Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 18 (1) : 67-76 (January-2023), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Assessment of Macrobenthic Invertebrates of a Central Indian Water Body (Jobat Dam) with Reference to its Water Quality

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Abstract

Present study was conducted in Jobat Dam of District Alirajpur which is one of the important water bodies for the local people of central India besides being an important resource for biodiversity. Analysis of various physico-chemical parameters of water samples collected from different stations of the Dam during the period 2019-2020 indicates that the Dam is moderately polluted especially at Station-1 and Station-3. Based on the present investigation it can be concluded that the Dam can be used for potable activities after treatment as per standard prescribed by CPCB.

Key words : *Anthropogenic activities, water quality, biodiversity, pollution.*

Introduction

Today almost all aspect of modern living process possesses potential health risk. The air we breathe the water we drink and the places we live and work in may be contaminated with toxic substances or chemical additives. The adverse affects of pollution in the environment especially due to population explosion are not only limited to ourselves but may be passed on to future generation by way of genetic mutations, birth defects, inherited diseases and soon.

Population explosion along with urbanization and industrialization in last few decades increased the intensity of pollution including water pollution all over the world. Water pollution means such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or any other liquid, gaseous or solid substance into water whether directly or indirectly, or is likely to create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health of animals or plants or of aquatic organisms. Control of water pollution is clearly one of the most critical of those challenges. It creates a problem of disease; environmental degradation and economic stagnation. Water resources become more and more contaminated therefore control of water pollution is the need of the hour.

The drinking water of most communities and municipalities is obtained from surface water resources like rivers, streams, and lakes. Such natural water supplies, particularly streams and rivers, are likely to be polluted with domestic and industrial wastes, i.e., sewage. Hence to understand the intensity of pollution periodical monitoring of water bodies, water quality and its impact is an essential component which should be evaluated by analyzing its various characteristics like ecology and relevant water quality parameters including physical, chemical and biological properties.

Among biological parameters macrozoobenthos are useful bio-indicators providing a more accurate understanding of changing aquatic conditions and most popular biological method in assessment of freshwater bodies receiving domestic and industrial waste waters. Benthic macroinvertebrates are the most popular and commonly used group of fresh water organisms in assessing water quality. Macroinvertebrates serve as a tool to measure continuous and chronic effects of pollution (1).

Considering this the macrobenthic fauna of Jobat reservoir was studied vis a vis few physico-chemical parameters to understand the existing water quality of the reservoir as well as biodiversity of the dam.

Description of study area : The Jobat water reservoir (Latitude 22° 16'50"N and Longitude 74° 35' 10"E) was constructed near Fata village about 6 km of the upper lake across the river Hathni, a tributary of Narmada river which is near village Waskal, 24 km from Kukshi town of Dhar district.

The water of this dam is used for multipurpose activities like irrigation recreation, drinking water and fish culture etc. The water from this reservoir is being supplied for annual irrigation of 12802.0 Ha land .The reservoir is having a catchment area of 792.00Sq. Km. and the gross storage capacity at full reservoir level is 106.00M.

Received : October-2022; Revised : October-2022; Accepted : November-2022

Materials and Methods

The present study was conducted from October 2019 to September 2020 to assess the water quality of Jobat Reservoir from four stations viz. Inlet, Northern Region, Southern Region and outlet. Integrated water samples were collected from surface, middle and bottom waters in every month.

Sampling Technique : During the period of investigation monthly samples were collected from 4 identified sampling stations. Water samples were collected in sterile glass bottles, jerry cans from surface middle and bottom of each station following the standard methods (12). After collection of the samples the three samples were integrated to one sample and the bottles were tightly capped and were immediately transported to the laboratory to avoid any unpredictable changes in the physico-chemical characteristics. Suitable preservation techniques were adopted as per the standard methods. The parameters like temperature, TDS, conductivity, pH, dissolved oxygen, TDS were analyzed on the field while rest of the parameters were analyzed in the laboratory as per the methods described in (2, 3, 4)

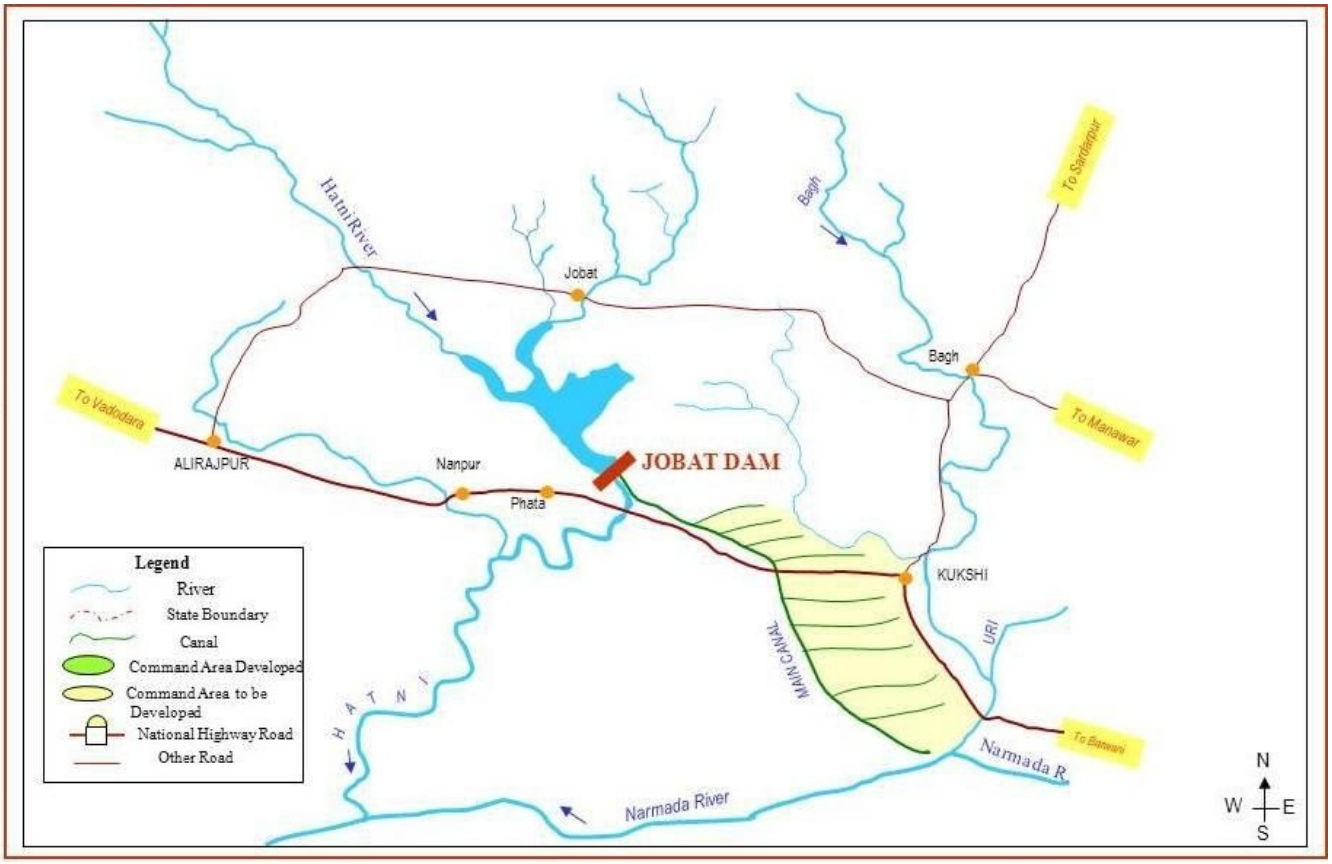
Parameters Analyzed

Physicochemical	Biological
1. Temperature	1. Macrobenthos
2. pH	
3. Conductivity	
4.Total Dissolved Solids	
5. Dissolved Oxygen	
6. Total Alkalinity	
7. Total Hardness	
8. Calcium Hardness	
9. Magnesium Hardness	
10. Chloride	
11. Nitrates	

Methods for Analysis of Biological Parameters

Macrobenthos

Quantitative Sampling : Quantitative sampling was done by Kick net Surber sampler.Macro-invertebrate samples were collected by using Kick net (20*20 cm) in to a single sample following the semi quantitative procedure of Organisms were collected by stirring and disturbing the substance for about 5 minutes to the depth of several inches to dislodge the borrowing macro-invertebrates



1. Air Temperature and 2.Water temperature.

Table-1 : Monthly fluctuations in Air Temperature of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Stations	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	29.1	27.4	22.4	27.1	28.4	33.1	36.1	39.2	36.1	31.9	29.7	28.1	22.4	39.2	22.4
St–2	29.3	27.8	21.9	27.9	29.1	33.4	36.4	39.2	35.9	32.3	29.4	28.4	21.9	39.2	21.9
St–3	28.9	28.1	21.7	27.4	29.3	33.1	36.1	39.6	35.3	32.6	29.9	28.3	21.7	39.6	21.7
St–4	28.7	28.3	22.1	27.6	29.7	33.7	36.7	40.7	36.2	32.9	30.1	28.6	22.1	40.7	22.1

Table-2 : Monthly fluctuations in Water Temperature of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Stations	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	27	26	19	18	22	24	29	29	27	27	24	27	18	29	18
St–2	28	27	17	21	24	25	28	29	28	25	24	29	17	29	17
St–3	27	26	19	15	22	23	28	27	27	26	23	28	15	28	15
St–4	27	27	20	20	23	25	28	29	32	26	23	28	19.5	31.5	19.5

3. pH

Table-3 : Monthly fluctuations in pH of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	7.6	7.8	7.7	7.6	7.69	7.91	8.1	8.24	8.4	7.6	7.4	7.5	7.44	8.36	7.80
St–2	7.4	7.6	7.1	7.2	7.64	7.48	7.9	8.11	8.4	7.4	7.3	7.4	7.11	8.42	7.61
St–3	7.6	7.7	7.2	7.3	7.58	7.59	7.5	8.16	8.2	7.5	7.4	7.4	7.23	8.21	7.61
St–4	7.2	7.5	7.4	7.4	7.29	7.66	7.9	7.98	8.2	7.3	7.5	7.3	7.22	8.17	7.58

4. Total Dissolved Solid (TDS)

Table-4 : Monthly fluctuations in Total Dissolved Solids of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	236	188	142	130	136	125	139	170	360	310	316	241	125	360	212.71
St–2	204	164	130	140	127	161	154	260	320	260	310	263	127	320	210.00
St–3	211	160	136	170	122	154	147	248	220	288	298	266	122	298	202.86
St–4	242	180	154	184	168	174	146	220	246	264	274	249	146	274	208.64

ahead of the net per square meter. Sample were obtained from the same location by brushing the organism of the cobbles and rocks, following standard method of (2, 5). Identification of the samples were done as per the standard procedure (2).

Results and Discussion

The water quality of a reservoir is determined by assessing three classes of attributes: biological, chemical and physical. There are standards of water quality set for each of these three classes of attributes. Some attributes are considered of primary importance to the quality of drinking water, while others are of secondary importance. Physical attributes of the effluent can be important indicators of water quality. Apart from this assessment of physical attribute, the chemical attribute includes measures of many elements and molecules dissolved or suspended in the water. Chemical measures can be used to directly detect pollutants such as nitrate, phosphate and other active nutrients. Chemical measures can also be used to detect imbalances within the ecosystem. Such imbalances may indicate the presence of certain pollutants. Since the chemical quality of water is important to the health of humans as well as the plants and animals that live in and around streams, it is necessary to assess the chemical attributes of water along with physical and biological attributes. Considering this the physico-chemical, biological characteristics of the Jobat Dam have been analysed during 2019-2020 to determine the environmental impact of various natural and anthropogenic variables on aquatic resources of the Dam which being used for multipurpose uses by the people living in the command area. The results obtained for various parameters are discussed below.

I. Physico-chemical Parameters : Variation in different physic-chemical parameters during 2019 - 2020 is depicted in Table-1 to 23.

The present investigation concludes that the water quality of the Jabot Dam though in general is good but sign of deterioration has been noticed at Station- 1&2 due to various factors. The concentration of BOD (1.2 mg/l to

5. Conductivity

Table-5 : Monthly fluctuations in Conductivity of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	0.387	0.308	0.233	0.213	0.223	0.205	0.228	0.279	0.590	0.508	0.518	0.395	0.204	0.590	0.35
St–2	0.334	0.269	0.213	0.230	0.208	0.264	0.252	0.426	0.525	0.426	0.508	0.431	0.208	0.524	0.34
St–3	0.346	0.262	0.223	0.279	0.200	0.252	0.241	0.407	0.361	0.472	0.489	0.436	0.200	0.488	0.33
St–4	0.397	0.295	0.252	0.302	0.275	0.285	0.239	0.361	0.403	0.433	0.449	0.408	0.239	0.449	0.34

6. Dissolved Oxygen (DO).

Table-6 : Monthly fluctuations in Dissolved Oxygen of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	8.8	10.4	9.6	8.8	8.2	9.6	8.8	9.6	7.2	6.4	7.2	8.8	6.4	10.4	8.59
St–2	8.4	8.8	7.2	8.4	8.4	10.4	7.6	10.4	6.8	7.2	7.6	9.2	6.8	10.4	8.40
St–3	7.6	8	6.4	9.6	8.8	9	7.2	8.8	6.8	6.8	7.2	8.8	6.4	9.6	7.93
St–4	7.2	7.6	6.6	8	8.4	8	7.2	7.2	7.2	5.2	6.6	8.4	5.2	8.4	7.23

7. Total alkalinity.

Table-7 : Monthly fluctuations in Total Alkalinity of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	140	156	130	148	126	190	214	220	170	224	202	164	126	224	173.8
St–2	138	132	136	152	128	210	196	218	168	230	210	188	128	230	176.0
St–3	144	128	132	144	132	212	210	214	160	236	216	176	128	236	176.2
St–4	130	124	140	128	120	216	188	202	172	218	186	148	120	218	165.0

8. Total Hardness as $CaCO_3$.

Table-8 : Monthly fluctuations in Total Hardness of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	120	140	112	116	110	128	136	140	156	160	166	138	110	166	135.57
St–2	110	135	108	102	108	122	128	136	140	146	144	140	102	146	126.21
St–3	112	128	104	108	104	120	124	128	138	142	140	136	104	142	123.57
St–4	128	124	118	110	112	124	130	138	142	140	156	148	110	156	131.14

12 mg/l) at this station reveals moderate degree of organic pollution at some intervals. The water samples of Station-1 and 2 contain significant amount of nitrate and orthophosphate at instances that provides nutrition for the growth and multiplication of microorganisms.

II. Biological Characteristics of Jabot Dam during 2019-2020

In recent times along with physicochemical parameters bio-monitoring studies are also being undertaken to define the trophic status of a water body. Using macro benthos as a tool of Bio monitoring study can not entirely replace the standard physicochemical water quality methods which provide information on water quality at a particular spatial unit during the time of sampling however, bio monitoring provide some historic insights into the water quality. Standard physico-chemical water quality methods therefore need to be carried out in conjunction with bio monitoring for comprehensive evaluation of health of a water body. Benthos being an important group in bio-monitoring evaluation demonstrates an integrated effect of pollution and community response is sensitive to organic loading, thermal impacts, substrate alterations, toxic pollution etc (6).

Considering this Macrobenthic community of Jobat Dam was also analysed along with physicochemical observations to obtain a realistic picture of water quality the Dam. Qualitative and quantitative distribution of various Macrobenthic communities belonging to different families recorded in Jobat Dam during the period 2019-2020 is depicted in Table–14 and Figures-1,2,3,4.

During present investigation majority of the macrobenthic species belonged to three Phylla viz. Mollusca, Arthropoda and Annelida. Total 83 species were recorded in which whereas phylum Annelida and Arthropoda were represented by 14 and 41 species respectively while Phyllum Mollusca was represented by

9. Calcium Hardness

Table-9 : Monthly fluctuations in Calcium of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	29.2	31.3	34.4	25.2	22.9	21.3	20.5	15.2	19.1	22.6	27.1	30.1	15.2	34.4	24.9
St–2	36	15	28	25	24	22	20.8	19	18	33	32	35	15	36	25.6
St–3	29	36	27.2	26	25	22	15.2	19	17	20.9	27	28.5	15.2	36	24.6
St–4	34.2	30.4	28	27	24.2	20.2	18.2	16	14.5	14	30	32	14	34.2	24.1

10. Magnesium Hardness

Table-10 : Monthly fluctuations in Magnesium of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	22	19.1	17.4	18	15.2	18.1	19.2	17.3	15.5	12.8	18.7	25	12.8	25	18.3
St–2	30.6	26	25.2	22.8	21.4	20.6	18.4	16.6	14.8	27.5	12.6	28.8	12.6	30.6	22.0
St–3	33	39	30	18	29	27	24	22	20	28	30	37	18	39	28.1
St–4	38.8	35.7	28.2	26.8	24.4	23.2	21.8	19.5	18.9	16.8	28.5	29.7	16.8	38.8	26.3

11. Chlorides

Table-11 : Monthly fluctuations in Chloride of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	38.97	33	25	21	21.5	23.4	25.7	34	42	29.98	33	26.2	20.98	41.98	29.8
St–2	29.98	31	22	19	22.5	24.2	30.5	33.4	23	21.98	29.8	24.98	18.97	33.4	26.0
St–3	27.97	30	25	17	21.5	24.5	28.2	27.8	25	22.97	28	23.97	16.98	29.97	24.9
St–4	24.98	22	21	18	22.5	25.9	27.3	28	24	26.98	22	23.98	17.98	28	23.8

12. Nitrate

Table-12 : Monthly fluctuations in Nitrate of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	2.96	2.15	1.35	1.25	1.75	2.25	2.45	2.35	3.23	3.55	3.15	2.88	1.25	3.55	2.4
St–2	2.75	2.375	1.35	1.35	1.25	2.15	2.35	2.35	3.75	3.55	3.65	2.85	1.25	3.75	2.5
St–3	2.89	2.25	1.05	1.15	1.45	2.75	2.25	2.15	3.12	3.51	3.65	2.95	1.05	3.65	2.4
St–4	2.15	2.25	1.08	1.15	1.45	2.75	2.42	2.15	3.18	3.45	3.75	2.86	1.08	3.75	2.4

28 species. Variation in different groups of macrobenthic fauna at various stations at Jobat Dam during different seasons of 2019-20 is depicted in Table-14.

In general arthropoda contributed maximum number of species (49%) followed by Mollusca (34%) and Annelida (17%) (Fig-1). While comparing the distribution of all the species it was observed that station -3 had maximum representation of species belonging to all three major groups followed by station-4 (Fig-2). Comparatively less number of species was recorded at Station-1 and 2.

Dams have been constructed for various purposes such as hydroelectricity, irrigation, flood control, drinking water supply, transportation, navigation and recreations. Dams and reservoirs contribute greatly to human prosperity and well-being. The changes in hydrodynamic characteristics of the dam water bring about physical and chemical changes, which can influence the aquatic biota in various ways including the process leading to eutrophication. Benthic fauna occupy an important intermediate trophic position and they are relatively sedentary and long lived. Macrobenthos serve as biological indicators of water pollution because these important group exhibit a relatively a wide range of response to chemical and physical water quality stressors. These groups are classified into two types, pollution tolerant and pollution sensitive. Studies on benthic diversity, population dynamics, community structure and changes caused by natural or anthropogenic processes are essential for resource management. Abundance and diversity of macrobenthic fauna and the relationships to environmental conditions are important parts in understanding the structure and function of estuarine ecosystems.

The catchment area of Jabot Dam where the present study was conducted is covered with natural vegetation on almost all sides except at few places where few rural settlements have been established have been established. The Dam receives most of its water during monsoon season. Information on the water quality is limited for this Dam especially with respect to physic-chemical parameters. A recent comprehensive

13. Phosphate

Table-13 : Monthly fluctuations in Phosphate of Shahid Chandra Shekhar Azad Sagar, Jobat October 2019 to September 2020.

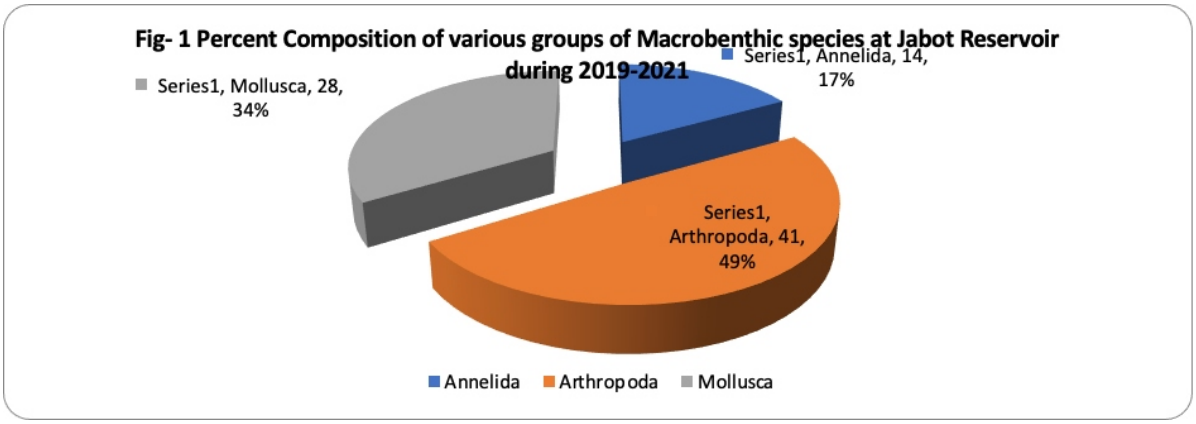
Station	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Min	Max	Mean
St–1	1.16	1.75	1.25	1.05	1.55	1.25	2.85	2.25	2.45	2.78	2.55	1.8	1.05	2.85	1.9
St–2	1.76	1.575	1.425	1.35	1.275	1.255	2.245	2.275	2.275	2.675	2.675	1.99	1.255	2.675	1.9
St–3	1.12	1.08	1.12	1.75	1.55	1.65	2.85	2.95	2.25	2.55	2.7	1.99	1.08	2.95	2.0
St–4	1.15	1.75	1.25	1.07	1.55	1.65	2.85	2.5	2.65	2.6	2.86	1.95	1.07	2.86	2.0

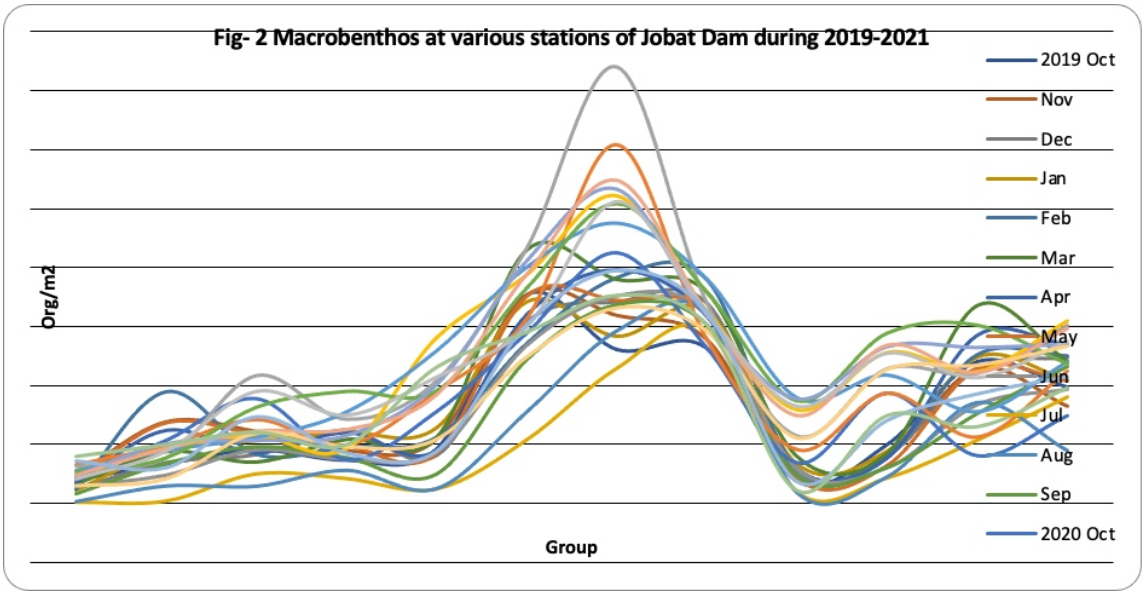
Table-14 : List of Macrobenthos Species observed in Jobat Dam during 2019-2020.

Annelida	Arthropoda	Mollusca
	Palaemonidae	*Bellamya bengalensis*
Tubifex albicola	*Gammarus pulex*	*Bellamya crassa*
Tubifex tubifex	*Berosus sp.*	*Bellamya colairensis*
Limnodrilus sp.	*Enochrus sp.*	*Bellamya mandiensis*
Branchura sp.	*Paracymus sp.*	*Bellamya dissimilis*
Stylaria lacustris	*Tropisternus sp.*	*Filopaludina sumatrensis*
Dero sp.		*Viviparus viviparus*
Chaetogaster sp.	*Cybister lateralimarginalisis*	*Viviparus contectus*
Glossiphonia complanata	*Hydrovatus cuspidatus*	*Viviparus mamillatus*
Hemiclepsis viridis	*Laccophilus sp.*	*Thiara tuberculata*
Batracobdella hardingi	*Neoporus sp.*	*Thiara granifera*
Hirudineria sp.	*Agabus sp.*	*Thiara scabra*
Poecilobdella granulosa	*Haliplus sp.*	*Gibbia alticola*
Lumbriculus variegatus	*Chironomus sp*	*Bithynia tenticulata*
	Bezzia sp.	*Bithnyia forcarti*
	Chaoborus sp.	*Bithynia pulchella*
	Culex sp.	*Pila globosa*
	Tipula abdominalis	*Physella acuta*
	Gomphus sp.	*Indoplanrobis exustus*
	Progomphus sp.	*Gyraulus convexiusculus*
	Hegenius sp.	*Gyraulus gilberti*
	Anax junix	*Lymnaea auricularia*
	Cordulegaster sp.	*Lymnaea acuminate*
	Gerris sp	
	Notonecta sp.	*Lymnaea ovate*
	Anisops breddire	*Unio tigridis*
	Micronecta scholtzi	*Parreysia occata*
	Sigara mekinstryi	*Lamellidens consorbinus*
	Micronecta minutissima	
	Micronecta quale	
	Abedus herberti	
	Nepa sp.	
	Ranatra sp.	
	Laccotrephes sp.	
	Baetis sp.	
	Caenis sp.	
	Ephemerella sp.	
	Ephemera sp.	
	Helopicus sp.	
	Polycentropodinae sp.	
	Lepidostoma sp.	
13	40	27

database on benthic productivity is still scarce from this unique water body, in the perspective of long term ecosystem management objectives.

The selection of sampling points for the present study is based on the criterion to represent the observation recorded at different places related to the

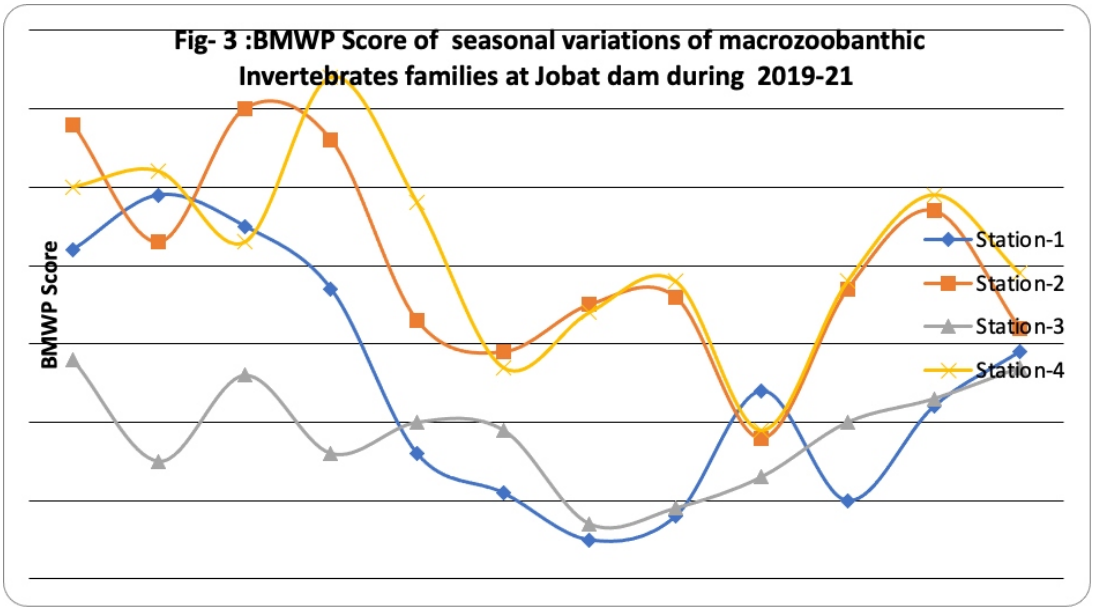




area specific activities and attempt has been made to compare different conditional changes at the selected sampling points and correlated these observations to know the status the water quality changes in seasonal, annual observations with the confirmation of observation from Physicochemical and biological parameters during these period i.e. 2019-2020. During present investigation several changes were observed in Physicochemical characteristics of water in Jobat dam with respect to hydrological dynamics. Dissolved oxygen levels were found to be high during summer, when sunlight is maximum and photosynthesis was strong. (7) noted that the amount of fresh water released was insufficient to increase the nutrient content of the water to a level that resulted in a significant increase in primary production. In Jobat Dam similar observation was recorded i.e. during summer with the receding of water and resultant increase in concentration of nutrients, productivity increased. This has been manifested with the increase in dissolved oxygen level. During the period of investigation, macrobenthic community in the dam exhibited a discontinuous distribution. The density, abundance and occurrence of benthic fauna were lower at the station station 1 and 3. In addition to the impact of pollution, the macrobenthic fauna was also found to be influenced by land drainage and hydrodynamic during the periods of the two monsoons. General composition of the macrobenthos in the four stations of the Jobat dam revealed the fact that the benthic organisms were fairly distributed during most of the time. A similar finding has been noticed by (7) in Bhopal lakes. The population density of benthic fauna in the dam water was maximum during the winter period (at all stations).This may be due to the changes associated with increase in water level after monsoon, accumulation of decaying vegetation present in the areas that contributed more food for benthos and it could have resulted in higher numerical abundance and population density of benthos during the post monsoon period. Similar situation have been reported by (8) from the Kadinamkulam backwater. (8, 9) reported a similar situation of monsoonal abundance of the benthic fauna from the Ashtamudi estuary. In present study also temperature did not show any definite pattern of variation during the study period. (10) reported a seasonal

Table- 15 : BMWP Score of seasonal variations of macrozoobanthic Invertebrates families at Jobat dam during 2019-20.

	Winter				Summer				Mansoon			
	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Station-1	72	79	75	67	46	41	35	38	54	40	52	59
Station-2	88	73	90	86	63	59	65	66	48	67	77	62
Station-3	58	45	56	46	50	49	37	39	43	50	53	57
Station-4	80	82	73	94	78	57	64	68	49	68	79	69



difference in the temperature of 2^0 to 4^0C that was noticed in the backwater and he also argued that temperature is not a limiting factor for the distribution of the macrobenthic fauna. The present observations were in close agreement with these findings. (11) observed that it was very difficult to distinguish individual impact of Physico-chemical parameters on macrobenthic fauna. Almost all environmental parameters had a positive relationship at its optimum level and influence negatively beyond this level. Influence of nutrient exposure on community structure of benthic fauna was studied by (11). According to (10), a single factor could not be considered as an ecological factor that affects the community structure of marcobenthos. This has been experienced in the present study also wherein many environmental parameters such as turbidty, dissolved oxygen, water movement, nutrient enrichment etc. were constantly affecting the population density of macrobenthos. This is in close agreement with studies of (12, 13) in the Dhamara estuary. (10) studied in the shelf region of Bay of Bengal that not only the Physico-chemical parameters but also the sediment texture and community interactions are the main reasons for the lesser density of macrobenthos. Harkantra and (10, 14) stated that sediment composition has no effect on the density of macrobenthos but community interaction involving competition, predation, recruitment and mortality are the main factors which can affect the density of macrobenthos. Similar findings were observed during present study.

Macrobenthic community structure has been used as a tool in pollution monitoring studies. A part of the catchment area of Jabot Dam where the present study was conducted is barren while remaining areas are covered with natural vegetation on almost all sides except at few places where few rural settlements can be noticed. Jabot Dam receives most of its water as runoff water that flow into the reservoir during monsoon season.

During this period, apart from qualitative and quantitative analysis of the macrobenthic community, the range of Saprobic Score (BMWP and ASPT) were also derived on the basis of seasonal data on macrobenthic parameters (Table-15&16 Figure 3&4) and values were compared with the index of Biological Water Quality Criteria Developed by Central Pollution Control Board (CPCB), GOI.

Based on the observations Stations 1 to 4 have been categorized to define the water quality class of different regions of the Dam (Table-17) with conjunction of physicochemical parameters. In general on the basis of physical, chemical and macro zoo benthic study, the Dam water can be classified as moderately polluted water body (Table-17).

In general the BMWP score was observed to be

Table-16 : ASPT Score of seasonal variations of macrozoobanthic Invertebrates families at Jobat dam during 2019-20.

	Winter				Summer				Mansoon			
	Oct.	Nov.	Dec.	Jan.	Feb	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.
Station-1	5.54	5.64	5.77	5.58	4.60	4.56	4.38	4.22	4.91	5.00	5.20	5.36
Station-2	6.77	6.64	6.43	6.62	5.25	5.36	5.42	5.08	4.80	5.58	5.92	5.64
Station-3	5.27	5.00	5.09	5.11	4.55	4.45	4.11	4.33	4.78	5.00	5.30	5.18
Station-4	6.15	6.31	6.08	6.27	6.00	5.18	5.33	5.23	4.90	5.67	5.64	5.75

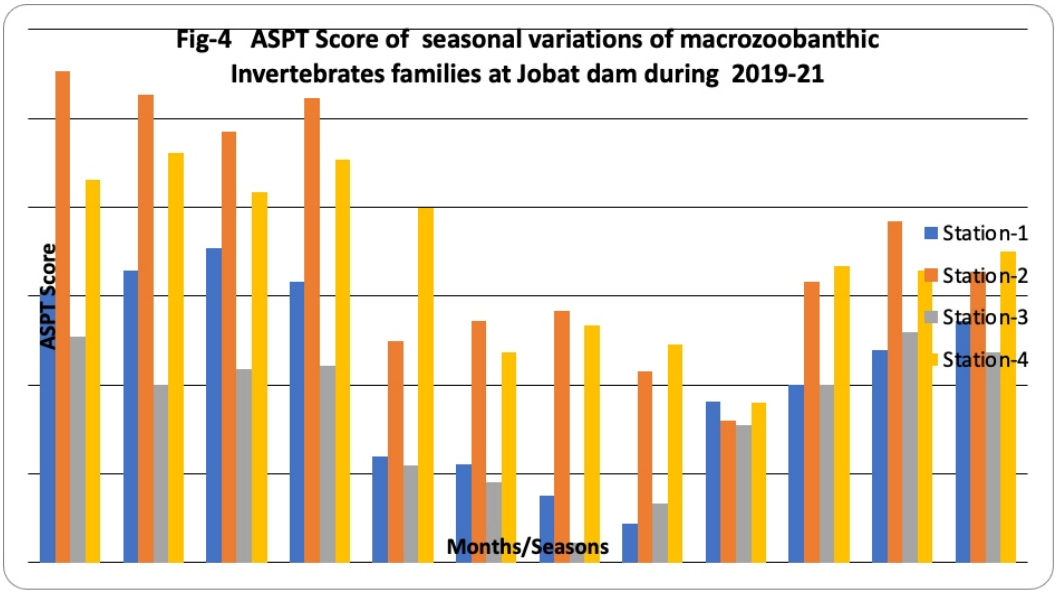


Table-17 : Status of Jabot Dam at different stations on the basis of observation on Physicochemical and Macro zoo benthic characteristics following the Biological Water Quality Criteria Developed by CPCB.

Stations	Range of Score (BMWP)	Range of Score (ASPT)	Water Quality	Water Quality Class
Station-1	38-79	4.22 -5.77	Moderate Pollution	C
Station-2	59-90	4.80-6.77	Clean	A
Station-3	37-58	4.11-5.30	Moderate Pollution	C
Station-4	49-94	4.90-6.31	Clean	A

[++]The site score so derived is averaged which are in the range of Zero to Ten. The range of Saprobic score was then transformed into the benthic saprobity index by multiplying by a factor of 10 to produce a score from Zero to Hundred.

slightly high during summer months. Station 2, Station 4 depicted higher score than rest of the stations, signifying presence of more number of species at these three stations. Whereas, station 1 and station 3 shows lesser score signifying presence of less number of species.

Thus, by detailed analysis of data it can be concluded that the quality of water in general with respect to most of the parameters were observed to be well within permissible limits of class–B of Central Pollution Control Board (CPCB, New Delhi) under designated best uses of water for irrigation and drinking water after conventional treatment. The study confirms that the results of the impacts observed during these studies are not an incidence but it is the characteristics of the water quality. The compilation of data and its relevance with Dam ecosystem has been invariably confirmed with the available references of the different researchers also who have reported similar findings in their respective studies.

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