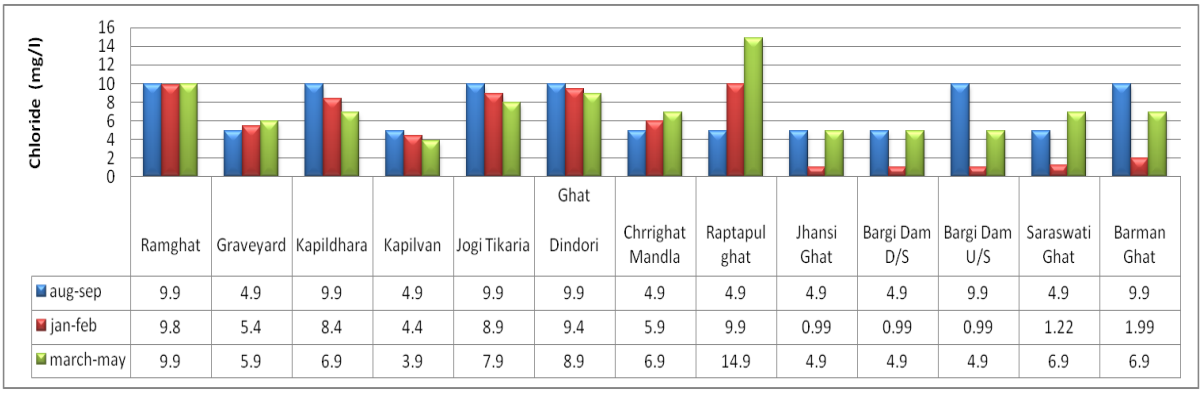
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	40	20	20	20	10	30	40	20	10	50	30	40	30
jan-feb	30	15	15	15	10	20	30	20	10	40	30	60	40
march-may	20	10	10	10	10	10	20	20	10	10	10	10	10

Fig. 8: variation of COD in eastern region of River Narmada



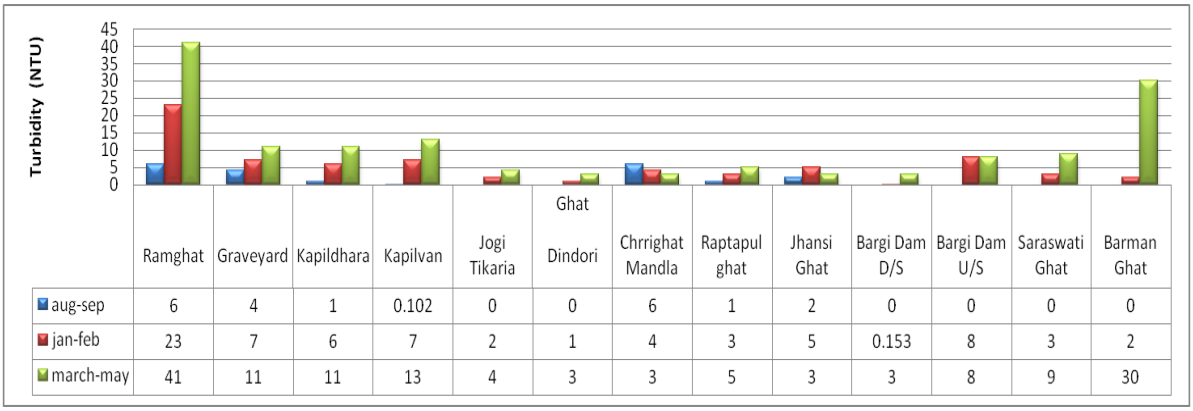
	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	0.132	0	0.099	0.264	0.165	0.198	0.165	0.198	0.066	0.198	0	0	0
jan-feb	0.148	0.12	0.066	0.231	0.112	0.165	0.181	0.142	0.165	0.165	0.198	0.198	0.363
march-may	0.165	0.132	0	0.198	0.099	0.132	0.198	0.099	0.264	0.066	0.099	0.066	0.165

Fig. 9: Variation of phosphate in eastern region of River Narmada



	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	9.9	4.9	9.9	4.9	9.9	9.9	4.9	4.9	4.9	4.9	9.9	4.9	9.9
jan-feb	9.8	5.4	8.4	4.4	8.9	9.4	5.9	9.9	0.99	0.99	0.99	1.22	1.99
march-may	9.9	5.9	6.9	3.9	7.9	8.9	6.9	14.9	4.9	4.9	4.9	6.9	6.9

Fig. 10: Variation of chloride in eastern region of River Narmada



	Ramghat	Graveyard	Kapildhara	Kapilvan	Jogi Tikaria	Ghat Dindori	Chrrighat Mandla	Raptapul ghat	Jhansi Ghat	Bargi Dam D/S	Bargi Dam U/S	Saraswati Ghat	Barman Ghat
aug-sep	6	4	1	0.102	0	0	6	1	2	0	0	0	0
jan-feb	23	7	6	7	2	1	4	3	5	0.153	8	3	2
march-may	41	11	11	13	4	3	3	5	3	3	8	9	30

Fig. 11: Variation of turbidity in eastern region of River Narmada

CONCLUSION

Physico- chemical characteristics of River Narmada are compared with Indian standards (BIS-2296) 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 of eastern zone of River Narmada i.e. from Amarkantak to Barman Ghat, Narsingpur falls under class 'A' as per calerorizttion of BIS :2296. The study indicates that the river water of Eastern zone of Narmada river is pollution free and can serve as a good habitat for many aquatic organisms including endangered species.

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