Chapter 3

Geo-environmental setting of the Study Area

3.1 Location and Extent

The Dhansiri (South) River basin lies between latitudes 26° 42´N and 25° 21´N and longitudes 94° 37´E and 93°10´E (Fig.3.1). The catchment area of the river basin is approximately 12,240 sq.km lying partly in the state of Assam and partly in Nagaland. It is drained by the river Dhansiri and its tributaries. The main tributaries of the river are the Diyung, Diphu and Gelabil on the right bank and the Nambar, Doigurung and Kaliyani on the left bank.

The Dhansiri River traverses a distance of 352 km from its source which lies in the Laishang Peak on the south-west corner of Nagaland up to its confluence with the Brahmaputra at Dhansirimukh. For the first 40 km from its source, the river flows in a north westerly direction and thereafter it flows to north-east for about 76km up to Dimapur. Beyong Dimapur, the direction of flow is generally northerly up to Golaghat, where the river takes an abrupt turn towards North West and ultimately joins the Brahmaputra. The part of the river basin that lies in Nagaland is covered by mountains and hill ranges, and partly by flat alluvial tract of the Brahmaputra Valley. The lower Dhansiri watershed comprises of unconsolidated sediments of Recent to sub- Recent age overlain by alluvial deposits of the Pleistocene age occur along the foothills.
Fig. 3.1: Location Map of Dhansiri (South) River Basin (Based on IRS Liss III Imagery, 2008)
The River Dhansiri is an important southern tributary of the mighty Brahmaputra River. It originates in the south-west corner of the Naga hills from Thimtubum Peak / Laishang peak of the Barail range at an altitude of 1,868 m and outfalls into the Brahmaputra at Dhansirimukh (Sarma, 1993). The Dhansiri river enters the Karbi Anglong at the confluence of the Watidisa river which is also a trijunction of Karbi Anglong, North Cachar Hills and Nagaland State and but for a little portion near about Dimapur it forms the entire eastern boundary of Karbi Anglong. The river flows through a distance of 352 km from south to north before joining the Brahmaputra on its south bank. Its total area is 12,240 square km. For the first 37 kms from the source, the river flows in a north-western direction where after turning to the north-east it flows for about 75.635 kms upto Dimapur, thereafter the direction of flow is generally northerly upto Golaghat. The river receives almost all the western and southern drainages of Nagaland.

Throughout its course the river meanders which is very much marked, down streams of Golaghat Town. It is the main river of Golaghat District of Assam as well and supposed to carry the discharge from Numaligarh refinery. The river attains a maximum breadth of 132 m near Golaghat and average depth is about 6.20 m. The hydrological station on the river at Numaligarh station indicates its danger level as 77.42 m and maximum, minimum and average water discharges as 209,185, 4.88 and 513 m$^3$ s$^{-1}$respectively. A hydrograph of the daily discharge of the river for years 1998, 1999 and 2000 is presented in fig. 3.2.
The annual discharge of sediment as recorded in the station was reported as 6.28 lakh ha m. The river Dhansiri was reported as one of the highly meandered river of the world (Sarma, 1993). Beyond Golaghat upto its out-fall in to the Brahmaputra, there are altogether 18 high loops in the river and at places it is found that the river meanders a distance of about 5 kms. in a straight reach of about 1.2 kms only. About 3.2 kms. upstream of its confluence with the Brahmaputra, near a place called Kuruabahi, there exists a big island of about 2000 ft. (609 m.) in length in the river. Downstream of the Dimapur (Nagaland) the banks of the river are low at several places where the river overflows during the floods and inundates large areas of the land. The river is navigable upto Bokajan by small country boats.

The basin includes a number of important biodiversity rich areas such as the Nambor Reserve Forest, Part of Dayang and Rengma Reserve Forests, Garampani-Doigurung Wild Life Sanctuary and the Kaziranga National Park. The river while flowing as the boundary between Karbi Anglong and Nagaland has on one side the Intanki National Park and on the other Dhansiri Reserved Forest. It has different types of important wood bearing trees along its bank like Intanki Forest. The Dhansiri River
along with Kapili by headward erosion has isolated the Mikir hills totally from the peninsular plateau. There are various perennially waterlogged swampy regions. The regions are locally known as bils associated with this river.

The principal tributaries of the Dhansiri on the right bank are Diyung, Diphu and Gelabil and those on the left bank are Deopani, Nambor, Doigurung and Kaliyani. A drainage network map of the study area is presented in fig.3.3.

**River Reaches of the Dhansiri (S)**

The river Dhansiri (S) may be divided into two main reaches on the basis of topography, river gradient and the confluence/bifurcation of important rivers. These are:

1) From source to the confluence of Diyung. The length of this reach is 266 km.

2) From the confluence of Diyung to the outfall of the Dhansiri (s) into the Brahmaputra. The length of this reach is 86 km.

The river in the upper reaches passes through Nambor and other reserve forests and in the lower reaches through the plains of Golaghat district. Four tributaries namely the Diyung, the Diphu, the Deopani and the Nambor join the Dhansiri(s) in the upper reach. The river at lower stage flows with considerable discharge and is comparatively wider than upper reach. The river also meanders acutely in the lower reach particularly downstream of Golaghat town. The left bank of the river in the lower reach is hilly and is covered by Karbi Anglong hill ranges and on the right bank it consists of flat alluvial plains with rugged and hilly section. The rivers joining the Dhansiri(s) in the lower reach are Doigurung, Kaliyani and Gelabil. A brief description of the tributaries of Dhansis(s) is given below:
**Diyung:** The river Diyung joins the Dhansiri (s) at Diyungmukh near Golaghat. The Diyung river drains approximately \(1/3^{rd}\) of the total area of Dhansiri(s) sub basin. The major catchment area falls in the hills of Nagaland. The total length of the river Diyung is 201 km. Diyung ia also known as Tapu in Nagaland part. Within Assam Diyung ia known as Dayang.

**Diphupani:** The Diphu is known as Diphupani in the upper reach from where it rises. It traverses its entire journey through the hills of Ngaland and outflows into the Dhansiri(s) 9.6 km downstream of Dimapur. The length of the river is 48 km.

**Deopani:** The River Deopani originates from the hills of Karbi Anglong and joins the Dhansir(s) on its left bank. The length of the river is 38.64 km. It traverses through the thick forests of Karbi Anglong district. The discharge of the river is very low and fluctuates.

**Nambor:** The Nambor River also rises from the hills of Karbi Anglong and joins the Dhansiri(S) on the left bank. It travels its entire distance through the thick forest of Nambor Reserve forest. The length of the river is 45.08km.

**Doigurung:** The river Doigurung joins the Dhansir (S) on its left bank at 46km upstream from its outfall into the Brahmaputra. It also originates from the hills of Karbi Anglong. The river traverses through the thick forest of Karbi Anglong district. Its catchment area also cover portion of Golaghat district. The discharge is very low and fluctuating.

**Kaliyani:** The River Kaliyani also originates from the Karbi Anglong hills and joins the Dhansiri (S) on its left bank. It traverses a length of 89 km in an easterly and north easternly direction and joins the Dhansiri(S) in two channels at 24 km and 27 km.
upstream of the Dhansiri(S)- Brahmaputra confluence point. The discharge is very much fluctuating in nature and is of considerable magnitude.

*Gelabil:* It joins the Dhansiri(S) at 6km upstream of Dhansiri-Brahmaputra confluence

### 3.3 Climate

The climate of the study area is tropical with hot and humid weather which prevails most of the summer and monsoon months with a moisture index of 0.2 % and an estimated length of growing period ranging from 270 to 300 days.

The river basin falling within south-west monsoonal regime, receives a mean monsoon rainfall of 1158.10 mm. The average annual rainfall in the basin is 1805.60mm. A map showing the isohyets is presented in fig 3.4. The monsoonal rainfall being concentrated mainly within a period of five months, usually from May to September, causes heavy landslides in the mountainous upper catchment areas and flash floods in the lower part of the basin (Bora et.al., 1993). Maximum temperature recorded in the river basin is 41° C in month of June and minimum temperature is 10.0° C in the month of December. Wind direction is from Northwest to Southeast and North to South.

### 3.4 Soil

The Dhansiri river basin falls in two Agro-ecological zones namely the Humid Bengal Assam basin and Humid Eastern Himalayan region. Both relict alluvial and residual soils are encountered in the basin developed over sedimentary and metamorphic rocks. The alluvial soils are found to occur in the alluvial plains and valleys. The residual soils are encountered primarily on hills as they are derived from the parent rocks like sandstone, shale, limestone, siltstone etc. of varying texture.
Fig. 3.3: Drainage Network Map of Dhansiri (South) River Basin
The soils encountered during field visit in the Assam part of the Dhansiri(S) River basin are very deep, well drained to somewhat excessively drained, brown to dark brown in colour and occur as loamy to fine textured, loamy sandy, sandy loam, loam, silty loam and are sandy in texture. The soils are acidic and medium in base saturation and cation exchange capacity (CEC) with appreciable exchangeable aluminium in certain places. The soils were classified as Typic/ Umbic Dystrochepts, Typic Paleudalfs, Typic Hapludults in the hills and Typic/ Aeric Haplaquepts, Typic aeric Haplaquents, and Typic Udorthents in the Assam plains (NBBS 1999).

3.5 Geology

The Dhansiri (s) River basin is characterized by a large variety of rock types ranging in age from the Pre-Cambrian to Recent. The Achaean group of rocks is encountered in the eastern part of the Dhansiri (s) river basin comprising hills of Karbi Anglong district of Assam. These include ortho and paragneisses, schists, migmatites and granulites. The sub-catchments of the tributaries Kaliyani, Doigurung and a part of the western side of the Dhansiri River are covered along their periphery by Quaternary alluvial sediments. The south and west part of the Dhansiri catchment is represented by a variety of rocks of Jaintia, Dupitila, Barail, Shillong, Surma and Granite Plutons of the tertiary group of rocks of Pleistocene to Recent period. The eastern and northern most part of the basin is largely covered with unclassified fluvial sediments of recent period.

3.6 Geomorphology

The Dhansiri(S) River Basin presents predominantly two kinds of landforms namely, the hilly terrain and alluvial plain. Three major types of geomorphological units have been identified in the study area namely: Denudational, Structural and Fluvial. The denudational landform unit includes dissected hill, dissected plateau and inselberg. The
structural landform unit includes ridges and valley provinces, structural plateau plains and dissected structural plateau. The fluvial landforms include present flood plain and older flood plain. A map depicting the geomorphology of the study area is shown in fig.3.5.

3.7 Landuse

Agriculture and forest provide the main means of livelihood to the people of the basin. The major part of the agro-eco zone is covered with mixed forests. Hilly foothills regions are presently covered by tea and coffee plantation. Major parts of the plain areas are used for cultivation of paddy, sugarcane, rotational crops and oil seeds along with varieties of vegetables. Paddy and tea are the main agricultural crops in the study area. The soils of the region also have tremendous potential for horticultural crops. The most common variety of paddy is Sali grown in the months of July to November. The other agricultural products are mustard, pulses, wheat and sugarcane. Since the hilly area in Karbi Anglong is 66% and in Dima Hasao is 85%, the adaptation of shifting cultivation is much wide. This is a mixed cropping system under and burn agriculture. The uneconomical agriculture, heavy soil erosion and continued depletion of soil fertility are the major problems in the zone. The catchment is endowed with vast forest cover. The variation in altitude, parent rock type, soil and climate has given rise to a diversity of forest type.

The forests are the treasure house of varieties of plants of economic importance, indigenous fruits and edible plants, orchid and medicinal plants.
Fig. 3.4: Isohyetal Map of Dhansiri (South) River Basin

Fig. 3.5: Geomorphology Map of Dhansiri (South) River Basin
Moist Semi-evergreen forests are widely prevalent in the Karbi Anglong district part of the basin. These forests contain commercially important species like Badam, Amari, Cham, Tita Sopa, Nahar, Bhelu, Gomari, Poma, Bonsum, Dhuna, Myrobalans, Bhola and Bon Am etc. in the top canopy.

Mixed moist Deciduous Forests have Haldu, Bohera, Simul, Ghogra, Azhar, odal, Outenga etc. in the top canopy.

Riverine Type of forest occupies the localities with alluvial soil of more recent origin in the vicinity of rivers and streams of the district. The common species of importance are Khair, Sissoo, Simul, Urium, Kokoli etc. Miscellaneous type of forest comprises of Amari, Sopa, Cham, Bonsum, Bogipoma, Gonsoroi, Dhuna and Hingori etc. Principal species of Bamboos are Dendrocalamus hamiltonii (Kako) and Bambusa tulda (Jati) besides a small proportion of other bamboos. Kako and Jati bamboos are mostly harvested by Hindustan Paper Corporation, Jagiroad. The forests of Karbi Anglong are extensive and rich in minor forest produces like Cane, Patidoi, Dhuna, Agar, Ekra, Thatches, Barks of Baghnala, Laham, Dalchini, Patihunda, Rema, Satkora and a variety of medicinal plants.

Soil acidity and flooding/water logging in soils of subdued topography and/or depressions are the main constraints in potential land use pattern.

Some of the important location within the basin area

Garampani Wildlife Sanctuary: It was notified during 1952 vide notification No, FR. 199/52 dated 10/07/52 with an area of 6.05 square kilometre wildlife sanctuary. It is located in Karbi Anglong district, Assam, India. It is 25 km from Golaghat and is full of
rare and endangered flora and fauna. It is one of the oldest sanctuaries containing Hot water spring and Waterfalls and surrounded by Nambor Sanctuary having 51 rare species of Orchid. Visit to see Tiger, Elephant, Gaur, Bear, Sambar, Barking deer, Rhesus macaque, Hoolock gibbon, Wild pig, The Great pied Hornbill, Hill myna, Python, Cobra, Monitor lizards etc.

**Nambor Wildlife Sanctuary:** The Govt. of Assam vide their Notification No. FEW.57/99/38 dated 27-07-2000 have notified the "Nambor Sanctuary" with an area of 37 Sq. KM. in Silonijan Civil Circle under Bokajan Sub-Division (Civil) under Karbi Anglong East Forest Division, Diphu in Karbi Anglong District under Karbi Anglong Autonomous Council. The Wildlife Sanctuary is situated with its Northern boundary along the western and southern boundary of Garampani Wildlife Sanctuary upto Dhansiri River.

**Nambor - Doigrung Wildlife Sanctuary:** It is a protected area located in Golaghat district of Assam in India. This wildlife sanctuary covers an area of 9715 sq.km. The forest type is Tropical Semi-evergreen with pockets of pure Evergreen, interspersed with small forest marshes. The area was declared as a Wildlife sanctuary in 2003. The sanctuary along with Garampani Wildlife Sanctuary (6 km²) and Nambor Wildlife Sanctuary (37 km²) are a part of the Kaziranga-Karbi Anglong Elephant Reserve, which was declared on 17 April 2003, with an estimated area of 3,270 km². Flora include Bhelu, Gomari, Ajar, Nahor, Udiyam, Poma, Bon Som etc. It harbors some rare species of Orchids. The Fauna is also diverse and contains Elephant, Hoolock Gibbon, Stumped Tailed Macaque, Pig Tailed Macaque, Slow Loris, Assamese Macaque, Rhesus Macaque, Tiger, Leopard, Fishing Cat, Barking Deer, Sambar, Wild Pigs, Gaur etc.[4]It
is a home to Birds like White Winged Wood Duck, Great Pied Hornbill, Wreathed Hornbill, Adjutant Stork etc.

**Kaziranga National Park:** The world heritage site Kaziranga National Park, the abode of the one horn rhinoceros is continuous to the Karbi Anglong boundary to the north and ends at Garampani within the Nambor Reserve Forest. The highest numbers of rhinoceros live in the national park but their numbers are becoming scarce. Herds of wild buffalos and wild bulls are found in Karbi Anglong. Bison generally found near hills and neighborhood of tree forests. Elephants commonly found near hills and when the crops are ripening they cause damage.

A map showing the locations of reserve forests present within the study area along with few photographs of wetlands and shifting (jhum) cultivation areas are shown in fig. 3.6.

A detailed landuse/landcover map prepared in the course of this study is given in Chapter 5 along with the discussion of methodology followed in its preparation.

### 3.8 Transport and Communication

The plains of the Dhansiri(S) river basin are served by a well-knit road system. The main artery is the NH-39, NH-36 and NH-37. NH-39 connects Golaghat and Dimapur towns and joins NH-37 which connects important towns like Jorhat, Nagaon, Guwahati and other towns in lower and upper Assam.

From Numaligarh, there is a bifurcation point from NH-37 i.e NH-39 which runs in a south easterly direction to meet Bokajan and Dimapur. The NH-37 from Guwahati to Dibrugarh passes through the basin in the lower reach connecting towns like Bokakhat, Kamargaon and Dergaon.
Fig. 3.6: Map showing locations of Reserve Forests, Wetlands and Jhum areas of the study area.
The main railway line from Guwahati to Tinsukia passes through the river basin. The railway connection is available almost in the entire sub basin except for some parts of Karbi Anglong district and the uppermost reach near Kohima. There is an airport in the Dimapur town and is only means of air communication to the sub basin.

3.9 Population and Human Settlement

According to the 2011 census Golaghat district has a population of 1,066,888. The district has a population density of 305 inhabitants per square kilometre. Its population growth rate over the decade 2001-2011 was 11.88%. Golaghat has a sex ratio of 961 females for every 1000 males and a literacy rate of 78.31%. The population under different religious groups area Hindus 813,263, Muslims 74,808 (7.9%), Christians 52,277.

The main communities of the district are the Tea tribes (Adivasi), Ahoms, Sutiya, Kalita, Assamese Brahmins, Mising and Kachari. There is also a small population of Turung and Aiton people living in in the district. Migrant communities like Marwari and Bengali live in the townships. The economy of Golaghat district is agriculture-based. Tea, rice and sugar cane are the main agricultural crops grown in the district, with tea being is the largest agricultural industry. There are 63 large tea gardens producing about 20,000 tons of tea per year. Moreover, the emergence of small tea growers has proclaimed a new improvement in the district. Small-scale tea growers have gotten considerable fame here because of large incomes compared to other highland crops. It has caught the desire of unemployed people to take owning tea-gardens as their profession. The rearing and reeling of muga and endi, the making of Japi (headgear) and earthen potential and the extraction of agaru oil are the cottage industries
prevalent in Golaghat district. Quality muga silk and agar oil in Golaghat district are well known in the state. Long-neck earthen potential made in Dhekial, especially for storing molasses, is unique in the world. 'Japi' of Naharani, Dergaon finds a market in the entire Brahmaputra valley.

Numaligarh Refinery Limited (NRL) is the only major heavy industry in the district. Numaligarh Refinery, situated in Numaligarh, is engineered to process 3.0 million tonnes per year of indigenous crude oil, adopting innovated technologies. Numaligarh Refinery was custom-built in October, 2000 as the latest multi-faceted refinery in the country, having up-to-the-minute facilities and an intricacy measuring 6.67 on the Nelson complexity index, which is the highest among the public sector refineries. NRL has achieved global standards by obtaining certification of its Quality, Environment and Occupational Health & Safety Management Systems. It has already adopted Hydrocracker technology to enhance the production of middle distillate (https://en.wikipedia.org/wiki/Golaghat).

According to the 2011 census Karbi Anglong District has a population of 965,280. The district has a population density of 93 inhabitants per square kilometre (240/sq mi). Its population growth rate over the decade 2001-2011 was 17.58%. Karbi Anglong has a sex ratio of 951 females for every 1000 males and a literacy rate of 74%, with male and female constituting 82% and 65% respectively. Population of this district is: Animists (often tagged as Hindus) 670,139, Christians 117,738, Muslims 18,091 (Wikipedia). A number of indigenous peoples reside in this district. The Karbis are the most prominent amongst them. Other indigenous peoples residing in this district include the Dimasas, the Koch, the Nepali (Gorkha), the Adivasis, the Rengmas, the Kuki-Chin
People (Kukis, Hmars, Mizos), the Garos, the Tiwas, the Khasis and the Chakmas. Besides, a large number of non-tribals also live together in this hill region.

In 2006 the Indian government named Karbi Anglong one of the country's 250 most backward districts (out of a total of 640). It is one of the eleven districts in Assam currently receiving funds from the Backward Regions Grant Fund Programme (BRGF). The settlement pattern of the Karbis is in the form of a village. Each village has a headman called Gaonbura or Sarthe who is appointed by the authority of Karbi Anglong Autonomous Council. But each revenue village has a number of hamlets situated kilometers apart. Each of such hamlets has also a Gaonbura. Each Karbi village is named after the Gaonbura. The Karbis, like the other hill tribes, have a tendency to live on the hill tops. But the people generally do not live in compact areas. The villages are not only smaller in size, but scattered too. In the plains portion of the Karbi Anglong District where the Karbi people practice permanent cultivation and where the village headmen are quite strong, the villages are found to be stationery. But in the interior areas of the district where shifting cultivation is practiced, shifting of village site is still in the practice (http://karbianglong.nic.in/). The district wise distribution of total population, male population and female population as per 2011 census in the Assam part of the basin is shown in Table 3.1 and Table 3.2. The plain area has a fairly good density of population while the hilly area is sparsely populated. The density of population is highest in Golaghat district being 305 persons per sq. km while that in the Dima Hasao is lowest being 44 persons per sq. km as per 2011 census.
### Table 3.1: Total Population as per 2011 census (Statistical Handbook of Assam)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2001</td>
<td>2011</td>
<td></td>
<td></td>
<td></td>
<td>2001</td>
<td>2011</td>
</tr>
<tr>
<td>Golaghat</td>
<td>946279</td>
<td>1066888</td>
<td>3.42</td>
<td>12.75</td>
<td>270</td>
<td>305</td>
</tr>
<tr>
<td>Karbi Anglong</td>
<td>813311</td>
<td>956313</td>
<td>3.06</td>
<td>17.58</td>
<td>78</td>
<td>92</td>
</tr>
<tr>
<td>Dima Hasao</td>
<td>188079</td>
<td>214102</td>
<td>0.69</td>
<td>13.84</td>
<td>38</td>
<td>44</td>
</tr>
</tbody>
</table>

### Table 3.2: Male and Female Population Statistic as per 2011 census

<table>
<thead>
<tr>
<th>District</th>
<th>Male Population</th>
<th>Decadal Growth Rate</th>
<th>Female Population</th>
<th>Decadal Growth Rate</th>
<th>Sex-Ratio 2001</th>
<th>Sex-Ratio 2011</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golaghat</td>
<td>490286</td>
<td>543161</td>
<td>10.78</td>
<td>455993</td>
<td>523727</td>
<td>14.85</td>
</tr>
<tr>
<td>Karbi Anglong</td>
<td>422250</td>
<td>490167</td>
<td>16.08</td>
<td>391061</td>
<td>466146</td>
<td>19.20</td>
</tr>
<tr>
<td>Dima Hasao</td>
<td>99822</td>
<td>110802</td>
<td>11.00</td>
<td>88257</td>
<td>103300</td>
<td>17.04</td>
</tr>
</tbody>
</table>
Table 3.3 District wise total number of villages falling within the river basin

<table>
<thead>
<tr>
<th>District</th>
<th>Total no. of Villages</th>
<th>No. of Villages within the river basin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Golaghat</td>
<td>1125</td>
<td>480</td>
</tr>
<tr>
<td>Karbi Anglong</td>
<td>2921</td>
<td>377</td>
</tr>
<tr>
<td>Dima Hasao</td>
<td>695</td>
<td>8</td>
</tr>
</tbody>
</table>

Table 3.3 shows the district wise total number of villages in Golaghat, Karbi Anglong and Dima Hasao and the number of villages of the following districts falling within the Assam part of the river basin. The table reveals that out of total number villages 42% of the villages of Golaghat district fall within the basin area under study. The villages of Karbi Anglong and Dima Hasao district constitute 12.9 % and 1.15 respectively. This shows that the hilly region of the river basin under study is sparsely populated than the plains. In Plate 1 few photographs of the local inhabitants using the river for different daily activities is presented.
Plate 1: River use by local inhabitants of the river basin

- **Bathing**
- **Drinking water collection**
- **Boat used for moving paddy**
- **Collecting river sediments for construction**
- **Fishing**
- **Washing**