Chapter 1

Introduction
Water is the basic need of life and essential for every living organism. Water is the most abundant substance in the protoplasm. Most of the biochemical reactions occur in the presence of water which is the universal solvent. It plays important role for the lives occurring both in aquatic and terrestrial habitats.

Water is one of the most precious resources. Millions of people all over the world, particularly in the developing countries are losing their lives every year from water-borne diseases due to the shortage of hygienic water.

Rapid population growth, increasing urbanization, industrialization, commercial and residential developments, production of domestic and industrial sewage, agricultural, fertilizers and insecticides are leading to pollution of natural water. As a result most of the lakes, ponds, reservoirs and rivers receive huge quantities of waste containing substances varying in characteristics from simple nutrients to highly toxic materials, all of which put together a great pressure on the existing water resources which can not escape from pollution. Thus, causative factors responsible for degradation of water quality and productive capacity of different water bodies need to be evaluated so as to take up proper steps before the situation deteriorates further.

The fresh water bodies provide an important habitat for aquatic biota on the land mass. The fresh water systems vary in extent and in seasonal behaviour and are very much influenced by the nature of surrounding land and biota. Extent and depth of the water bodies, their geographical locations, the bottom substrate and the biotic interference are some of the important factors which influence the ecology of fresh water bodies.
Fresh water habitats occupy a relatively small portion of the earth’s surface as compared to marine and terrestrial habitats. But they are the most convenient and cheapest source of water for domestic and industrial needs and take important role in the hydrological cycle. Such habitats are of two general types \textit{i.e.} Lentic (standing water \textit{i.e.} lakes, ponds etc.) and Lotic (running water \textit{i.e.} river, streams etc.) system (Reid and Wood 1976). The lentic water bodies differ from the lotic ones in physical, chemical and biological aspects. These differences are caused by their geographical locations, altitudes, extent of waterbody, geological nature of the bed rock and the surrounding catchment area and vegetation in and around the water bodies. Lentic waters are turbid during the rainy seasons, but get cleared up after the rains when the suspended dirt (soil and organic debris etc) settles down on the bottom. Diurnal and seasonal fluctuations in temperature at the water surface and the lower levels are more pronounced in lentic systems in comparison to the lotic bodies. The muddy bed contains more of organic debris and gradually gets filled up due to deposition of silt washed down with rains into the system. The process of filling up accelerates the hydroseric succession in lentic environment.

Man made ponds and lakes etc. are better managed water resources for municipal water supply, fishery and irrigation etc. Numerous isolated small lentic water bodies are formed in dry months which receive the showers of rainy season. They are purely rainwater harvesting structures.

Throughout the world, the ecologists have given importance on lakes, ponds and rivers as major natural resources of water, leading to an increased study of the ecology of water bodies. In India, studies of freshwater bodies date back to the latter half of 18\textsuperscript{th} Century. George (1980) has given an excellent review of the historical resume of Indian Limnology. Studies on the dynamics
of various abiotic parameters in lentic systems are essential for understanding the distribution pattern and growth of micro and macro flora and fauna.

The study of lakes as a science started as early as 1844 when Forbes (1987) described lake as a “Microcosm” – a little world within itself. Lakes are naturally formed from hollows or depression on the surface of the earth, which get filled with water. Welch (1952), on the other hand, regards all water bodies of standing water as lakes and excludes ponds in his definition. According to him ponds are very shallow bodies of quiet standing water characterized by the extensive infestation of higher aquatic plants. Ponds are mainly of three general classes:- (1) those which represent the pond stage of previously existing lakes; (2) those whose basin has never been large or deep (not preceded by a lake) but instead has been small in area from the start and (3) those whose basins are the results of man’s activities (excavations, quarries, impoundments etc.). With respect to seasonal duration, ponds are customarily divided into two general classes: (1) Permanent those which contain some water the year round; and (2) temporary those in which the basin contains water at certain times or seasons and becomes dry at others. Those ponds which occur for only a limited period in spring are called vernal ponds and contain water only in spring, dry up during summer, and again contain water in autumn are called vernal autumnal ponds; and those which contain some water throughout the season but freeze to the bottom in winter have been called estival pond (Welch 1952).

Although earlier ecologist like Odum (1957) had demonstrated the importance of detritus materials derived from marshy plants in the aquatic food chains, man has not been giving due importance to the wetlands. Until recently wetlands received little attention beyond their recognition as important waterfowl habitats for which a wetland conservation guideline was adopted in
1971 at the “Ramsar Convention” in Iran (IUCN, 1971). Ramsar is a term used for wetlands of high ecological importance. Ramsar convention defines that wetlands are areas of submerged or water saturated lands, both natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including area of marine water, the depth of which at low tide not exceed 6 meters. Later, Cowardin et al. (1979) have given a more cryptic but comprehensive definition as “lands transitional between terrestrial and aquatic systems when the water table is usually at or near the surface or the land is covered by shallow water”.

Wetlands are world wide in distribution. As per the WWF Atlas of the Environment, 1990. Wetlands cover about 6% of the earth’s surface, are complex hydrological and biogeochemical systems characteristically and transitory between aquatic and terrestrial ecosystems. They are well known for rich biodiversity and many physical, hydrological, chemical, biological and socio-economic functions (Williams, 1990). They support a wide variety of plant and animal species restricted to such environments. In India wetlands are distributed in various regions ranging from the cold arid zone of Ladakh through the wet zone of Imphal in Manipur and the warm and arid zone of Rajasthan to the tropical monsoon central part and the wet humid zone of the southern peninsula. It is estimated that freshwater wetland alone supports about 20% of the known range of biodiversity in India (Deepa and Ramachandra, 1999). According to Pandey (1996), India has about 4.1 million hectares of wetlands (excluding paddy fields and mangroves) of which 1.5 million hectares are natural and 2.6 million hectares are man-made.

At present, most of the wetlands of India are threatened to extinction mainly because of cultural eutrophication and conversion into agricultural land.
Similarly, as a result of industrial development and agricultural purposes 80% of wetlands in West France, 70% in Portugal, 90% in New Zealand, 54% in USA and 40% in Britain have been lost (Dugan, 1994). In India, the Ministry of Environment and Forest reports that wetlands have been destroyed by over-exploitation of resources, pollution, constructions of dams, encroachments and other malpractices of human beings. Keeping in view of the impacts of wetland lost to the natural ecosystems. WWF and IUCN launched the International Wetland Conservation Programme in 1985 in over 20 countries in five continents. In our country also, realizing the crucial role of wetlands, Government of India has set up a “National Wetland Committee” consisting of experts on various disciplines to lay down broad policy guidelines for research, to decide priority of the wetlands to be taken up for conservation and to monitor the implementation of the programme.

The most problems pertaining to India’s wetlands are related to human population. About 74% of the human population is rural (Anonymous, 1994) and many of these people are resource dependent. Healthy wetlands are essential in India for sustainable food production and potable water availability for human and livestock. They are also necessary for the continued existence of India’s diverse population of wildlife and plant species, a large number of endemic species are wetland dependent.

Manipur has a wide distribution of wetlands occupying 524.51 sq.km. area (DSTE, 2001) and covers about 2.35% of the total geographical area of the state. In 1950’s there were about 50-55 lakes in Manipur whereas at present there are only about 15 lakes and some ponds comprising the freshwater bodies.
Limnological Significance of Aquatic Macrophytes

Macrophytes are the aquatic vascular and non-vascular plants of macroscopic size. They can be categorized into several kinds viz. Submerged, Rooted and floating, free floating and marshy etc. They accumulate large amount of nutrients. Floating mat (Phumdi) in Loktak lake Manipur and along the Amazon river in Brazil are examples of extensive floating marshes. In Jammu and Kashmir also, a large number of floating islands have been formed which are now utilised for vegetable cultivation and dwelling purposes. Of all the plant species in the fresh water wetlands, the macrophytes are increasingly being recognised as the most productive communities (Westlake, 1975). Although they cover only 1% of the land surface they contribute as much as 5% of the total primary production. Due to high rates of production specially by species like Eichhornia and Ipomoea etc., the biomass reserves of the fresh water wetlands represent an enormous potential for exploitation on a sustainable basis and these macrophytes can be effectively used as economical sources for a number of purposes such as food, paper, pulp and board production, bio-fertilizer and energy production.

The macrophytes are very important for the regulation of mineral cycling in the water bodies and they can serve as indicators for the degree of damage in the ecosystem (Pieczynska and Ozimek, 1976). Aquatic weeds like water hyacinth, Salvinia, Duckweed and Hydrilla can effectively be used for wastewater treatments as the same can scavenge some organic and inorganic compounds including heavy metals (Gopal, 1976).

Various physico-chemical characteristics of freshwater are essential to understand the distribution and productivity of macrophytes in a freshwater ecosystem. In deciding the quality of water resources, an adequate knowledge
of existing nature of physico-chemical parameters and pollutants is essential (Reddy et al., 1994). Assessment of water quality of any region is an important aspect for the developmental activities of the region, because the rivers, lakes, man made ponds and reservoirs are used for water supply of domestic, industrial, agriculture and pisciculture purposes (Jain and Seethapatil, 1996).

Studies on aquatic ecosystem in Manipur are very few as compared with other states of India. There are many unexplored freshwater ecosystem in this region and ecological studies especially of the macrophytes are very few at present. Most of the freshwater ecosystems of Manipur are subjected to advanced stages of pollution and degradation and therefore have reached the status of Wetland (Sharma, 1999). Ecological information on studies of primary productivity, phytosociology and biomass along with physico-chemical analysis of water are currently thought to be inadequate to compile the composite ecological data of the freshwater ecosystems of the state. Various works have been carried out with relevance to wetlands of Manipur. However, there has been no information about the ecological assessment of the community ponds which are the important source of water for domestic consumption and for fishery and agricultural sector in many parts of the state. One of the major problems being faced by the people of Manipur is the shortage of water for drinking and other purposes though the state falls under high rainfall region. For their daily needs people use surface water from ponds, rivers, reservoirs etc. which is also inadequate. Hence, people made small pond (private pond) in almost every house and some larger ponds in nearby public places to harvest rain water. Such larger ponds are known as community ponds locally called as “Leikai pukhri” and may be called the traditional source of water supply in Manipur. People especially residing in rural areas depend to a
great extent on such ponds. However, the ignorant way of utilization of water for domestic purposes *i.e.* bathing, bathing of animals, washing of clothes and utensils, dumping of household garbage, etc. may deteriorate water quality of the ponds with considerable impact on the health of the local people. Hence, assessment of status of the water bodies becomes of paramount importance. If proper management and conservation measures are not taken up as soon as possible, the degradation of these ponds would continue which may ultimately lead to the death of these ponds. Studies on such ponds may serve as a prerequisite in assessing the ecological status of the ponds and investigation to generate scientific data base for improvement and conservation of the pond. Therefore, with the focal objective of conserving these water bodies from further deterioration, the present investigation to study the Ecological assessment of some community ponds in Imphal valley, Manipur has been undertaken with the following objectives:-

1. To understand the phytosociology, biodiversity and distribution of macrophytes in the selected community ponds.

2. To assess the biomass dynamics of macrophytes in the selected community ponds.

3. To investigate into the productivity of macrophytes in the selected community ponds.

4. To study the physico-chemical and bacteriological characteristics of water and sediments.