

NATURAL RESOURCES MANAGEMENTAL ASPECTS AND NATURAL
PRODUCTIVITY OF BAREEJI LAKE, A WETLAND OF DISTRICT BADIN,
SINDH, PAKISTAN

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Abstract

Bareeji lake located 24°47'47.58"N longitude and latitude 68°44'21.71"E. Lake is surrounded by agriculture lands cropping seasonally rice paddy, wheat and vegetables. Certain physico-chemical parameter ranges of water quality of the lake were studied viz; Temperature of air 25.25±11.97318°C, Temperature of water 17.75 ± 9.003967°C, Transparency/ Turbidity 49.375±19.93516 cm, pH 7.716667±0.30605, Salinity ppt 1.02875±0.517285, Conductivity µS/cm 101.0013±88.82615, Alkalinity mg/L 66.8125±7.184793, Hardness mg/L 253.625±27.79999, Dissolved Oxygen mg/L 10±2.560134, Nitrates µg/L 68.9375±12.68654 and Phosphates µg/L 1.61625±0.665302. High growth of eutrophic and pollution indicators micro biomass of phytoplankton and other algal species were reported. These are basically grown at higher budget of micronutrients. The genera were Chroococcus sp. (No. of individual/ 50 L 68.25±14.5459); Merismopedia sp. 52.25 24.97165; Microcysts sp. 316±122.3628; Oscillatoria sp. 50±24.88641; Anabaena sp. 73±38.27096; Nostoc sp. 63±8.445906; Lungbia sp. 48.5±13.91642; Euglena sp. 38.5±18.66369; Chlamydomonas sp. 41.25 31.31959; Phacus sp. 3±3.829708; Navicula sp. 341± 229.1564; Nitzschia sp. 72.75±16.87947. Among zooplankton High population growth of Rotifers (59%), cyclopes, cladocerans and herpactoids were reported from the water body. Among other invertebrates fauna higher population of snails, bivalves, worms were found attached on leaves and stems of marshy plants. Among macrophytes, majority of Marshy plants such as Typha sp. and Phragmite sp. of anthropogenic activities resulted higher growth of macrophytes and shallowness of the water body. If lake water situation remains same, then the lake wrecked into crop land. It is therefore suggested that proper measures may be taken for life of the water body by the responsible authorities. Quantitative values of insects, worms and mollusks show a great deal of organic and inorganic budget at shallow areas of the lake which come

from surrounded agriculture run off. The results of the water quality variables and bioindicators revealed that Bareeji lake in Badin district is at meso-eutrophic stage, this may be due to nonseriousness of the authorities and local dwellers. Therefore, it is recommended that environment protection agencies, concerned departments, national and international organizations come forward for protection and conservation of this natural heritage of Sindh, Pakistan and world.

Introduction

Bareeji lake is a freshwater lake situated longitudinally and latitudinally 24°47'47.58"N and 68°44'21.71"E on the global map. Bareeji Lake, locally known as Bareeji Dhand, is a natural freshwater lake located in District Badin, approximately 7 km from Peeru Lashari Station in southern Sindh. It spread on the area of about 150 acres having depth 4-9ft. Lakes are among the most significant natural ecosystems on Earth. They serve as reservoirs of freshwater, habitats for diverse species, regulators of local climate, and sources of economic and cultural value. Lakes support human life by providing water for drinking, agriculture, fisheries, livestock rearing, and recreation, while also maintaining biodiversity and ecological balance. In semi-arid regions like Sindh, Pakistan, lakes are particularly critical, as freshwater resources are limited, and rainfall is seasonal and unpredictable. It receives inflow primarily from the Dhokia Canal and drains into the Sim Canal. The lake is a shallow water body, covering an approximate area of 533 acres, with a depth ranging from 8 to 10 feet. Its size fluctuates seasonally, expanding during the monsoon and shrinking during dry periods. The lake has historically supported local communities, particularly the Mohana fishing community, providing a source of livelihood through fishing, agriculture, and livestock rearing. In recent decades, climate change has become a major threat to Lake Bareeji. Rising temperatures, irregular rainfall, and frequent droughts have disrupted natural hydrological patterns, reduced freshwater inflows, increased evaporation, and altered water quality. These climatic changes have affected sedimentation, nutrient cycling, and biological productivity. Additionally, human activities, including agricultural runoff, domestic waste,

overfishing, and encroachment, have compounded the stress on the ecosystem. The combined effects of climatic and anthropogenic pressures have led to reduced fish productivity, loss of biodiversity, and increased challenges for local communities dependent on the lake. The present research aims to assess the impacts of climate change and human activities on Bareeji Lake, focusing on water quality, ecological status, and socio-economic significance. This study is the first comprehensive scientific assessment of Bareeji Lake and provides baseline data crucial for sustainable management and conservation. Despite the ecological, economic, and social importance of Bareeji Lake, it has received little scientific attention. There is currently no published research on its water quality, biodiversity, or the influence of climate variability. This data gap restricts the ability of policymakers, environmental authorities, and local communities to make informed decisions regarding conservation and sustainable use. The lake is home to fish, plankton, macrophytes, and migratory birds. Preserving the lake is vital for maintaining biodiversity and ecological balance. The lake supports livelihoods, particularly the Mohana fishing community, while providing water for domestic, agricultural, and livestock purposes. Located in a semi-arid region, the lake is highly sensitive to temperature increases, low rainfall, droughts, and extreme weather events. A lack of baseline scientific data makes it essential to conduct this study to monitor the lake's health and guide future research. The study will provide validated scientific information to inform management, policy, and conservation efforts, ensuring both ecological integrity and sustainable use by local communities.

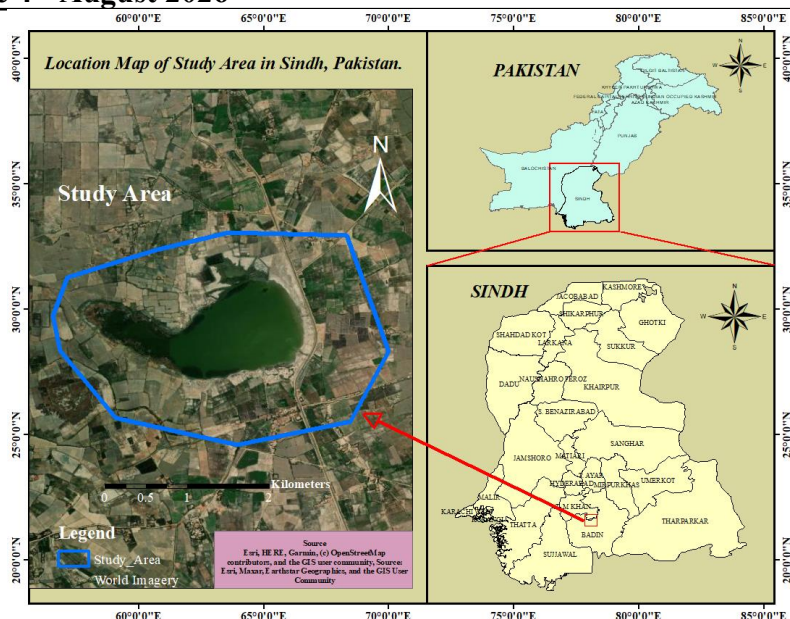


Fig.1 Map of Bareeji lake Badin Sindh Pakistan

The primary aim of this research is to evaluate the impacts of climate change and human activity on Bareeji Lake. Specific objectives are; To assess current physico-chemical water quality parameters, including temperature, pH, dissolved oxygen, salinity, alkalinity, hardness, conductivity, nitrate, and phosphate. To examine seasonal variations in water quality and ecological indicators across winter, pre-monsoon, monsoon, and post-monsoon seasons. To evaluate plankton productivity and aquatic vegetation as indicators of ecological health. To analyze climate variability and human activities affecting the lake ecosystem, using field observations, community interviews, and secondary data. To provide evidence-based recommendations for sustainable lake management, biodiversity conservation, and local livelihood support.

Materials and Methods

Site Selection: Bareeji Lake is approximately 7 km away from a famous Peeru Lashari Station, District Badin. It is a shallow, freshwater lake covering an area of about 533 acres with depths ranging from 8–10 feet. The lake receives water primarily from the Dhokia Canal and drains into the Sim Canal, forming a dynamic hydrological system influenced

by monsoon rainfall and seasonal evaporation. Sampling locations were selected to capture spatial heterogeneity, including points near inflow (Dhokia Canal), central lake areas, and outflow (Sim Canal). Accessibility and safety considerations were also considered to ensure consistent sampling.

Water samples were collected seasonally to represent four key periods i.e Winter (December–February), Pre-Monsoon (March–May) Monsoon (June–September), Post-Monsoon (October–November), Sampling frequency: Monthly sampling at each site for one year. Water level and Sample depth: Surface water (0.5 m) and mid-depth (~5 feet) to account for vertical variation in parameters. Water samples were collected for analysis of physical and chemical parameters. Temperature of air and water (°C) was measured through digital thermometer model CE TP101. Transparency of water was measured with help of Sechhi Disk (Black/White disc) by lowering in water observing the appearance and disappearing visual point and then wet rope was measured in cm scale (Mahar et al., 2000). Total salinity (%) and sodium (mg/l) were measured with the help of HM digital meter model SB1500PRO. Electrical Conductivity EC and total dissolved

solids TDS were measured with the help of 5-star Multi meter. pH of water was measured by digital pH meter model WTW 320. The water's total alkalinity (CaCO₃) (P&M) (mg/L) was measured using a water test titration kit (Lohand Hangzzhou Biological, LH, ISO 9001). Ten milliliters of the water sample were put into a conical flask using a syringe. The sample turned pink and scarlet after three drops of reagent I were added. The water sample (liquid) was then treated drop by drop with reagent III until it turned clear and colorless (reagent N1 drops were counted and recorded).

Following the procedure outlined in the literature study, Step 5 was then finished. The identical water sample was mixed with three drops of reagent II, and the flask was shaken until the liquid turned green. After that, drop by drop, Reagent III was added until the liquid turned dark crimson instead of green. The reagent droplets were counted using N2. The results were obtained by calculating the phenolphthalein alkalinity (N1 (drops number) x 10 ml water sample, total alkalinity (N1+N2) X 10 ml = 00 mg/l). The LH Biological water testing kit (Lohand Hangzzhou Biological, LH, ISO 9001) was used to measure total hardness. One sealed packed powder content of one total hardness (I) (LR) reagent was added to a conical flask along with ten milliliters of water sample, which was then swirled to dissolve. The water sample in the flask turned blue, indicating a hardness of less than 0.4 mg/l; step 4 was preempted if a red tint appeared.

Therefore, 1ml of the total hardness (II) (LR) reagent was progressively added drop by drop to the water sample using a second syringe while swirling until the color changed from red to blue. If 1 mL was not enough, steps 4 and 5 were repeated in compliance with the broacher's specifications. The volume was measured and the droplets were counted using a pipette. The estimated result was Total Hardness mg/L = $V \times 200$ (mg/l). The ammonia nitrogen test was performed using the LH biological testing kit (Lohand Hangzzhou Biological, LH, ISO 9001). The reagent dissolved evenly, one packet of reagent-I was put to the 15 ml testing liquid (water

sample) in the testing tube, the lid was covered, and the liquid was shaken.

After 2 minutes one packet of reagent-II again covered lid and shake well until reagent completely. Samples were placed at 10-30 °C for 15 minutes. The testing liquid sampled tube was compared with a chart for matching the colour chart for getting the results of ammonia in water samples. The dissolved oxygen was measured using the modified Wrinkler techniques. The suspended orthophosphate chemical was examined using the spectrophotometer technique. Ascorbic acid and molybdenum blue were used as reagent chemicals. Nitrogen was calculated using the Jeldhal method. Nitrate and phosphates were measured using established methods in the state-of-the-art research facilities at the Institute of Chemistry, University of Sindh Jamshoro (APHA, 1982; Boyd and Tucker, 1998).

A 55µm plankton net mesh was used to collect zooplankton and phytoplankton samples from Barechi Lake. Samples were stored with a 2% formalin solution in polypropylene vials. Samples were brought to the lab to evaluate the bacteria' condition and availability. 50 liters of water were squeezed through a 55µm plankton net mesh to collect plankton samples for quantitative assessment.

Aquatic invertebrate samples were collected from the lake's shallow and pelagic regions using iron and nylon sieves with mesh sizes of 0.1, 0.3, 0.5, and 1.2 cm. Samples were preserved by placing them in polypropylene jars filled with a 5% formalin solution.

Fish samples, both qualitative and quantitative, were gathered using a seine net with a mesh size of 1.2 cm. 1.5 cm and gill net mesh size 3 cm by the study's research experts and local fishermen. Samples were kept in ice cases in plastic bags.

The specimens were identified using taxonomic keys and illustrations (Ali, S.S. 1999; Battish, 1992; Desikachary, 1959; Day, 1877; Jhingran, 1975; Mirza, 1982; Nazir and Younis, 1979; Shameel, 2001; Ward and Whipple, 1959; Yungfang, 1995). A 0.1-pixel mobile camera and the DCM 35 (350 pixels USB0.1) binocular microscope (Swift M.3300D) connected to a

computer were used to take pictures of the specimen at magnifications of x100 and x400.

Macrophytes were collected using a plant gripper, an iron sieve, and an iron trap lowered into the water by a boat.

Results and Discussion

Results indicate that Bareeji Lake exhibits moderate ecological health, with water temperature peaking during monsoon and lowest in winter (05–34°C). The lake remained slightly alkaline (pH 7.3–8.2), while DO was lowest in monsoon (6.3–7.6 mg/L) due to higher temperatures and organic load. TDS and conductivity reached their highest values during pre-monsoon, reflecting concentration effects from evaporation. Nutrient levels remained moderate, supporting seasonal peaks in phytoplankton and zooplankton productivity, with macrophyte populations highest during Monsoon. Inter relationship between temperature and phytoplankton chlorophyll are well known patterns for a eutrophic water body (Pothoven and Vanderploeg, 2020). The air temperature was 25.25 ± 11.97318 °C, while the water's physicochemical properties were 17.75 ± 9.003967 °C. The pH was 7.716667 ± 0.30605 , and the measured transparency/turbidity was 49.375 ± 19.93516 cm. The salinity was 1.02875 ± 0.517285 ppt (g/L), and the electrical conductivity was 101.0013 ± 88.82615 µS/cm. Alkalinity was 66.8125 ± 7.184793 mg/L and hardness was 253.625 ± 27.79999 mg/L. Nitrate and phosphate concentrations were 68.9375 ± 12.68654 µg/L and 1.61625 ± 0.665302 µg/L, respectively, while dissolved oxygen was 10 ± 2.560134 mg/L.

Seasonal and meteorological variations, as well as anthropogenic variables like agricultural runoff, were shown to have an impact on water quality and biological production, highlighting the lake's susceptibility to environmental stresses. Mahar et al. (2000), Mahar et al. (2007), and Mahar et al. (2008) state that the bioindicators of the water bodies in Sindh province are significantly correlated with the effects of water quality parameters on fish and plankton production, especially in freshwater lake ecosystems. The study provides baseline data essential for sustainable

lake management, including recommendations for water quality monitoring, ecological restoration, pollution control, community engagement, and climate adaptation strategies. These findings contribute to understanding the dynamics of small inland lakes in semi-arid regions, informing conservation efforts, policy decisions, and the long-term sustainability of both biodiversity and livelihoods dependent on Barechi Lake. Physical and chemical parameters of water quality of Barechi lake are given in table 1.

Total nine (09) genera of algae belong to class Cyanophyta and Bacillariophyta were reported from Barechi lake aquatic ecosystem (Table 2). All species are referring as pollution indicators showing the eutrophic condition as well as creating problems for other lives as well as human society using the water for drinking and domestic purposes (Mahar et al., 2000; Yousafzai et al., 2010; Wehr et al., 2015; Bellinger & Sigee, 2015; Carvalho et al., 2011; Ortega et al., 2016; Ali et al., 2007; Barinova et al., 2013, 2016; Khuram et al., 2014, 2017, 2019; Mursaleen et al., 2018a, b). The algal genera that were quantities included *Chroococcus* number of individual/10 L 68.25 ± 14.5459 ; *Merismopedia* 52.25 ± 24.97165 ; *Microcysts* 316 ± 122.3628 ; *Oscillatoria* 50 ± 24.88641 ; *Anabaena* 73 ± 38.27096 ; *Nostoc* 63 ± 8.445906 ; *Lunbia* 48.5 ± 13.91642 ; *Euglena* 38.5 ± 18.66369 ; *Chlamydomonas* 41.25 ± 31.31959 ; *Phacus* 3 ± 3.829708 ; and *Navicula*. Impacts of water quality variables are greatly influence on the dispersal and survival of algal life forms (Wehr et al., 2015; Khuram et al., 2019). The qualitative and quantitative assessment of the genera indicated the status of the water body as high nutrients budget and specie richness in 50 Liter of water sample. In the light of presence of algal species in Barechi, the lake can be considered at middle stage of eutrophication. The trophic state index of the water is closely related to abundance and distribution of phytoplankton and filamentous algae interact with water quality variables (Barinova, 2017).

Zooplankton form are active ecological indicators of the water bodies as suggested by different

authors (Chen, 2019; Wetzel, 2001; Levine and Weathers, 2005; Kagalou et al., 2001) numbers/50 L water *Cyclops* 22.25±19.10279; *Diaptomus* 18±2.160247; *Onychocamptus* sp. 5.25±0.957427; *Ceriodaphnia* sp. 18±4.966555; *Alona* sp. 2.5±3; *Brachionus* sp. 55.75±13.57387; *Cyclotella* sp. 25.75±30.20348 and *Filinia* sp. 2.25±2.629956.

The invertebrate's fauna of the lake is very diversified. It includes worms, insects, snails and bivalves. The presence of shallow animals qualitatively and quantitatively described as *Tubifex* (Sludge worm) 7.75 ± 3.304038; *Oligochaetes* (aquatic worm) 7.75 ± 1.707825; Mayflies larvae 27 ± 10.36018; Midge fly *Chironomidae* 24 ± 5.09902; Blackflies 6.25 ± 2.362908; *Viviparus* snail 5.75 ± 2.217356; *Lymnaea* sp. 5.75 ± 2.217356 and *Unio* sp. 1.25 ± 0.957427. Quantitative values of insects, worms and mollusks show a great deal of organic and inorganic budget at shallow areas of the lake which come from surrounded agriculture run off.

Fish fauna of the lake shows a great deal of those species who grow qualitatively and quantitatively in saline and rich nutrient contaminated waters. Present study reported the available fish genera in the Barechi lake *Oreochromis* sp. 13.5 5.972158; *Channa* sp. 7.75 2.872281; *Mugil* sp. 10.75 3.304038; *Mastacembelus* sp. 3.5 3.316625; *Rita* sp. 3.25 3.316625; *Wallago* sp. 4.75 0.957427; *Aorichthys* sp. 3.5 2.516611; *Heteropneustes* sp. 4.25 3.593976; *Labeo* sp. 14.5 7.325754; *Cirrhinus* sp. 14.25 5.315073; *Catla* sp. 12.25 5.965177 and *Puntius* sp. 7.75 4.5.

Aquatic macrophytes of the lake are diverse consisting of marshy, floating, emergent and submerged plants. Qualitative and quantitative record of collected aquatic plants waved dry weight in kgs per 1 cubic meter in Barechi lake Badin. High growth rate of these plants is clear indication of eutrophication status of the lake. Table 6 shows the seasonal status qualitatively and quantitatively of the plant's genera at various zones of the lake. The mean values with standard deviation of genera *Lemna* sp. 0.3125 7.54656; *Eichhornia* sp. 5.5 2.559129; *Pistia* sp. 6.25 3.605521; *Ceratophyllum* sp. 1.625 4.146987; *Myriophyllum* sp.

0.875 2.457184; *Najas* sp. 7.5 2.766365; *Potamogeton* sp. 5.25 2.136778; *Typha* sp. 10.75 4.383956 and *Phragmites* 7.5 3.344771 respectively.

Bareeji Lake serves as a critical freshwater ecosystem in southern Sindh, providing both ecological services and socio-economic benefits. This study establishes the first systematic baseline of water quality, plankton, and macrophyte productivity, highlighting seasonal variability and the influence of climatic and anthropogenic factors. Sustainable management of Bareeji Lake requires a multidisciplinary approach, combining scientific monitoring, community engagement, climate adaptation strategies, and conservation interventions. By implementing the recommendations outlined in this chapter, it is possible to protect the lake's ecological integrity, support local livelihoods, and ensure the long-term sustainability of freshwater resources in the region. The seasonal assessment of Bareeji Lake indicates that it maintains moderate ecological health, with clear temporal and environmental variations influencing its physicochemical and biological characteristics. Water temperature exhibited pronounced seasonal fluctuations, reaching maximum values during the Monsoon season, attributable to increased solar radiation and elevated air temperatures, while the lowest temperatures were recorded in Winter, corresponding with reduced solar intensity and lower ambient temperatures. The lake's pH values remained slightly alkaline throughout the year, reflecting stable buffering capacity, whereas dissolved oxygen concentrations decreased during the Monsoon, likely due to higher water temperatures, increased organic load, and elevated microbial respiration. Total dissolved solids and electrical conductivity were highest in the pre-monsoon period, reflecting concentration effects from elevated evaporation rates and reduced freshwater inflow. Nutrient levels, including nitrate and phosphate, remained moderate, supporting seasonal productivity of phytoplankton and zooplankton, which in turn sustained higher trophic levels, particularly fish populations. Biological assessments revealed that

both plankton and macrophyte communities exhibited strong seasonality, with peak abundance during periods of favorable temperature, nutrient availability, and water level. This seasonal variation emphasizes the influence of both climatic factors and hydrological dynamics on the lake's ecological functioning. Overall, Bareeji Lake continues to provide essential ecosystem services, including habitat provision for aquatic species and support for local community livelihoods. However, the study also highlights that seasonal and climatic fluctuations, compounded by anthropogenic pressures, have the potential to

impact water quality, biological productivity, and ecosystem stability. These results provide a critical baseline dataset, offering valuable guidance for the development of sustainable lake management practices, long-term ecological monitoring programs, and targeted conservation strategies. The lake needs strong attention by the concerned authorities and organizations in relation to the protection, conservation and restoration with sustainable management for proper survival of the lake ecosystem saving the natural most important heritage and assets of world aquatic source in general and Badin, Sindh, Pakistan is particularly.

Table 1. Physical and chemical parameters of water quality of Barechi lake.

Parameters	Spring		Summer		Autumn		Winter		Mean values	Standard deviation
	Min	Max	Min	Max	Min	Max	Min	Max		
Temperature of air (°C)	20	39	26	43	15	30	7	22	25.25	11.97318
Temperature of water (°C)	15	24	20	34	11	21	5	12	17.75	9.003967
Transparency/ Turbidity (cm)	49	69	15	37	32	66	57	70	49.375	19.93516
pH	7.5	8.0	7.3	7.8	7.6	8.1	7.8	8.2	7.716667	0.30605
Salinity ppt (g/L)	0.9	1.6	0.28	0.53	0.8	1.3	1.02	1.8	1.02875	0.517285
Conductivity (μS/cm)	125	22.2	3.88	73.61	11.1	180.5	141.66	250	101.0013	88.82615
Alkalinity (mg/L)	62.6	70.4	65.7	74.5	70.8	75.2	54.8	60.5	66.8125	7.184793
Hardness (mg/L)	235	280	215	225	280	290	256	248	253.625	27.79999
Dissolved Oxygen (mg/L)	10.2	12.5	6.3	7.6	8.4	9.5	11.7	13.8	10	2.560134
Nitrates (μg/L)	50.2	58.7	63.2	85.9	59.5	78.2	75.2	80.6	68.9375	12.68654
Phosphates (μg/L)	0.8	1.3	0.9	2.02	1.2	2.31	1.8	2.6	1.61625	0.665302

Table 2. Qualitative and quantitative record of algal genera Numbers/50Lwater sample.

S.#	Genera	Spring	Summer	Autumn	Winter	Mean	Standard Deviation
1	<i>Chroococcus</i> sp.	67	56	89	61	68.25	14.5459
2	<i>Merismopedia</i> sp.	27	37	63	82	52.25	24.97165

3	<i>Microcysts</i> sp.	178	456	371	259	316	122.3628
4	<i>Oscillatoria</i> sp.	63	16	48	73	50	24.88641
5	<i>Anabaena</i> sp.	37	56	73	126	73	38.27096
6	<i>Nostoc</i> sp.	68	71	52	61	63	8.445906
7	<i>Lunobia</i> sp.	44	62	57	31	48.5	13.91642
8	<i>Euglena</i> sp.	45	23	24	62	38.5	18.66369
9	<i>Chlamydomonas</i> sp.	20	36	22	87	41.25	31.31959
10	<i>Phacus</i> sp.	4	0	0	8	3	3.829708
11	<i>Navicula</i> sp.	256	294	671	143	341	229.1564
12	<i>Nitzschia</i> sp.	56	78	94	63	72.75	16.87947

Table 3. Qualitative and quantitative record of zooplankton Numbers/50L water sample in Barechi lake Badin.

S.#	Genera	Spring	Summer	Autumn	Winter	Mean	Standard Deviation
1	<i>Cyclops</i> sp.	5	8	31	45	22.25	19.10279
2	<i>Diaptomus</i> sp.	16	18	21	17	18	2.160247
3	<i>Onychocamptus</i> sp.	5	6	4	6	5.25	0.957427
4	<i>Ceriodaphnia</i> sp.	25	15	18	14	18	4.966555
5	<i>Alona</i> sp.	4	6	0	0	2.5	3
6	<i>Brachionus</i> sp.	39	54	72	58	55.75	13.57387
7	<i>Cyclotella</i> sp.	58	0	45	0	25.75	30.20348
8	<i>Filinia</i> sp.	4	0	5	0	2.25	2.629956

Table 4. Qualitative and quantitative record of snails, insects and worms (% 1³m) in shallow areas.

S.#	Genera	Spring	Summer	Autumn	Winter	Mean	Standard Deviation
1	<i>Tubifex</i> (Sludge worm)	8	4	12	7	7.75	3.304038
2	<i>Oligochaetes</i> (aquatic worm)	7	8	10	6	7.75	1.707825
3	Mayflies larvae	13	28	38	29	27	10.36018
4	Midge fly Chironomidae	24	17	26	29	24	5.09902
5	Blackflies	6	8	3	8	6.25	2.362908
6	<i>Viviparus</i> snail	6	8	5	4	5.75	1.707825
7	<i>Lymnaea</i>	7	5	8	3	5.75	2.217356
8	<i>Unio</i>	0	2	1	2	1.25	0.957427

Table 5. Qualitative and quantitative record of fish in percentage per catch at landing centers.

S.#	Genera	Spring	Summer	Autumn	Winter	Mean	Standard Deviation
1	<i>Oreochromis</i> sp.	22	12	12	8	13.5	5.972158
2	<i>Channa</i> sp.	8	11	8	4	7.75	2.872281
3	<i>Mugil</i> sp.	14	9	13	7	10.75	3.304038
4	<i>Mastacembelus</i> sp.	4	8	1	1	3.5	3.316625
5	<i>Rita</i> sp.	2	5	2	4	3.25	1.5
6	<i>Wallago</i> sp.	5	4	4	6	4.75	0.957427

7	<i>Aorichthys</i> sp.	3	3	7	1	3.5	2.516611
8	<i>Heteropneustes</i> sp.	5	9	1	2	4.25	3.593976
9	<i>Labeo</i> sp.	7	11	16	24	14.5	7.325754
10	<i>Cirrhinus</i> sp.	8	12	17	20	14.25	5.315073
11	<i>Catla</i> sp.	9	8	11	21	12.25	5.965177
12	<i>Puntius</i> sp.	13	8	8	2	7.75	4.5

Table 6. Qualitative and quantitative record of collected aquatic plants waved dry weight in kgs per 1 cubic meter in Barechi lake Badin.

S.#	Genera	Spring	Summer	Autumn	Winter	Mean	Standard Deviation
1	<i>Lemna</i> sp.	0.33	0.28	0.26	0.38	0.3125	7.54656
2	<i>Eichhornia</i> sp.	4	7	6	5	5.5	2.559129
3	<i>Pistia</i> sp.	5	7	8	5	6.25	3.605521
4	<i>Ceratophyllum</i> sp.	2	0.5	1.8	2.2	1.625	4.146987
5	<i>Myriophyllum</i> sp.	0.8	0.4	1.2	1.1	0.875	2.457184
6	<i>Najaz</i> sp.	6	8	9	7	7.5	2.766365
7	<i>Potamogeton</i> sp.	2	6	8	5	5.25	2.136778
8	<i>Typha</i> sp.	12	11	8	12	10.75	4.383956
9	<i>Phragmites</i> sp.	4	7	8	11	7.5	3.344771

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