

## 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<sup>0</sup>C. 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 soils 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<sub>2</sub> and NO<sub>x</sub>. 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<sub>x</sub>, NO<sub>x</sub> 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-spectral 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 data was also collected through scanning and compilation of records as available at the local offices of the Forest Department. Published flora, research papers and gazetteer were also referred. 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 i.e. post-monsoon (September 2005), winter (October 2005) and pre-monsoon (February 2006) at project area and accessible sites in the catchment. The sampling sites for phyto-sociological study were selected based on the topography and floristic composition. Phyto-sociological studies were carried out using quadrat method, covering various aspects viz., frequency and abundance of each species of trees, shrubs, herbs & grasses, floral density, IVI, Shannon Diversity Index etc. In addition, plants of economical and medicinal uses and

endangered species (as per BSI Red Data Book) were also identified. For floral study detailed methodology as per Jain & Rao, 1977 was followed. During field survey, a list of wild animals identified through visual field observations, pug marks, pellet identification, scratch marks on trees, local enquiry, etc. was also prepared. The data as available with the local offices of the Forest department was also collected. The information on wildlife habitats, migratory routes, etc. was also collected 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 schedule of animals enlisted in the Wildlife (Protection) Act, 1972.

### **(ii) Aquatic Ecology**

The data on the prevailing fish species in river Dibang was 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. Information was also gathered through local enquiry.

*Note: Valuable information on biodiversity was also obtained from locals by showing them pictures of fish, snakes, birds etc.*

## **2.2.3 Human Resources and Quality of Life Values**

### **(i) Demographic Characteristics**

A detailed socio-economic survey was undertaken to understand the overall social and economic status of the project affected families (PAFs), their life style and to assess the likely impacts of the proposed project in terms of loss of their personal and community properties. The study area for the survey comprised the land getting affected due to submergence and construction of other project components / working areas. It extended from the river bed level to Full Reservoir Level (FRL) i.e. El 545 m. Total land requirement in Lower

Dibang Valley and Dibang Valley districts where individual/ community have claim, is 4589 ha. All the families belong to Idu-Mishmi tribe.

The field surveys were conducted in the villages falling under the following categories:

- Villages / Households likely to be submerged fully along with their properties.
- Villages / Households which are situated above submergence level but having agriculture land /properties below submergence level.
- Community / Households which are situated away from submergence area, no agriculture land/ properties likely to be acquired but having claims over Unclassified State Forest (USF) / Community forest land which will be diverted to the project by the Forest department.

Further, for collecting required information from the primary sources, four schedules have been designed, broadly covering the following components:

- i. Socio-Economic Household Schedule
- ii. Infrastructure Schedule
- iii. Village Schedule
- iv. Property Schedule

Based on the above survey, Resettlement and Rehabilitation Plan for the project has been framed to minimize the negative impacts of the project and also to compensate PAFs for their loss of livelihood. The R & R Plan has considered to strike a balance between preservation of tribal identity, culture and values, protecting the tribes from being swamped by mainstream lifestyles, while at the same time increasing and ensuring their access to better education, healthcare and income generation so that their quality of life is improved along with the construction of the project.

## **(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
<b>A. Land Environment</b>	
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>B. Water Resources &amp; Water Quality</b>	
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
<b>C. Aquatic Ecology</b>	
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
<b>D. Terrestrial Ecology</b>	
Construction phase	- Increased pressure from labour to meet their fuel wood & timber requirements
	- Adverse impacts due to increased accessibility of the area
<b>E. Socio-Economic Aspects</b>	
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.