Chapter 1

General Introduction
Wetlands

Wetlands are highly productive ecosystems. Their values and functions support other ecosystems and are significant to economic development as they support fish population and are a major source of income. Wetlands are area of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters (Ramsar convention, 1971). Floodplain wetlands, in their natural state, have been cited to be of particular value since they have a high biodiversity, provide critical habitats for many plants and animals, and are an important, natural element in the maintenance of water quality (Mitsch and Gosselink, 1986; Whiting and Pomeranets, 1997; Takatert et al., 1999; Hupp, 2000). They are feeding and breeding ground for fish, amphibians, insects, crustaceans and thousand of migratory birds. Rightly called nature’s kidney (James, 1995), wetlands are among the most important ecosystems on planet earth but unfortunately, wetlands are presently among the world’s most threatened habitats (Tiner, 1984; William, 1990). They are unique ecosystems providing livelihood to millions of people all over the world (FAO, 1997). During monsoon, the flood-plains are inundated, connecting the lakes with the main river system. At falling and low water level the flood water drains to the river, leaving the lakes isolated. Thus the floodplain constitutes a “second-axis” running perpendicular to the ‘first’ that is the river, and encompasses the lateral extent of aquatic, semi-aquatic and terrestrial habitats (Dudgeon, 1994). As water inundates the flood-plain, it produces a “moving littoral” which prevents permanent stagnation and allows rapid recycling of nutrients and organic matter thus increasing the productivity (Junk et al., 1989). Junk et al. (1989) put forwarded the “flood-pulse” concept, which postulates that the terrestrial plants remove bio-elements from the dry sediments at low water and release them to the lake water when decomposing during the flooded period. On the other hand, floating aquatic macrophytes store dissolved bio-elements during the flooded period and releases them when decomposing at low water on the exposed sediments. Thus these two processes coupled together ensure a higher nutrient status for the flood-plain wetlands (Furch and Junk, 1993). Hence, the major biological activities of production, decomposition and consumption in the riverine ecosystems are driven by the flood-plain
(Sparks et al., 1990). The wetlands in India support subsistence and livelihood to thousands of people through fishing, collecting edible plants, agriculture, water transports, irrigation and commercial fisheries, besides rich biodiversity (Vass, 2001). In India, ninety-four wetlands have been identified for conservation and management under the National Programme for Conservation and Management of Wetlands (WWD Booklet, 2007). In Assam there are a total of 1125 seasonally waterlogged or floodplain wetlands which constitute an area of 23431.50 ha and represent 23.15% of the total area under wetland. Floodplain lakes locally called Haors or Beels are common features of the Barak river system in Assam, northeastern India. In Barak valley the total wetland area is 13737.5 ha, which in turn, represents about 14 % of the total natural wetland area in the state of Assam. Haors or Beels together are known to comprise 72.91 % of the total area under wetlands of Barak Valley. They also comprise 42.75 % of the total area under floodplain wetlands in the State of Assam, although Barak Valley comprises a meager of the total geographic area of Assam (Garg et al., 1998). These Beels are highly productive systems, producing around 100 kg/ ha/ yr of fish in contrast to a meager 6-7 kg/ ha/ yr from Indian reservoirs (Jhingran and Tripathy, 1969; Jhingran, 1991). Those Beels that maintain connection with the river, have great potential for development of fisheries, as gravid fishes of several species such as the Indian major carps, the minor carps and other forms like Eutropicthys vacha and Gudusia chapra migrate in large numbers into the Beels during monsoon and form a post monsoon fishery of considerable economic prospect (Jhingran, 1991). Even long range migrants like Hilsha ilisha are known to migrate into these floodplain lakes, the monthly catch during Hilsa season varying from 1.3-715 kg in different systems (Yadava et al., 1986). Two species of shrimps Macrobrachium dayanum and M. lamarrei that are commonly found in the wetlands of Barak Valley were shown to be rich in several nutrient elements like calcium, magnesium, iron and zinc (Paul and Gupta, 1995).

**Fishery, aquatic insects, socio-economy and ecological footprints**

In the study of wetlands emphasis is often placed on higher organisms but all depend on the producers and consumers at the base of food chain as productivity of fishes is mainly dependent on plankton and insect community of the system. They constitute major food for planktivorous and insectivorous fishes. Knowledge of these levels are therefore
fundamental to ecosystem functioning. In rivers, streams, ponds and other freshwater bodies grazing and predatory aquatic insects dominate intermediate levels in food webs. In the food web of floodplain wetlands aquatic insects play key role in the production of insectivorous fishes. Aquatic insects play a potentially major qualitative role in the processing and turnover of nutrients in the fresh water ecosystems. There are many literatures on the general association between the distribution of aquatic insects and various nutritional resources (Egglishow, 1964; Edmunds and Edmunds, 1979; Haefner and Wallace, 1981; Padhy and Mahapatra, 2001). Swamps with abundant insect population can be probably utilized for fish production. Rahman et al. (1998) obtained an average (per swamp) fish production of 382 kg/ha in 8 months. Alikunhi et al. (1972) reported a maximum fish production in India as 700-4900 kg/ha/year. Water resources can be successfully managed for fisheries and aquaculture for economic development. Fish yields are high and often more profitable than paddy cultivation. Rice-fish farming is one of the best options to increase the food production from limited land through ecological agriculture (Jintong, 1996; Sugen et al., 1996; De la Cruz, 1994). This attributes to an environment friendly rice-fish farming for increased productivity by recycling the energy and matter in sustainable manner (Coche, 1967; Edwards, 2000). These resources also regulate the ecological footprint of local communities. The ecological footprint for a particular population is defined as the “total area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth that land and water may be located” (Rees, 2000). The ecological footprint is expressed in ‘global hectares’. Each unit corresponds to one acre of biologically productive land/productive space with ‘world average’ productivity. Ecological footprint can be summarized as a measure of the sustainability of life styles. The ecological footprint has gained popularity for its didactic strength as it expresses the results of its analysis in spatial units that can easily be communicated and which allow for the comparison of human consumption directly to nature's limited productivity. Also, it is one of the few measures that aggregate a variety of human impact in consistence with thermodynamic laws and ecological principles. Therefore, it becomes an attractive tool for communicating about, teaching and planning for sustainability (Holmberg et al., 1999).
Chatla floodplain
Chatla floodplain (24°42′697″ N and 92°46′264″ E) is situated in the south of Silchar town, Barak Valley, Assam. Unfortunately this wetland is in a derelict condition with 73% loss of wetland area (Phookan and Laskar, 2006). Paddy cum fish cultivation is a common practice in Chatla floodplain area. A preliminary study (Das, 2002) on the capture fishery potential of the wetland pointed out the stressed environmental status of Chatla floodplain. The lake Chatla and its floodplain ponds are colonized by different macrophytes which provide diverse niches to a variety of fauna and aquatic insects which play an important role in the ecology of fresh water ecosystems occupying a significant position in the food web and thus influence fish production and in turn livelihood. This floodplain is known for harbouring a large variety of insectivorous fishes. While there are preliminary studies on macrophytes, plankton, floodplain trees etc. of the Chatla wetland, no such study has been made on the aquatic insect diversity and density. Hence knowledge of the status of aquatic insect community of the wetland along with the habitat quality in terms of various abiotic variables will give a proper understanding of the problems, constraints and prospects of the fishery ponds of the wetland. The wetland basin has about 32 villages whose economy is highly dependent on fish and agricultural crops produced in the area. Most of the fisher folk prefer to use the Gill net as it is easier to operate and a single person can operate it. Besides this, a sizable number of fisher folk use Seine and Fine mesh seine. This unscientific and indiscriminate fishing not only led to the decline of fish density it also showed severe impact on its diversity. Several species of fishes are becoming increasingly rare in Chatla. For the fisher folk of Chatla floodplain area, fishing is not enough for sustaining their family nowadays. This is largely supplemented by wage labour, rice farming, to a lesser extent small trade and rickshaw pulling in the nearby town of Silchar. Use of fine mesh to maintain catch size in turn leads to further depletion. It has been reported that fish as small as 1.5cm is also captured to be consumed fresh or dry (Das, 2002). Hence a study on the status of capture fishery and the socio-economic status of the fisher folk community of the wetland was also very much required. In this context comes the scenario of socioeconomic support provided by the wetlands and flood plain fisheries and their importance in maintaining the ecological footprints of a particular community directly or indirectly. To determine the level of
sustainable living, the study of ecological footprint is very important. Although lots of studies have been conducted on wetlands in India, very fewer studies have been conducted on Ecological Footprint and socio-economic conditions. In the present study an attempt has been made to generate relevant baseline information on the habitat quality of this riverine wetland along with the aquatic insect diversity, density, their relation with capture fishery status and socio-economic status of the inhabitants of Chatla wetland, Barak Valley, Assam. An attempt has also been made to study the ecological footprints of the fisher folk community.

**Objectives**

Objectives of the study are as follows –

1. To evaluate the seasonal variation in physico-chemical properties such as Temperature (AT and WT), pH, Conductivity (EC), Dissolved Oxygen (DO), Free CO$_2$ (FCO$_2$), Total Alkalinity (TA), Phosphate (PO$_4$), Nitrate (NO$_3$), Nitrite (NO$_2$), Ammonium (NH$_4$), Trace elements like Copper (Cu), Cadmium (Cd), Chromium (Cr), Zinc (Zn) and Iron (Fe) of water in ten selected sites of Chatla floodplain lake.

2. To enumerate diversity, density and distribution of the aquatic insects of Chatla on seasonal basis.

3. To study the status of capture fishery, socio-economic condition of the fisher folk community as well as environmental ethics related to conservation of water bodies in Chatla floodplain area.

4. To study the ecological footprint of the fisher folk community of Chatla floodplain area, Barak Valley, Assam.