PHYSICAL AND CULTURAL BACKGROUND OF THE BASIN

River basins or drainage basins are generally considered as ideal units to study landscape evolution as they exhibit nearly all components or terrain attributes that exist within an ideal geomorphic unit. It was during the first quarter of the 20th century that the study of drainage basins as a geomorphic unit was begun and supported by both Playfair and Davis who considered the drainage basin as the most satisfactory unit for landform evolution (Jha; 1996).

Drainage basins require geographical study for three chief reasons. They are:

i. their existence in the physical landscape and their significance in producing fluvial landforms,

ii. their importance indirectly in relation to many other geomorphological processes in fluvially dominated landscapes, and

iii. their significance for human use (Gregory and Walling 1973, Jha 1996)

The analysis of drainage basins, either as single units or as a group of basins taken together, which comprise a distinct morphological region has particular relevance to geomorphology. Fluvially eroded landscapes are composed of drainage basins and these provide convenient units into which an area can be subdivided. The development of landscape is equal to the sum total of the development of each individual drainage basin of which it is composed. The fact that morphological regions can be recognized suggests not only that within each region the drainage basins have forms similar to each other. Thus, by analyzing the development of each drainage basin, greater understanding of the landscape as a whole may be achieved. This is possible if there are definable relationships between the forms of a drainage basin and processes at work within it. (Doornakamp and King, 1971, Jha, 1996).
Horton (1932), was followed by Strahler (1958), to regard a drainage basin as a geomorphic unit and notable contributions were made by them in this field.

A systematic description of the geometry of a drainage basin and its stream channel system requires measurement of linear aspects of the drainage network, areal aspects of the drainage basin, and relief aspects of channel network and contributing slopes. Whereas the first two categories of measurement are planimetric, the third category treats the vertical inequalities of the drainage basin forms (Strahler,1964, Jha,1996).

Kalyani River Basin being antecedent in character exhibits polycyclic nature and maximum examples of fluvially eroded landforms are found within the basin area. The river is rainfed as well as supplied by underground recharge and is the only biggest tributary to the Dhansiri river (Golaghat district) in Assam.

The drainage basin analysis will reveal the past antecedents of the river which has helped to shape its present form. This helps to identify and record the changes in the process of cycle of erosion which may be recorded and review the magnitude and type of adjustments that have taken place with relevance to local landscape.

The northern part of the basin is separated from the northwards sloping land towards the Brahmaputra River Basin by the Langkangtang Langso river basin which is a primary waterdivide.

The peaks from west to east on the northern periphery are Haru Kurjat Anglang at 816 m, Mangbe Anglang at 776 m, Tamai Bheti Anglang at 820 m, Inglang Phuchita at 778 m, Bar Inku Anglang at 802 m, Haru Inku Anglang at 733 m. The waterdivide between the Hangi Langso (which feeds the Deopani River) in the north and the Tarapung Nadi (which supplies water to the Kaliani River) in the south helps to demarcate the Kalyani River Basin from its northern periphery. Further east the Langhi Anglang (a sharp ridge) with a spot height
at 668m helps to separate the basin of Naga Langso in the north from that of the Chbekang Langso flowing south to join the Tarapung Nadi (a tributary to the Kaliani River). The highest spot here is Theisibi Anglang at 855m.

The Kamburu Pahar separates the tributary basins of Barjan Langso (flowing north) from the basin of Tarapung Langso (flowing south). The Kanko Jan basin situated along the central section of the northern limit of the Kalyani Basin is a primary divide. Mutangru Parbat, Bhaluk Parbat and Deogarh Parbat complete the northern boundary of the Kalyani River Basin.

The eastern part of the Kalyani River Basin is demarcated by the floodplains of the Dhansiri River flowing northwards towards the Bramhaputra River.

The southern part of the Kalyani River Basin is separated by the primary water divide of the Daigurung River.

The basins of Horgati Nadi, Chiri Langso and Langkangtang Langso form secondary divides.

The western part of the basin is demarcated by the primary waterdivides of the Arnam Langso, Luchin Langso, Phang Langso and Langlakso Nadi (all flowing east towards the central portion of the basin).

Besides these there are numerous secondary and tertiary divides that separate the tributary basins of the Kalyani River from one another.

In the northern part the secondary divides are aligned N–S direction while the major divides are aligned W.N.W to E.S.E or E–W. In the southern portion the primary water divide is aligned W–E.
ALTITUDINAL ZONES

The altitudinal zones of the Kalyani River Basin are shown in Fig. 2.1. About 377 km² or 31.42% of the basin area lies in the altitudinal zone of 300 m - 500 m. It occupies a large part of the basin along the base of major scarps or elevated regions (Table 2.1).

This region in the study area is chiefly covered by dense bamboo forests and the western, northern and southern part of the basin is characterized by this type of altitudinal zone.

The next height category of 100 m - 300 m occupies about 230 km² or 19.17% of the study area. This type covers the valley bottoms of the primary channel Kalyani and of the secondary channels or the tributaries. The height categories of 500 m – 700 m covers about 192 km² or 16%, < 100 m covers about 170 km² or 14.17%, 700 m – 900 m covers about 148 km² or 12.33%, 900 m – 1100 m or 77 km² covers about 6.42% and > 1100 m covers about 6 km² or 0.5% of the study area.

The highest altitudinal category of over 1100 m covers only 0.5% of the basin and includes the upper catchment of the Karju Langso and the Nihang Langso located to the SSW of the Kalyani River Basin.

The lower valley parts of Deithar Nala and Pichchla Jan have elevations less than 100 m which covers about 14.17% of the basin area. (Fig. 2.1)
### TABLE 2.1: DISTRIBUTION OF ALTITUDINAL CATEGORIES

<table>
<thead>
<tr>
<th>Altitudinal Categories (in Metres)</th>
<th>Area (km²)</th>
<th>Area (%)</th>
<th>Cumulative Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 &lt; 100</td>
<td>170</td>
<td>14.17</td>
<td>14.17</td>
</tr>
<tr>
<td>2 100 - 300</td>
<td>230</td>
<td>19.17</td>
<td>33.34</td>
</tr>
<tr>
<td>3 300 - 500</td>
<td>377</td>
<td>31.41</td>
<td>64.75</td>
</tr>
<tr>
<td>4 500 - 700</td>
<td>192</td>
<td>16.00</td>
<td>80.76</td>
</tr>
<tr>
<td>5 700 - 900</td>
<td>148</td>
<td>12.33</td>
<td>93.09</td>
</tr>
<tr>
<td>6 900 – 1100</td>
<td>77</td>
<td>06.42</td>
<td>99.50</td>
</tr>
<tr>
<td>7 &gt;1100</td>
<td>06</td>
<td>0.5</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1200</strong></td>
<td><strong>100</strong></td>
<td></td>
</tr>
</tbody>
</table>

**FIG. 2.1: DISTRIBUTION OF ALTITUDINAL CATEGORIES**
DRAINAGE

The Kalyani River is the trunk stream of the study area. It flows in a south-easterly and easterly direction in the upper and lower part of its catchment respectively. Its total length from its source (108 m) near Delap Parbat (693 m) to Kamargaon (80 m) where it meets the Dhansiri River is 102 km (Plate 2.1).

The Kalyani River Basin has 18 major tributaries which have been selected for study and which are described below (Fig. 2.2):

Right Bank Tributaries

1. The Shilkuti Jan

The Shilkuti Jan is located on the southeastern part of the Kaliani River Basin.

Its first order streams originating west of Kala Pahar (890 m) form two third order streams, Naga Langso and Saru Shilkuti Jan flowing through scarp-like slope. They join near the rural settlement of Takbigaon (120 m) to flow north and join the channel of the Kalyani River on the right bank at Bar Chaligaon (100 m).

The stream length is 13 km and total catchment area of Shilkuti Jan is 10 km² which accounts for 0.8% of the area of the trunk stream. It is a fourth order stream. The lower course joins the trunk stream near its pronounced meander.

2. The Rangali Nadi

The Rangali Nadi is located on the southern part of the Kalyani River on its right bank. Its first order streams form the two tributaries of Ridang Jan and Rihang Jan which originate from heights of 1024 m and 918 m respectively and flow over gneissic terrain. It joins the trunk stream at a height of 188 m. The total length of the stream is 18 km, and covers a basin area of 28 km² which is about 2.3% of the total catchment area of the trunk stream. It is a fourth order stream.

3. The Jhanganri Nala

The Jhanganri Nala flows from south to north on the right flank of the Kalyani River. Its first order streams originate from Inglang
Karai (1105 m). There are a total of 4 tributary streams which make up the catchment of the Jhanganri Nala.

The total length of the Jhanganri Nala is 48 km. and occupies a basin area of 162 km² which accounts for 13.5% of the total catchment area of the Kalyani River Basin. It joins the trunk stream at 188 m. The tributary streams are Bar Langparpan, Haru Jhanganri Nadi, Karju Langso (its longest tributary) Arnam Langso, Kaila Langso and Langkanglang Langso starting from the right bank. The Jhanganri Nala passes over coal seams at a height of 600 m after it is joined by the Kaila Langso on its left bank.

Notable peaks are Hungi Parbat (830 m), Basatiplang Anglang (679 m), Inglang Karai (1105 m), Tardung Anglang (633m), Warekmushak Anglang (1049) and Arlangbati Anglang (800 m). The Jhanganri Nala occupies the largest basin area of the Kalyani River.

4. The Majangari Langso

The Majangari Langso flows from southwest to east and turns northwest to join the Kalyani River on the right bank. Its first order streams originate from Majangari Anglang (869m) and joins the trunk stream at 200 m. It is about 15 km in length and covers an area of 10 km² which accounts for 0.8% of the total catchment area of the trunk stream. It has no big tributaries but minor first order streams.

5. The Rinukang Langso

The Rinukang Langso flows from west to east and joins the trunk stream on the right bank at 208 m. It is about 28km in length and is spread over 6 km². The total basin area of the Rinukang Langso is 0.5% of the total basin area of the trunk stream.

6. The Nihang Langso

The Nihang Langso flows from south towards north on the western edge of the Kalyani River Basin. Its length is 49 km and the area of its catchment is 81 km². The basin of the Nihang Langso covers about 6.75% of the total basin area of the trunk stream. The tributaries of the Nihang Langso are Sangri Langso, Langkangram
Langso, Banger Langso and Langterai Juri. The confluence with the trunk stream is 7 km east from the settlement at Danka Rangpahar (280 m). Notable hills are Manat Anglang (1008 m), Inglang Ikpi (1281 m), Inglang Ikso (1009 m) on the right bank of the Nihang Langso and Tak Pahar (406 m), near the confluence on the left bank.

Due to faulting the river bends towards west and then turns south near Dikru Timanggaon (305 m). Evidences of faulting are further noted due to the straight channels of Sangri Langso and the Nihang Langso on the right bank. The drainage pattern comprises of rectangular and contorted due to structural control along the channel and radial at the peaks from where they originate.

7. The Langlakso Nadi

The Langlakso Nadi originates at Cheksa Parbat (593 m) and flows from west to east. Its confluence with the trunk stream is 7 kms to the east from the settlement of Danka Pahar (280 m). The tributaries are Taukau Langso, Langkangtang Juri, Sartheng Juri. A spring flows near the settlement of Dak Takbigaon. The isolated peaks in the basin are numerous, the notable being Cheksa Parbat (593 m) and Takrang Pahar (795 m). The Langlakso Nadi flows through flat terrain at an elevation of 400 m and major settlements are found along its stream banks.

Both the Nihang Langso and the Langlakso Nadi together merge at the same point to flow east as the Phang Langso. The Langlakso Nadi is 36 km in length and covers a basin area of 42 km² which is 3.5 % of the total basin area of the Kalyani River Basin.

Left Bank Tributaries

8. The Arnam Langso

The Arnam Langso originates at Hijung Langri Anglang (865 m) and joins the trunk stream near settlement Danka Rangpahar on the left bank. The channel flows from west to east after emerging from its source to turn south towards the Kalyani River.

The Arnam Langso basin has good examples of abrupt changes of course due to faults and the results can be seen in the numerous
waterfalls that have formed. The area around geo-coordinates 26° 23' 15" N and 93° 17' 05" E just before the confluence of the Arnam Langso and Pranpri Langso the highest waterfall (56 m) of the basin is noted on the left bank. On the right bank the Arnam Langso has 6 bends along its course and a waterfall of 43 m before it merges with the Pranpri Langso. Another notable waterfall at 35 m is found along the Rampak Langso a tributary to the Arnam Langso on the right bank. The tributaries of Luchin Langso has a waterfall of 48 m, that of Chikang Lang Jan 24 m and unnamed minor waterfalls of 14 m, 8 m, 7 m and 5 m height are found within the basin. This points to the fact that the Arnam Langso basin has undergone faulting and upliftment along its northern portion, post Miocene. The tributaries to the channel are Luchin Langso, Chikang Lang Jan, Phang Langso as it emerges from the Takrang Pahar (795 m), Rampak Langso, Dakkechu Langso, Pranpri Langso, Dukhia Langso and Rulpi Langso I. Notable peaks are Chota Lauri Parbat (563 m), Dangar Lauri Anglang (829 m), Takrang Pahar (795 m), Mumlakbang Anglang (800 m). A scarp (780 m) is named Teke Lang Jan on the northern part and Langchhang Theppu on the southern part of the basin.

The Arnam Langso basin has best evidences of tectonics controlling and shaping the morphology of a river basin. Unpaired terraces, interruptions in the normal cycle of erosion, upliftments are all examples of such a phenomenon.

The Arnam Langso on the left bank is 71 km in length and the basin area is 58 km² which accounts for 4.8% of the total area of basin of the Kalyani River.

9. The Bar Langso I

The Bar Langso I joins the trunk stream on the left bank at 280 m. It is 40 km in length and flows from north to south. Its source is at Dangar Lauri Anglang (829 m). The Wualang Langso is the only big tributary to the Bar Langso I and there are minor ones of first and second order. A waterfall (41 m) is noted 300m contour at the midstream. The basin area is 17 km² which is 1.4% of the basin area.
of the trunk stream. The isolated peaks within the basin of the Bar Langso I are Haru Lauri Anglang (727 m) and Arteng Marak (700 m). A scarp is noted at Inghin Langri (760 m).

10. The Langkangtang Langso

The Langkangtang Langso joins the trunk stream at 250 m on the left bank. It flows from northwest to south and its source is at Delap Parbat (700 m) to the north west of the basin. The stream is 75 km in length and covers a basin area of 56 km² which is 4.7% of the total basin area of the trunk stream. The tributaries of the Langkangtang Langso are Inghin Langri, Chirplak Langso, Rulpi Langso II, Langso Mepi, Chambini Langso, Naga Langso, Warlang Langso and Paklangdo Langso. The notable peaks within the basin are Tamai Bheti Anglang (820 m), Naharbari Anglang (800 m), Thengklang Anglang (829 m), Inglang Klampi (769 m) and Delang Anglang (500 m). A single spring and two waterfalls are noted within the basin.

A ridge is noted at Haru Thengklang Anglang (760 m).

11. The Barpung Langso

The Barpung Langso has its source at Bar Inku Anglang (802 m) and flows from north to south to meet the Kalyani River at 198 m about 4 km upstream from the settlement of Khelan Terangaon. The stream flows along the periphery of a isolated dome, situated on its left bank. The only big tributary to the Barpung Langso on its right bank is the Ingchin Langso or Loha Juri. Another tributary on the right bank is the Langparat Langso. The isolated peaks within the basin of the Barpung Langso are Theisibi Anglang (855 m), Inglang Mangho (682 m) located on the left bank, Langle Angpi Anglang (620 m) and Thengklang Anglang (869 m). A hot spring is noted to the southeast of the crater on the right bank of the Langprat Langso. Another hot spring is noted 7 km upstream from the confluence with the trunk stream.

The Barpung Langso is 43 km in length and its catchment covers an area of 47 km² which is about 3.9% of the total basin.
area of the trunk stream. The channel flows on the western edge of a crater.

12. The Tarapung Nadi

The Tarapung Nadi originates at Raidang Parbat (713 m) and flows west for about 6 km. It is called as the Raidang Langso and a foot track here follows the bed of the river as the channel is only half a metre deep. Two settlements of Bepar Terrangaon, Dhanram Takbigaon and Kharsinghlekhthegaon are located at 300 m. The channel turns south to flow towards the trunk stream.

The tributaries to the Tarapung Nadi are Chhekang Langso, Miri Langso, Langup Langso, Tiok Langso, Noka Langso, Haru Tarapung, Langpher Langso, Chappi Langso, Haru Langcharchu Nadi, Langcharchupi Nadi, Langlangchar Langso, Arthungso Langso or Baja Juri (hot spring at 260 m).

Two waterfalls are noted of 6 m and 8 m respectively due to presence of a minor fault in the upper reaches before the channel meets with Chhekang Langso at 460 m. The confluence (200 m) being at Barpung floodplain where the Tarapung river meanders twice on the left bank. The Kalyani here has a sharp bend due to lithological influence.

The Tarapung Nadi is 35 km in length and its basin covers an area of 98 km².

This accounts for 8.2% of the total basin area of the trunk stream.

The isolated peaks in the basin of the Tarapung Nadi are Pung (513 m), Hima Parbat (510 m), Tarapung (472 m) which is a ridge, an unnamed peak (750 m) opposite Khelebhison (886 m) and Kiangchaon Parbat (520 m).

The Tarapung Nadi flows through the eastern edge of a crater.

13. The Bar Langso II

The Bar Langso II flows on the left bank of the trunk stream. It is 28 km in length and its tributaries together cover an area of 19 km² of the total basin area of the Kalyani River Basin. This
accounts for 1.6% of the total basin area. The tributary to the Kalyani River has its source at Anaki Bheti (567 m) and joins the trunk stream (180 m), 1 km downstream from the settlement of Tuchhagaon. It flows from west to east and turns south near the base of Klukedesh Parbat to join the trunk stream.

14. The Bar Jan

The Bar Jan flows from east to west and veers to the east again and then after flowing for about 7 km turns south to join the trunk stream at 180 m near the settlement of Khirang Rengmagaon. The Bar Jan has its source upon a ridge at 608 m situated just opposite Guasm Parbat. The notable tributary to the Bar Jan is the Riphang Nadi on its right bank. The river flows between a scarpface on both of its banks. Its length is 30 km from source to mouth and covers a basin area of 44 km² which is 3.7% of the total basin area of the trunk stream.

15. The Khuta Jan

The Khuta Jan flows from northwest to south east and has its source (600 m) at Guasm Parbat. It is 25 km in length and joins the Kalyani River at 180 m. There are no known tributaries to it but mostly first order streams that join the channel. The Khuta Jan covers a basin area of 11 km² which is 0.95% of the total basin area of the trunk stream.

16. The Pora Jan

The Pora Jan flows from west to east and has its source at Luinkital Parbat (600 m). It is 45 km in length and covers a basin area of 17 km² which is 1.4% of the total basin area of the trunk stream. It joins the Kalyani River near Teran Kurugaon (160 m) where the river has braided. The Pora Jan follows a lineament aligned west to east and this perhaps explains its almost straight course after it emerges from the highlands.

17. The Inghi Langso

The Inghi Langso flows from west to east and has its source at 300 m. It is 17 km in length and covers a basin area of 8 km².
which is 0.7% of the total basin area of the trunk stream. It joins the Kalyani River at the settlement of Bhitar Kaliani (120 m). The tributary is dry during the summer months and hence motorable and is lined by settlements on both of its banks. The Inghi Langso flows over a minor lineament aligned west to east.

18. The Deuri Nadi

The Deuri Nadi has its source at Pehu Nichang (509 m) and flows from south to north and turns east near the settlement of Deuri Changrangaon (100 m). The channel flows for a distance of 30 km and joins the trunk stream near the settlement of Rangbang Pathargaon (80 m). Its basin area is 64 km² which is 5.3% of the total basin area of the trunk stream. The tributaries to the Deuri Nadi are Manpa Langso, Pathar Jan, Nehang Langso I, Arnam Langso I and Bar Pan Jan (flows absolutely straight for 8 km as flows over a minor fault).

The notable peaks are Inglang Puchim (384 m), Pehu Parbat (300 m) and Chekang Parbat (300 m). Fresh water springs are noted near Pehu Parbat (300 m), the settlements of Rangpisogaon and Pora Intigaon on the left bank.

SURFICIAL DEPOSITS

Surficial deposits are loose earth materials upon the surface and own their nature and character to the parent material from where they originate. The decay of rocks due to physical, chemical or biological processes brought about by various climatic processes over a prolonged time span aided by the nature of the topography, mineral composition of the rocks and physical features such as joints, planes, fractures and faults that are found in the rock strata of the area are chiefly responsible. (Plate 2.2)

The Kalyani River Basin exhibits a wide array of surficial deposits owing to its gneissic terrain formed during Precambrian times. The basin is strongly influenced by wind, precipitation and running water. Exfoliation, mass wasting and movement, soil creep, slumping, landslides and scree deposits are common.
Quartzite produces dry, sandy soil but as the rock is hard it produces very steep gradients on upper slopes. The gentler slopes of the valley bottoms may produce fluvial deposits. Gneiss, granite and schists all produce light sandy deposits which are excellent for tree growth. (Jha.1996). The following processes have been noticed at:

**Exfoliation** Exfoliation occurs normally due to differential heating and cooling of layers within a rock mass. This happens because rocks are composed of different minerals which do not have the same rate of thermal expansion. Exfoliation in the Kalyani River Basin has resulted in formation of spheroidal boulders due to spalling of secondary minerals which make up the shells. Such exfoliation domes are found located in the study area. (Plate 4.2)

**Mass wasting** Mass wasting can be explained as the detachment and downslope movement of weathered soil and rock debris under the influence of gravity.

This process can be further classified as according to Sharpe (1938) under four classes: 1. Slow flowage 2. Rapid flowage 3. Landslides and 4. Subsidence. The Kalyani River Basin experiences nearly the four classes in the form of:

**Soil Creep** (slow flowage) - This is the downslope movement of soil and is witnessed near the settlement of Deuri Changrangaon on the foothills of Chekang Parbat (300 m) in the Deuri Nadi tributary basin on the left bank.

**Slumping** (landslides) - This is the downward slipping of one or several units of rock debris usually with a backward rotation with respect to the slope over which movement takes place. (Thornbury 1986). This phenomenon is noticed along the slopes of Bar Supang Parbat (445 m) left bank, Changi Parbat (482 m) right bank and Hima Parbat (510 m) situated in the Tarapung tributary basin on the left bank of the Kalyani River.
As per Sharpe (1938) rapid mass wasting were divided into passive and activating or initiating causes which includes lithological factors, structural factors, topographic factors as well as organic factors (scarcity of vegetation).

The surficial deposits of the Kalyani River Basin can be broadly grouped under four categories:

i. **Deposits of hill areas**: About 35.17% or 442 km² is covered by deposits of hill areas in the Kalyani River Basin. This comprises a thin cover of mass wasted debris highly acidic in nature and having high contents of organic matter and nitrogen. Found on the slopes of hills and ridges all over the basin.

ii. **Scarps and shoulder deposits**: This covers 20.67% or 248 km² of the Kalyani River Basin and is composed of loose pebbles, boulders and weathered granite blocks. The thin regolith layer is sandy and gritty. Found at the base of steep scarps and terraces of the fourth order tributaries like the Nihang Langso, Arnam Langso and Barpung Langso.

iii. **Deposits of terraces and former river valleys**: This covers about 8.5% or 102 km² of the Kalyani Basin and is composed of small pebbles, sandy loam to fine silt. The terraces are mostly used for cultivation of seasonal crops and vegetables. Found along river valleys of almost all tributaries of late youth to mature stage like Jhanganri Nadi, Nihang Langso, Langkangtang Langso, Tarapung Langso, Bar Jan and Khuta Jan.

iv. **Recent alluvial deposits**: This covers about 12.5% or 150 km² of the Kalyani Basin. The deposits are of fluviatile origin and have been deposited along the channel banks consisting of fine loams, small rounded pebbles and fine silt.
Found along abandoned channels and floodplains especially in the lower stage of the Kalyani river i.e. the floodplains.

**Soils**

Soils, the outer weathered mantle of the earth’s crust, differs from the parent material (bedrock) in physical, chemical and biological properties. Factors which control soil development and types are composition of the parent rock, temperature, rainfall, slope, weathering processes, timespan and associated organisms including vegetation. (Fig.2.3)

The chief soil types in the study area are:

- **Red soils**: Red soils have formed by weathering of the ancient crystalline and metamorphic rocks. These are found in areas of low rainfall and high temperatures. They are red due to high iron content and are poor in phosphorus, nitrogen, lime. The depth varies between 25 cm to 50 cm and the pH varies between 5.0 to 7.5. Since the region is composed of a fair distribution of metamorphic rocks of igneous origin this type of soil is predominant in the lower flanks of the highlands. The southern flank of the basin have this type and a few patches in the northern part. This is further segregated into sandy loam and clayey loam and deposits of hill areas.

- **Laterite**: Laterite soils are zonal soils. They have ferruginous aluminous elements, formed in regions of heavy rainfall accompanied by high temperature conditions for most part of the year. The topsoil is completely leached and a high proportion of iron and aluminium is left as residue. Laterite soils are deficient in phosphorus, potassium, lime and nitrogen. The pH ranges from 4.5 to 5.5 and the base exchange capacity is low. The soil has a reddish hue due to presence of iron oxides. The soil depth does not exceed 25 cms. The eastern part of the Kalyani River Basin exhibits this type of soil in patches which also experiences heavy rainfall.

- **Alluvial**: Alluvial soils are formed through the process of deposition of sand, silt and clay in layers. They are chiefly found along river banks and low lying tracts. They are classified into new alluvium and old alluvium. The soil depth is more than 300 cm and the pH ranges from 6.5 to 8.4. Newer alluvium is found on the eastern part of the Kalyani River Basin which received its prior sediments during the collision of the Gonwanaland with the
Asian Plate. Later subsequent deposits were also made by the Dhansiri River flowing south to north along the eastern fringe of the basin. The eastern part of the Kalyani River Basin is also referred to as the Kalyani plains. There are both older alluvium and newer alluvium in the study area.

The forests and the flanks of the highlands within the Kalyani River Basin have Udalfs and rock outcrops – Udalfs. The former are moist alfisols and develop under the influence of hills and mountain systems. The soil cover is thin and warm with high humus content. The later variety are found in regions of steep slopes. The soil cover is thin and supports grasses and those varieties of vegetations which fibrous root system. Eg., bamboo, coarse grasses.

The soils of the Kalyani River Basin have been further divided into six categories which are primarily derived from the above mentioned classes. They are:

1) Sandy Loam: This covers 372 km² of the Kalyani River Basin which is approximately 31% of the total basin area. The central portion of the basin is covered by this type.

2) Old Alluvium: This is found on the northern part of the basin and covers an area of 120 km² i.e 10% of the total basin area approximately.

3) Recent Alluvium: This category covers the eastern part of the Kalyani River Basin with an areal coverage of 276 km² or 23% approximately of the total basin area.

4) Clayey Loam: This category covers 156 km² or 13% of the total basin area approximately. This type covers the southwestern part of the basin and the southern part. The lower valley slopes of the Nihang Langso and the Jhanganri Nadi have this type of soil.

5) Deposits of Hill areas: This category covers the western part of the basin. It covers an area of 240 km² or 20% of the total basin area approximately.

6) Laterite: This is found in very small patches within the basin and covers only 36 km² or 3% of the total basin area approximately. The eastern part and a few places in the central part of the basin have this type of soil.
VEGETATION

Vegetation is normally of two types: One that develops without any human influence in any region and is a product of climatic, edaphic and biotic elements and is intrinsic in nature to that region. (Table 2.2)

This type of vegetation is referred to as the natural vegetation of that particular region. Man influenced vegetation is usually planned and organized according to climate, and nature of terrain. It is termed as agriculture and usually undertaken for commercial gain besides subsistence. (Plate 2.3 and 2.4)

The natural vegetation of the Kalyani River Basin has been classified as per Champion’s classification pattern (1936) of forest types of India and Burma.

TABLE 2.2: DISTRIBUTION OF VEGETATION TYPES WITHIN THE BASIN

<table>
<thead>
<tr>
<th>Vegetation Zones</th>
<th>Height Categories (m)</th>
<th>Area (km²)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eastern sub Montane Semi Evergreen Forest</td>
<td>&gt; 500</td>
<td>80.04</td>
<td>6.67</td>
</tr>
<tr>
<td>Moist Mixed Deciduous Forest</td>
<td>500 - 300</td>
<td>336</td>
<td>28</td>
</tr>
<tr>
<td>Assam Valley Tropical Wet Evergreen Forest</td>
<td>400 - 200</td>
<td>760.09</td>
<td>63.41</td>
</tr>
<tr>
<td>Cachar Tropical Semi Evergreen Forest</td>
<td>&lt; 200</td>
<td>23.06</td>
<td>1.92</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1200</td>
<td>100</td>
</tr>
</tbody>
</table>
i) Eastern sub Montane Semi evergreen Forest (< 500 m)

The predominant species found along this zone are bamboo of Moli (Melocanna bambusoides), Hill Jati (Bambusa tuida), Kako (Dendreccalamus hamiltoni), Bhaluka (Bambusa balcao) and Jati (Bambusa pallida) varieties. Canes such as Raidang (Calamus tcatan) and Jali cane (Calamus uimehelis) are found in the upper parts of the Kaliani River Basin. They cover about 80.04 km² or 6.67% of the basin area and are found especially where the soil cover is thin and deficient in organic matter. Bamboo extracted from the forest is sold all over India and has a variety of use ranging from building to decoration. It is also used as weapon baskets and utensils by the Karbis and the Dimasas who inhabit the region. The cane is used for chiefly furniture making and for binding bamboo aided structures like foot bridges, watchtowers and platforms.

ii) Moist Mixed Deciduous Forest (500 m - 300 m)

The chief varieties of trees found in this zone are Simul (Bombaxceiba), Bohera (Terminalia Beberica), Gameri (Gmelina arborea), Kadam (Anthrocaphalus Cadam), Owtinga (Dillenia indica), Jia (Lannea Coromandelic) and Ahoi (Vitex Pedun ularis). They cover about 336 km² or 28% of the total basin area.

They are found along the tracts of Jhanganri Nadi, Nihang Langso, Barpung Langso and Bar Jan. The forest here are dense and forms the Kaliani Reserve Forest area.

The forest is interspersed with patches of bamboo groves and creepers like Pahari lota (Dalhonsic bracteata), Loti – sorot (Cnesmone javanica), Kolia lota (Marremia umbeletta) and Bomdar kekawa (Mucuna prurita).

iii) Assam Valley Tropical Wet Evergreen Forest (400 m - 200 m)

The major varieties here are hardwood trees with dense undergrowth and creepers. The forest floor is congested with profuse undergrowth and a rich loamy cover. The dominant varieties of trees found are Ben Am (Mangifara sylrctica), Modar (Erythrina variegate), Sida
(Lagerstromia Parviflo), Bagi Poma (Chukrssia Velutina) and Khorir (Bridelia retusa). This zone shares a transition zone (300 m belt) with the moist mixed deciduous forest and some trees are common to both zones.

This zone is found chiefly along the gentle slopes where the tributary channels are in their mature or late mature stage. About 760.09 km² or 63.41% of the total area of the Kalyani River Basin is covered by this vegetation type.

iv) Cachar Tropical Semi Evergreen Forest (> 200 m)

The Cachar region lies to the southwest of the Diphu subdivision to the district of Karbi Anglong and since some trees are similar hence the reference. The notable varieties in this zone are Sal Mugra (Havdaickia binneta), Mani Muni (Decringea amramtchopae), Narasinga (Murraya koenigli), Jarmoni Ban (Eupatorium odratum), creepers like Bhadai lota (Pacderia scandens), and fodder plants like Durari ban (Cyndon dctylon), Kuh bon (Saccharum spontaneum) and Kanchan (Baulinia retusa). Simul (Bombaxceiba) and Bon Kapah (Abroma augusta) are found in the forest fringes as well as domestic households. (Ref. Fig.2.4)

Agriculture in the Kalyani River Basin:

The present system of agricultural practice is still very primitive. The following two methods are chiefly followed:

i) Jhumming (shifting cultivation) - practiced with hoes and spades on the hill slopes

ii) Ploughing (using manual labour) - in wet paddy cultivation with traditional ox and buffaloes on the alluvial flat lands or abandoned channels.

The varieties cultivated are:

Sugarcane, Paddy, Mustard, Ginger, Potatoes, Pumpkins, Chilli (Bhoot Jolakia), Turmeric horticulture varieties include Pineapple, Oranges, Banana, Passion fruit, Papaya and Kharif vegetables.

Cultural Background of the Kalyani River Basin:

The Kalyani River Basin with a total area of 1200 km² is covered by dense forests and situated in the Karbi Anglong – Autonomous Tribal Hill Districts of
Assam within the 6th Schedule Autonomous provision created on 17th November 1951. The region is inhabited by the major tribes of Karbis, Dimasas and Bodos. The density of population is 20.5 per km². The total number of villages in the Kalyani River Basin is 69 only comprising 2652 households. These settlements have cows, goats, buffaloes, poultry and piggeries to supplement their protein requirements. The majority of the people practice Hinduism, followed by Christianity and a minority follow Buddhism. So with this trend there are 14 temples, 4 churches and no Buddhist Hall of worship in the Kalyani Basin Area. The total number of schools are 108 from primary to secondary level. The total number of playgrounds in the region are only 16 for children, most being part of their schools. To access higher secondary level schools the children have to go to nearby Numaligarh or Bokakhat town. The literacy rate is 50.82%. The weekly markets at Dokmoka, Sammelangso, Bogijan, Chowkihola and Silonijan serve as nodal points for transport by small mechanized motor vehicles, foot, rafts along the Kalyani river or cart.

The roads from Sammelangso, Sikaribasti, Balijan Naga and the settlements in the upper reaches of the Tarapung Nadi (a tributary on the left bank) are motorable only in winter on mechanized two-wheelers. The central part of the basin is accessible only through footpaths. The eastern lowlands comprising the Kalyani Plains can be accessed by trucks for extraction of river sand from the lower course of the river channel, collection of smooth rounded pebbles for making water filters in households, collection of bamboo brought downstream as rafts from the Kaliani Reserve Forest by the locals.

There are no metalled roads traversing the Kalyani River Basin within. Footpaths and cart tracks are operational only in the dry season and the river is used chiefly to travel downstream while the locals walk back upstream to reach their villages. The Karbi Anglong Plateau has National Highway no. 36 running along its southern periphery, no.37 on its northern periphery and no.39 running along its eastern boundary. The N.H. no.36 meets with N.H. 39 at Diphu the district headquarter in the south and N.H. 39 meets with N.H. 37 at the oil refinery township of Numaligarh in the north east.