PART- I

INTRODUCTION
CHAPTER- 1

INTRODUCTION

1.1 Statement of the Problem

Rivers are dynamic entities (Knighton, 1984) and form a fundamental feature of landscape (Pett, 1983). They have their boundaries delimited by watershed within which there develop characteristics erosional and deposition features in response to the upstream control, geologic and physiographic condition, vegetation cover and landuse. A drainage basin delimited by such watersheds and being characterised by a network of drainage channels of different orders, strength and functions reflect fluvially and geomorphologically, or in a more comprehensive sense fluvio-geomorphologically, significant system of physical characters in terms of relief, slope, dissection, erosional and depositional features, and of cultural development in terms of landuse etc. Thus, a drainage basin has morphologically identifiable features of linear, areal and relief characteristics on the one hand and complex cultural development on the other. The ‘Hortonian Revolution’ in drainage basin study (1945) in the subsequent period attracted a number of geomorphologists to take drainage basin as an ideal, efficient and effective unit for geomorphological and cultural studies. Such a study was further substantiated by Leopold, Wolman and Miller (1964) by taking various aspects of drainage organizations. Chorley (1969) caught up the basin as a fundamental geomorphic unit dealing with morphologic, morphometric and morphogenetic relationship of variables. The drainage basin, for these reasons extends the opportunities to search for basic areal unit within which data can be collected, analysed and organised. Because of the importance and effectiveness of drainage basin as a unit study a number of works have been done in developed countries like Japan, the U.S.A., France and U.K. etc. The developing countries like India are not lagging far behind. In India a number of development and multipurpose projects were initiated in early part of (1960s) following the integrated development model (1958) of the United Nations. The importance of this project lies partly on the physical conditions and partly on the socio-economic ones.
Despite being a focal area of land and water resources, human habitat, effective human endeavors and development, the basin has been creating a number of problems in the arena of physical and cultural dynamics and development. In a basin drainages and their networks are seen to be the major landform producers and modifiers, though human interference with natural landscape cannot be ignored. The topographic control, specially in its upper reach extends its functional capacities over water force, while in the downstream part the topographic control yields to more hydraulic action. All this situation results in differential flows of water and sediment in the upstream and downstream areas. Moreover, floods, river bank erosion, channel migration, sheet and gully erosion, river channel congestion tend to evolve a composite physical scenario of a drainage basin. Furthermore, human interference with the differential uses of resources including land and water of the area, embraces an important place of development scenario of both positive and negative nature. Therefore, there is a need of proper utilisation of resources, physical as well as human. The need for integrated river basin development actually arises for the studies of the relationship between the availability of natural resources and their possible uses in the various sectors in a drainage basin (United Nations, 1958). Following the highland-lowland interaction model of B. Messeray and J.D. Ives, a serious scientific analysis with regard to the crucial problems related to ecological interaction between the Himalayan highland and the adjacent lowlands of the Ganga and the Brahmaputra, including the impact of human activities on the environment was done by the Department of Geography, Berne in 1979 as referred by Thomas Hoffer (1998).

Being impressed by the fluvio-geomorphic entities and dynamics, human endeavours and developments of the Pohumara Basin, the researcher has been interested to explore some of the fluvio-geomorphic characteristics of the basin so as to find out a rational meaning of geomorphology and its relationship with the landuse in the basin. The Pohumara Basin under study covers quite a substantial area of 688.62km² below the Bhutan Himalaya in the northern part of Brahmaputra valley. The basin being covered by foothills, built-up plain and chronically flood-affected areas tappers towards the Brahmaputra and extends latitudinally from 26°21'N to 26°59'N and longitudinally from 91°0'E to 91°16'E. The basin has been influenced by the river Pohumara and its
tributaries like Doisim nadi, Kokoidong nadi, Hawali nadi, and Digdari nadi etc. The Pohuraara and its major and minor tributaries together form a dendritic network of drainages having their different influences on highland and lowland areas. The channels mainly being fed by rain waters are never static; rather, the main channel viz., the Pohumara changes its course very frequently and there are historical records of such changes. Due to such changes the network has partly yielded to reticulated nature being devoid of efficient flows of water and sediment during the rainy period each year. Not only that, there are still existence of abandoned channels in addition to marshes, swamps and beels etc. along the old tracts of the Pohumara. The river has somewhere metamorphosed (Schumm, 1956) to yield a pattern of modified landform. The river oozing in the highland and flowing over both the highland and lowland have differential pattern and processes of fluvio-geomorphic significance. The sediments carried down from the highland by the river and its tributaries have developed coarse soil layer in the foothill zone. The built-up and chronically flood-affected areas have fine-textured alluvial soils.

The Pohumara Basin being a part of the Brahmaputra Valley has significantly developed categories of landuses of both simple to complex nature. While the foothills area of the basin in the north has developed forest landscape even there are ample areas lying unused. The built-up areas, on the other hand, have yielded to a variety of crops in addition to horticultural plants in the 'bastis'. Moreover, these parts of the basin have been characterised by complex pattern of human habitation, activities and areal developments in terms of roads and communications, market centers and location of cottage industries. The area is inhabited mostly by the high caste indigenous Hindus and the Muslims. There are also tribals scattered hither and thither in these areas. The land of the chronically flood-affected areas has been used mostly by the Muslim peasants of erstwhile East Pakistani origin. They use the land for raising jute, paddy, pulses, vegetable, etc. All these landuses and human habitation have a good conformity with the composite geomorphic situation of the basin and evidently there are geomorphologically developed areas of landuse systems and units.
The basin is studded with fluvio-geomorphic problems like frequent floods, sedimentation, bank migration, sheet and gully erosion, drainage congestion, etc. Also there are a lot of problems with landuses. Again there have developed some geo-ecologic problems of cultural nature related to land use, and landuse management. But the question is how to maintain eco-friendly solution of the geomorphic and geo-ecologic problems? The fertile land of the basin has been squizzed. Somewhere, it is damaged badly and somewhere becomes unuseable. Such a situation has been hampering the sustainability of the society and production of crops, etc. Moreover, the unscientific human interference with the land, water and other resources in the basin has aggravated in many places the pattern of the overall landuses. There is the need to think of how to make the land available to produce more crops to meet the demand of the ever-increasing population and to properly use the same without making imbalance between land and man. Therefore, there is the need of formulating strategies for landuses in the basin. On the above rationale in mind, the researcher has taken the problem entitled 'Fluvio-Geomorphic Characteristics of Pohumara Basin, Assam and Strategies for its Landuse Management' for investigation.

1.2 Significance of the Study

The study is supposed to be significant mainly because of the following facts:

(1) The basin under study has remained unexplored in the fields of geomorphology, assessment of land resource and its potential uses.

(2) The major task in the study relates with the understanding, identifying and evaluation of fluvio-geomorphologically developed landform features, phenomena and events, etc. on the one hand and in suggesting the ways and means for proper landuse on the other.

(3) The study is supposed to help the future generations of geomorphologists, field workers, planners, administrators and land managers and users.
1.3 Review of Relevant Literature

The studies of rivers and their basins began at the dawn of human civilization that had occurred mainly in the river plains and basins. As the human endeavour on and response to land, water and resources had increased gradually, the need for studies of river regimes also increased. As a result, a number of fluvio-geomorphologically significant problems and prospects were identified and tried for their solutions. The river regime has been so much important that a variety of studies done by workers of different disciplines, all aiming to fluvio-geomorphology for its use in the society were published in different journals and books.

The scholars, philosophers, and natural scientists of ancient times contributed a lot for the drainage basins. Herodotus, the father of history before the birth of the Christ recognised the importance of the yearly increments of silt and clay deposited by the Nile (Thornbury, 1954). He concluded that “Egypt is the gift of the Nile’. Strabo, another Greek naturalist and philosopher also studied drainage basin and rightly inferred upon the importance of the river alluvium in the building of river basin. Seneca living up to 65 A.D. observed the power of streams to abrade their valleys and basins, thus conforming to erosional development of the basin and its characteristics.

The ‘Monalisa’ famous genius Leonardo da Vinci (1452-1519) while observing drainage basin recognised that valleys were cut by streams which carried materials to deposit elsewhere. The Frenchman Guetthard (1715-1786) discussed the degradation of mountains by stream and recognised that only a part of waste materials went down the valley to build up the flood plains. Hutton (1726-1797), the father of the great law of uniformitarianism gave importance to fluvial erosion, specially on the development of river valleys by streams. John Playfair (1748-1819), a professor of mathematics and philosophy at Edinburgh studied the pattern of drainage network and their mutual interdependence while developing a system of valleys and topographic relief and slope (Thornbury, 1954. P.7). W.M. Davis, the great definer and analyst while studying landform under normal cycle of erosion argued for systematic sequence of landform development through cyclic time (Schumm, 1977). Davis (1895) emphasized the
erosional development of landform through time in his paper entitled ‘The Development of Certain English Rivers’.

Characteristics of relief features have been ascertained differently by different scholars. Glock (1932) expressed the amplitude of relief, while Smith (1932) tried to explain the nature of relative relief of an area. The relative relief was also analysed by Raisz and Henry (1937) in New England region by adopting Smith method. Another important method devised by Robinson (1948) to produce a quantitatively precise relief map from areal slope data can be mentioned here. Elliot (1953) worked to present relative relief and slope in one map. Trewartha (1957) worked on local relief and angular inclination of landform. Another scholar, G.P. Shipitsyn (1991) studied about the stages in relief evolution of the southern Koryak Highland through structural-geomorphological investigation and sediment studies of the Khakinar Ridge (Russia). The average slope was depicted by Wentworth (1930) and Strahler (1956). J. Szabo (1990) conducted a correlation study on relative relief and inclination of northern Hungarian uplands. The contributions of M.A. Pritchard and K.W. Savigny (1991), B.J. Carter and E.J. Ciolkosz (1991) in this respect are also worth-mentioning. Dissection of landform due to erosional activities of agents was studied by Miller (1949), Schumm (1956) and Dovi Nir (1957). Miller in 1948 from the chair of the 14th General Meet of the British Geographers addressed the geographers on a theme of dissection of relief and analysis of maps. A simple statistic called the ‘relief ratio’, defined by Schumm (1956) as the ratio of the maximum basin relief to the maximum basin length provides an effective analysis of the pattern of relief dissection in a drainage basin. Dovi Nir (1957) was able to find out dissection index (D.I.) as the ratio between the maximum relative relief and maximum absolute relief in a local area. Hypsometric analysis based on area and height of different-groups of elevation was used by Wooldridge (1928) and Strahler (1952).

The variation of altitude which bears a great significance in understanding geomorphic characteristics and implementation of plan and programmes was studied by Miller (1953) and Dickinson (1969).
Coming to drainage network studies one can mention quantitative analyses of channel ordering suggested by different scholars. The work of Horton (1932, 1945) marked the widespread use of channel ordering system in geomorphology. Strahler (1952) modified slightly the Hortonian drainage order model and tried for a better and effective analysis of the network pattern. Alternative systems of ordering were suggested also by Scheidegger (1961), Woldenberg (1966) and Shreve (1966). The hydrological parameter of drainage density which influenced on the drainage basin morphology was studied by Carlston (1963), Gregory et al. (1968), McCoy (1971), Gardiner (1971), Mark (1974) and Gregory (1975).

The works on drainage basin morphology and evolution as the part of a broader discussion of landforms were conducted by Leopold et al. (1964), Shreve (1966), Smart (1969) and Abrahams (1984) made statistical treatments of drainages with topological expression. Langbein (1947), Milling and Tuttle (1964) made contributions to morphometric analysis of drainage basin.

Length of stream channel brings a dimensional property which can be used to reveal various morphometric and hydrologic characteristics including networking pattern of channels in a drainage basin. Schumm (1956) while analysing the evolution of drainage systems and slopes in badlands of Perth Amboy, New Jersey adopted techniques to analyse drainage length and network. Strahler (1964) in his quantitative analysis of watershed geomorphology well described the pattern of channel networks in a drainage basin. Chorley (1969) adopted morphometric techniques applied to various parameters of channel network to explain lucidly the characteristics of a drainage basin as a fundamental geomorphic unit. Leopold, Wolman and Miller (1964) had also attempted to discern characteristics of drainage network and its relationship with geomorphometry of the basin.

Study of hydrological parameters in downstream part of a drainage basin is found to be always important as they have their manipulating effects on the character of river environment. In this respect studies of Leopold and Maddock (1953), Leopold and Wolman (1957) and Rozovskii (1957) deserve mentioning.
Callender (1978), Chang (1979), Yang et al. (1979), Burnett et al. (1983), Hickin (1983) and Yang, et al. (1988) also attempted to work on the line.

The studies on relation of discharge parameters with drainage area are also found to take vital position in the study of fluvial geomorphology. Such a type of study deals with the mechanics of the drainage basin. The river mechanics have been discussed extensively by Leliavsky (1955). Crickmay (1974) in his book on “The Work of the River” had discussed and explained the fluvial dynamics of the river in a more clear and vivid way. Wain et al. (1994) in their paper entitled “Diurnal River Flow Variation and Development Planning in the Tropics” tried to analyse water levels by using stage-discharge relationships in order to assess water resources availability for development planning in some areas of Kenya.

Studies of floods as a geomorphic agent have, of late, initiated a new vista in fluvio-geomorphology. Stochastic approaches to flood analysis were formally introduced in 1914 by Fuller when he presented a discussion of flood frequencies and used the return period as a measure of the probability of recurrence of floods of different magnitudes (Fuller, 1914). This concept soon expanded into the use of theoretical probability distribution functions to describe the actual frequency distribution of the floods (Foster, 1924; Hazen, 1930; Gumbel, 1941). Such studies are still in active use, what might be referred to as standard probabilistic flood frequency analysis (U.S. Water Resources Council, 1981)

Numerous methods for calculating the best estimates of flood frequency have been evolved. The worth-mentioning works are due to Jarvis and others (1963) and Benson (1962), etc. This group of workers recommended that all the U.S. Government Agencies should adopt the Log-Pearson Type III distribution as the base method in order to achieve an uniform procedure for computing flood estimates.

The nature of hydrographs may be used to evaluate the morphometric characteristics of a basin. It is found that the time gap to produce hydrograph peaks would vary with basin shape. Strahler (1964) gave a general idea about the shape of hydrograph and basin morphometry. Sherman (1932), Taylor and Schwartz (1952),

Another important investigation has been carried on to account for floods and their estimates in broad perspective. The worth-mentioning works in this context are of Langbein (1949), Chow (1954), Wolman et al. (1960), Benson (1962), Beard (1962), Irish (1977) and Acreman (1985), etc. Another work was done by Walsh, Davis and Musa (1994) to analyse the nature and history of flooding problems at Khartoum since the early nineteenth century A.D. They examined the conditions of flood problem by using archival flow, river height records and historical sources. They also stated that the flooding consequences for greater Khartoum would be very serious, not only because of extension of settlements into the low-lying land prone to flooding by the Nile or ephemeral rivers, but also because of run-off responses to rainfall, particularly within the capital region.

Knowledge of sediment transport in alluvial channels maintains a good record in the chapter of fluvial geomorphology. The ability of a stream to transport bed material is relatively small along the river channels where bed roughness consists of ripples and/or dunes. In the upper regime of flow the streams are capable of carrying much larger volumes of sediment per unit volume of water. This has been suggested by Simons et al. (1965), and Bishop et al. (1965).

The processes involved in erosional and depositional activities and their nature in an alluvial channel are found to carry significant studies. Study of this line goes to Coleman (1969), Carson (1985), Galay (1987), Gardner et al. (1993), and Cenderelli et al. (1998). The sediment left over the basin by the rivers through their water discharges forms fundamental aspect of geomorphic studies.

Schumm (1954) has plotted mean annual sediment loss in acre-feet as a function of the relief ratio for a variety of small drainage basins in the Colorado-Plateau Province of the U.S.A. Gelbert (1914) analysed the transportation of debris by running water. Yang (1973) tried to interpret in his paper the incipient motion and sediment transport. Contribution about the discharge and sediment supply controls on erosion

The balance between input and output of sediment and discharge is found to have a strong impact on basin geomorphology. Such a study in the purview of open system was made by Chorely, et al. (1962), Strahler (1964), Schumm and Lichty (1965), Slaymaker (1966). The study of steady state condition in the context of geomorphic processes and time was worked out by Schumm and Lichty (1965).

Measurement of channel flow bears a great significance in geomorphological studies as stream flow comprises a major component of output in a drainage basin system associated with erosion and transportation of sediment and solutes. Detailed measurement of flow processes and their variables are complex.

A competent mean velocity otherwise known as the competent bottom velocity which is just able to move the material of a given size and specific weight was handled by DueBat in 1786 and Bauniceau in 1845 as mentioned by Grade and Ranga Raju (1995).

In India geomorphological and hydrological aspects of study have been carried out by different scholars. The quantitative geomorphological and hydrological aspects of study have been made for interpretation and interrelationship of basin parameters by Gupta et al. (1965); Ghose, Pandey, Singh and Lal (1967); Singh and Kumar (1969). A study about the morphological analysis of River Terraces of the Subarnarekha Basin was conducted by Mukhopadhyay (1973). Pal (1974) made a commendable work on the 'integrating field work' in geomorphology. Another set of names can also be mentioned here who made intensive studies in the field of basin geomorphology. They are Singh et al. (1993), Jawahar Raj (1998) etc. About the influence of lithological and terrain characteristics on slope development was described by Davendra Kumar (1996).

A significant aspect of geomorphological study is related to the ravine erosion in India. In this branch contributions have been made by Gorrie (1957), Ahmed (1968, 1970), Sharma (1968, 1976, 1980), and Gadkary and Rao (1955). Ahmed (1968) and
Sharma (1968, 1980) had given a new dimension of the problem and suggestions of the ravine erosion in the country under different ecological settings.

Flood hydrology has also been duly weighted. Analysis of channel dynamics, floods and their impact on different aspects of drainage basins are demonstrated by Kale, Dhar, Sinha and Jain, Wohl and Cenderelli, Seth and Garde (1998) as mentioned in the book entitled ‘Flood Studies in India’ edited by Kale (1998).

Study of landuse in an area bears a great significance in the chapter of applied geomorphology. The landuse pattern of a region not only depends on climate but also on geomorphology or physiography. In abroad Haggett (1961) in his paper Landuse and Sediment Yield in an Old Planation Tract of the Sena do Mar, Brazil' expressed his views on the relationship nicely. Kamp (1968) made a study for Denmark to analyse the Agro-geographical divisions and time factor related to them. Dunne (1979) made an interpretation of the characteristics and relationship of sediment yield and landuse in tropical river catchments.

In India notable works on landuse and geomorphology have been done by many scholars. Ghose et al. (1965) in their paper observed the relationship of geomorphology and landuse in Kitnod village based on Areal Photo-Interpretation and Analysis of land. Sharma (1979) contributed in this field by developing his paper on ‘The Physiography of the Lower Chambal Valley and Its Agricultural Development.’ Raghavaswamy et al. (1980) in the paper ‘Morphology and Land Systems of a Part of Visakhapatnam District, Andhra Pradesh’, tried to analyse the relationship between the physical characteristics of land and its user. Samba Siva Rao (1981) also contributed in the field of morpho-agricultural region. Mokhopadhyaya (1986) studied the relationship between landform and landuse in the Kangasabati Basin. Singh et al. (1992) made an attempt to follow the dictum set in Morpho-Agricultural regionalization of Belan-Son Interstream Region of the eastern Rewa Plateau. Another related study was done by Bannett (1943), Iyer et al. (1977), Raghavaswamy et al. (1980), Rai (1980) etc.

In North-East India a number of works are done by many scholars and researchers. They contributed works on various aspects from morphometric analysis to

Slope on population distribution and land-use in the Boko Thana area was done by Sarma and Bhagabati (1989). Work on the relationship of geomorphology and landuse in the Meghalaya was done by Singh et al. (1995). Landuse in North East India and Pagladia-Puthimari Basin was done by Das and others (1986, 1989).

1.4 The Objectives of the Study

The major objectives of the study may be outlined as:

(i) To examine the physical and hydrological bases in terms of geological foundations, soil, climate and vegetation conditions, earthquake events, drainage and water bodies and underground water conditions as the causes of fluvio-geomorphic development of the Pohumara Basin.

(ii) To examine morphometric characteristics of landforms of the basin in terms of relief, slope, dissection, hypsometry, drainage network, channel meandering and shifting patterns, etc. and processes.
(iii) To examine the hydraulic characteristics in terms of water discharge, flood frequency and the width, depth and velocity in channels and the sediment characteristics in terms of bed and bank materials.

(iv) To identify and evaluate the fluvio-geomorphic processes responsible for morphometric development of landform and hydrologic regimes.

(v) To examine the social bases of the basin in terms of population distribution, density of population, communitywise distribution of population, etc.

(vi) To evaluate the existing pattern of landuses in the basin in respect of land quality, land unit, cropping intensity problems of land uses, etc.

(vii) To examine historical development of landuse and the need of better landuse and land management.

(viii) To suggest for assessment of landuse problems and prospects and to formulate the strategies for mitigation of geomorphic and landuse problems.

1.5 Research Questions

In order to follow up the objectives, some research questions are also formulated as stated below:

1. How did the Pohumara Basin evolve and develop from geological point of view?

2. How do edaphic, vegetation and climatic conditions and physical characteristics in terms of relief, slope, drainage, etc. act as the bases of fluvio-geomorphic action, interactions and development?

3. Are there differential relationships of base material structure and composition and the process functions with the varying landform development of the basin?

4. Are there any endogenetic causes of the recent past to affect and modify the landform of the basin?
5. Are there distinguishable geomorphological micro units in the basin characterised by differential landform developments due to differential fluvial actions?

6. Are the drainage network characteristics in terms of length, area, density, frequency and channel patterns quite different in different morpho units?

7. Is the Pohumara Basin differentially dissected by streams to ooze out significantly different dissection units on different relief and slope categories?

8. Is the Basin a deadly flat plain characterised by graded surface because of continuous levelling by erosional and depositional activities of the river and floods?

9. Are there any differences of hydraulic and topographic influences towards the development of topographically and hydraulically significant landforms according to their locational conditions?

10. Is their any deviation from the normal condition of sediment assortment on the bed and banks of the river Pohumara?

11. Is there any historical development of human habitation and landuse in the basin to affect and effect landuse from simple to complex one?

12. Is there any relationship between landforms and existing landuse in the basin?

13. Are there any significant problems of landuse from geomorphic point of view?

14. Keeping in view the picture of the existing landuses and conditions of availability or otherwise of lands in different morpho units can we conceive of better prospects of more productive landuses and their proper management?

15. For achieving the required goal of better landuses can one formulate strategies to administer, manage, conserve and protect land and landuses?
1.6 Scope and Limitation of the Work

The researcher while conducting the work on the Pohumara River Basin had to face a number of problems right from the preparation of base map to the representation of the data. As the study area partly lies on Bhutan there arises the problem of getting a complete detailed topographic map of the basin. Moreover, the toposheet of this area are not easily available because of governmental restrictions. Again there are strict restrictions even to move upper catchment of the area and the foothill areas of the basin because the area is infested by extremist and terrorist activities. So the researcher finds difficulties in collecting information and data of the basin. As regard secondary data, the Government agencies were not found to be easier with the motive of the researcher. Again many of the information stored by such agencies bear doubt about their accuracy levels. Therefore the researcher had to search for the levels for accuracy and presentable form. The Pohumara Basin has its micro geomorphic units having their own distinctiveness in their natural and cultural landscapes. The researcher finds difficulties with collecting data and information of both the physical and cultural nature including the variations of landuses. However, the researcher tried her best to present the work with an appropriate data base giving due considerations on data manipulation and data generation. Again the work lacks in the use of sophisticated instrument or the technique. But the researcher did her job to bring out the reality of geomorphic surfaces and landuse characteristics in the basin by using no such sophisticated instruments.

1.7 Methodology and Database

The study is based on empirical-analytical method of investigation. The various steps of the study are mainly categorised into three stages, viz. (1) Pre-field work, (2) Field work and the (3) Laboratory work.

(1) Pre-Field Work

In this stage or work the formulation of the present title is made with reference to the consultation of relevant books, journals, bulletins, souvenirs, maps, etc. In this
stage a number of base materials are collected and compiled as data based from Indian
topographical sheets of 1:63360 and 1:50,000. Also a working bibliography is prepared
for convenience of the work.

(2) Field Work

This stage of work includes (i) visit to the study field (ii) Collection of the
primary data especially on bed and bank materials. In this stage measurements of
channel width, depth and water velocity on the one hand and the relevant information
as regards floods, erosion, river bank migration, sand deposition are taken (iii) Data and
information of secondary nature as regards water discharge, sediment quality, rainfall
and temperature conditions on selected stations are collected from sources like
Brahmaputra Board, Govt. of India, Flood Control and Irrigation Department, Govt. of
Assam, at Guwahati, Barpeta Road and Pathsala, Meteorological Department, at
Guwahati, etc. Data on landuse, agricultural production and population are collected
from Census Hand Book, etc. along with the offices of the Sub-Deputy Collectors,
Block Development Officers, etc.

In this stage primary data and information relating to also of different categories
of landforms and population are collected from the randomly identified households of
the most respective villages by using standard schedule and questionnaires.

(3) Laboratory Work

This part of work deals with the processing of the raw data collected form
primary as well as secondary sources by using simple quantitative and hydrologic
principles and methods. The samples of bed and bank materials collected from field are
treated in the laboratory to sort out grades of sediments by using sieveing techniques.
Necessary maps and diagrams are than drawn in order to depict a number of themes
related to geomorphology, population and landuse conditions of the basin. Finally, the
thesis is prepared based on the analysis of the data, information, maps, diagrams, etc.
1.8 Organisation of the Thesis

The work is organised under three main parts, viz., (i) the preliminaries (consisting of acknowledgement, contents, etc.), (ii) the main text and (iii) the reference materials (containing bibliography, appendix, etc.). The main text, further, contains three parts, such as the introduction part spread over the 'Introduction of the problem' including the introduction of the study area. The part two contains six analytical chapters including (i) physical and hydrological bases, (ii) Social bases, (iii) morphometric characteristics of landform in the basin, (iv) hydraulic and sediment characteristics, (v) impact of geomorphic processes on landform, (vi) existing pattern of landuse in the basin and (vii) strategies for landuse management. The last part covers up the synthesis of the work providing summary, findings, conclusion and prospect for further studies.

1.9 Local Terms and Terminology used

Ahu - A paddy generally sown by broadcasting method during month of February to March and harvested during June to August.

Bananchal - Forest land.

Bao - It is a variety of paddy sown by broadcasting during the month of February to March in the lowlying areas. It stands in the field for long ten months and is harvested in the month of December.

Bari or Basti - The dwelling compound is known as bari or basti in Assamese.

Beels - Naturally developed water-logging shallow areas where local fishes live.

Bodo - A large group of aboriginal people of Assam belonging to Tibeto-Burman family living largely in the parts of lower Assam at present time.
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Bordoichila</td>
<td>An Assamese word originated from Bodo word ‘Bordoichikhla’. It is the local name given to the westerly disturbances occurred with strong storms before the advent of the monsoon wind.</td>
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<tr>
<td>Bunds</td>
<td>Dams or embankments constructed along the banks of the rivers to check flood effects to the land and people outside the river banks.</td>
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<td>Chaparis</td>
<td>The river islands formed of sands and covered by grass or thatch, subjected to frequent inundation by floods.</td>
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<tr>
<td>Charlands or Chars</td>
<td>The riverine sandy areas that remain bare or covered by grassland of sparse vegetation. These areas are frequently inundated by flood.</td>
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<tr>
<td>Dhari</td>
<td>A mate prepared by small elongated sheets made of reeds.</td>
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<td>Kharif</td>
<td>The summer crops.</td>
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<tr>
<td>Nekheri</td>
<td>A kind of aquatic nut-like fruit eaten by man.</td>
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<tr>
<td>Pati</td>
<td>A mate prepared by small elongated sheets made of leaves of tall aquatic grass of hard variety.</td>
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<tr>
<td>Rabi</td>
<td>The winter crops.</td>
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<tr>
<td>Reserve Forests</td>
<td>Forestland declared by the government as reserved for the protection of trees, and conservation of forest resources.</td>
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<tr>
<td>Sali</td>
<td>The winter variety paddy.</td>
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<tr>
<td>Schedule tribe</td>
<td>Some groups of tribals classified in India.</td>
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<tr>
<td>Scheduled caste</td>
<td>Some groups of background non-tribal people of India.</td>
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<tr>
<td>Sub-division</td>
<td>A division of district.</td>
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<tr>
<td>Tribal belt</td>
<td>Belt where tribal people are concentrate heaving and protected by law.</td>
</tr>
<tr>
<td>Village</td>
<td>A revenue unit comprising some households.</td>
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