CHAPTER 2
METHODOLOGY

2.1 STUDY AREA

Total catchment of river Dibang up to the dam site is 11276 sq km out of which 59811.88 ha comprises of directly draining catchment. The floral and faunal studies have been carried out in the entire catchment of the project. However, the studies related to physical aspects like landuse/land cover, soil, slope, etc., for identifying critically degraded areas, have been restricted to the directly draining catchment.

2.2 ENVIRONMENTAL BASELINE STUDY

Based on the scoping matrix as outlined in table 2.1 various aspects were collected to understand the environmental setting of the proposed project site. The various parameters were classified into physical, ecological, socio-cultural & economical aspects. Field studies for various aspects including water quality, soil quality, land use pattern, terrestrial & aquatic ecology, socio-economic and ethnographic issues were conducted by NPC. The basic parameters on which data were collected and the methodology adopted for data collection are discussed in the subsequent sections.

2.2.1 Physical Resources Aspects

(i) Meteorology

Meteorological factors like precipitation and evapo-transpiration are important considerations since they affect water availability, cropping pattern, irrigation and drainage practices, soil erosion, public health, etc. The data were obtained from NHPC and Brahmaputra Board

(ii) Water Resources

Water available in the project catchment has been considered in terms of precipitation, surface runoff, rivers, lakes and groundwater. The surface water bodies such rivers, lakes, reservoirs, tanks and ponds have been identified.

Hydrological data for river Dibang as provided by NHPC has been utilized in the study.

(iii) Water Quality

The existing data on water quality was collected to evaluate the river water quality both upstream and downstream of the project site.

As a part of the field studies water samples were collected from seven locations (viz. Near Ithun Bridge, Near Tangon River Bridge, downstream of Dam Site, Kronli, Munli Camp, Emra river and Dambuk) within the study area. The parameters analysed are (i) pH, (ii) electrical conductivity, (iii) total dissolved solids, (iv) total alkalinity, (v) chlorides, (vi) iron, (vii) Ca hardness, (viii) Mg hardness, (ix) phosphates, (x) sulphates, (xi) manganese, (xii) nitrates, (xiii) BOD, (xiv) COD, (xv) total coli forms. The samples were collected in three seasons namely post-monsoon (September 2005), winter (October 2005) and pre-monsoon (February 2006). The analysis of the physico-chemical parameters are carried out following the standard method of analysis. Basic methodology for major parameters is as under:

Amount of the total soluble salts in a sample is generally expressed in terms of the sample electrical conductivity (EC). The EC was measured with the help of an electrical conductivity meter. The pH has been determined by Calomel Electrodes or combined electrodes of a pH meter. Mohr's titration method has been used for Chloride estimation.

Biochemical Oxygen Demand (BOD) is defined as the amount of oxygen required by micro organisms to stabilize biologically decomposable organic matter in a waste under aerobic conditions and is an approximate measure of the amount of biochemically degradable organic matter present in the sample. The BOD test is widely used to determine (i) the degree of pollution in lakes and streams at any time and their self purification capacity (ii) the pollution load of wastewaters and (iii) efficiency of waste treatment plants. Since BOD test is based mainly on bio-assay procedure measuring amount of oxygen consumed by bacteria, it is necessary to provide standard conditions of nutrient supply, pH, absence of substance inhibiting microbial growth and

temperature. Because of the low solubility of oxygen in water, the sample was diluted proportionately depending upon the expected BOD so that the demand does not exceed the available oxygen. A mixed group of organisms should be present in the sample. If not, the sample has to be seeded artificially. Temperature is controlled at 20^0C. The test was carried out for 5 days, as 70 to 80% of the BOD is satisfied during this period.

The Chemical Oxygen Demand (COD) determines the amount of oxygen required for oxidation of organic matter using a strong chemical oxidant such as potassium dichromate under reflux conditions. The test was widely used to determine (I) the degrees of pollution in river Dibang and its self purification capacity (ii) pollution loads, etc.

(iv) Water Supply and Sanitation

The information on existing water supply, sanitary waste disposal practices in the submergence area of the reservoir was collected as a part of the detailed socio economic survey.

(v) Soil Quality

In order to know the soil quality in the project area detailed field survey was carried out at three sampling sites one near Apruli cane bridge (site 1), second near dam site (site 2) and third near Ithun river bridge (Site 3). The samples were collected in three seasons namely post-monsoon (September 2005), winter (October 2005) and pre-monsoon (February 2006). Soil testing was done in order to find out the quantity of essential nutrients available to plants and other relevant physical and chemical characteristics which influence plant growth such as water retention, acidity, salinity, alkalinity etc. It was also required for the determination of various physical and chemical properties of the soil.

As root penetration is important for crop growth, soil was sampled to a depth of 0-15 cm. A composite sampling was done with 10 to 15 soil samples collected from a homogenous sampling unit are pooled and intimately mixed

and a smaller sample was drawn which represented the entire sampling unit in its physical and chemical properties by cone and quartering method.

Following materials were used to take soil samples:

i. Soil auger/soil tube/spade/pick-axe/Khurpi
ii. Bucket or tray
iii. Paper tags (labels)
iv. Information sheet
v. Cloth bags (alternatively polythene bags)
vi. Ball point pen or copying pencil.

A composite sample was taken from the sites as per the procedures mentioned below:

The litters from the surface were removed without much disturbing the soil. Soil samples from 10-15 random spots were taken in a random manner from the site. The samples were taken from a depth of 15 cm with spade in 1.5-2 cm thick uniform slice of soil and were collected in a clean and dry container. The samples were mixed thoroughly and at least 0.5 kg composite samples were taken by following the procedure as mentioned below:

- The soil were spread in a disc-like shape and were divided into four parts (quartering) and one set of opposite quarters was disposed off.
- The soil remaining two quarters were mixed well and the exercise was repeated till the sample size was reduced to 0.5 to 0.75 kg (by taking only two parts). The samples were then kept in a clean cloth bag free from any contamination of fertilizer, salts, etc.
- The samples were dried in the air under the shade.
- Samples were appropriately labeled for identification.
- One dully filled up soil information sheet was accompanied with each soil sample.

(vi) Air Quality

Ambient air quality is a complex interwoven network involving interaction of emissions, chemical changes and transport of pollutants in the atmosphere. A

well-designed monitoring programme was designed to assess the status of ambient air quality in the project area. The parameters studied were SPM, SO_2 and NO_x. The monitoring was done using High Volume Samplers at three (3) stations. The samples so collected were analysed as per methods specified by Bureau of Indian Standards (IS:5182). The ambient air quality monitoring stations established by the Consultants are near Dam Site, near Apruli Cane Bridge and near Ithun River Bridge. The prime objective of the ambient air quality monitoring was to assess the existing level of air pollutants. The parameters monitored were SPM, SO_x, NO_x and CO. 24 hourly sampling was done at each station.

(vii) Noise Quality

Noise quality is measured by Noise meter at one site viz. near Apruli Cane Bridge.

(viii) Landuse/ Land Cover

Land use and land cover mapping of the study area was carried out by standard methods of analysis of data through remote sensing technique coupled with GIS, followed by ground truthing. Geo-coded LISS-III data on CD ROMs and hard copies on the scale 1: 50,000 (October 2003) were procured for digital image processing and preparation of thematic maps. Survey of India topographic sheets 82P/5, 82P/6, 82P/9, 82P/10, 82P/11, 82P/13, 82P/14, 82P/15, 82P/16, 82O/16, 91D/1, 91D/2, 91D/3, 91D/4, 91D/6, 91D/7, 91D/8 on 1:50,000 scale were used for the preparation of the base maps. These toposheets were also used for the delineation of sub-watersheds of the immediate catchment of the project area. The sub-watersheds were then overlaid on the drainage map and land use map for determining drainage and land use details. All the thematic maps of catchment, viz., base map, drainage map and land use / land cover map, etc., were then transferred to Geographic Information System (GIS) for further overlay analysis. The land use landcover map is prepared using GIS mapping where inputs of toposheets of the catchments area and satellite imageries are used to come out with the land use / land cover pattern.

Multi-variate statistics have been used for the analysis of multi-spectural data. As a first step, clustering algorithm was established to a set of multi-variate class statistics against which each pixel measurement vector in the scene was compared. Then a classification decision rule, such as the probability of maximum likelihood that the pixel belongs to a particular class amongst the statistics set was calculated and the pixel was assigned to the particular class.

The satellite data were classified using unsupervised classification technique where the radiance values of the image data set were submitted to clustering algorithms that generate statistics until the stopping rule i.e. minimum number of points per cluster, was reached and the minimum distance between clusters and separability measure was established.

2.2.2 Ecological Aspects

(i) Terrestrial Ecology

Data on the forest types and their extent in the reservoir area and other areas likely to be affected were collected during extensive field surveys. The relevant data were collected through scanning and compilation of records as available at the local offices of the Forest Department. From the existing records already available, the following data were collected:

- types of forest,
- species of trees available in the forest and details regarding their extent, and
- information on other aspects of biological diversity.

Detailed field studies were undertaken in three seasons namely post-monsoon (September 2005), winter (October 2005) and pre-monsoon (February 2006). The sampling sites were selected based on the topography and floristic composition. Phyto-sociological studies were carried out using quadrate method covering various aspects viz., frequency and abundance of each species of trees, shrubs, herbs & grasses, floral density, etc. In addition, plants of economical and medicinal uses and endangered species (as per BSI Red Data Book) were also identified.

During field survey, a list of wild animals identified through visual

observations, pug marks, local enquiry, etc. was also prepared. The data as available with the local offices of the Forest department, etc. were also collected. The information on wildlife habitats, migratory routes, etc. was also conducted as a part of the study. The conservation status of fauna was studied retrospectively with International Union for Conservation of Nature & Natural Resources (IUCN) Red Data Book and schedules of animal enlisted in the Indian Wildlife (Protection) Act, 1972.

(ii) Aquatic Ecology

The data on the prevailing fish species in the river Dibang were collected through field surveys. Fishing was done using suitable nets at various sites (Munli Camp, Pather Camp and Etalin). All the fishes caught during this fishing exercise, were released after identification and measurements. An inventory of the fish species found in the area was prepared. Migratory fish species and their migratory pattern were identified/studied during the field survey.

2.2.3 Human Resources and Quality of Life Values

(i) Demographic Characteristics

The demographic and socio-economic characteristics of the project area, including submergence area, were studied through a detailed socio-economic survey. A Census Survey of the affected families was conducted in the months of October 2005 and March 2006. The basic aim of the social survey was to understand the socio-economic status of the population residing in the project area. The survey was conducted taking the help of field investigators who were from the local area. A questionnaire was designed and provided to investigators for collection of data. Separate questionnaires were used to collect the village level and household level information.

(ii) Infrastructural Facilities

The present status of various infrastructural facilities such as electricity and its uses, drinking water supply, road network, transport, communication, markets, educational facilities, health and medical facilities, veterinary services, etc.

were collected during the demographic and socio-economic survey.

2.3 ASSESSMENT OF IMPACTS

Assessment of impacts is essentially a process for evaluating the future environmental conditions of the project area due to implementation of the project. Matrix method has been used to identify the environmental impacts anticipated during construction of the project.

2.3.1 Scoping Matrix

An EIA study is conducted to understand the impact of the project on various facets of environment. The existing environmental scenario with respect to different aspects which might be adversely affected due to the construction and operation of the proposed Dibang Multipurpose Project has been derived through an appropriate 'Scoping Matrix'. The 'Scoping Matrix' is given in Table 2.1

Table 2.1 Scoping Matrix for EIA Study for Dibang Multipurpose Project

Aspects of Environment	**Likely Impacts**
A. Land Environment	
Construction phase	- Increase in soil erosion
	- Pollution by construction spoils
	- Acquisition of land for labour colonies and other project appurtenances
	- Deforestation and acquisition of forest land
	- Solid waste from labour colonies, workshops, hospitals, project colonies, offices etc.
B. Water Resources & Water Quality	
Construction Phase	- Increase in turbidity of nearby receiving water bodies
	- Degradation of water quality due to disposal of solid and liquid wastes from labour colonies, construction sites, offices, workshops etc.
Operation phase	- Disruption of hydraulic regime

	- Sedimentation & siltation risks
	- Impacts on D.O. due to reservoir stratification
	- Risk of eutrophication
C. Aquatic Ecology	
Construction phase	- Increased pressure on aquatic life due to human interference resulting in indiscriminate fishing.
	- Reduced productivity due to increase in Turbidity and change in hydraulic regime.
Operation phase	- Impacts on migratory fish species
	- Impacts on spawning & breeding grounds
	- Degradation of riverine ecology
	- Increased potential for reservoir fisheries
D. Terrestrial Ecology	
Construction phase	- Increased pressure from labour to meet their fuel wood & timber requirements
	- Adverse impacts due to increased accessibility of the area
E. Socio-Economic Aspects	
Construction phase	- Improved employment potential during the project construction phase
	- Development of allied sectors leading to greater employment
	- Pressure on existing infrastructural facilities
	- Friction between the labour and the native population
	- Impacts on cultural diversity of tribal
	- Loss of lands
	- Loss of private properties
	- Loss of infrastructure
	- Impacts on archaeological & cultural monuments
Operation phase	- Increased revenue from power generation

	- Overall improvement in quality of life in the project area.
	- Better infrastructural facilities, civic amenities etc.

Based on the scoping matrix, the environmental baseline data has been collected on which the impacts due to the project have been superimposed to understand the beneficial and deleterious impacts due to the construction and operation of the project.