CHAPTER III
MATERIALS AND METHODS

3.1 Description of the study area

Moridikhow is an oxbow lake situated in the Dikhowmukh area of Sivasagar District of upper Assam (Fig. 1). This oxbow lake is a perennial water body which was formed from River Dikhow, a tributary of the Brahmaputra River. The Moridikhow beel lies between 26°98′18″ N and 26°98′82″ N, and between 94°46′60″ E and 94°48′90″ E (Fig. 2) and is situated about 25 km west from Sivasagar town. It covers five villages- Bheselimari, Bharalua, Ujoni Bharalua, Raghubari and Gual gayen. The nearby villagers use this water body for various household purposes and as a source of capture fishery. For convenience, the study area is divided into five stations (Fig. 3).

3.2 Climate of the study area

Sivasagar district experience a humid subtropical climate with an average rainfall of about 230 to 240 cm a year. The mean temperature ranges between 18 °C (winter) to 34°C (monsoon) in the study area. As the Brahmaputra River passes near to the study site, therefore the area is very humid.

3.3 Study period

The study was done for consecutive three years-from January, 2012 to December, 2014. Collection of data was made seasonally- pre monsoon (March to
May), monsoon (June to August), post monsoon (September to November) and winter (December to February). Three replicates were taken for each season.

Fig 1: Location map of Sivasagar district showing the study area

Fig 2: Satellite imagery of Moridikhow oxbow lake with five sampling stations
Fig 3. (A-E): View of different sampling stations of Moridikhow
A: Station I  B: Station II  C: Station III
D: Station IV  E: Station V
3.4 Abiotic parameter

3.4.1 Sampling and analysis of water sample

Water samples were collected monthly from five sampling stations of Moridikhow lake. The sampling points were selected so as the samples represent the entire lake. Surface water was collected from sampling sites at the morning hours (before 9 am). BOD bottles were used for collecting water for dissolved oxygen determination. For other physicochemical analysis, 300 ml plastic bottles were used for water collection. The bottles were filled to the neck under water avoiding any air bubble and transported to the laboratory in an ice-filled cooler box. pH, temperature, transparency and conductivity were determined on the spot during sampling period. Other physico-chemical analysis was performed within the time limit as recommended by APHA (1998) in the laboratory. For each parameter from each station, determinations were done in triplicates and the mean values recorded.

A. Physical parameter of water: Air and water temperature was determined using a mercury thermometer, transparency was determined using a Secchi disc, conductivity was determined with a portable digital conductivity meter (model- HANNA) and TDS were determined as per Trivedy et al. (1987).

B. Chemical parameter of water: pH was determined using a digital portable pH meter (model- HANNA), dissolved oxygen (DO) was determined following modified Winkler’s method (Trivedy & Goel, 1986). Free carbon dioxide, total alkalinity, hardness and nitrate were estimated as per APHA (1998) and Trivedy & Goel (1986).
3.4.2 Sampling and analysis of soil sample

Soil samples were collected seasonally from the depth of 1 m under water from five different sampling stations. Collected samples were spread out on a tray for air drying. Then they were preserved in air tight polythene bag. Chemical analysis were done in the laboratoty of soil analysis department, TRA, Tocklai. Prior to analysis, dried soil samples were seived over 2 mm sieve.

A. Chemical parameter of soil: pH of water extract was determined by electronic pH meter, Carbon % on dry weight was estimated by Walkley and Black’s rapid titration method (Jackson, 1973), and Nitrogen % on dry weight by Micro-kjeldahl method (Jackson, 1973), available phosphate as P$_2$O$_5$ (mg/kg) were calculated by colorimetric blue colour method (Bray & Kurtz, 1945).

3.5 Biological parameters

A. Aquatic macrophytes: Adequate field visits were undertaken to collect and record aquatic macrophytes species. Macrophytes samples were collected seasonally over a period of three years. The specimens of aquatic plant were collected by hand or rake or using a snorkel in the deeper areas. Collected species were photographed, packed in the plastic bags to make dry herbarium mounts or kept in the bottles filled with 70% formalin aceto- alcohol (FAA) depending on the specimen type (Sass, 1958). Then they were preserved by preparing herbarium sheets and were identified following Mishra (1974), Hutchinson (1975) and Biswas & Calder (1984).
B. Ichthyofauna: Fish samples were collected from the local fishermen at the time of fishing on a seasonal basis and were preserved in 4% formaldehyde solution in well labeled glass bottle. They are identified following Talwar & Jhingran (1991) and Vishwanath (2002). The conservation status of the fish species is based on CAMP (1998) and IUCN (2011). The abundance of the fish species has also been recorded as abundant (A), common (C), occasional (O), and rare (R) depending on the frequency of availability of a particular species.

3.6 Diversity indices

For determination of diversity indices, random samples of fish were taken from five nettings for each month. Total number of species, total number of individuals in a sample and total number of individuals of a species were determined every month. For collecting quantitative data for aquatic macrophytes, quadrat method was used. From these data, Shannon diversity index, Simpson diversity index, Margalef Richness index and Berger-Parker dominance index were calculated to study the diversity of the biotic parameters (aquatic macrophytes and ichthyofauna) of the study site using the following equations:

3.6.1 Shannon Diversity Index (Shannon, 1948)

$$\hat{H} = - \sum \left( \frac{n_i}{N} \times \ln \frac{n_i}{N} \right)$$

where, $\hat{H}$= Shannon Diversity Index; $n_i$= Number of individuals belonging to i species; $N$= Total number of individuals
3.6.2 Simpson’s Index (Simpson, 1949)

\[ D = \frac{\sum n_i (n_i-1)}{N (N-1)} \]

where, \( D = \) Simpson’s Index ; \( n_i = \) Number of individuals belonging to \( i \) species ; \( N = \) Total number of individuals

**Simpson’s index of diversity**: \( 1 - D \) (\( D = \) Simpson’s Index)

3.6.3 Margalef Richness Index (Margalef, 1958)

\[ M_a = \frac{(S-1)}{\ln N} \]

where, \( M_a = \) Margalef Diversity Index; \( S = \) Total number of species

\( N = \) Total number of individuals

3.6.4 Berger-Parker dominance index (Berger & Parker, 1970)

\[ d = \frac{N_{\text{max}}}{N} \]

where, \( N_{\text{max}} = \) number of individuals in the most abundant species;

\( N = \) total number of individuals in the sample

3.7 Fishing gear and techniques

Types of fishing gears and techniques were documented by undertaking monthly field visits and discussion with the fisherman of the nearby villages. Catch per unit of fishing effort (CPUE) was measured by the total catch divided by the total fishing effort in a given period.
3.8 Fish production

Fish production of Moridikhow was ascertained from monthly catch statistics recorded from all landing stations of the wetland. The monthly catch data recorded from mahaldars were pooled together and average production of different categories of fish on a monthly basis was reported.

3.9 Cage culture

A demonstrative cage culture of six commercially important fish species was carried out at the study site as a technology for enhancement of fish production as well as an alternative source of livelihood for rural people. The cage culture practice was repeated with two trials. Rectangular bamboo cages of the size $3\times1.5\times1.5$ m fitted with nylon *hapa* was installed in water for 3 months. 600 fries (100 numbers / $m^3$) of 6 fish species (100 individuals of each species) were released into each cage. Fish species were- *Gibelion catla*, *Cirrhinus mrigala*, *Labeo rohita*, *L. bata*, *L. calbasu* and *L. gonius*. Healthy fish fry of the length 40-60 mm were selected for stocking into the cage. Prior to release, they were dipped in a 5-6 % salt solution as well as potassium permanganate (5-8 %) for 1-2 minutes as prophylactic measure to protect them from disease and then released into the cage water. Pelleted floating feed with 28% protein content as supplementary feeding was given at the feeding rate 10% body weight of fishes and one time a day. Size of the pellet was increased from 0.5 mm to 2 mm with increasing body size of fishes. Rice bran and mustard oil cake in the ratio 1:1 was also given once a day @ 5% body weight of fishes. Dry fish powder and vitamins were also given along with feed once in a week. Monitoring of fish health and growth was done.
regularly. Length-weight data of randomly sampled specimens were recorded at regular interval for assessing the growth of reared species.

3.10 Statistical analysis

Pearson correlation and ANOVA were used to analyse abiotic and biotic parameter data in order to make relevant statistical comparisons among sites and seasons. Data were analyzed using Microsoft office Excel (2010 version) and SPSS (version 16).