The district Bongaigaon is situated within the geographical limit of 90°21'33" E to 90°54'32" E and 26°41'56" N to 26°10'27" N covering an area of 2510sq km in the north bank of mighty river Brahmaputra in western part of Assam in northeast India. It was declared a district on 29th Sept, 1989 and curved out from erewhile Goalpara and Kokrajhar districts. At the time Bongaigaon district was bounded by the district Kokrajhar (adjacent to Royal Bhutan) on North, Barpeta on East, the river Brahmaputra on South and district Dhubri and Kokrajhar on the west. After formation of Bodoland Territorial Area Districts (BTAD) in Assam, a part of the district Bongaigaon is curved out to establish Chirang district under BTAD in 2004. Accordingly, some villages, some forest areas, wetlands and industrial site earlier in the district Bongaigaon are now in the district Chirang under Bodoland Territorial Council (BTC). So, at present, the district Bongaigaon is bounded by district Chirang on North, Barpeta on East, the river Brahmaputra on South and district Dhubri and Kokrajhar on the west.

Since BTC was formed in 2004 and the present study initiated in 2001, hence here, to refer the study area, the name Bongaigaon district is used in wider sense i.e, the undivided Bongaigaon district extending to international boundary with Royal Kingdom Bhutan to the north. (Map No.: 3)
4.2. Physiographic and Climatic conditions:

Topography:

Though the topography of the Bongaigaon district is predominantly plain but a tinge of lofty green hills, rich biodiversity, silvery Brahmaputra and Aie River with their tributaries, natural wetlands, waterfronts, etc. all combine to give it a spectacular grandeur. No mountain of any importance exists in the district, but a few ranges of hills run irregularly and divide the plain into several drainage sections. The mighty Brahmaputra flows along the southern boundary and its tributary Aie River flows from the Bhutan Hills in southerly direction through the district to Brahmaputra. The River Manas and river Champamati, both of which take its rise at two different points in the Bhutan Hills enter the district from its Eastern and Western side and form the Eastern and Western boundary respectively. These along with many rivulets streams and beels as well as small hills and elevated tracts provide the land mass of the district with spectacular area for rich flora and fauna. These major rivers not only provide water resources but in combination with high elevated hills also act as natural barrier to the areas of lower Assam beyond Manas National Park.

Climate:

The climate of the district is moderate in winter. It is hot humid during May to October. The temperature varies from $14^\circ$ C to $36^\circ$ C. Monsoon starts in April and lasts up to August. The heaviest rainfall (more than 1300 mm) occurs during the month of May to July. Humidity is much throughout the year, ranges from 70% to 98%, which favours the growth of diverse flora in the area. (Figure 1-3, Appendix I)
Figure 1. Bar diagram showing temperature variation in Bongaigaon district from 2002 to 2005.
Rainfall variation in Bongaigaon (year 2002 to 2005)

Fig. 2: Bar diagram showing rainfall variation in Bongaigaon district from 2002 to 2005.
Fig. 3: Bar diagram showing variation in relative humidity in Bongaigaon district from 2002 to 2005.
Soil:

The soil of Bongaigaon District is generally characterized by its acidity. The formation of the hills and the higher ground consists of red ochreous earth and large blocks of granite, intermixed with sand stone. The latter is subject to disintegration from exposure to the atmosphere. In the plain the soil is composed either of tenacious clay or of clay more or less mixed with sand. Along the great river there are large tracts of alluvial formation.

Forests:

Aie Valley Forest Division with its Head Quarter at Bongaigaon is the only forest division in the area to which Bongaigaon district and adjacent areas fall. This division includes 12 Reserved Forests (Incl. one proposed wildlife sanctuary), nine Proposed Reserved Forests and 13 Unclassed State Forests. As per the forest survey of India, state of forest Report (SFR) 2001; the forest cover in the district was 63,100 ha forming about 25.14 percent of the total geographical area. But, due to unabated deforestation and encroachment, the area under forest is dwindling very fast. The following list enumerates the forest areas under Aie Valley Division of Forests, Bongaigaon, Assam as per official record in 2004. (Forest Department, Govt. of Assam, 2005-06). (Map No.: 4)

<table>
<thead>
<tr>
<th>Forest</th>
<th>Area (in hectares)</th>
<th>Encroached area (in hectares)</th>
<th>District</th>
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<tr>
<td>Reserved Forests</td>
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<tr>
<td>Nakkati</td>
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<td>Bamungaon</td>
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<td>-</td>
<td>Bongaigaon</td>
</tr>
<tr>
<td>Name</td>
<td>Area (hectares)</td>
<td>Value (Rs)</td>
<td>District</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------</td>
<td>------------</td>
<td>----------</td>
</tr>
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<td>Kakoijana (Proposed Wildlife Sanctuary)</td>
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<tr>
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<td>Ranisundari</td>
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<td>Sissubari</td>
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<td>Teklai</td>
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<td>Amtola</td>
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<td>Unclassed State Forests</td>
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<td></td>
</tr>
<tr>
<td>Bamuni hill, Korea hill, Lungai, Shilghagri, Pacho -nia, Jogighopa, Narikola, Sahamura, Boangaon, Kumurakata, Nima gaon, Chaprakata, Sitkagaon.</td>
<td></td>
<td></td>
<td>Bongaigaon</td>
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Map No. 4: **Forest Cover Map of Bongaigaon District, Assam**
(Map Prepared Based on IRS LISS III Satellite Imagery)
**Hills and Elevated tracts:**

Although the major portion of the area of the District is almost a level plain, but a few ranges of hills are scattered irregularly on the northern bank of the Brahmaputra, southern bank of the river Aie, Eastern bank of the river Manas and also on the western boundary of the district and finally on the northern boundary of the District connecting Bhutan. These isolated hills rising above the alluvium are maintaining their heights varying from 100 to around 350 meters above mean sea level.

On the southern end of the district i.e. on the northern bank of Brahmaputra there appears a long range of hills. In Jogighopa area a long range of hills can be seen, with caves where hermits are believed to have dwelt in ancient times. Just about two kilometers east of Jogighopa, there lies Mahadev hill and to its north rises the Malai hill. Bhairab Chura is the highest peak (about 1600 feet) in the district. The Dugdhanath hill is also famous for its huge plain roof. Beyond Abhayapuri there exist several ranges such as the Phagkati, Narikola, Sonakuchi, Chipansila, Bamani Pani and the Lathuri hill. On the north of Jogighopa in Bongaigaon area there are several hills like the Bhumeswar (300 to 400 ft in height), the Nandagiri and the Nakkati hill. Besides these prominent hills, there are some small isolated hills scattered in the western and northern part of the District.

The hillocks are surrounded by alluvial traces and are covered by dry and moist deciduous forests. In general, the hilly formations are made up of gneissic origin rocks with occasional super imposed strata of the cretaceous system consisting of sandstone and conglomerates. There are two main types of soil formations in this
region- the red sandy-loam soil with pebbles, characteristic of Meghalaya hillocks, found in southern part and the black sandy alluvial soil with pebbles, characteristic of Himalaya, found in the north part along the Indo-Bhutan border.

Wetlands:

River Aie, which blows from Bhutan (North) to Brahmaputra (South) through the district, is one of the major rivers in lower Assam. River Manas on the East and Brahmaputra on the West Boundary of the district also add importance to the area. Though these rivers overflow during monsoon which frequently cause flood and soil erosion & siltation in the area, still provide micro climate for many aquatic plants and animals and water for agriculture. Kujia and Tunia are other two mentionable rivulets in the area. In the district, there are a number of ponds (2882), Beels (55), Swamp (47) and low lying area (23) (Agarwala, 1998). Among the Beels, Tamranga, Konora, Paraputa, Sristi, Junjuna, Doloni, Soksoka, Mara Kujia, Sisubari, Nayachara, Genda, Dakhin Genda, Kachu part-I, Kachu part- II, Hatimutura etc. are significant. Of these, Tamranga alone covers an average area of 409.40 hectare and Doloni is seemed to be larger than Tamranga. (Agarwala, N. K. 1998) (Map No. 5)

4.3. Demography:

Total population of Bongaigaon district is 9,06,315 with density of 361 persons per sq. km. and sex ratio 945 female:1000 male as per 2001 census. Of the total population, rural occupies 79,5,028 whereas the urban population is 1,10,287. The literacy rate of the district 60.27 % which is lower than the state average 64.28%.
Map No. 5: *Wetland Map of Bongaigaon District*  
(Map Prepared Based on IRS LISS III Satellite Imagery)
Total Scheduled tribe population of the district is 1,10,696 (12.23% of the district’s total) and total Scheduled Caste population is 92,770 (10.25% of the district’s total).

The rural area are dominated by communities like Koch Rajbanshi, Garo, Rabha, Mech, Bodo among tribes; along with General category Assamese people, Bengali, Nepalese and Muslims. Traditional agriculture is the main occupation of most of the rural people but small scale business, trading, Government and private sector services, farming, fishing and daily wage labourers are also common.

Different languages spoken in the area are Assamese, Bengali, Bodo, Garo, Rabha, Hindi etc. Traditional agriculture is the main occupation of most of the rural people but small scale business, Govt. and private Sector services, fishing and daily wedge labouring are also common.

4.5. Major industries, main roads and Railways etc.: 

"Bongaigaon Refinery and Petrochemicals Limited" established in 1972, is one of the major industries of Assam, was once situated in Bongaigaon. The industry, covering an area of 1041 acre, located at Dhaligaon, seven kilometers apart from the Bongaigaon town towards west deals with crude oil refining, synthetic fibre production and other petroleum-based chemicals since its inception. This major industry, having its own township and separate plant area, is now under jurisdiction of newly formed Chirang district.

National high way NH 31 and NH 31c are passing through the district in east-west direction. "Bir Chilarai path", a road by the name of historic leader and ruler Chilarai, with a length of 17.4 km, connects these two highways.
4.6. Vegetation Type:

Twenty nine per cent of the District area is under forest cover. The vegetation could be described as mixed moist deciduous, semi-evergreen, low alluvial savannah woodlands. The forest type in the district is further divided as follow:

A. Very moist Sal forest:
   a. East Himalayan upper bhabar sal
   b. East Himalayan lower bhabar sal
   c. Eastern Terai Sal
   d. Eastern hill Sal forest

B. Moist plain Sal forest (eastern heavy alluvial plain sal)

C. Northern secondary moist mixed deciduous forest.

D. Assam Valley tropical wet evergreen forest.

E. Lower alluvial savannah woodlands

F. Eastern hill alluvial grasslands

G. Riparain fringing forest

H. Khoir-sisoo forest

I. Secondary moist bamboo brakes

J. Cane brakes

(Source: Department of forest, Aie Valley division, Bongaigaon).

In general view, the vegetation of the study area presents a very open appearance so that the trees and shrubs are widely spread. The bulk of the vegetation consists of co-ordinate herbs and shrubs with scanty of species. The general vegetation of the
study area is of moist deciduous type. Sal forests along with Teak plantations represent this vegetation. Some pockets of mixed forests with a few Semi-evergreen patches are also found. The notable point of the vegetation is that it is of secondary one. This is due to biotic interference like grazing animals, destruction of forests for various purposes are regular factor. Hill cutting for filling up the low lands and construction of roads, construction of embankment etc. also affects the vegetation. Introduction of exotic species, by any means, such as *Tectona grandis, Acacia auriculiformis, Cassia seamaea, Chromolaena odorata, Mikania micrantha, Parthenium hysterophorus* etc. is another important factor to affect the normal vegetation of the area. Some portions of forests of the area are found planted with *Tectona grandis, Michelia champaca, Cassia seamaea, Cassia nodosa, Cassia javanica, Gmelina arborea, Terminalia arjuna* etc. by social forest division of the State Forest Department. So, from the present scenario, it is hard to say the past forest type in this area; but from the naturally growing *Shorea robusta* patches and their large basal remains of the past, it can be marked as basically Sal forest area. In general, for convenient study, the vegetation of the district can be described as follows:

Philodendrons etc. are some plants in the forests. Bamboo patches mainly composed of Bambusa tulda, B. balcooa, Melocanna baccifera etc. are also found. (Photo No. 1.1 of plate 1)

Melastoma malabathricum, Clerodendrum serratum, C. viscosum, Micromelum minutum, Solanum ferox, S. surattense, Murrya koenzii, Phlogocanthus sp. etc. are some of the common shrubs that found along the edges of the forests and road sides. (Photo No. 1.2 of plate 1)

2. Aquatic vegetation: Tetramelos nudiflora, Barringtonia acutangula, Lagerotroemia flos-reginae etc. are found along the edge of the water bodies. Nelumbo nucifera, Nymphaea nouchali, N. rubra, Nymphoides spp., Eurayale ferox, Trapa bispinosa, Vallisneria, Hydrilla, Hydrocharis, Typha Sp., Eichhornia cressipes, Scirpus, Ipomea aquatica, I. carnea var. fistulosa, Ludwigia sp. etc. are some common plants representing aquatic vegetation of the district.

In the marsh lands, Commelina benghalensis, Polygonum hydropiper, Alternenthera sessilis, A. philoxeroides, Ageratum conyzoides, Spilanthes paniculata, Ipomoea carnea var. fistulosa, Alpinia alloghas, Costus speciosus, Cyperus spp. etc. are found. (Photo No. 1.3 of plate 1.)

3. Road side and open area vegetation: The open areas are generally covered by herbaceous and shrubby formations. Among them a few are in cultivated condition. Some of the common species among herbs and undershrubs are-

*Melastoma malabathricum*, *Clerodendrum serratum*, *C. viscosum*, *Micromelum minutum*, *Solanum ferox*, *S. surattense*, *Glycosmis pentaphylla*, *Pandanus fascicularis*, *Sida cordifolia* etc. are some of the common shrubs along the road sides and other open spaces in nature. *Chrysopogon* spp., *Cynodon* spp., *Cyperus* spp., *Eleocharis* spp., *Imperata cylindrica*, *Paspalum* spp., *Oplismenus* spp. etc. are common grasses that are found along roadsides and open areas, homesteads etc.

The social Forestry division of the State Forest Department have been planting several species of plants including some exotic ones along roadsides of the area to beautify the roads. (Photo No. 1.4 of plate 1.)

4. **Weeds of paddy field:** Rice is the main crop in the district. Common weeds in rice field as well as in other cultivation and household gardens are *Alternenthera sessilis*, *Amaranthus spinosus*, *A. viridis*, *Cassia tora*, *C. hirsuta*, Centella asiatica, *Chrysopogon* spp., *Commelina benghalessis*, *Croton bonplandianum*, *Cynodon dactylon*, *Cyperus rotundus*, *Drymaria cordata*, *Eleocharis* spp., *Euphorbia hirta*, *Hedyotis corymbosa*, *Ipomoea carnea* var. *fistulosa*, *Eclipta prostrata*, *Evolvulus nummularius*, *Imperata cylindrica*, *Leucas plukentii*, *Mikania micrantha*, Chromolaena odorata etc.
4.7. Deforestation: a threat to the vegetation:

The socio-economic conditions of the rural people in Bongaigaon district is mostly dependent on forest for various day to day requirements. Due to overexploitation, the existing forest cover has reduced to a great extent. The district has vast wastelands both under Govt. and private ownership which are mostly not useful for agriculture. Therefore there is a need for massive afforestation and wasteland development programme through social forestry and farm forestry in particular for restoring both ecology and economy.

Rapid deforestation is noticed in almost all demarcated forest areas in the district because of the tree cutting for house hold use and sale. Encroachment is another problem that has been facing by the forests (Ref. Aie Valley Division of Forests, Bongaigaon). Collection of soil from the hillocks helps in soil erosion and subsequent siltation in the adjacent area during monsoon. Indiscriminate collection of vegetables such as *Pygmaeopremna herbacea, Paederia foetida, Colocasia* spp. etc., fruits and medicinal plants are also going on in the area. Apart from these man made threat, there is flood during monsoon which also harms the natural flora. Over grazing, conversion of river sides to agricultural fields, filling up of water bodies etc. are some recent problem that may cause threat to existence to the natural flora.

(Photo No. 1.5 and 1.6 of plate 1.)
PLATE 1.

Photo No. 1.1: Forest vegetation

Photo No. 1.2: Shrubs in degraded forest

Photo No. 1.3: Aquatic vegetation.

Photo No. 1.4: Road side plantation

Photo No. 1.5: Anthropogenic pressure on the vegetation

Photo No. 1.6: Deforestation due to natural calamity