# INTRODUCTION

Lakes are naturally formed from hollows or depressions on the surface of the earth containing standing water. Natural lakes are of diverse geological origin. A lake has been defined by Forel (1892) as a body of standing water occupying a basin and lacking continuity with sea. A reservoir can be defined as a large expanse of impounded water artificially created by putting across a stream an earthen, stone masonry or concrete bundh or dam. Reservoirs are constructed mainly for irrigation, power generation, flood control, recreation, fishery development etc. (Jhingran, 1991). Reservoirs in a way are man made fresh water lakes. The global water resource has been estimated about 1,560,000 $km^2$ of surface area and their distribution estimates 97.2% by oceans, 2.15% by ice caps and glaciers, 0.62% by ground water, 0.009% by freshwater lakes, 0.008% by saline lakes, 0.005% by soil moisture and 0.001% by stream channels (Nace, 1964). The global lakes represent a volume of 229,000 $km^3$ in which the freshwater lakes cover an area of 91,000 $km^2$ of the total water of the planet (Keller, 1984). Although relatively fewer in number, 90% of the world's inland surface water supply is shared by 253 large lakes (Herdendorf, 1982). The Northern Hemisphere constitutes over 87% of all the large lakes and the Southern Hemisphere with relatively few lakes found mostly in Africa. North America possesses nearly half of all the large lakes but only one third of the world's total surface area for large lakes. Asia with one fourth of these lakes has over 42% of the lake area.

Lakes in the Himalayan region are unique in its geographical setting, geomorphology and biota. The Himalayan lakes draw special interest to environmentalist as they have been influenced by the biotic pressure over several thousands of years and continue to be rapidly deteriorating in the wake of ever increasing stress.

Darjeeling is universally described as the "Queen of Hills" for its uniqueness and versatility. The district of Darjeeling in West Bengal is situated at the height of 2,134 m and lies between 26°31' and 27°13' north latitude and between 87°59' and 88°53' east longitude. It is somewhat triangular in shape. The district has a total area of 3,075 $km^2$ with Nepal on the west, Sikkim on the north, Bhutan on the north-east, Purnea district of Bihar abutting on the south and district Jalpaiguri of West Bengal on the south-east. The town Darjeeling is the administrative headquarter of the district. The town Darjeeling is situated

in the lower Himalayas in $27^0$13' north latitude and $38^0$16' east longitude. The district has four sub-divisions namely Darjeeling, Kalimpong, Kurseong and Siliguri. The name Darjeeling is believed to have been derived from the Tibetan word 'Dorje' which is the scepter of Indra, the God of thunderbolt and 'ling' means the place. The name therefore means the place of Dorje or the thunderbolt. The name could also have been inherited from a Buddhist Monestery of the same name once situated on the top of the observatory hill.

Darjeeling falls into two distinct tracts, the Tarai immediately beneath the hills and the ridges and deep valleys of the lower Himalayas. The Tarai portion of the district is a low lying belt, traversed by numerous rivers and streams rushing down from the hills and by the upland ridges which mark their courses. Behind the Tarai, the mountains tower abruptly from the plains, which are here only about 300 ft above sea level, in lofty spurs reaching to 6,000 and 10,000 ft, and culminate in a series of long ridges and valleys. The slopes, from about 6,000 ft downwards, are now dotted with trim tea gardens interspersed with small tracts of land reserved for native cultivators. Above that level they are clothed in dense forest, through which torrents rush down, but at the higher levels on the Singalila range, there are wide grassy slopes broken here and there with pine forests and masses of *Rhododendrons*. The district of Darjeeling has a population of 1605900 (2001 Census) of which 67.56% of the population still lives in rural areas. The density of population is about 510 persons per $km^2$ and the sex ratio is 940 females to 1000 males.

Mirik is one of the famous hill resorts in the Kurseong sub-division of Darjeeling district of West Bengal at an altitude of 1767 meters. It extends between $26^0$ 53'N and $88^0$10'E and covers an area of 135.9 ha. It is situated 49 km away from Darjeeling and 52 km from Siliguri. Mirik is surrounded by some of the best tea gardens of this region. Mirik is the largest producer of oranges in West Bengal. Cardamom is an important cash crop of this place. Mirik has an excellent scenic beauty and the climate of Mirik remains pleasant for most part of the year. It attracts a vast number of visitors from various parts of the world; as a result, tourism becomes a great source of income of the inhabitants of this region.

The terrain of Mirik is shaped like a tiny valley. Within the valley, there is a flat stretch of about 2.02 ha, which is rare in hill areas of Darjeeling. Along the west side of this flat

ground there is a lake named "Sumendu Lake" or "Mirik Lake" which is an important reason behind the increasing popularity of Mirik (Fig. 1). The term "Mirik" has derived from Lepcha tradition and culture. "Mee" denotes burning and "reek" denotes remaining ashes and fire. Hence the meaning of Mirik is "Burning ashes and fire". The entire lake which was marshy and swamp was recognized as "Sumendu Dhap" which means a compact marshy land in Lepcha. The Sumendu area was a center of worship for the Lepcha ethnic communities.

After the independence, people of Mirik organized a fair and turned the marshy land into a small pond. A temple of Lord Krishna was also built in the vicinity of Sumendu complex and thus the area was named Krishnanagar after the name of Lord Krishna. However, in 1972 the concept of pond was expanded into a lake by some like minded people of Mirik and along with this concept a boat "Jalpari" was also sponsored by Moktan Company to add beauty and recreation in the lake. The government of West Bengal started its tourism project at Mirik in 1974. The project consisted of the construction of a permanent dam near Kali Khola to store water for the lake. This glorious task was executed by renowned construction agency, Moktan and Moktan Company. The construction was exercised by leaps and bounds. Beside this, the digging of soil from the entire marshy land was done massively. Apart from tourist lodge and restaurant a beautiful garden and a bridge were constructed.

With the completion of the project in 1979, Mirik has developed as the newest hill resort in West Bengal during the past two decades with increasing popularity. The prosperity and livelihood of most of the people of the surrounding area are associated with the advancement of this emerging tourist place. The area, under jurisdiction of Mirik Municipal Corporation, is overall controlled by Darjeeling Gorkha Hill Council (DGHC). This lake has been included under National Lake Conservation Programme formulated by the Ministry of Environment and Forests, Government of India.

The total lake area is about 16.188 ha with approximate length of 1.25 km and the peripheral road is about 3.5 km. The arch-type over bridge across the lake is 80 ft long.

Initially the maximum depth of the lake was 26 ft. and minimum was 6 ft. (Dwivedi, 1998). The level stretch forms eastern bank of the lake, the western bank being hill slopes covered by a rich forest of about ten thousand *Cryptomaria japonica* trees.

The lake is fed by both perennial streams and rainwater. Since the lake is situated in a valley encircled by hill ridges with extensive natural drainage network, it receives wastewater from human settlements through numerous inlets. There is one out-fall point through which the spillover water of the lake discharges into the river Mechi situated to the Western side of the lake. The catchments area consists of residential areas, vacant lands and commercial centers comprising of hotels, restaurants and other shops (Fig. 2).

Mirik Lake and its surroundings as a whole contain multifarious recreational features like boating, jogging, organising fair (Fig. 3), picnic and many others. Many people from different parts of the world come to enjoy the beauty of the lake. Besides attracting tourists, the lake water also serves as a major source of drinking water to the local people.

However, the lake and its surrounding areas are under acute pressure due to unregulated anthropogenic activities. The major identified threats are as follows:

1. Discharge of wastewater to the lake through different drainage networks (Fig. 4).
2. Non-point source of pollution: washing, bathing, disposal of solid wastes, cleaning of vehicles etc. (Figs. 5, 6 and 7).
3. Encroachment of the lake area by constructing hotel (Fig. 8).
4. Indiscriminate use of lake surroundings by picnic parties from neighbouring areas/ districts (Figs. 9 and 10).

Very little work has been carried out on lakes of Darjeeling Himalaya. The main objectives of this study are:

1. To study some physico-chemical parameters of lake water.
2. To determine the microbial load of lake water.
3. To study the plankton diversity in the lake water.

# Plate 1

## Explanation of figures

Fig. 1 shows a view of Mirik Lake.

Fig. 2 shows extensive commercial activities in the catchments area of Mirik Lake

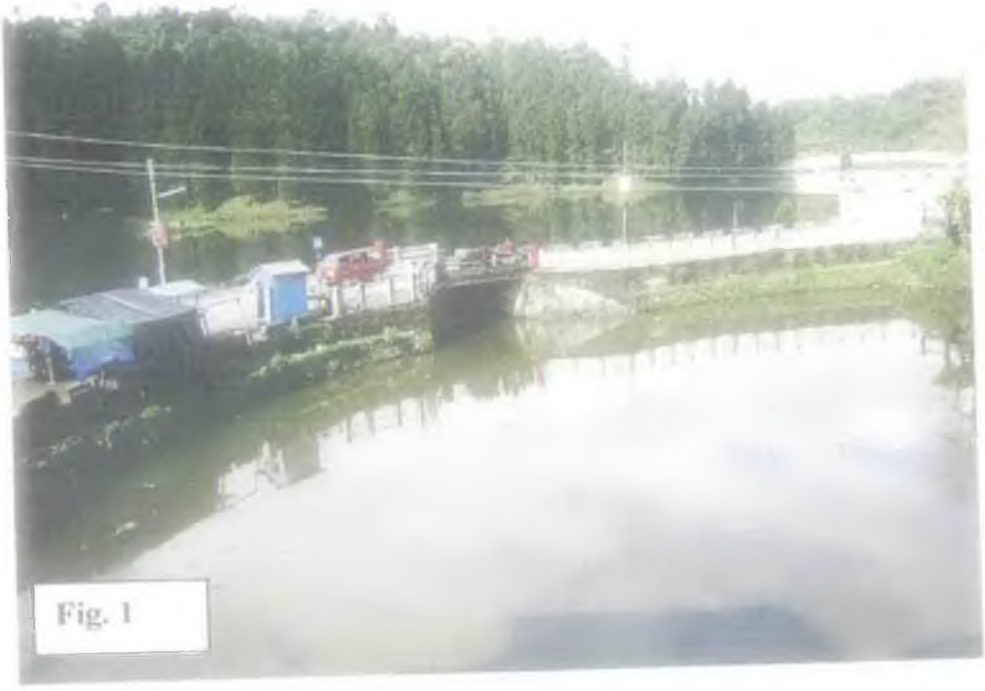

Fig. 1

Fig. 2

# Plate 2

## Explanation of figures

Fig. 3 shows organisation of fair on the eastern bank of the lake

Fig. 4 shows discharge of wastewater in Mirik Lake from residential areas

Fig. 3

Fig. 4

Fig. 5

Fig. 6

# Plate 4

## Explanation of figures

Fig. 7 shows dumping of solid wastes on the banks of Mirik Lake.

Fig. 8 shows existence of a hotel on a portion of the lake (eastern side).

Fig. 7

Fig. 8

# Plate 5

## Explanation of figures

Fig. 9 shows picnic parties on the banks of Mirik Lake

Fig. 10 shows disposal of wastes by the picnic parties in the peripheral areas of the lake

Fig. 9

Fig. 10