

Structure and Function of Bhimtal Lake Ecosystem

Lakes are an integral component of the hydrological system; and perform diverse roles in the biosphere. Studies on lake ecosystems are however, often neglected, probably, due to their little size. There is no doubt that little things perform many important activities in our lives. The wetland ecosystem is one of the most significant ecosystems on Earth. Its unique ecological system feature is interaction between water and land. Wetland ecosystems offer animals, plants and microorganisms a place to live, while also being rich in biodiversity. Wetland ecosystems are known as the "kidney of the Earth" because they purify the environment by processing pollutants. Literature survey on lake environment studies shows very little work in India. The 2010-2011 report of the Central Pollution Control Board (CPCB) shows that there are only 60 CPCB lake water quality monitoring stations in the country. In the recent years research on wetland ecosystems is getting more and more attention for wetland ecosystem services such as flood mitigation, climate control, pollution prevention, soil erosion prevention, biodiversity maintenance and productivity function.

Lake in focus

The present article focuses on one of the famous lake in the lake district. The present article focuses on one of the famous lake in the lake district of Nainital, which is named Bhimtal lake. The lake is situated at 29°20'24"N to 29°23'07"N Lat. and 79°31'25"E to 79°34'12"E Long at an altitude of 1350 m asl in Nainital district. This lake is located 22 km from the main city of Nainital. Morphologically the lake is of crescent shape and occupies 72 ha area, with 1128 ha catchment area. The catchment area of the lake ranges from 1350-1950 m asl while the maximum depth of the lake is 25.8 meter. According to geologists the origin of the lake is attributed to a number of geological faults which occurred due to shifting of the earth's crust. This caused blockade of the overland flows and resulted in creation of the lake. The catchment area of the lake, particularly the hills have dense forest cover; the type of forest vegetation consists of Chir pine (*Pinus roxburghii*), banj oak (*Quercus leucotrichophora*) and mixed deciduous forests. The basin experiences sub-tropical to temperate climatic conditions. Precipitation in the basin is very high, mostly occurring during the monsoon period. The lake plays a significant role in conserving the aquatic biodiversity while the dam (created in 1883 when Kumaon region was under the British Raj) solves the water crisis of nearby downhill areas. The lake ecosystem consists of various biotic and abiotic components such as algae, phytoplanktons, zooplanktons and various aquatic plants along with various fish species, which are namely Common carp (*Cyprinus carpio*), Mahsheer (*Tor tor*) and Rohu (*Labeo rohita*). Until past two decades the lake was in its pristine form with distinct organization of its trophic structure (Fig. 1). However, in recent decades the lake is losing its pristine value due to many factors that are deteriorating its water quality.

The lake has a gross storage capacity of 4.63 million cubic meters (164×106 cu ft) with a live storage of 3.54×106 m³ (125×106 cu ft). The surface inflow into the reservoir is only 1.756×106 m³ (62.0×106 cu ft) and the balance storage is contributed by subsurface sources. The reservoir has been classified as monomictic with prolonged stratification extending over a period from March to November and one intercirculation (December-January). Major problem of the lake is the large amount of sediments that flows from the catchment into the lake and get deposited on the bed. Dredging is required frequently. The waste water also flows into the lake as the houses are not connected to the sewer lines, for which the intervention has recently been done.

Bhimtal lake is mesotrophic as the inflow of organic substances and nutrients is low. There is inflow of sediment from the catchment due to intense building activity on the banks. This has necessitated dredging of the lake regularly.

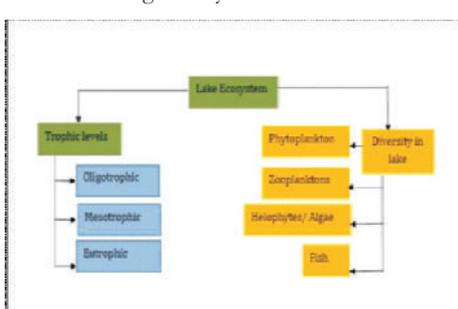


Fig 1. Trophic system of lake

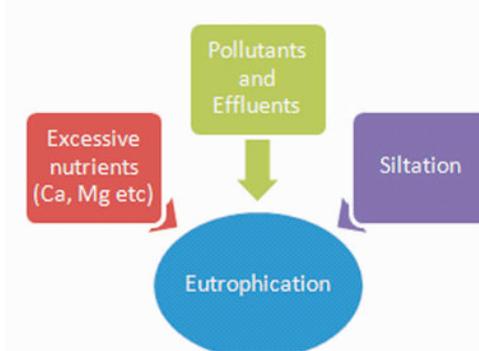


Fig. 2. Causes of eutrophication in lake ecosystem

Gola River, which is utilized to supplement the flows of the downstream canals. As the reservoir water is released, the water surface area of the lake gets reduced, when the water getting released, by 11 metres (36 ft) with consequent reduction of the

size of the reservoir to half its original spread. Water quality of the lake is in a "retrogressive ecological change" on account of sewage disposal, sediment inflow, and tourist's pressure causing waste disposal. The nutrient characteristics of Bhimtal lake includes: Calcium= 12-20mg/l, Magnesium = 9 mg/l, while the GPP (gross primary productivity) of the lake is 223-914 mg cm³/d. The transparency of lake is 123-340 cm, while the PH ranges between 7.0-9.1. The silt load in lake is 600-700 ppm (Fig. 2). This has resulted in dissolved oxygen level recorded at harmful levels to both domestic consumption and pisciculture.

Nitrate level is also stated to be high at 350 mg/l which is considered a "pre-eutrophication stage". In the bed of the lake there are deposits of injurious matter and as a result fish mortality rate is high and the quality of drinking water has also suffered. As the lake water is polluted with organic matter, it is in a mesotrophic state due to disposal of sewage directly into the lake from the residential complex built around the periphery of the lake. It has now been planned to build a sewer line around the periphery of the lake to trap all the sewage from the residential areas and prevent it from entering the lake. A treatment plant to treat the waste water is also part of the waste water treatment process.

Future implications

The change in lake's ecosystem leads to the change in living conditions of the dependent organisms and the electric conductivity of lake water was recorded to be higher at Bhim temple site, which shows high concentration of total dissolved ions in water (Negi *et al.*, 2013). This increase in nutrient eventually leads to eutrophication of lake (high nutrient and algal bloom status which cause fish mortality and decrease in water quality) and decline in diversity (Fig. 3). For the conservation of lake ecosystem basic awareness from the grassroots level, especially the young children are required. Last but not the least, one should follow the practice of "being aware and making others aware also" that can be undertaken to follow the environmental protection basics, only then the fragile ecosystem of the lake can be conserved sustainably.



Fig.3. (a) Example of eutrophicated lake (b) Bhimtal lake: an attraction for tourists

References:

https://en.wikipedia.org/wiki/Bhimtal_Lake.

Negi GCS, Singh S, Dhyani PP (2013). Impact of transforming livelihood scenario in Bhimtal lake catchment in western Himalaya. *Journal of Hill Research*. 26 (1 & 2): 112-116.

Harshit Pant (drharshitpant@gmail.com)
 GBPNIHESD, Kosi-Katarmal, Almora,
 Uttarakhand