

Assessment of water quality of Chambal River by Benthic Macroinvertebrate, Madhya Pradesh, India.

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ABSTRACT

Biological monitoring includes the identification of different macro invertebrate species collected at the sampling sites and further calculation of saprobic score and diversity score to determine the water quality. Water quality of River Chambal was assessed by identifying the inhabitat benthic macro invertebrates. About 36 numbers of families of macro zoo benthos invertebrates were identified during the study period from April 2019 to March 2021 at 12 monitoring sites (from Origin Point of Chambal River at Janapav to Taal, Ratlam). On the basis of diversity score at most of the sampling locations quality of Chambal river water was classified under class B to C. However, at one locations it was under class A.

Key words : Benthic macro-invertibrates, River Chambal

Introduction

The Chambal River is the most important water resource in the State of Madhya Pradesh and meets the demand of drinking water of a large number of human in cities and towns located on its banks. In addition to the supply of drinking water, the river is also very important from an ecological point of view, as it hosts a very rich flora and fauna (Crawford, 1969; Verma *et al.*, 1993). The deteriorating quality of water is mainly due to anthropogenic activities such as disposal of industrial, domestic sewage and agricultural runoff, which are the main cause of ecological fluctuations. In the present study, attempts have been made to assess the water quality of river Chambal by using Macro invertebrates as bio indicators. Bio indicators are biological species or set of species, which can be used to assess the quality of an ecosystem. Identification of flora and

fauna is a systematic and easy tool for collecting qualitative and quantitative information about the status of aquatic environment. Biological monitoring includes the identification of different macro invertebrate species collected at the sampling sites and further calculation of saprobic score and diversity score to ascertain the water quality.

Material and Method

Study Area

Chambal River is a tributary of Yamuna River in Central India, and thus forms a part of the greater Gangetic drainage system. The river flows north-northeast through Madhya Pradesh, running through Rajasthan, then forming the boundary between Rajasthan and Madhya Pradesh before turning southeast to join the Yamuna in Uttar Pradesh. The perennial Chambal originates at Janapav, South

of Mhow town, near Manpur, Indore, on the south slope of the Vindhya Range in Madhya Pradesh. The Chambal and its tributaries drain the Malwa region of northwestern Madhya Pradesh, while its tributary, the Banas, which rises in the Aravalli Range, drains southeastern Rajasthan. It ends at Pachnada near Bhareh in Uttar Pradesh at the border of Bhind and Etawah districts after confluence of five rivers, i.e. Chambal, Kwari, Yamuna, Sind and Pahuj.

For the study purpose river stretch in MP was divided into two zones viz. Indore and Nagda zone and 12 sampling sites (6 sampling sites in each zone) were selected from Janapava origin point of river Chambal to Nagda before it reaches to Uttar Pradesh.

Sample Collection, Preservation and Identification

Aquatic macro invertebrate samples were collected at all sites using a sweep net. Three biotopes at each site were sampled for 15 min in total, specifically: stones, gravel, sand, mud and vegetation (Saksena *et al.*, 2008; Dickens *et al.*, 2010). Stones biotopes were sampled by disturbing the stones with the feet, while continuously sweeping the net downstream over the disturbed area. Samples were preserved with 70 % ethanol for identification in the laboratory. Macro invertebrates were identified upto family level with the help of pertinent literature (APHA, AWWA., 2017; Adoni *et al.*, 1985; Needham *et al.*, 1962; Pennak, 1953; Victor *et al.*, 1985) and CPCB protocol.

Observation

Biomonitoring involves the measurement of biological indicators to assess the condition of rivers. Biological indices are used to assign classes and categories in order to describe the state of the river reaches.

By identification and quantification of different macro invertebrate species collected from the sampling sites, saprobic score and diversity score are to

be calculated and assess the water quality. The criteria of classification of the water quality is depicted in Table 1.

Obtained value of saprobic score and diversity score and categorization of the Chambal river depicted in Table 2 & 3 respectively and graphical representation was shown in Figure 1

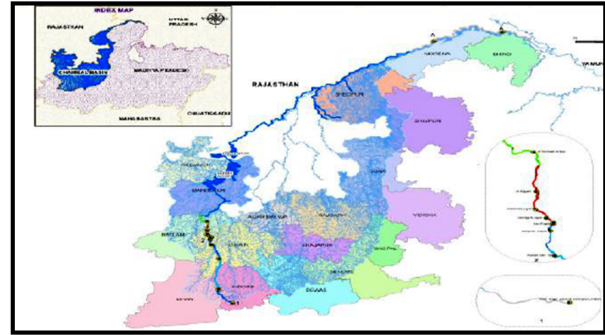


Fig. 1

Results and Discussion

The seasonal monitoring was performed except rainy season for two years i.e. 2019-2021.

Families identified: In River Chambal, about 36 families of macro zoobenthos of 10 groups (Heptageniidae, Ephemerellidae, Gomphidae, Euphaeidae, Corbiculidae, Viviparidae, Planorbidae, Asellidae, Gammaridae, Corixidae, Nepidae, Gerridae, Chironomidae, Hydrophilidae, Gyridae, Baetidae) were identified during study span across the river stretch. In Zone-I Indore Region, 16 families of macro zoobenthos were identified. In Zone-II Nagda Region, about 20 families were identified. The dominating group as per the identified families appears Mollusca in all the two study zones with families Viviparidae, Neritidae, Thiaridae, planorbidae, Lymnaeidae and Corbiculidae. Saprobic and diversity scores were calculated based on the identified families.

Table 1. Biological Water Quality Criteria (BWQC) for River/ Lakes/Ponds and Reservoirs

S. No.	Range of Saprobic Score	Range of diversity Score	Water Quality	Water Quality Class	Colour Indicator
1	7-10	0.5-1	Clean	A	Blue
2	6-7	0.5-1	Slight Pollution	B	Light Blue
3	3-6	0.3-0.9	Moderate Pollution	C	Green
4	2-5	0.4 & Less	Heavy Pollution	D	Orange
5	0-2	0-0.2	Sever Pollution	E	Red

Table 2. Saprobic & Diversity Score of Chambal River 2019-2021

Quarter	Origin Point	Sampling Locations											
		Chambal River Near Naichha village Aachna, Pithampur	Chambal River U/s Ghatabillod near road bridge Dhar	Chambal River D/s Ghatabillod near road bridge Dhar	Chambal River behind government primary school Medaad, Dhar	Chambal River near road bridge Shifraj, Pithampur	Chambal River U/s Piploda Bagla near Stop Dam, Nagda	Chambal River D/s Piploda Bagla near Stop Dam, Nagda	Chambal River U/s inspection banglow, Nagda	Chambal River D/s near road bridge Chamunda Dev Mandir, Nagda	Chambal River U/s near road bridge at Taal, Ratlam	Chambal River D/s near road bridge at Taal, Ratlam	
I	5.9	6.0	6.2	6.4	5.3	6.4	5.5	6.5	5.7	4.8	5.1		
II													
III	5.5	5.5	5.5	5.6	5.5	5.3	5.9	5.3	6.4	6.4	6.0		
IV	5.8	6.3	6.1	5.3	6.6	6.0	5.5	5.9	5.8	5.9	5.1		
I	6.2	5.7	6.0	-	5.3	6.2	-	5.8	6.7	-	5.5		
II													
III	6.5	5.3	6.8	-	5.7	6.3	-	7.5	5.9	-	7		
IV	5.3	6.0	4.9	-	6.4	6.6	-	6.4	6.2	-	6.3		
I	0.62	0.61	0.59	0.70	0.58	0.65	0.65	0.62	0.58	0.64	0.66		
II													
III	0.64	0.60	0.70	0.69	0.59	0.59	0.62	0.58	0.70	0.71	0.72		
IV	0.66	0.67	0.65	0.68	0.65	0.61	0.68	0.64	0.59	0.62	0.63		
I	0.62	0.53	0.56	-	0.56	0.60	-	0.61	0.69	-	0.60		
II													
III	0.59	0.49	0.68	-	0.62	0.58	-	0.52	0.50	-	0.59		
IV	0.68	0.62	0.59	-	0.50	0.54	-	0.5	0.81	-	0.6		

In Zone-I only two families of group Ephemeroptera i.e. Heptageniidae, Ephemerellidae were present whereas, in Zone-II families of group Ephemeroptera were Ephemeridae, Caenidae, Heptageniidae, Ephemerellidae, Siphonuridae, in addition to these Baetidae was also detected in Zone-II. Plecoptera group with family Perlidae was found in Zone-II whereas, it was not detected in zone-I. Two families from the group Crustacea (Gammaridae & Paleamonidae) was detected in both zones. Similarly, two families (Gomphidae, Euphaeidae) from group Odonata was found in both zones, However Zone-II contained one more family of Odonata group i.e. Libellulidae. One family from each group Diptera, Coleoptera and Trichoptera were found in Zone-II during the study. Among Diptera group Chironomidae were the only representative family found in both Zone-I and Zone-II.

Saprobic and Diversity scores

In Zone-I Indore Region, Saprobic score and diversity score of Chambal River was found between 5.3 -6.5 and 0.53 - 0.68 respectively at Origin Point Janapava and water quality was of Class B to C, i.e. Slight to moderately polluted. Degradation of water quality to class "C" is mainly due to low flow of river throughout the year. Water

Table 3. Water Quality on the Basis of BWQC Score 2019-21

Quarter	Sampling Locations											
	Origin Point	Chambal River Near Naichha village Aachna, Pithampur	Chambal River U/s Ghatabilod near road bridge Dhar	Chambal River D/s Ghatabilod near road bridge Dhar	Chambal River behind primary school Medaad, Dhar	Chambal River near road bridge Shifraj, Pithampur	Chambal River U/s Piplođa Bagla near Stop Dam, Nagda	Chambal River D/s Piplođa Bagla near Stop Dam, Nagda	Chambal River U/S inspection banglow, Nagda	Chambal River D/s near road bridge Chamunda Dev Mandir, Nagda	Chambal River U/s near road bridge at Taal, Ratlam	Chambal River D/s near road bridge at Taal, Ratlam
I	Moderate Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution
II	Rainy Season											
III	Moderate Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution	Slight Pollution	Slight Pollution	Slight Pollution
IV	Moderate Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution
I	Slight Pollution	Moderate Pollution	Slight Pollution	-	Moderate Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	-
II												
III	Slight Pollution	Moderate Pollution	Slight Pollution	-	Moderate Pollution	Moderate Pollution	Slight Pollution	Clean	Moderate Pollution	Clean	Clean	-
IV	Moderate Pollution	Moderate Pollution	Moderate Pollution	-	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	-
2020-2021 Water Quality												
I	Moderate Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Slight Pollution	Moderate Pollution	Moderate Pollution	Moderate Pollution
II												
III	Slight Pollution	Moderate Pollution	Slight Pollution	-	Moderate Pollution	Moderate Pollution	Slight Pollution	Clean	Moderate Pollution	Clean	Clean	-
IV	Moderate Pollution	Moderate Pollution	Moderate Pollution	-	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	Slight Pollution	-
2020-2021												
Water Quality Class												
I	C	B	B	B	C	C	B	C	B	C	C	C
II												
III	C	C	C	C	C	C	C	C	C	B	B	B
IV	C	B	B	C	B	C	B	C	C	C	C	C
2019-2020												
I	B	C	B	-	C	-	B	-	C	B	B	-
II												
III	B	C	B	-	C	-	B	-	A	C	A	-
IV	C	C	C	-	B	-	B	-	B	B	B	-

quality of Chambal River at Nalchha village aachna, Pithampur was again moderately polluted due to mixing of domestic sewage in this area. Saprobic score and diversity score was found between 5.3-6.0 and 0.49-0.62 respectively at these locations. Similarly, saprobic and diversity score of both sampling site of Chambal River at U/s and D/s Ghatabillood near road bridge Dhar found between 4.9-6.8 and 0.56-0.70 the water quality degrades due to Human influences (Religious activities and cattle wadding).

Behind government primary school Medaad, Dhar Chambal River water quality was improved during 4th Quarter. Lower saprobic value was observed during 1st Quarter, when compared it to the 3rd and 4th Quarter. Diversity score was also higher during 3rd and 4th Quarter, as compared to 1st Quarter. During the study period 2019-21, the water quality of river Chambal in Zone-I, Indore Region, classified under class B to C based on BWQC.

In zone - II Chambal River water quality at Piploda Bagla near Stop Dam, Nagda was slightly polluted throughout the year. Saprobic score and diversity score were found to be in the range of 6.2-6.6 and 0.54-6.0 respectively. Chambal river water quality falls under Class C at D/s near road bridge Chamunda Dev Mandir, Nagda. Saprobic score and diversity score were found least (5.9 and 0.5 respectively) during 3rd Quarter. Moderately polluted water was found during 1st quarter in Chambal river u/s inspection banglow, Nagda which improved (slightly polluted) during 3rd and 4th Quarter of study period. The degradation in water quality was may be due to anthropogenic activities like religious activities, and because of industrial effluent, agriculture runoff. Chambal river water quality at D/S near Road Bridge, Taal, Ratlam was observed under class "B" i.e. slightly polluted. Here, the saprobic score and diversity score were present in the range of 5.5-7.0 and 0.59-6.0 respectively. Thus, in Zone-II

Nagda Region, water quality of river Chambal was observed A to C based on BWQC.

Conclusion

Benthic macro-invertebrates identification based on BWQC is used for categorization of rivers Chambal. Chambal River has distinctive diversity of benthic macro invertebrates throughout its stretch. The presence/ absence/ frequency of appearance/ disappearance and abundance of these organisms act as biomonitoring tool in pollution load assessment. In river Chambal 36 numbers of families of macro zoo benthos invertebrates identified during study period from April 2019 to March 2021. The benthic macro invertebrate fauna exhibit an enormous range of diversity in river bed and are highly sensitive or tolerant to changes in water quality. In Indore zone 16 families of macro zoo benthos were identified, the water quality class at most of the locations of class B based on BWQC score. At some sampling locations degradation of water quality was observed mainly due to merging of domestic and industrial effluent within and around the river bed of Indore zone. In this zone water quality remains same throughout the study period. In Nagda zone, about 20 families were identified. Water quality at most of the sampling locations was clean to moderately polluted i.e. Class A to C. The reasons for the degradation of water quality in some locations are mainly due to human activities which include idol immersion cattle influence as well as industrial & domestic sewage affecting the water quality of river.

Study reveals that water quality of Chambal river water classified slightly polluted to moderately polluted category as per BWQC score.

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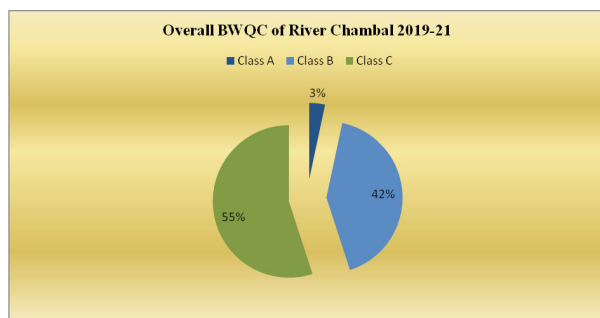


Fig. 2.

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