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Physicochemical and biological parameters of different Reservoirs from Ahmednagar District: A Review

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ABSTRACT

This review of literature concentrated on physicochemical and biological parameters in various dams and water reservoirs in the District of Ahmednagar located in Maharashtra. Parameters like pH, Temperature, Transparency-Turbidity, Total Alkalinity, Total hardness, Chlorinity, Salinity, DO, Free CO2, Total acidity, BOD, COD, Nitrate-Nitrogen, and Nitrite-Nitrogen are the components of water, which indicate the water quality. Major fluctuations in the concentrations or the levels of any of these parameters impact the quality of life adversely either directly or indirectly. Biological parameters like Microorganisms, Zooplanktons, Phytoplankton's, Fish, Birds, and Reptiles are also important components of any ecosystem. These organisms are either benefited or adversely affected due to the physicochemical variations in the ecosystem. Periodic assessments of these parameters help in evaluating the health of any ecosystem. The literature reviewed in this article would help us understand the conditions of freshwater aquatic ecosystems, especially dams and other water reservoirs in Ahmednagar District.

Figure : 00 References : 32 Tables : 03

KEY WORDS : Ahmednagar, Bhandardara Reservoirs, Biological parameters, Ecosystem, Physiochemical parameters, Reservoirs, Water.

Introduction

The district of Ahmednagar is located in central Maharashtra. The district covers an area of 17048 square kilometers, which is about 5.6% of the state's total area.

Reservoirs are essential for the sustenance of the vast majority of the human race. Our greatest civilization originated on the banks of rivers.Millions of individuals worldwide inhabit the shores of rivers and rely on them for sustenance.The most significant resource on earth is fresh water: it's the key ingredient of life. Natural aquatic ecosystems are being heavily affected by increasing demand for resources.Water is one of the essential needs in a person's life, with its uses for different purposes like drinking water, irrigation, transport, sanitation, power generation and industry. Today, more than 1 billion people in developing countries have no access to safe drinking water[29].

Healthy aquatic ecosystem depends on biological diversity and physicochemical characteristics of water[25]. Physicochemical analysis of water is important for finding out its quality.

Around 69 different bird species are recorded in Nathsagar reservoir area in earlier studies[18]. The birds observed around this reservoir belong to 7 orders, 19 families and 67 species. The primary interest in the avian studies was mainly due to their correlation with fish fauna because the prime food for most of the migratory birds is fish. Out of a total of 67 fish species reported from this reservoir, 40 are food fishes and 27 fish species belong to weed fish category. It has been recorded that the population of large carnivorous fishes in the Nathsagar reservoir has increased by 16% in recent years incomparison with the weed fishes.

The physico-chemical parametersof Bhandardara reservoir water were studied, and Statistical analysis studies was performed. Various statical parameter such as mean, standard deviation, covariance and correlation

TABLE – 1 : Species Composition of Zooplankton at Bhandardara reservoir (July 2022 to June 2023)

S. No.	Zooplankton Group	Family	Name of the Species
1.	Rotifera	Brachionidae	*Brachionus quadri dentatus*
			Brachionus calyciflorus
2.	Copepoda	Diaptomidae	*Mesocyclops*
			Cyclops nauplis
			Undinula valgaris
			Thermocyclops
			Microcyclapo
3.	Cladocera	Daphniidae	*Ceriodaphnia reticulata*
		Sididae	*Diaphanosoma brachyurum*
		Macrothricidae	*Macrothri xhirsuticornis*
		Chydoridae	*Chydorus spharicus*
		Daphniidae	*Daphnia pulex*
		Moinidae	*Moina macrocopa*
4.	Ostracoda	Cypridiidae	*Cypridopsis vidua*
			Stenocypris
			Cypridopsis
5.	Protozoon	Vosticellidae	*Vorticella campanulas*

coefficients were taken into consideration[17]. The results of these studies indicated that the water from Bhandardara reservoir is suitable for consumption as shown by positive and negative correlation parameters.

In the present work at Bhandara dam, it has been shown that there are variations in the groups of phytoplankton species[10]. In this study, 5 types of Cyanophyta, 22 varieties of Chlorophyta, 14 varieties of Bacillariophyta and a single representative of Xanthophyta were identified. The Bhandardra dam had a wide range of aquatic algae, dominated by the Chlorophycean members: bacillariophyceae, cyanophychiae and xanthophyceae. To assess and reduce water pollution, it was essential to conduct algal studies. Unlike more traditional descriptors of biomass and productivity indices, Phytoplankton or its spring succession can be used as an indicator of the long-term environmental changes in aquatic ecosystems.

According to some other researchers[9] specific heavy metals are reported in Bhandardara Reservoir for the purpose of determining and reporting quality and sustainability on a variety of occasions. These observations show that some heavy metals have been detected in water samples at several sites, with significant concentrations. The results of this study showed that the detrimental effects resulting from heavy metals and their synergistic activity may be a potential hazard to humans, plants and the environment.

The diversity of zooplankton and physicochemical characteristics were observed[11] at Sadatpur Reservoir during the year 2009-10. During this study total, 25 zooplankton species were found. They belong to different taxonomic groups. Among these, 6 species belonged to *protozoa*, 10 species to *rotifer*, 5 species of *cladocerans*, 3 species of *copepods* and 1 species of decapods were reported. The frequency of occurrence of some protozoa and rotifers has been shown to be 81.8% by the numerical superiority of zooplankton. The maximum value of relative density (4.36) was recorded in the *Sinantherina* species (rotifer). For the species Rotaria (rotifer), a maximum relative frequency of 15.35 was recorded. The maximum value of relative abundance (7.6) was recorded in *Rotaria* and *Asplanchuna* species (rotifer). These are pollution indicator species used for monitoring the aquatic body.

A similar kind of record was procured in the studies conducted by us at Bhandardara water reservoir. Our studies revealed that the Bhandardara dam reservoir contained 3 species of rotifers of family Brachionidae, 5 species of copepods of family Diaptomidae, 6 Species of Cladocera of 5 different families, 3 species of Ostracods of family Cyprididae and a species of Protozoan of family ofVosticellidae[13] (Table-1).

The avian diversity of Bhandardara Dam was studied extensively by our team from July 2022 to June 2024. The data collected revealed that the birds inhabiting the dam area at its surrounding forest belonged to 56 species of 42 genera, 31 families and 12 orders. The species identification was performed using photographs clicked with the help of Digital camera of Nikon., Nikkon DX VR AFP NIKKOR70-300MM 1:4.56.3 GED 5300 DX, at Lat 19.537001 Long 73.765047. Identification was done with the help of the field guide [20,31,32] and e-Birds website and mobile application. Reauthentication of the identified data were done at BHNS Mumbai (Table-2).

Order Passeriformes represented the highest number of species followed by Columbiformes, Coraciiformes, Pelecaniformes, Charadriiformes, Accipitriformes, Anseriformes, Bucerotiformes, Cuculiformes Galliformes, Piciformes and Suliformes. The distribution of birds within a habitat is influenced by factors such as water depth, vegetation type, salinity, pollution, and human disturbances. Additionally, the habitat, habitat structure, vegetation, and food resource availability all directly affect the birds relative abundance[5,30].

As far as the Mula dam Reservoir is concerned,its biodiversity is rich, inhabited by 19 species of fish belonging to 6 orders and 10 families. The study was performed during the period from January 2004 to March 2004[(2)]. For the assessment of fishery practices in this area, individual observations and interviews were useful. The order Cypriniformes is dominant followed by the Perciformes; Beloniforms, Silurianformse, Synbrachiformes and Osteoglossiformes. The fish diversity of the reservoir is excellent; there are economically important and cultivable species as well as ornamentals fishes inhabiting the dam. Although this research article does not provide the data on phytoplankton and zooplankton diversity of Mula dam, it can conveniently be said that the excellent fish diversity and population density is mainly supported by high population of zoo and phytoplankton.

Zooplankton and phytoplankton diversity studied by our team at Bhandardara dam can be a supporting data if one wish to study fish diversity of Bhandardara dam.

Current research compares the physical-chemical characteristics of the water from the Bhandardara and Mula dams in Maharashtra's Ahmednagar district[3]**.** In addition to characteristics pertaining to temperature, pH, TDS, free CO2, alkalinity, chlorides, total hardness, calcium hardness, magnesium hardness, dissolve oxygen, BOD, and COD, four samples were taken during the investigation. The result indicated that the physico-chemical parameters of this dam water vary considerably. Most parameters are shown to have a prescribed limit from IS and WHO during the present study[4,20,29].

Similar work was also carried out in our research at Bhandardara dam reservoir (Table-3).

Our results revealed there is a fluctuation in ambient temperature, by about 3°C from temperature of 25°C.The fluctuation ofapproximately 3°Cis observed in water temperature from its average value of 23°C.This ambient temperature and the water temperature is conducive for the excellent ground of phytoplankton, zooplankton and fishes.

pH of water remained on alkaline side, ranging between 8.12 to 9.4.This may influence the avian and population density of phytoplankton and zooplankton in during the summer season, which may intern affected the fishes adversely. Increase of water pH in summer season towards alkaline scale can be best supported by the result often from estimation for total alkalinity which was reported to be the highest in May.Onset of monsoon in the month of June showed graduall reduction of total alkalinity and pH of water.

Estimation of total hardness in a specific pattern and seasonal trends having highest values in December and lowest in September. Probably the highest value of

TABLE – 2 : List of Birds Diversity at Bhandardara reservoir (July 2022 to June 2024)

Species No.	Order	Family	Zoological Name
BS1	Passeriformes	Passeridae	*Passer domesticus*
BS2	Charadriiformes	Scolopacidae	*Actitis hypoleucos*
BS3	Accipitriformes	Accipitridae	*Accipiter badius*
BS4	Passeriformes	Corvidae	*Corvus splendens*
BS5	Columbiformes	Columbidae	*Columba livia*
BS6	Coraciiformes	Meropidae	*Merops persicus*
BS7	Passeriformes	Campephagidae	*Coracina bicolor*
BS8	Passeriformes	Sturnidae	*Sturnia pagodarum*
BS9	Accipitriformes	Accipitridae	*Elanus caeruleus(Desfontaines)*
BS10	Passeriformes	Nectariniidae	*Leptocoma zeylonica*
BS11	Pelecaniformes	Threskiornithidae	*Pseudibis papillosa*
BS12	Passeriformes	Estrildidae	*Lonchura malacca*
BS13	Pelecaniformes	Ardeidae	*Ardea ibis*
BS14	Cuculiformes	Cuculidae	*Centropus sinensis*
BS15	Passeriformes	Muscicapidae	*Saxicola caprata*
BS16	Passeriformes	Sturnidae	*Acridotheres fuscus*
BS17	Pelecaniformes	Ardeidae	*Ardea cinerea*
BS18	Passeriformes	Dicruridae	*Dicrurus macrocercus*
BS19	Columbiformes	Columbidae	*Treron phoenicopterus*
BS20	Passeriformes	Muscicapidae	*Copsychus saularis*
BS21	Passeriformes	Corvidae	*Corvus philippinus*

Species No	Order	Family	Zoological Name
BS22	Passeriformes	Motacillidae	*Motacilla maderaspatensis*
BS23	Charadriiformes	Charadriidae	*Vanellus indicus*
BS24	Passeriformes	Dicaeidae	*Dicaeum erythrorhynchos*
BS25	Passeriformes	Alaudidae	*Alauda gulgula*
BS26	Galliformes	Phasianidae	*Pavo cristatus*
BS27	Passeriformes	Nectariniidae	*Nectarinia purpureiventris*
BS28	Passeriformes	Ploceidae	*Ploceus philippinus*
BS29	Passeriformes	Sturnidae	*Acridotheres tristis*
BS30	Passeriformes	Nectariniidae	*Leptocoma sperata*
BS31	Passeriformes	Aegithinidae	*Aegithina tiphia*
BS32	Passeriformes	Motacillidae	*Anthus trivialis*
BS33	Passeriformes	Turdidae	*Turdus simillimus*
BS34	Bucerotiformes	Upupidae	*Upupa epops*
BS35	Charadriiformes	Charadriidae	*Thinornis dubius*
BS36	Coraciiformes	Alcedinidae	*Alcedo atthis*
BS37	Coraciiformes	Alcedinidae	*Halcyon smyrnensis*
BS38	Suliformes	Phalacrocoracidae	*Microcarbo niger*
BS39	Pelecaniformes	Ardeidae	*Butorides striata*
BS40	Passeriformes	Estrildidae	*Lonchura punctulata*
BS41	Passeriformes	Passeridae	*Gymnoris xanthocollis*
BS42	Passeriformes	Laniidae	*Lanius schach*
BS43	Piciformes	Megalaimidae	*Psilopogon viridis*
BS44	Passeriformes	Muscicapidae	*Copsychus saularis*

Species No	Order	Family	Zoological Name
BS45	Passeriformes	Monarchidae	*Terpsiphone paradisi*
BS46	Columbiformes	Columbidae	*Spilopelia senegalensis (F)*
BS47	Columbiformes	Columbidae	*Spilopelia senegalensis (M)*
BS48	Passeriformes	Pycnonotidae	*Pycnonotus cafer*
BS49	Passeriformes	Pycnonotidae	*Pycnonotus jocosus*
BS50	Coraciiformes	Meropidae	*Merops orientalis*
BS51	Anseriformes	Anatidae	*Anas poecilorhyncha*
BS52	Columbiformes	Columbidae	*Spilopelia chinensis*
BS53	Passeriformes	Estrildidae	*Lonchura punctulata*

hardness in December could be up willing of the water of the reservoir vertically from bottom to the surface. Dissolved oxygen escape from water as temperature increases hence during cold months of the year then the summer months[12,14,23,24]. Similar trends has been observed in our studies as we reported highest level of dissolve oxygen in January and lowest in July.

Chloride values were found to the fluctuating and not following in a trend seasonally. While the calcium and magnesium values showed more or less stable concentrations with an exception in magnesium concentration in the month of September showing lowest value and in December the highest.

Nitrate values were also found to be within the range with no seasonal fluctuation probably because there was no organic matter discharge directly in water of the reservoir. Phosphate concentration on the other hand were found to be fluctuating between monsoon to summer. Highest concentration reported in the monsoon and lowest in the winter. This could be due to discharge of water coming from several brooks discharging the mineral rich water in the reservoir.

A typical trending increase in the salinity values was observed from monsoon to summer with highest values in April and May and lowest in June, July and August.

The current study demonstrated the wide diversity of fish in the Lonimavla reservoir[16]. 11 fish species from five orders and 6 families were discovered in the dam throughout the study period. 6 species dominated the order Cypriniformes, followed by 2 species in the Perciformes order and 1 species each in the Clupeiformes, Mastacem beliformes, and Siluriformes orders.

The study investigated that Chlorophyceae 34 genus, and 69 species are the dominant class in the Kotmara reservoir[26]. In the present work, 11 genera and 22 species of Bacillariophyceae and 14 genera and 30 species of Cyanophyta. Xanthophyceae, Dinophyceae, and Charophyceae are the other groups of algae were identified. In Summer session, the least amount of development in algal density, with winter and monsoon seasons showing the greatest growth.

In this study 25 species of fish, spread throughout 10 families, 19 genera, and 6 orders were identified at GhodReservoir[19]. With 14 species, the Order Cypriniformes was the most abundant, followed by the Perciformes (4 species), Mastacembaliformes and Siluriformes 2 species), Clupeiformes and Beloniformes (1 species each).The results of the investigation showed that the fish diversity in the Ghod reservoir is abundant and its potential for fish cultivation.

The present work deals with study of Distribution and Ichthyofaunal biodiversity in Mula Dam Reservoirfrom 1 April 2020 to 31 March 2021[15]. In this work the freshwater15 species of fish were recorded and confirmed belong to 6 Order and 7 Families. This reservoir is rich in fish diversity and inhabited by economically important.The present investigation of Mandohol reservoir the physicochemical characteristics

TABLE-3: Monthly variation of physicochemical parameters of Bhandara reservoir (July 2022 to June 2023)

S. No	Parameter		July	Aug	Sep.	Oct	Nov.	Dec.	Jan.	Feb	March	April	May	June
1.	Temp °C	Air	26.6	23	22	21.4	26	23	22	22.4	24.3	27.8	28	27
		Water	23.5	26.5	26.8	23.9	24	21.5	23	24	20.6	22.2	26	24
2.	Water pH		9.1	9.2	8.9	9.0	8.3	8.2	8.5	8.1	9.2	9.4	9.3	8.2
3.	Alkalinity (mg/L)		190	160	163	170	95	120	143	151	190	195	210	205
4.	Total Hardness (mg/L)		125	124	95	115	140	142	139	133	131	127	119	130
5.	Dissolve oxygen (mg/L)		3.17	4.61	6.27	7.19	6.5	6.78	9.3	9.25	7.29	5.71	4.3	3.19
6.	Chloride (mg/L)		39.8	25.80	35.70	37.90	28.90	22.190	14.20	12.35	18.00	25.69	32.58	40.105
7.	Calcium (mg/L)		22.745	20.920	23.790	31.05	25.95	18.45	26.49	27.455	29.890	30.60	24.550	25.51
8.	Magnesium (mg/L)		107.240	102.410	69.450	84.970	97.450	147.90	113.290	97.980	103.10	96.810	102.090	103.90
9.	Nitrate (mg/L)		0.082	0.089	0.079	0.087	0.077	0.038	0.042	0.053	0.063	0.074	0.062	0.080
10.	Phosphate (mg/L)		11.205	10.890	11.110	9.650	7.540	4.430	7.970	6.280	4.760	8.870	11.780	12.330
11.	Salinity (mg/L)		26.300	20.910	39.320	25.90	24.310	35.70	71.10	76.60	67.90	79.80	78.10	21.70

All parameters are mg/L; except pH, Temperature

and water quality index (WQI) was studied from September 2020 to August 2021[8]. This work mainly aimedat determining whether this water was suitable for industrial, drinking, irrigation, fishing, and other uses. Standard techniques were used to evaluate the water parameters such as temperature, electrical conductivity, total dissolved solids, pH, dissolved oxygen, total alkalinity, hardness, chloride, nitrate, nitrite, nitrite, sulphate, phosphate, BOD, and COD. By using the Weighted Arithmetic Index approach, the reservoir's WQI was found to be 38.67068 (Grade- B).

The average observed values of the parameters under investigation were lower than the drinking water quality requirements set by the WHO, ICMR, and BIS. This suggested that there is a moderate amount of water pollution but had no signs of eutrophication. Although reservoir water does not need any specific treatment if it is used only for domestic, commercial, or agricultural purposes, including fish culture,it does need prior treatment before it is consumed.

A year long survey from September 2020 to August 2021 was carried out to study the avifauna of Mandohol reservoir[7]. The survey intended to study the diverse assemblage of algae, aquatic weeds, phytoplankton and zooplankton which are important for facilitating the growth of fishes and other aquatic animals and attract several birds. 8 piscivorous bird species were observed from 4 different families and 3 orders. It was found that 1 species (12.5%) was very common, 3 species (37.5%) were uncommon, and 4 bird species (50%) were occasional. As per the IUCN status, 7 species (87.50%) of observed birds belong to least concern and1 species (12.50%) was nearly threatened. The migratory status of observed bird species showed that 6 species were residential (87.50%) and one was a local migrant (12.5%). Out of the piscivorous birds sighted, the family Ardeidae was abundant in the study area but have the lowest predation threat.

Foraging behaviour of the observed species showed that, Cattle egret *(Bubulcus ibis)* and little cormorant *(Phalacrocorax niger)* were frequent in feeding. Kingfisher *(Halcyon smyrnensis)* consumes only small fish but feeds more frequently. On evaluation of the prevailing conditions of the reservoir this research paper revealed that the reservoir presented a good opportunity for fish culture as there exists a minor diversity and population density of piscivorous avifauna, good quality of water and manageable human interference.

The physico-chemical parameters, seasonal variations and the water quality of the Mandohol reservoir were also studied in the same year to determine whether it was suitable for fishing[6]. In this work the physico-chemical parameters were found to be within the desirable limits for fish and fisheries practices. These parameters were temperature during the monsoon and summer, chloride only during the summer, electrical conductivity, total dissolved solids, pH, dissolved oxygen, total alkalinity and hardness, nitrate, nitrite, BOD, and COD in all seasons. All seasons showed relatively low levels of calcium, magnesium, and sulphate. Water temperature from post-monsoon to winter and chloride from monsoon to winter were found to be increasing while phosphates were high in all the seasons.

Conclusion

The review article presented here is based on the evaluation of physicochemical and biological parameters of the various water reservoirs spread across the largest district of Maharashtra, which is Ahmednagar. Eight reservoirs across the district were evaluated. Nathsagar, Bhandardara, Sadatpur, MulaDam,Kotmara reservoir, Lonimavla reservoir, Ghod reservoir, Mandoholreservoir were the ones to name.

Most of the workers have found that the physicochemical parameters of water of most of these reservoirs were well within the permissible limits to qualify the drinking water standards as suggested by WHO. The variations in some of the physicochemical parameters of water, in almost all the reservoirs could be attributed to the seasonal fluctuations. The physicochemical parameters tested for Bhandardara water was in support with the studies performed by others as we have also notice a seasonal trend in their fluctuations.

Biological evaluations based on biodiversity assessment were carried out by many workers as well as our team in and around these water reservoirs. Most of them have recorded excellent fish diversity, amphibian fauna, reptilian as well as avian fauna. Especially at Bhandardara the avian fauna was reported in high and diverse reveled from our research. Bhandardara and Sadatpur waters were found to be rich in phytoplankton and zooplankton diversity based on our research, which consecutively suggests the rich diversity of fish in these waters. The feasibility report on sustainable pisciculture in Mandohol reservoir suggests the same.

Based on the review presented in this study it can be concluded in one line that the water reservoirs under consideration were in good condition looking at their physicochemical and biological parameters.Continuous efforts by the government and locals of the region could help in continuing the existing good condition of these reservoirs.

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