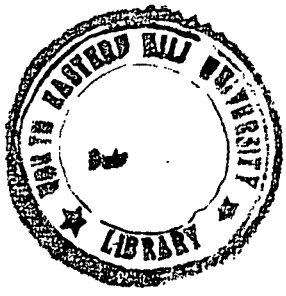
PATTERN OF LAND HOLDING AND AGRICULTURAL PRODUCTIVITY

A. Case Study Of Upper Brahmaputra Valley Of Assam

HAREN SAIKIA

THESIS SUBMITTED FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY (Ph. D.) IN GEOGRAPHY



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CERTIFICATE

Certified that the thesis entitled **PATTERN OF LAND HOLDING AND AGRICULTURAL PRODUCTIVITY : A Case Study of Upper Brahmaputra Valley of Assam** submitted by **Mr. HAREN SAIKIA** for the **Degree of Doctor of Philosophy (Ph.D.) in Geography** is a bonafide study to the best of my knowledge and belief. Other academic studies referred to and cited in the thesis have been duly acknowledged.

The thesis may be placed before the examiners for due evaluation.

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C O N T E N T S

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Haren Saikia

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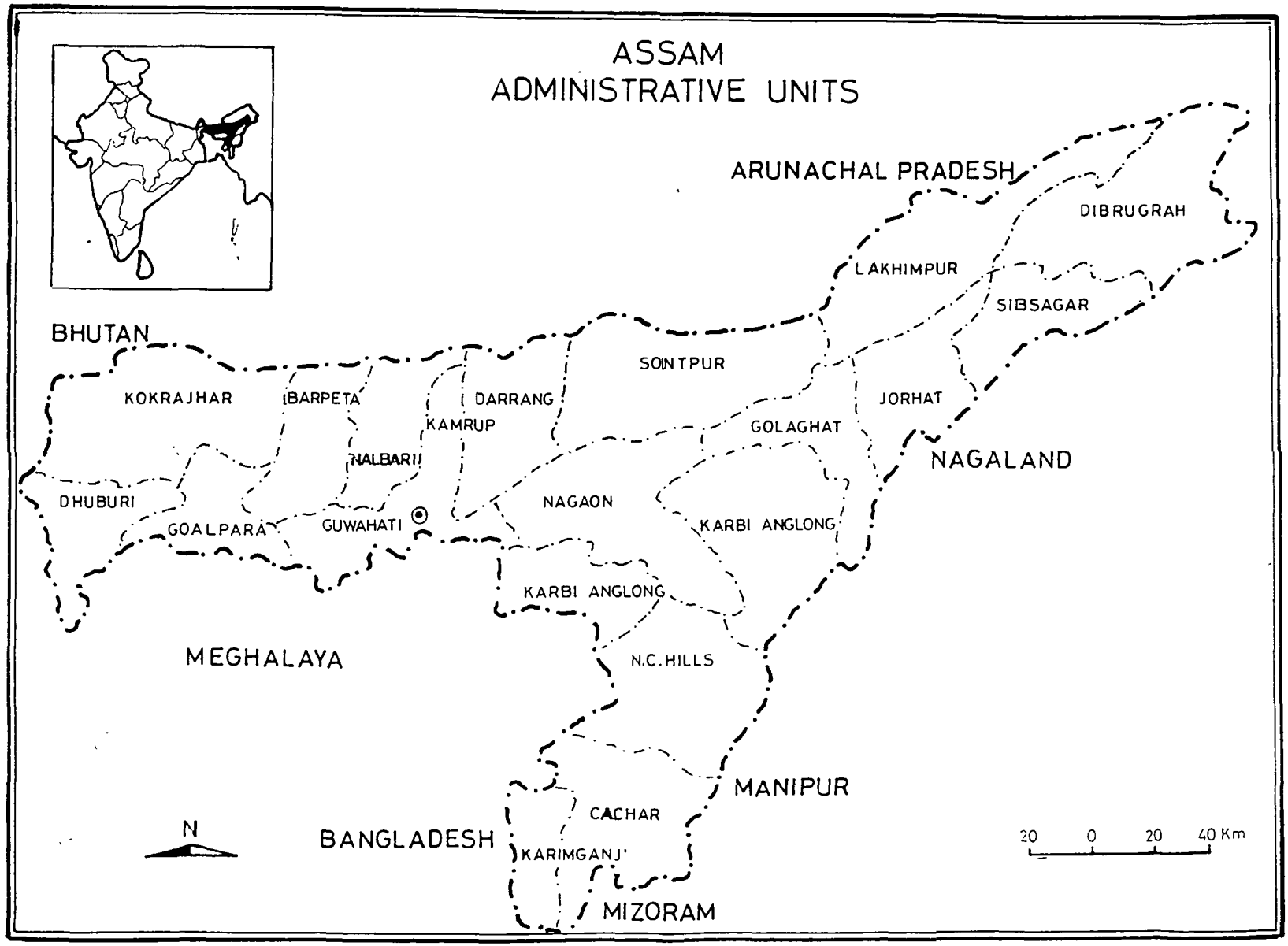

ASSAM
ADMINISTRATIVE UNITS
ARUNACHAL PRADESH
DIBRUGRAH
LAKHIMPUR
SIBSAGAR
BHUTAN
SONTPUR
KOKRAJHAR
BARPETA
DARRANG
JORHAT
KAMRUP
GOLAGHAT
NALBARI
NAGALAND
DHUBURI
NAGAON
GOALPARA
GUWAHATI
KARBI ANGLONG
KARBI ANGLONG
MEGHALAYA
N.C.HILLS
MANIPUR
CACHAR
N
BANGLADESH
KARIMGANJ
20 0 20 40 Km
MIZORAM

Fig. 1

I

INTRODUCTION

1.1. Statement of the Problem

Agriculture is the most extensive form of human occupation where half of the world's population earns its livelihood. Agricultural Geography, dealing with the spatial organisation of crops and their concentration, provides an interesting field in which geographers can play a vital role for well being of the society.

The process of economic development inevitably entails effort to raise productivity in the agricultural sector so that not only a small working force can produce enough food for the rest of the

society, but also to release a big chunk of its working hands to join the industrial sector. Thus raising agricultural productivity forms one of the most important tasks of most of the developing countries aiming at a quicker pace of economic development. In India, efforts have been made to raise agricultural productivity by raising more and more land under cultivation in its early decades of planned development. However, it is soon realised that emphasis has to be laid more on productivity than production. All out efforts were made to increase productivity of land by way of introducing improved varieties of seeds, mechanization and other modernized methods of cultivation popularly known as "Green Revolution" in the history of post-Independent India by the late sixties. But it was seen that the effects of Green Revolution were highly localised and in the large parts of the country, its impact was minimal.

Agriculture is the most dominant sector of the Indian economy and crop production occupies the most important part of the agriculture. The agricultural sector was most neglected during the colonial rule and immediately after the Independence food became the prime concern of the National Government and it became

most necessary to pay attention to increase food production on a priority basis to feed the ever growing population of the country.

Indian food production increased from a bare 55.6 million tonnes in 1950-51 to 115.0 million tonnes in 1984-85 showing a considerable increase in the productivity of crops. The per hectare average yield of rice in India increased from 668 kg. in 1950-51 to 1425 kg. in 1984-85. Similarly in case of wheat, it increased from 663 kg. to 1873 kg. during the period. This indicates only the spectacular achievement of crop production during the last 35 years, i.e., from 1950-51 to 1984-85.

It is true that one cannot expect a uniform pattern of agricultural development in a country like India, with wide variation in natural, economic, cultural and historical conditions. But the objectives of Agricultural Planning failed to achieve the balanced regional growth in the agricultural sector, as a result of which, a wide inter-state differences of growth of agricultural production was noticed. The growth of agriculture was highly localized in some areas of the country. States like Punjab, Gujarat, Tamil Nadu and Haryana has much higher rate of growth than most of the

other states of the country.

The development of agriculture without structural changes is a difficult task. This difficulty is more pronounced in countries with high population growth and high pressure of population on land. All these contributed to a regional disparity or regional imbalances in the rate of growth of crop output and productivity. This aspect has drawn the attention of both the agricultural planners and scholars and it is now accepted that the various national level plans and programmes would be limping without proper location of specific schemes and plans on the basis of agricultural regions. Macro-economic magnitudes and approaches do not give deeper insight into the problems of agricultural development in India and, therefore, planning should be extended to lower level units, i.e., agro-climatic and agro-economic zones.

Assam has a strong agro-climatic base yet its economy in general and agriculture in particular is not showing satisfactory performances. A low level progress in the primary sector of this region has resulted in many socio-economic problems. Agriculture is the principal source of livelihood for a majority of

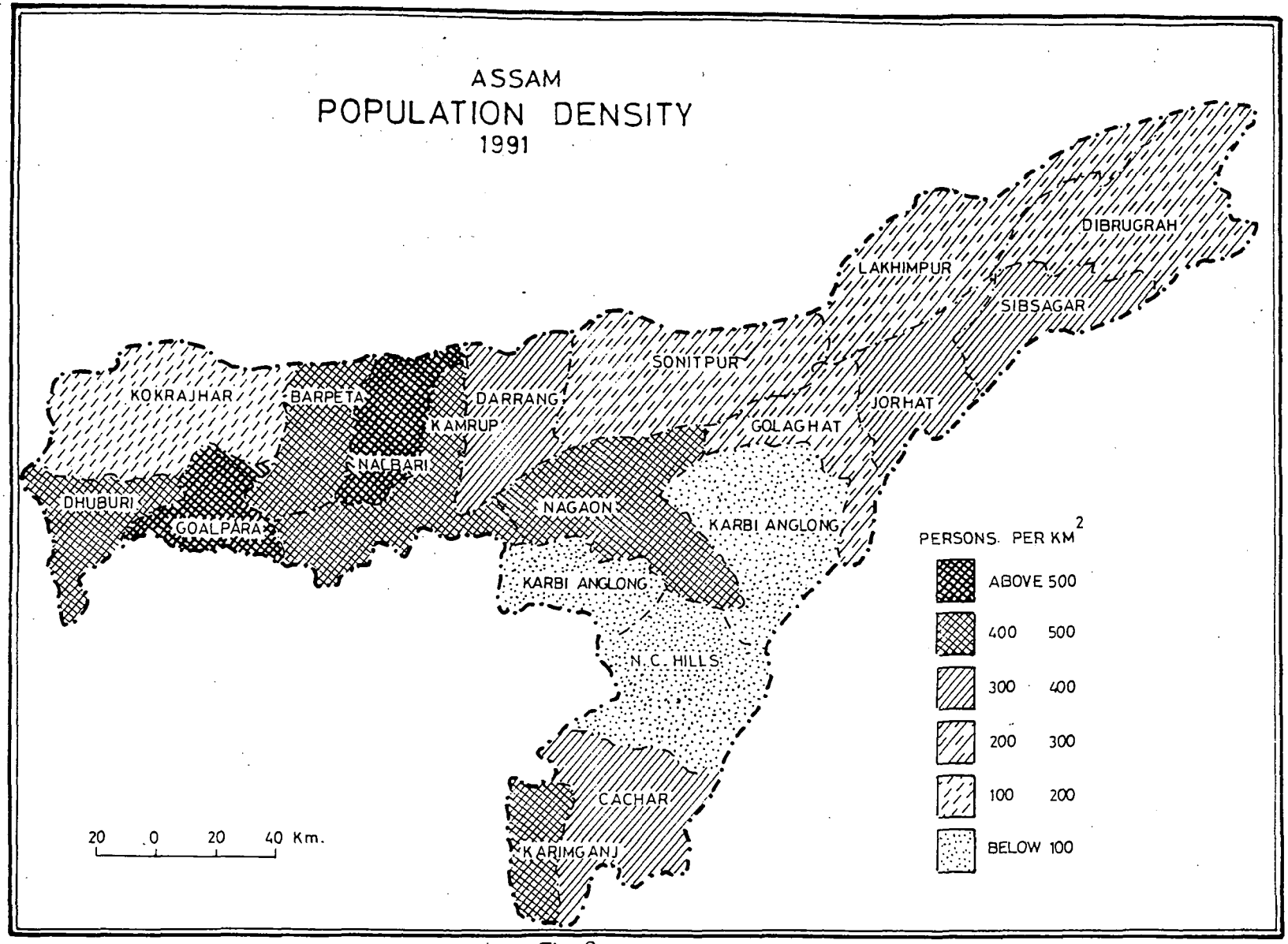

ASSAM
POPULATION DENSITY
1991
DIBRUGRAH
LAKHIMPUR
SIBSAGAR
SONITPUR
KOKRAJHAR
BARPETA
DARRANG
KAMRUP
JORHAT
GOLAGHAT
NALBARI
DHUBURI
GOALPARA
NAGAON
KARBI ANGLONG
KARBI ANGLONG
N.C. HILLS
CACHAR
KARIMGANJ
20 0 20 40 Km.
PERSONS PER KM2
ABOVE 500
400 500
300 400
200 300
100 200
BELOW 100

Fig. 2

the people in the rural areas of Assam. The agricultural sector is so important to the state's total economy that it alone contributed 56 per cent to the state's total income at the current price in 1985-86 as compared to 45 per cent for India as a whole. Agriculture has another most important role to play. It acts as the main absorber of the working population as it engages as high as 77 per cent of the total working population in the state. In fact, the average yield of cereal and non-cereal crops in Assam is much lower compared to that of other states, the technology deployed in agriculture is traditional and diffusion of innovations is insignificant. Although Assam ranks seventh out of the twentyfive states in India in terms of per hectare productivity, it is not an impressive record considering the potentiality of its arable land and natural endowment. About half of the total districts (undivided) i.e., Darrang, Goalpara, Kamrup, Nowgong, Lakhimpur and Dibrugarh of Assam has very low agricultural productivity per hectare of land. It is obvious that the present agricultural potential of the state is highly under-utilized and much remains to be done.

1.2. Literature Survey

Systematic and scientific study of Agricultural Geography is of very recent origin. It was only the beginning of the second half of this century, when the real work in this branch of Geography started. The work of O.E. Baker, Olaf Jhonson, Clarence F. Jones, Samuel Van Valkenburg and Griffith Taylor[1] had been considered as significant contribution to the field of Agricultural Geography during the inter-war period. Most of these pioneer works were mainly devoted to agricultural regionalisation in order to establish the broad spatial pattern of this activity.

In recent years, schools like, W. Bunge, Buchanan, Blaut, Brookfield, Franklin, Reed and Redfield have influenced the conceptual approach to agricultural problems in theoretical Agricultural Geography.[2] The methods of Agricultural Geography have been benefitted from the "quantitative revolution" of the fifties, and computerisation of large amount of data has opened up a new vista of research possibilities.

Another approach of model building to the study of agricultural activity was initiated by a German scholar Von Thunen[3] in the early 1826. His model of

agricultural land-use was based on the decline of locational rent with the distance from market. Based on this theory, he predicted a concentric series of agricultural zones around a central city. Von Thunen's model drew attention of some scholars like Hoover, Losch and Dunn[4] who used the framework of it as a basis for normative model. The other outstanding models of Agricultural Geography are Weaver's model which attempted to set up a quantitative technique for the classification of agricultural regions.[5] The input-output model by Leontief as a method of analysing natural economics and later used for the analysis of agricultural activity by Peterson and Heady.[6] The diffusion model of Hagerstrand developed to describe the diffusion of an innovation over space.

Apart from these models, sophisticated techniques were to be used by the modern geographers in the field of Agricultural Geography. Advanced techniques and conceptual models had further been developed for specialised studies in plantation and peasant agriculture. The work of H.F. Gregor on plantation agriculture and that of S.H. Franklin on peasant agriculture are noteworthy in this context.[7]

Another line of approach to the study of Agricultural Geography by the most recent geographers

is to search for the most legical and meaningful structure which helps categorize and represent variations of agricultural practice on a global scale. Spencer and Stewart have attempted to recognise generic forms and kinds of agriculture and their potential valaue as a basis for differentiation of world agricultural systems.[8]

Works on Agricultural Geography done in India is not intensive inspite of its crying necessity.

M. Shafi has divided the works of the Indian geographers in the field of agriculture under the heads of (a) Regional agriculture, (b) Food and commercial crops, (c) Agricultural problems and planning and (d) Food supply and population.[9]

The work of B.N. Mukherjee and P. Dayal on agricultural regionalisation in Meerut district has assessed carefully the importance of food crops, commercial crops and land tenure system.

Some interesting papers on agricultural problems and planning were brought out by S.P. Chatterjee, M. Shafi, S.S. Bhatia and B. Banerjee[10] in the beginning of the sixties to the early seventies.

Available data and studies on agricultural development in Assam suggest that the growth of crop output and productivity in Assam during the past years was not satisfactory. Works on agricultural Geography in Assam are still in the initial stage.

Assam Agricultural Commission (1975)[11] had reviewed the progress of the agricultural production in Assam and observed that the method of cultivation in the state, by and large, remained traditional and increase in total output was mainly due to increase in area under crops.

The Indian Council of Social Science Research (ICSSR) study on North-East India by Goswami and Phukon (1982)[12] indicates that studies on agricultural economy of Assam are limited in number. Most of the existing studies are partial and deal mostly in macro-level problems. Nevertheless, these studies provide valuable informations for understanding problems of rural areas. The studies carried out by the Agro-Economic Research Centre (Assam Agricultural University) for North-East Region helped in comprehending the agro-economic problems of the region.

The first study on Agricultural development in Assam was made by Saha (1975)[13] from 1950-51 to 1973-74

obtaining data from Directorate of Economics and Statistics, Government of Assam and other agencies.

A districtwise study on agricultural development by Phukon (1980)[14] for 1950-51 to 1975-76 give valuable information on the agricultural economy of the state.

M.M. Das (1984)[15] in his published doctoral thesis, "Peasant Agriculture in Assam" presented the structural analysis of peasant agriculture in Assam. Das has earned the fame of being the pioneer agricultural geographer of the region. He has meaningfully discussed in detail the spatial and temporal patterns of the peasant agriculture in Assam and very complicated processes involved with it from the structural stand point and tried to build a normative model for rational development of the sector. His treatment of the socio-economic-cultural-institutional complex of the state's agriculture is quite interesting and is indicative of his direct personal involvement with the peasant society and its problems.

The study of Economy of farm management in Nowgong district of Assam by Goswami and Bora[16] provided some basic information on input use and

production of crops in the district.

In a ecology-oriented study, Taher[17] successfully analysed the physical basis of agricultural planning in the Brahmaputra Valley and correlated the patterns of cropping with different ecological settings.

Nath[18] in a micro-level study gave a detailed analysis of the agricultural development in the Mangaldoi Region since 1961. Kakoty[16] traced the pattern of adoptation of agricultural innovation and its effects on the agrarian change in the Bajali Block of the Barpeta district. Chattaraj[20] in his study "Emerging Pattern of Agricultural Land-Use in Kamrup District" analysed the spatio-temporal changes in general land-use and cropping pattern of Kamrup district and also the study highlighted the pattern of inequality of landholding size and land utilization in six sample villages. Sahu[21] in his study "Diffusion and Distributional Pattern of High Yielding Varieties of Rice in the various Size of Holdings in the Lower Brahmaputra Valley" studied the diffusion pattern and performances of high yielding varieties of rice in the various size of holdings in the Lower Brahmaputra Valley and ascertained the influence of the physico-socio-economic factors on the spread of high yielding

varieties of rice. Mipun[22] in his study "Immigrants and the Agricultural Changes in the Lower Brahmaputra Valley" studied the pattern and extent of influence of immigrants among the indigenous farmers of the region and also the impact of immigrants in the distribution of output in the agricultural sector.

1.3. Objectives and Hypotheses

There are extremely few studies which have been conducted on landholding pattern and agricultural production in the North-Eastern Region of India. This is understandable from the context and concept of holding in the region which significantly differs from the rest of the country. In the light of new strategy adopted by the Government of India during 1966-67 for agricultural development, the individual operational holdings assumed special significance in India as the unit of decision-making. It became more important as the agricultural census centred around the operational holdings. The study, therefore, is undertaken with the following main objectives :

i) to assess the nature and extent of inequality in the distribution of landholding among various segments of the population;

ii) to examine the technology, economic and social factors alongwith the physical landscape of the region which are closely related to the agricultural productivity under different agro-climatic conditions;

iii) to examine the specific nature of the relationship which exists between the pattern of landholding and productivity in the study region;

iv) to develop insights into various programmes on agricultural plannings and policies and suggest necessary reformative measures aiming at better productivity of land.

In order to achieve the above objectives the following hypothesis are proposed and an attempt has been made to test these hypotheses in the course of this research work :

i) the farm sizes in Assam are quite uneconomic with little capacity of extension which acts as a critical limiting factor for the agricultural growth in the state;

ii) because of traditional mode of agriculture the farmers of Assam have been adversely affected by various natural calamities;

iii) since there is very less impact of Green Revolution in Assam, the small farms are comparatively more effective than the large farms;

iv) there is a serious misuse of family labour in Assam because of small farm size;

v) most of the farmer, do not utilize their small plot of agricultural land intensively.

1.4. Sources of Data

The data used for this study have mostly been obtained from secondary and primary sources through extensive field survey. All together 200 farm families are taken into account well-distributed over all the districts of the study area which comprises of five plain districts of the Upper Brahmaputra Valley of Assam. The other sources of data are the published and unpublished records of the state's reports on agricultural census, Government of Assam. Apart from these sources, information have been obtained from census reports of India and various periodicals and other sources.

1.5. Study Area

The present study pertains to the Upper

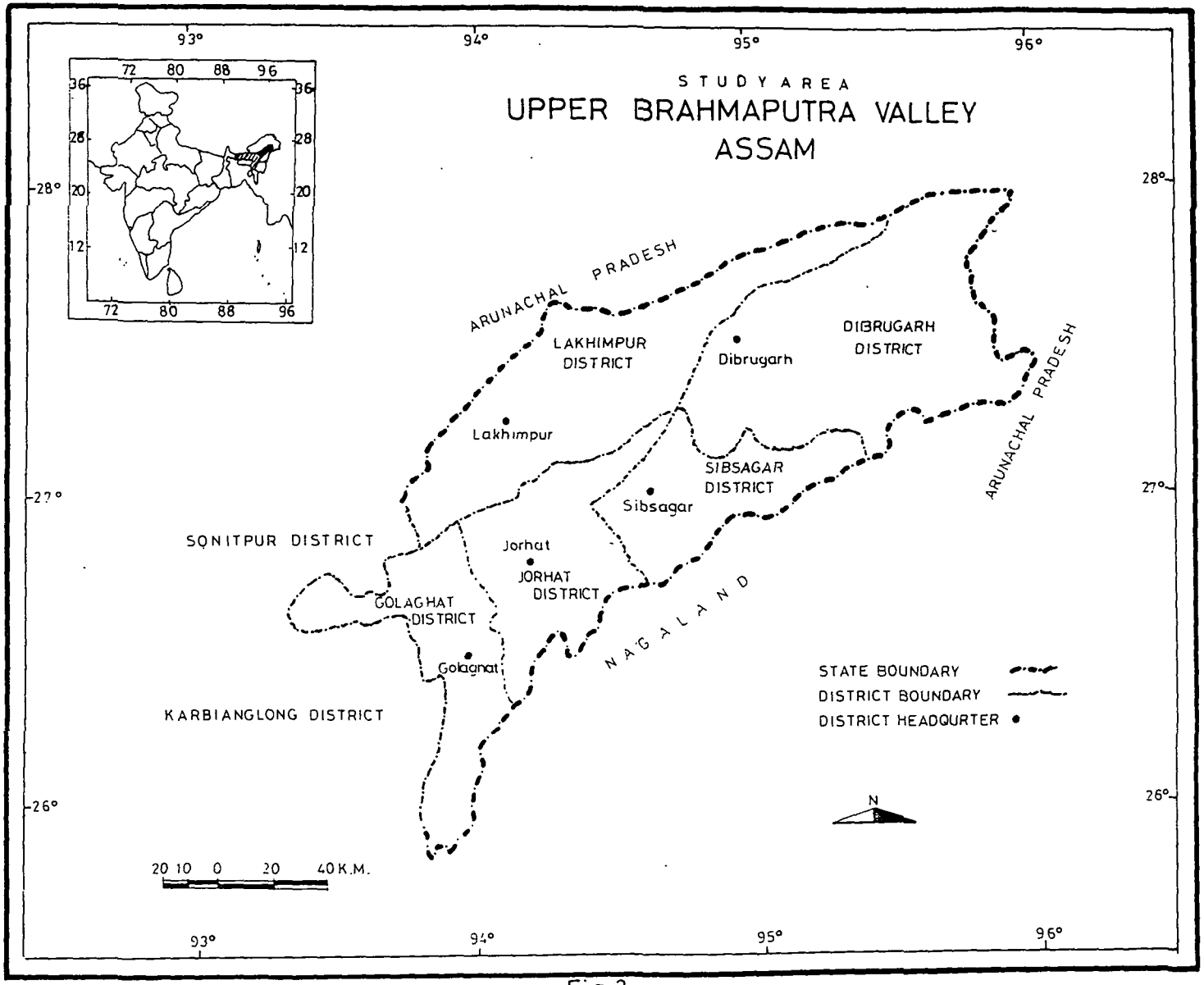
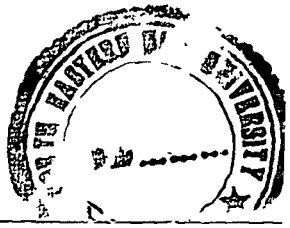

STUDY AREA
UPPER BRAHMAPUTRA VALLEY
ASSAM
93°
94°
95°
96°
28°
27°
26°
72 80 88 96
36 28 20 12
ARUNACHAL PRADESH
LAKHIMPUR DISTRICT
Lakhimpur
Dibrugarh
DIBRUGARH DISTRICT
SIBSAGAR DISTRICT
Sibsagar
Jorhat
JORHAT DISTRICT
GOLAGHAT DISTRICT
Golaghat
SONITPUR DISTRICT
KARBIANGLONG DISTRICT
NAGALAND
STATE BOUNDARY
DISTRICT BOUNDARY
DISTRICT HEADQURTER
N
20 10 0 20 40 K.M.

Fig. 3

Brahmaputra Valley of Assam, which is one of the fertile regions of India. It comprises of five plain districts of Assam, viz., Lakhimpur, Dibrugarh, Sibsagar, Jorhat and Golaghat. The mighty river Brahmaputra passing through the study region making it very fertile.

The study area extends from 25°12' to 28°0' north latitudes and 93°20' to 96°0' east longitudes surrounded by Arunachal Pradesh to the north and east, Nagaland to the south and the districts of Sonitpur, Nowgong and Karbi-Anglong to the west. There are five districts in the region at the time when this work was undertaken in the year 1986. But at present with the creation of two new districts, viz. Dhemaji and Tinsukia the total number of districts in the valley increased to seven.

The total geographical area of the Upper Brahmaputra Valley is 21.67 lakh sq. km. The total population of the study area is 57.88 lakh with 30.13 lakh males and 27.65 lakh females which is 25.96 per cent to the total population of Assam according to 1991 census. The decadal growth of population in the valley was +27.63 per cent against +34.95 per cent of the state as a whole during the period of 1961 to 1971.



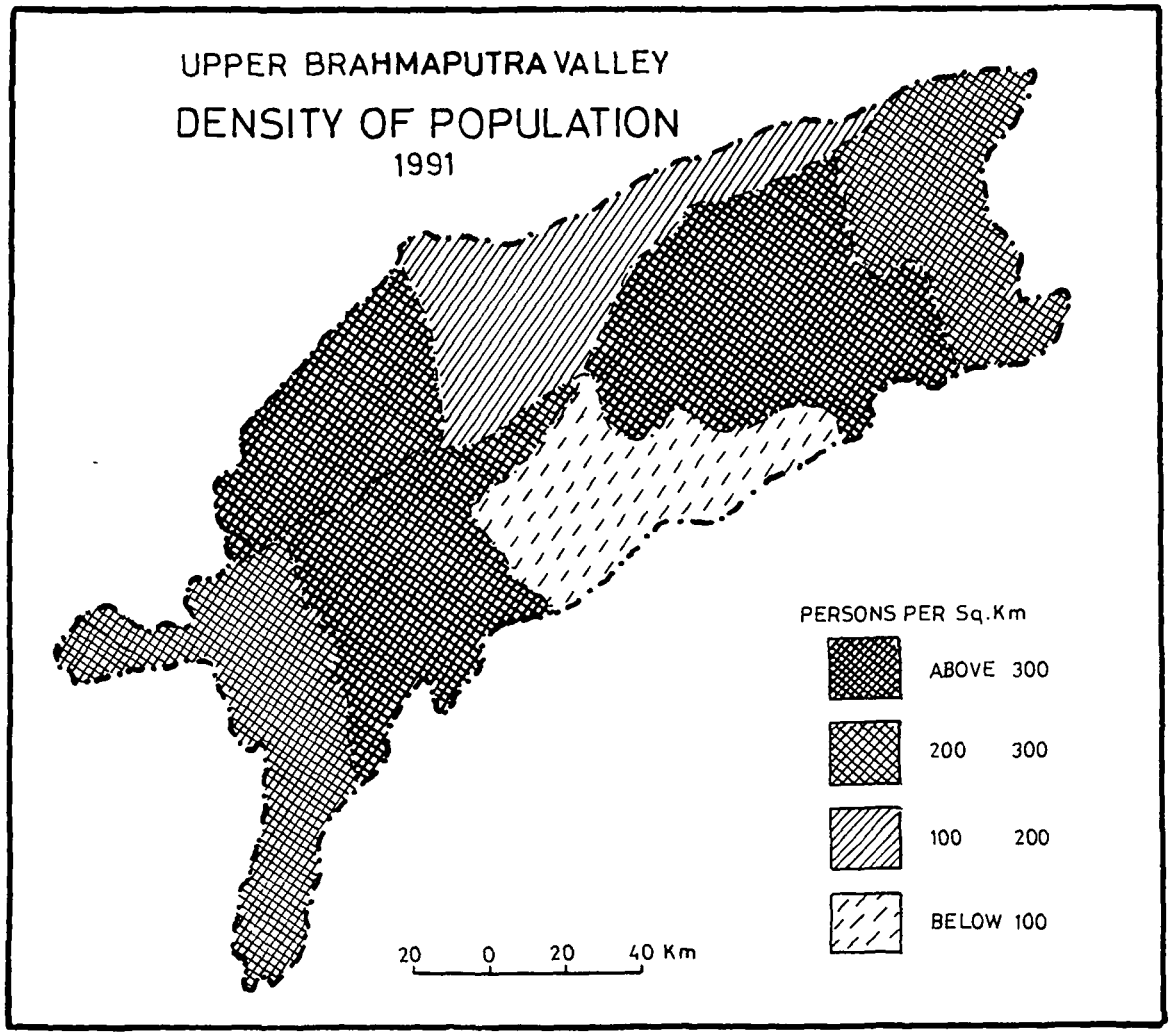

UPPER BRAHMAPUTRA VALLEY
DENSITY OF POPULATION
1991
PERSONS PER Sq.Km
ABOVE 300
200 300
100 200
BELOW 100
20 0 20 40 Km

Fig.4

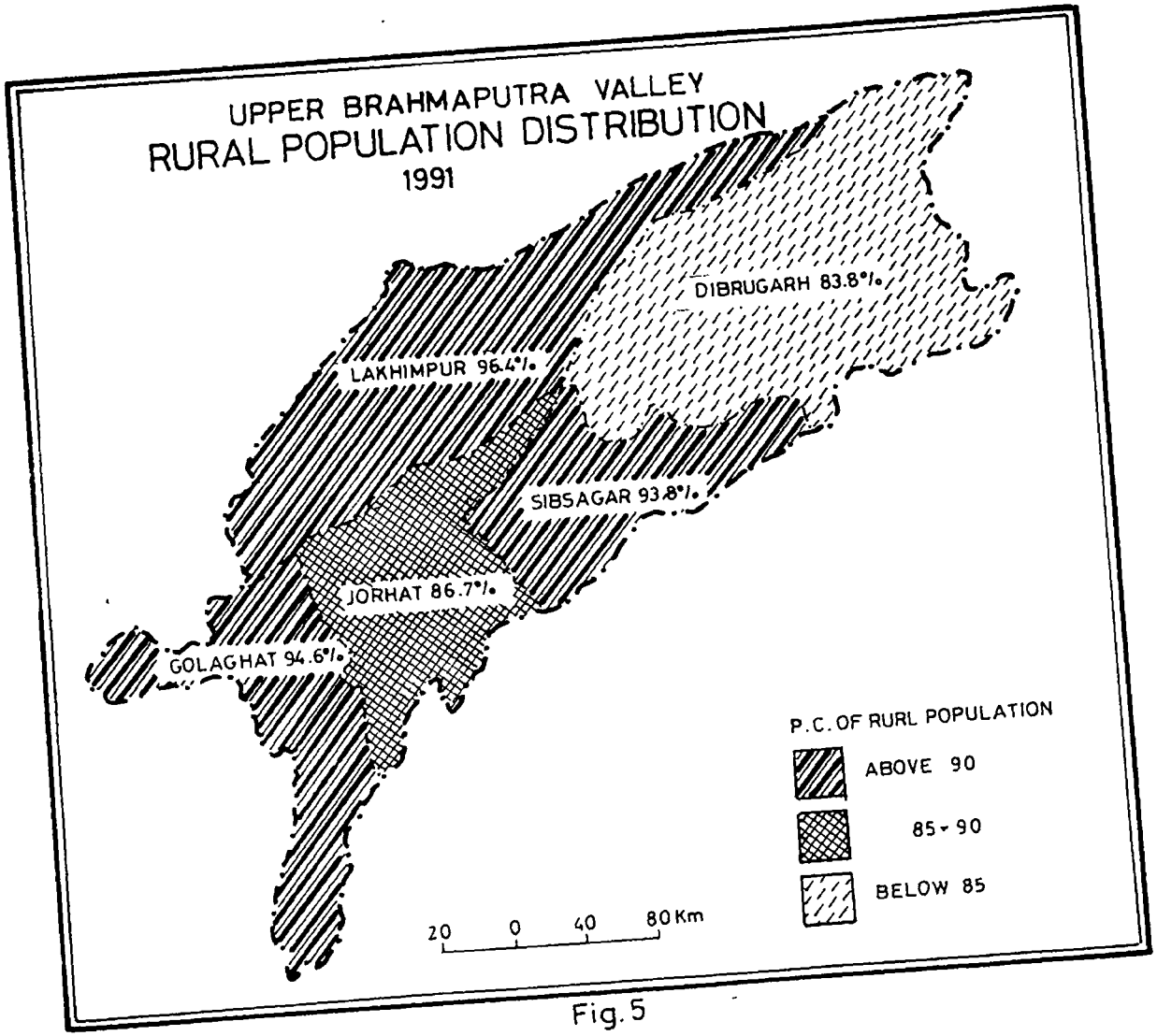

UPPER BRAHMAPUTRA VALLEY
RURAL POPULATION DISTRIBUTION
1991
DIBRUGARH 83.8%
LAKHIMPUR 96.4%
SIBSAGAR 93.8%
JORHAT 86.7%
GOLAGHAT 94.6%
P.C. OF RURL POPULATION
ABOVE 90
85 - 90
BELOW 85
20 0 40 80 Km

Fig. 5

But during the period 1971 to 1991 the growth of population goes upto +44.13 per cent against the state growth of +52.44 per cent.

The entire Upper Brahmaputra Valley is thickly populated. The density of population in the valley was recorded at 295 persons per sq. km. against the state figure of 284 persons in the year 1991. The density of population in the valley was 207 persons per sq. km. according to 1971 census report. But over the last 20 years, the density of population per sq. km. increased upto 295 persons in the valley.

1.6. Methodology

Despite the fact that Assam is rich in various mineral and other resources, the economy of the state is still based on agriculture. Though the state is one of the best agricultural region in the country, its agriculture is in subsistence level and farmers are economically very poor.

Although an Agricultural University has been established in the state and a number of research works, planned programmes and schemes have been undertaken and carried out, there is still a big gap between farmers and agricultural reformers. Therefore,

it is inevitable to have an analysis of the very structure of the whole system before taking any kind of innovative schemes.

Systematic methodology is the key of success of any research project as it has direct bearing on the relevance of research findings. Specially in the case of social research, it is essential to adopt some pattern of standard procedure which is designed for a particular practice.

With this end in view and to achieve the objectives, the present study has been completed through survey, direct observations, collection of secondary data from blocks, district headquarters and other available sources, planned and designed within an environmental-cum-socio-economic framework.

The study has been completed within four distinct parts. The first part which includes chapter-II discusses the physical setting of the study region which influences the existing agricultural system.

Part two comprises of chapters III and IV which deal with the existing land-use and cropping pattern and existing landholding. pattern - the main institutional factors affecting agriculture.

The third part which includes chapter-V deals with the existing agricultural productivity of the region, the various factors affecting agricultural productivity and discusses the various infrastructural needs for the over-all development of agriculture in the region.

Finally, the fourth part which includes the chapter-VI, deals with the debated issue "Farm Size and Productivity". Here an attempt has been made to discuss the inverse relationship between farm size and productivity with the help of data collected through field survey from sample villages of the region.

1.7. Chapter Scheme

The chapter scheme for the present study is designed as follows :

Chapter-I is the introductory chapter and it discusses the problem of the study with the relevant literature available on the problem both in the international as well as national and state levels. It also discusses the objectives of the present study with number of hypotheses which are tested during the course of the work. The various sources of data and informations are discussed here with a brief

introduction to the study region which includes its location, total area, demographic characteristics etc. Lastly, it discusses the methodology adopted in the study.

The second chapter which is designed as the physical setting of the study region discusses the geology, relief, drainage system, soil types of the study region. It also discusses the climatic condition and agro-climatic condition prevails over the region.

Chapter-III discusses the existing land-use classification, its changes and variation over the last 10 years with the help of Settelite Imagery data taken from the Assam Remote Sensing Application Centre, Guwahati. It also discusses the existing cropping pattern of the study region, its changes over the periods both at regional and district levels.

Chapter-IV dicusses the existing land-holding pattern of the study region. The important land reform measures in the region since independence, land tenure systems since Ahom kingdom are discussed here. It also dealt with the districtwise as well as castewise distribution of land-holding pattern in the region.

Chapter-V pertains to the existing agricultural production in the region. It discusses about the crop

output and various factors affecting agricultural productivity in the region. These various factors are discussed as physical and biological factors, socio-economic-cultural complexes, technology , and infrastructural needs.

Chapter-VI is designed as farm size and productivity. This chapter attempted to discuss about the relationship between farm size and productivity in the Upper Brahmaputra Valley. The entire chapter is based on primary data, which were collected from 200 farm families of the valley during the field survey. It discusses the farm size, fragmentation, land-use and cropping pattern, farm assets, agricultural production and the efficiency of farms in the study region.

The last chapter summarises the study and concluded the work with some suggestions.

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22. Mipun, B.S. (1987), Immigrants and the Agricultural Changes in the Lower Brahmaputra Valley, Unpublished Doctoral Thesis, NEHU.

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hydrology etc. although they are clearly inter-related. For instance climate is influenced by altitude and also slope aspects, soil by rainfall and evapo-transpiration, etc. Therefore, the role of these factors in the areal agricultural complex is undeniable.

2.2. Geology

Geologically, Assam possesses rocks from the Archaean, Pre-Cambrian to the Lower and Upper Tertiary, i.e. from oldest group of rocks to the youngest one.[1]

The Arachaean rocks in the form of metamorphic complex of gneisses and schists intruded by younger acidic and basic rocks in the northern and central parts of Mikir Hills and isolated inselberg of the Archaeans scattered along the north and south banks of Brahmaputra in Goalpara, Kamrup, Darrang and Nowgong districts.

Stratigraphically, the Archaean group consists of banded composite, biotite, biotite horne lalend, biotite sillmanite gneisses and schists, associated with fieldspathic biotite, pyroxene, hornblend granulitics, cele-granulitics, aplites and younger coarse to fine grained granite, gneisses intruded by massive perphyritic and coarse biotite granites, pegmatites and quartz veins.[2]

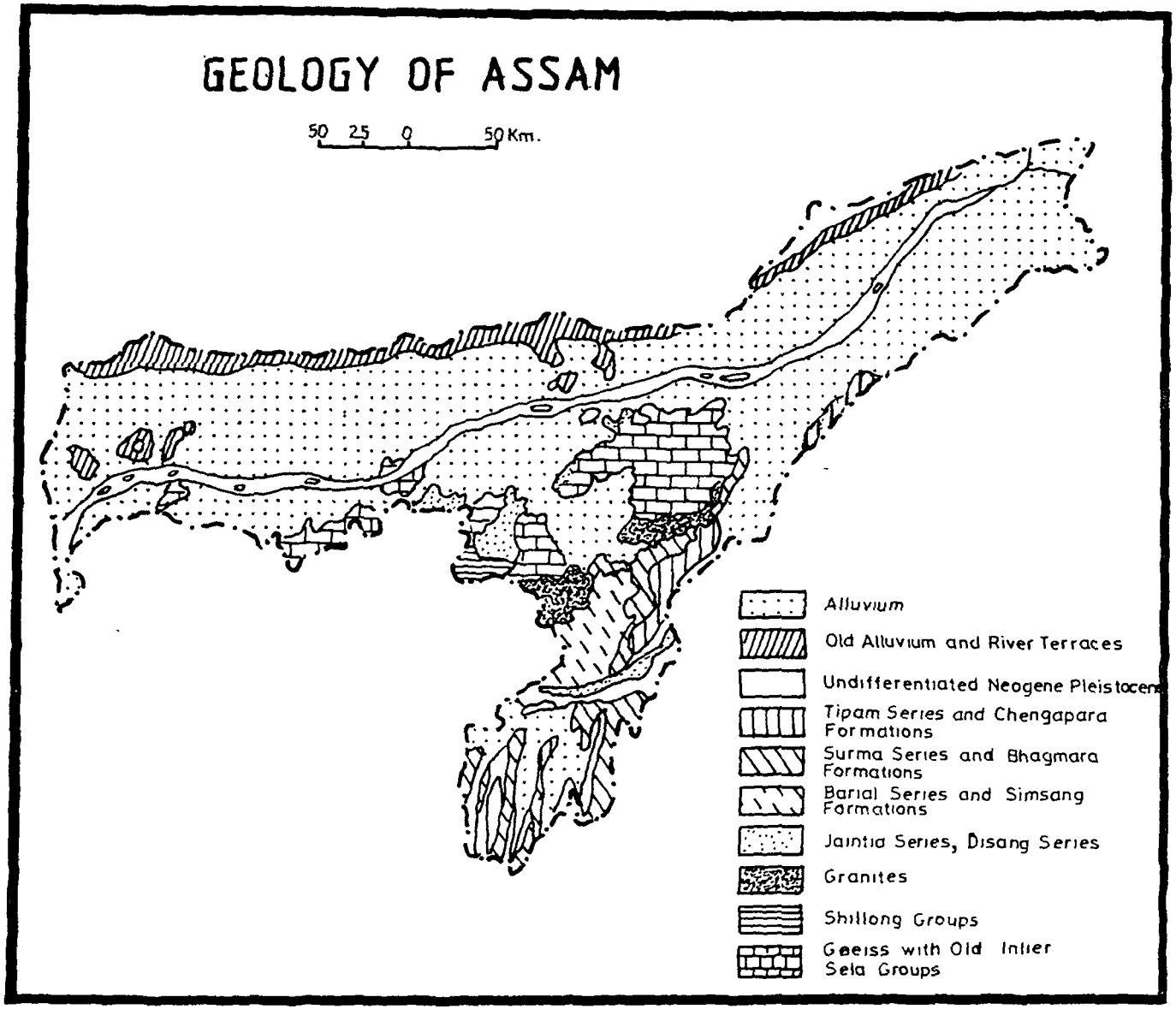
GEOLOGY OF ASSAM
50 25 0 50 Km.
Alluvium
Old Alluvium and River Terraces
Undifferentiated Neogene Pleistocene
Tipam Series and Chengapara Formations
Surma Series and Bhagmara Formations
Barial Series and Simsang Formations
Jaintia Series, Disang Series
Granites
Shillong Groups
Geeiss with Old Inlier
Sela Groups

Fig. 6

The Pre-Cambrian groups consisting of quartites and phyllites restricted to small areas over the western flank of the Mikir Hills and northern part of the North Cachar Hills. The Archaeans are overlained by the Pre-Cambrian Shillong groups of rocks in the northern part of the North-Cachar Hills and over in small areas over the Western flank of the Mikir Hills across the Kopili Valley in Assam. Here the rocks are mainly quartzard phyllete.

The lower tertiary shelf (Eocene) sediment of Jaintia group extending along the southern flanks of the Mikir Hills as well as the geosynclinal Disang group over parts of the North Cachar Hills. The Jaintia group extends in the north-easterly direction along the southern and eastern slopes of the Mikir Hills. In these hills, workable seams of coal and lime deposits are the major economic minerals.

In Assam, the Disang are restricted to a narrow strip to the south of Haflong. Disang thrust in the central part of North Cachar Hills, from the Jaintia Valley eastward upto the headwaters of Dhansiri.

The Upper tertiary (Oligocene-Miocene-Plio self and geosynclinal-cene) sediments covering the southern

flanks of Mikir Hills, the North Cachar Hills and the Hills of the Cachar district in the Surma Valley, the north foothills of the Naga-Patkai range bordering the southern margin of the Sibsagar and Dibrugarh districts, and narrow fringe of under classified Siwalicks along the southern foothills of the eastern Himalaya facing the northern border of Assam.

Unclassified older and newer alluviums (quaternary deposits) comprising high level terraces, the red bank soils and the recent alluvial deposits of the Brahmaputra and Surma Valley. The new alluvial soil consists of indurated yellowish to brownish or raddish clay with sand, gravel and boulder deposits.[3] The alluvium formation shows much variation in depth ranging approximately from 200 to 300 metres.

The geological history of Upper Brahmaputra Valley which comprises of five plain districts of Assam viz., Lakhimpur, Dibrugarh, Jorhat, Golaghat and Sibsagar, as a whole, is related to two long narrow subsiding trough (Geosyncline) lying on either side of an old ridig continental shield (foreland). The foreland is geologically a north-eastern continuation of the Shillong and Mikir Hills Plateau and is concealed in the valley by a great thickness of alluvial and tertiary

rocks. To the north of this mainland of Archaean rocks was ancient central geosyncline sea known as Tethys. An arm of a sea invaded Assam from the south in the Cretaceous time. With the beginning of the tertiary era, the sea extended further south-east and submerged the greater part of Assam. But for occasional and temporary retreat of the sea, marine conditions prevailed till about the Miocene time. Hundreds of metres of sediments were deposited on the foreland as well as in the geosynclines, the floor of which, was slowly but continuously sinking.

Meanwhile, a series of intermittent earth movement went on in the Assam region. The movement accentuated in the post-pliocene age and the piles of sediments that were severely compressed and uplifted into the lofty Himalaya in the north and east and Naga, Lushai and other associated ranges of hills in the south. Erosion moved many hundreds of metres of materials from the rising areas. Finally, deposition on the foreland areas of the Upper Brahmaputra Valley, presumably late in the Dihing times and continued untill the present day. The geology of the entire region is thus concealed by alluvial deposits. Geological surveys, aided by drilling for oil, have shown that under the recent

deposits there are hundreds of metres of Tertiary sediments which lie over an Archaean Basement Complex.

2.3. Relief

Physiographically the study region, Upper Brahmaputra Valley, is a part of the Brahmaputra Valley or Assam Valley. The greater part of the valley is alluvial plain criss-crossed with numerous rivers and water-ways and dotted over with 'beels' and marshes. The entire Brahmaputra Valley consists of an area of 56,339 sq. km. representing 72 per cent of the total geographical area of the state. It is an alluvial plain formed due to the depositional work of river Brahmaputra and its innumerable tributaries. The altitude of the valley is 200 metres above sea level. The length of the valley is 725 km. from Sadiya to Dhubri with an average width of 80 km. The general slope of the valley is north to south in the north bank and south to north in the south bank of the river Brahmaputra. The general gradient of the valley from north-east to south-west is 12.5 cm. per km. As the river is sluggished with a low gradient, innumerable almond shapped river islands called 'chaporis' or 'chars' are formed by the deposition of sediments in the middle of the river course. Most of these 'chaporis' are washed away by

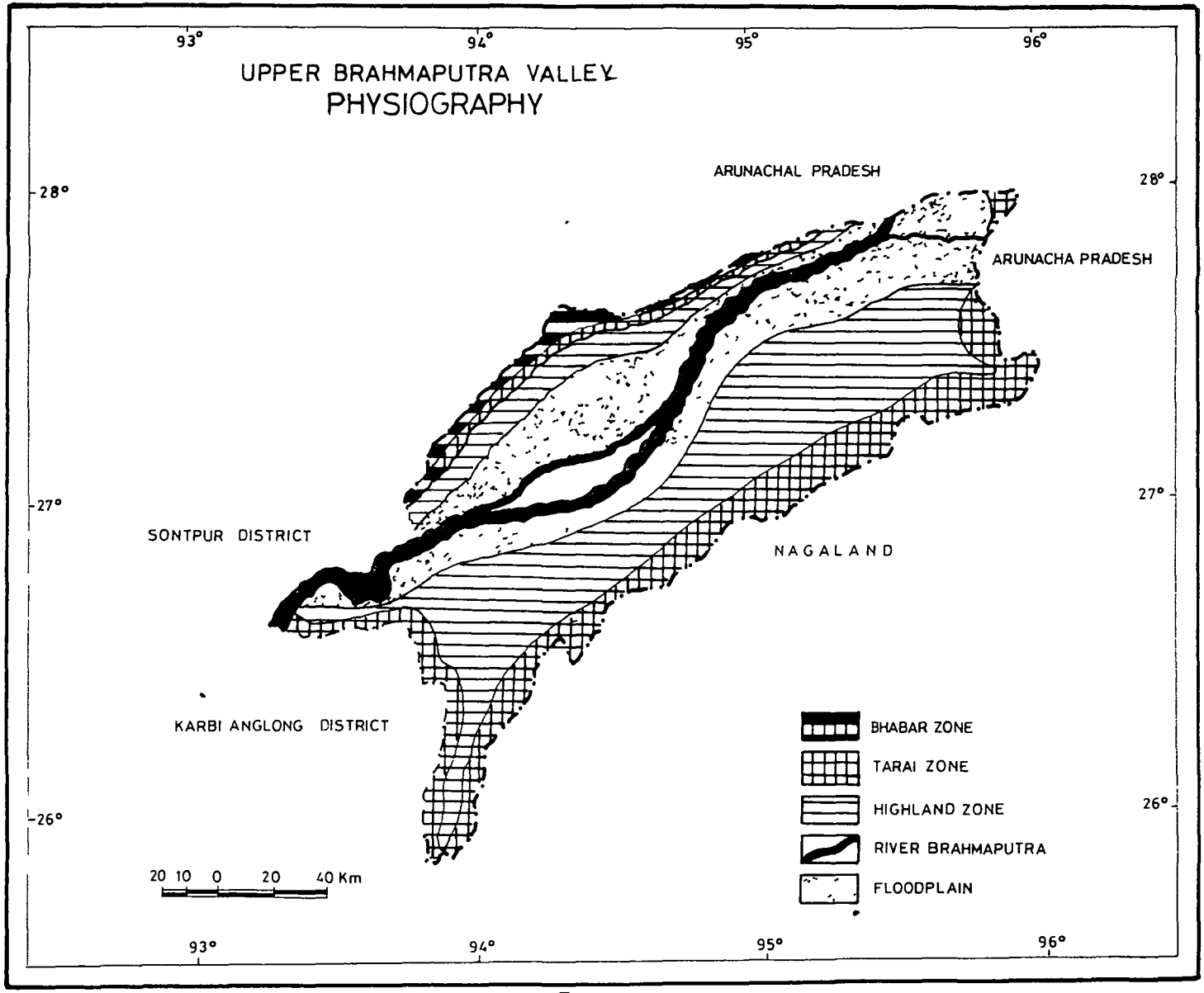
UPPER BRAHMAPUTRA VALLEY
PHYSIOGRAPHY
93°
94°
95°
96°
28°
27°
26°
ARUNACHAL PRADESH
ARUNACHA PRADESH
SONTPUR DISTRICT
NAGALAND
KARBI ANGLONG DISTRICT
BHABAR ZONE
TARAI ZONE
HIGHLAND ZONE
RIVER BRAHMAPUTRA
FLOODPLAIN
20 10 0 20 40 Km

Fig 7

flood during rainy season while new 'chaporis' are formed.

The land surface of the Upper Brahmaputra Valley may be divided into five distinct physiographic zones running parallel or sub-parallel to the Brahmaputra river. These are :

i) the northern foothill zones of the lesser Himalaya;

ii) the middle plain of the north bank;

iii) the active flood-plains and 'charlands';

iv) the middle plain of the south bank, and

v) the southern foothills zone.

The Northern Foothills Zone :

This zone consists of a relatively high but narrow "Bhabor" zone and a flat "Tarai" belt. The coalescence of alluvial zones at the Piedmont of the Himalaya gives rise to the formation of highlands or the Bhabor zone composed of unassorted detritus. Due to the sudden fall of the streams from the high mountain to the plains, water percolates down the unconsolidated soil and appears a few kilometres downstream. The Bhabor zone is bordered northward by a region called the Tarai, a plain of unhealthy damp soil supporting tall grass. It is

interesting to nore that the water that steeps out here from Bhabor region gives rise to many small tributaries of the Brahmaputra. Human settlement is very sparse. The zone is narrow towards the north-eastern part of the valley.

The Middle Plain of the North Bank :

Between the Tarai in the north and the flood plain in the south lies a comparatively high and extensive plain, spreading east-west parallel to the course of river Brahmaputra. Like the Tarai belt, this plain is also gradually tapering towards east and broadening towards west. This is one of the most densely populated area with rice field of the valley.

The Active Flood Plain and Charlands :

South of the middle plain of the north bank there lies an extensive and active flood plain of the Brahmaputra on its both banks. The islands inside the river course may also be included in this zone. The north bank is widest in the western part of Lakhimpur district. Therefore, this region is mostly flood prone. In the south bank, it is extensive from Saikhowaghat to Dibrugarh and also form the confluence of the Buridihing to Neemati. It is also extensive over Majuli and the

northern part of Bokakhat Thanna including the Kaziranga National Park. Severe floods are experienced every year in all these areas.

The Middle Plain of the South Bank :

Unlike the counterpart of the north bank this zone is very extensive in all the districts of the region. This plain contains the rice-belt and tea growing areas of the region.

Southern Foothills Zone :

In the districts of Dibrugarh, Sibsagar, Jorhat and Golaghat, the southern foothills zone consists of innumerable highland and isolated hillocks interspread with plain embayments entering into the Tirap and Naga Hills. The high grounds composed of lateritic soils and covered with either tea gardens or dense forests.

2.4. Drainage System

The drainage system of the entire Brahmaputra Valley is dominated by river Brahmaputra. It controls the entire drainage system of the valley. Swamps and marshes are ubiquitous along the course of the Brahmaputra and its tributaries in the valley.

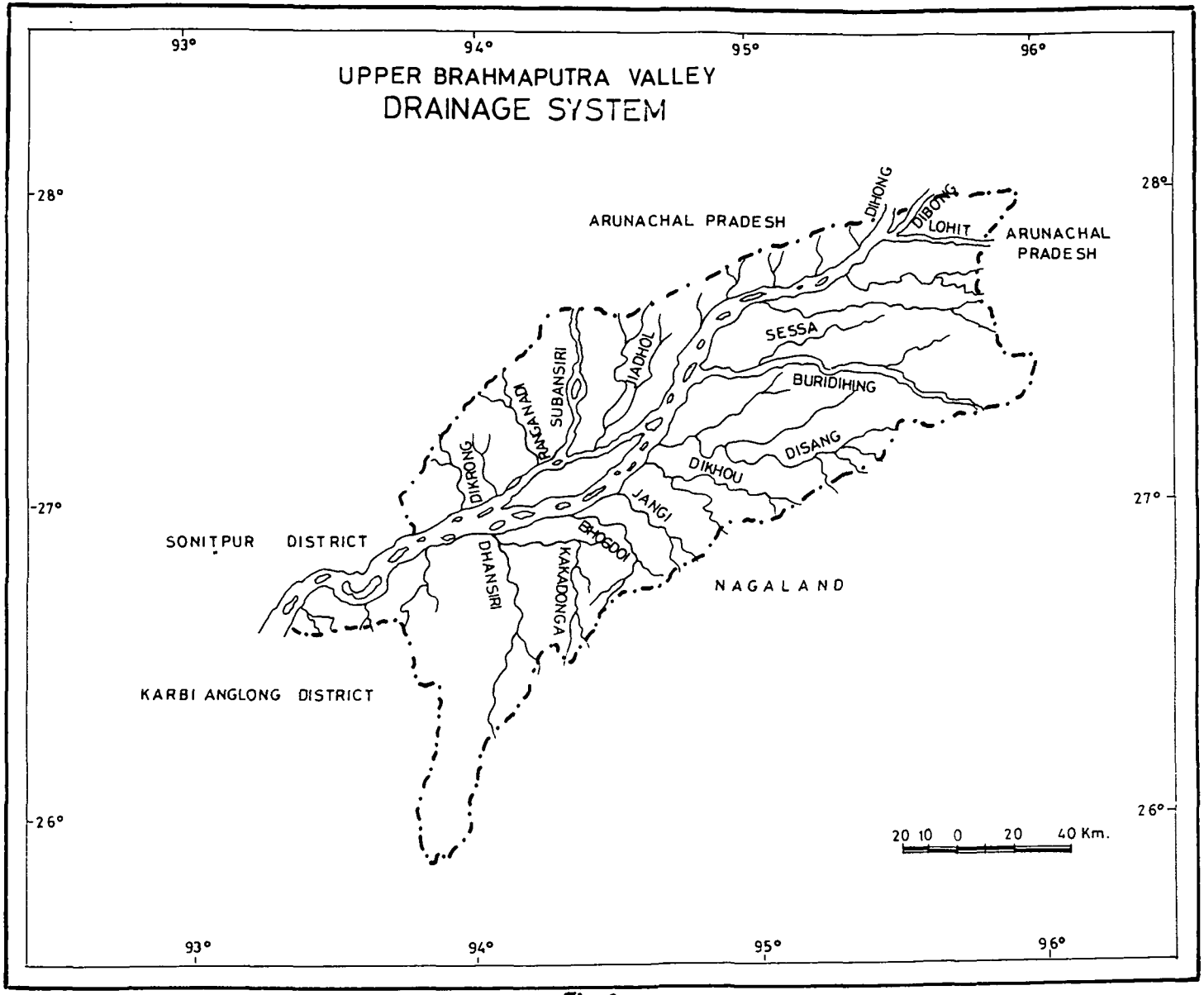
UPPER BRAHMAPUTRA VALLEY
DRAINAGE SYSTEM
93°
94°
95°
96°
28°
27°
26°
ARUNACHAL PRADESH
DIHONG
DIBONG
LOHIT
ARUNACHAL PRADESH
SESSA
BURIDIHING
DISANG
DIKHOU
JADHOL
SUBANSIRI
RANGANADI
DIKHONG
JANGI
BHOGDOI
DHANSIRI
KAKADONGA
SONITPUR DISTRICT
NAGALAND
KARBI ANGLONG DISTRICT
20 10 0 20 40 Km.

Fig. 8

Brahmaputra, the principal river of the Upper Brahmaputra Valley which flows through the entire region and the whole drainages of the region ultimately find their way to it. All the major north-bank tributaries of the Brahmaputra river originate in Himalaya where the south-bank tributaries are originated from Naga Hills.

The principal tributaries of the north-bank are Kundil, Dibong, Sessari, Subansiri, Jiadhal, Ranganadi and Dikrong - all originating from the Himalayas.

The important tributaries of the south-bank are Dibru, Disang, Dikkou, Janji, Bhogdoi (Disoi), Kakodonga, Dhansiri and Dayang all originating from the Naga Hills.

In addition to the rivers mentioned above, there are numerous streams and streamlets locally known as 'Jan' and 'Juri' which carry the sediments of the hills into large rivers which finally fall into the river Brahmaputra.

2.5. Soil

The soil of Upper Brahmaputra Valley is mostly alluvial. The new alluvial soil is found in the middle plain of the valley both in north and the south of the river Brahmaputra. An elongated narrow patch of old

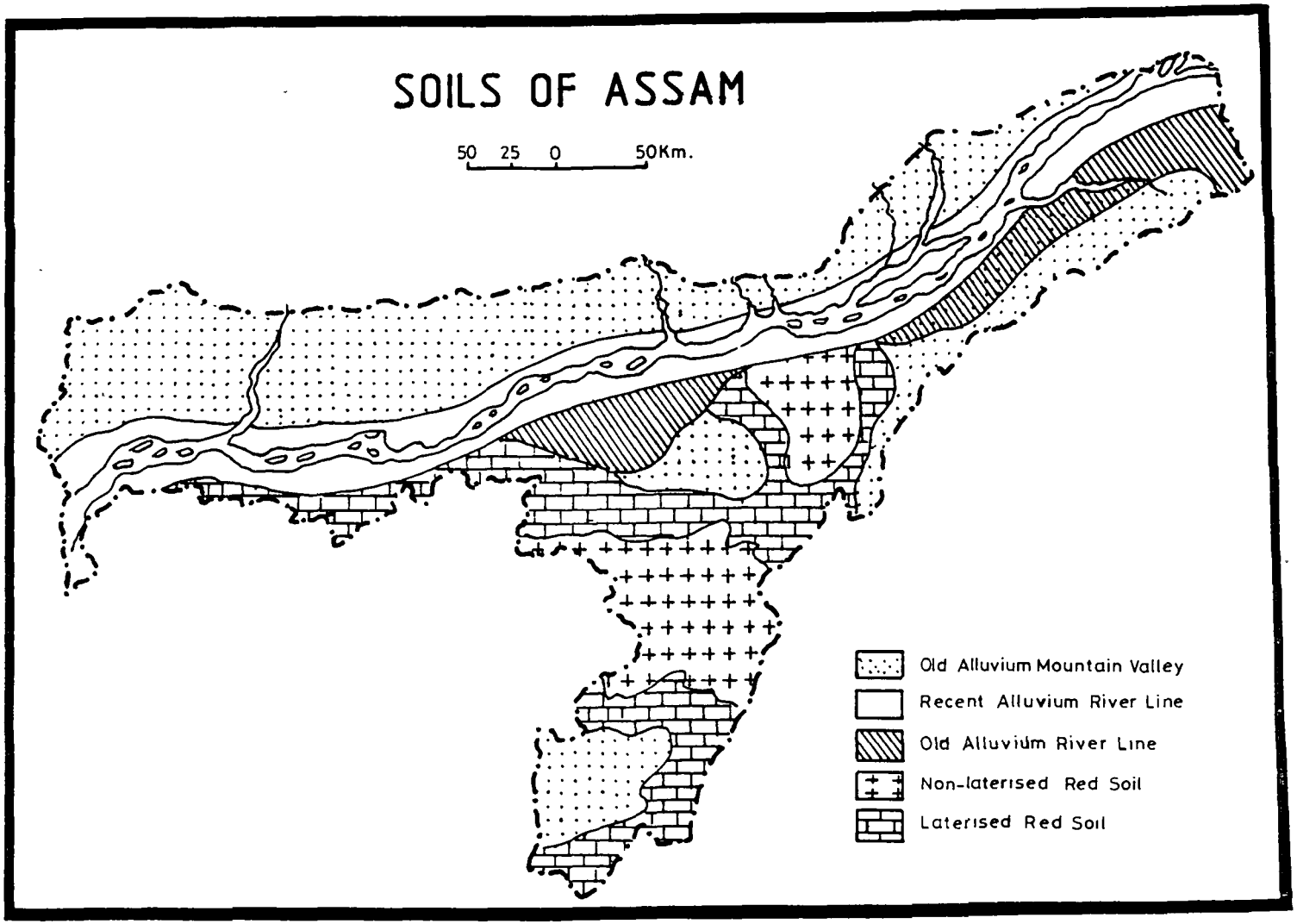
SOILS OF ASSAM
50 25 0 50Km.
Old Alluvium Mountain Valley
Recent Alluvium River Line
Old Alluvium River Line
Non-laterised Red Soil
Laterised Red Soil

Fig. 9

alluvial soil occurs along the southern margin of south bank middle plain stretching from Golaghat district to Dibrugarh district of the region. In the northern part of the valley alongwith the foothills of Himalaya a narrow patch of soil of submontane tract is found in the Lakhimpur district. On the other hand, to the southern margin of the valley alongwith the foothills of Naga Hills mostly red loamy and lateritic soils (hill soils) are found. In between new alluvial and hill soils in the south bank of the river Brahmaputra the soil type is mostly old alluvial which covers an extensive area of Dibrugarh district. Broadly speaking, the soil of Upper Brahmaputra Valley is acidic in character with a satisfactory content of nitrogen and organic matters.[4]

The majro soil goups found in the valley are as follows :

(a) New alluvial soil :

The recent riverine alluvial soils are derived mainly from the materials deposited by the river Brahmaputra and its tributaries. A few kilometres on both the sides of the Brahmaputra are included in this area. Flood occurs frequently in this area causing great variation in mechanical composition and chemical properties due to the deposition of sediments which

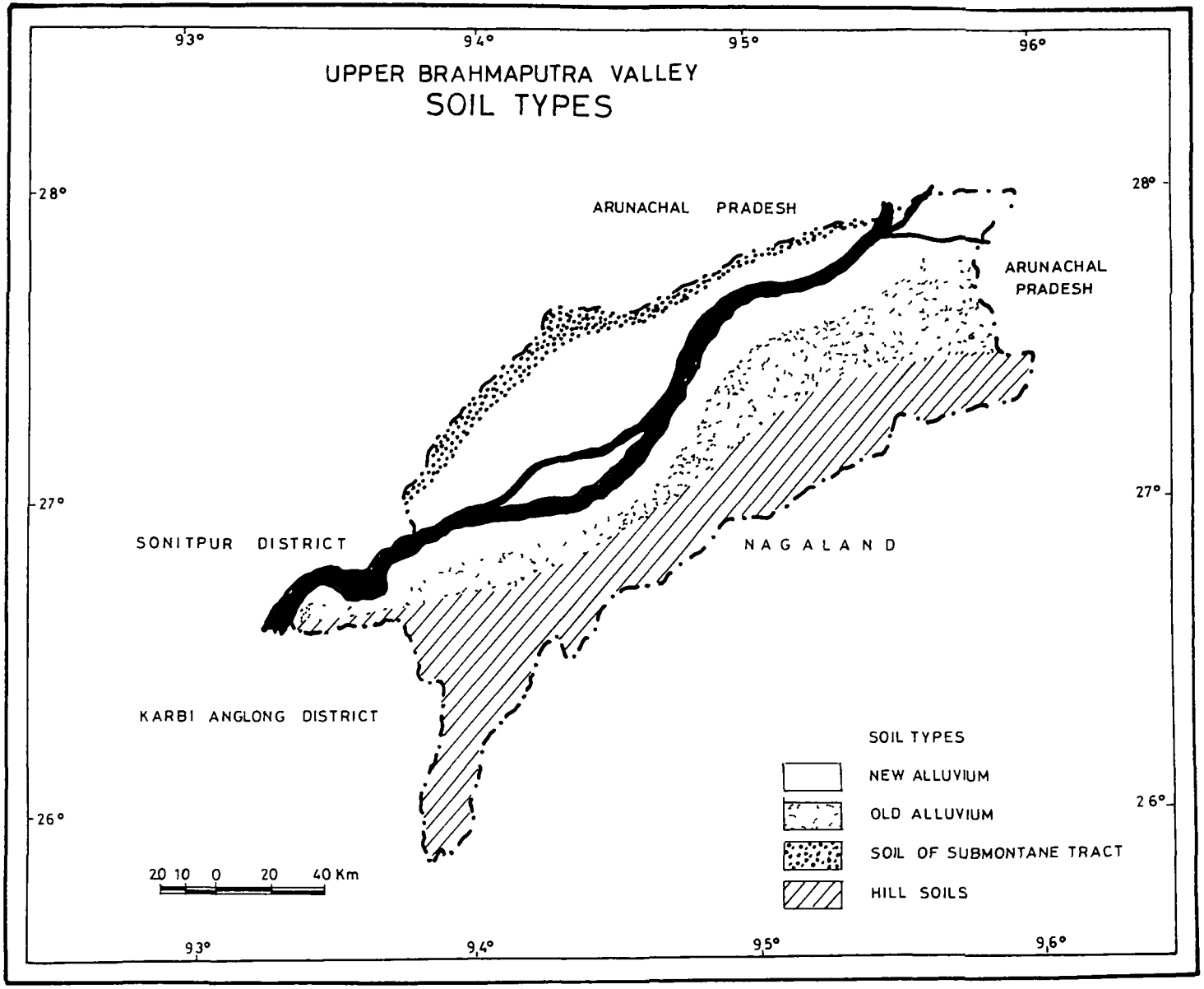
UPPER BRAHMAPUTRA VALLEY
SOIL TYPES
93°
94°
95°
96°
28°
27°
26°
ARUNACHAL PRADESH
ARUNACHAL PRADESH
SONITPUR DISTRICT
NAGALAND
KARBI ANGLONG DISTRICT
20 10 0 20 40 Km
SOIL TYPES
NEW ALLUVIUM
OLD ALLUVIUM
SOIL OF SUBMONTANE TRACT
HILL SOILS

Fig.10

differ greatly depending upon the parent materials in their respective catchment areas. The texture of the uppermost horizons of these soils are sandy loam or silt loam. In general, the lower most horizons are mostly sandy or loamy sand and soil texture becomes lighter alongwith depth, less acidic and often neutral or slightly alkaline. The ground water table is 1 to 3 metres in some areas.

(b) Old alluvial soil

The riverine old alluvial soils are also formed from the materials deposited by the river Brahmaputra and its tributaries in the long past. This group of soil is mainly found in the region parallel in between new alluvial and hill soil to the south. The ground water table is generally deeper than the recent riverine alluvial soils. Profile development has taken place to some extent. These soils are not subjected to flood and the texture of the surface soil ranges from sandy loam-loam-silty clay loam to silty-clay acidic in reaction.

(c) Hill soil : This group of soil is located in the foothills of Naga Hills in the districts of Dibrugarh, Sibsagar, Jorhat and Golaghat.

These soils are built of alluvial materials wash down from the hill slopes. The surface soils are compact, very sticky and very plastic. The texture of the soils also become heavier along with depth.

(d) Soil of submontane tract

This type of soil is found in the northern part of the valley, alongwith the foothills of Himalaya, a narrow patch of soil of submontane tract is found in the district of Lakhimpur.

2.6. Climate

The climate of the Upper Brahmaputra Valley is not much different from that of the rest of the state. It is characterised by a highly humid atmosphere, abundant rains and general coolness. The cold season from December to February is followed by the season of severe thunder storms from March to May. The south-west monsoon season in the valley is from June to about the beginning of October. October and November constitute the post-monsoon season.

The mean annual temperature of the valley is 22.79°C with mean relative humidity of 80.25 per cent. The average annual rainfall in the valley is 2197.00 mm. The rainfall generally increases from the south-west to

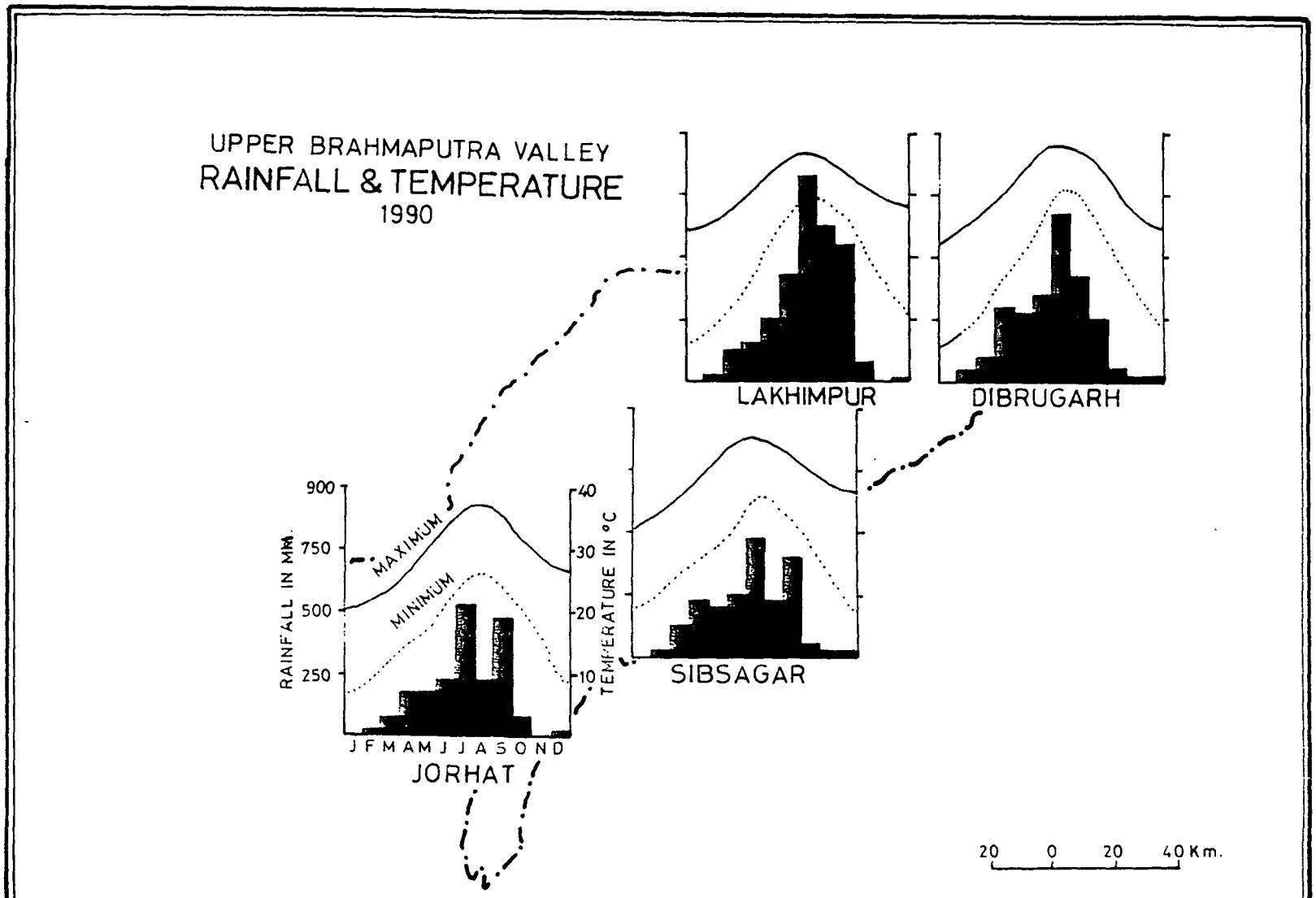
UPPER BRAHMAPUTRA VALLEY
RAINFALL & TEMPERATURE
1990
LAKHIMPUR
DIBRUGARH
SIBSAGAR
JORHAT
MAXIMUM
MINIMUM
RAINFALL IN MM.
TEMPERATURE IN °C
900
750
500
250
40
30
20
10
J F M A M J J A S O N D
20 0 20 40 Km.

Fig.11

north-east. About 64 per cent of the annual rainfall is received during the monsoon season, July being the month with maximum rainfall. On an average, there are about 199 rainy days in a year.

Table 2.1

Monthly Maximum and Minimum Temperature and Humidity in Upper Brahmaputra Valley, 1989

Temperature in C.
Humidity in P.C.

Months	J	F	M	A	M	J	J	A	S	O	N	D	Mean
Maximum	22	22	24	27	31	31	30	32	30	30	26	23	27.33
Minimum	9	12	16	18	22	24	24	26	24	21	15	9	18.25
Humidity	84	80	70	74	75	85	90	85	89	79	76	76	80.25

Source : Directorate of Economics and Statistics, Assam

There are three distinct seasons in the Upper Brahmaputra Valley. They are - pre-monsoon, monsoon and dry winter.

The pre-monsoon starts by early March along with the gradual rise of temperature. The early part of this season upto mid-April is affected by very strong storm which turns into duststorms.

The south-west monsoon enters Upper Brahmaputra Valley by the middle of June and continues upto

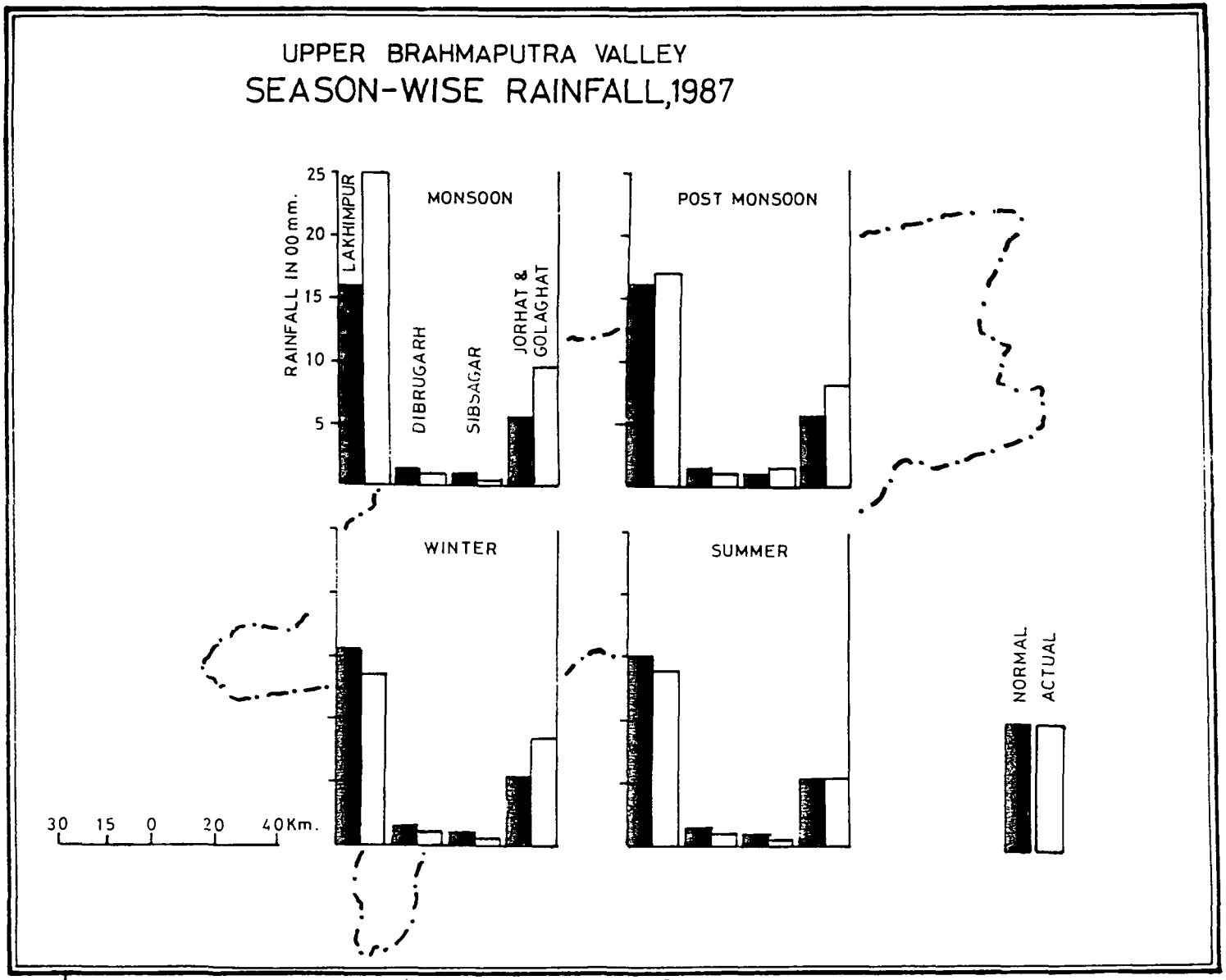
UPPER BRAHMAPUTRA VALLEY
SEASON-WISE RAINFALL,1987
RAINFALL IN 00 mm.
25
20
15
10
5
LAKHIMPUR
DIBRUGARH
SIBSAGAR
JORHAT & GOLAGHAT
MONSOON
POST MONSOON
WINTER
SUMMER
NORMAL
ACTUAL
30 15 0 20 40Km.

Fig.12

September. This season is the period of the year with the highest temperature. Being also the period with high moisture in the air, the weather is often unpleasant with the damp heat particularly in between the spells of rains. Rain is so frequent that about 18 to 20 days in a month are normally recorded to be rainy. With the withdrawal of the south-west monsoon by about the second week of October, the weather gradually becomes cooler.

The cold season starts about the end of November and continues upto the end of February, where both day and night temperature begin to drop rapidly. January is the coldest month of the year with the mean daily minimum temperature of 8°C and mean daily maximum temperature of 21.6°C. The main characteristic of this season is absence of rainfall, cold and dry weather, low temperature and frequent morning fogs. This is the season for pleasant weather for the Upper Brahmaputra Valley. Temperature begins to rise from about the beginning of March and by July it attains the highest point.

2.7. Agro-Climatic Condition

Identification of specific agro-climatic zone is essential, particularly for planning crop improvement

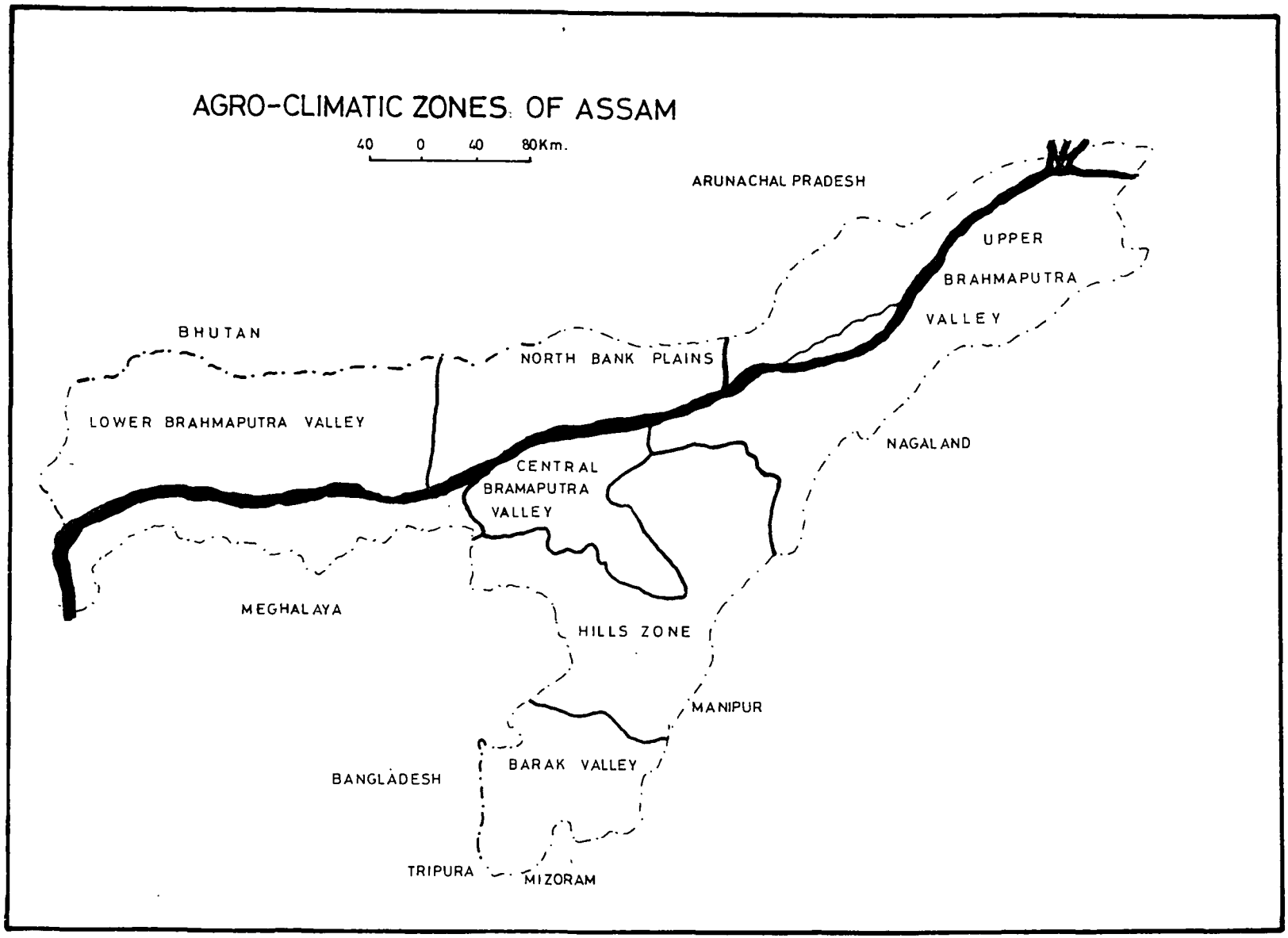
AGRO-CLIMATIC ZONES OF ASSAM
40 0 40 80Km.
ARUNACHAL PRADESH
UPPER
BRAHMAPUTRA
VALLEY
BHUTAN
NORTH BANK PLAINS
LOWER BRAHMAPUTRA VALLEY
NAGALAND
CENTRAL
BRAMAPUTRA
VALLEY
MEGHALAYA
HILLS ZONE
MANIPUR
BARAK VALLEY
BANGLADESH
TRIPURA
MIZORAM

Fig.13

Table 2.2

Districtwise Monthly and Annual Rainfall for the Year 1987 in Upper Brahmaputra Valley

(Figures in mm)

Districts	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Lakhimpur	0.6	48.4	131.7	159.8	263.0	432.4	871.9	625.0	563.1	82.4	6.3	17.3	3201.3
Dibrugarh	1.0	57.8	113.8	303.8	292.9	348.1	673.4	437.0	258.6	87.2	13.6	16.9	2604.1
Sibsagar	6.7	29.1	129.4	214.9	208.6	249.5	485.3	228.7	418.6	59.1	16.7	17.8	2064.4
Jorhat and Golaghat	3.5	16.6	71.7	173.9	172.5	214.4	518.6	221.9	468.3	89.1	5.6	22.0	1978.1

Source : Directorate of Economics and Statistics, Assam

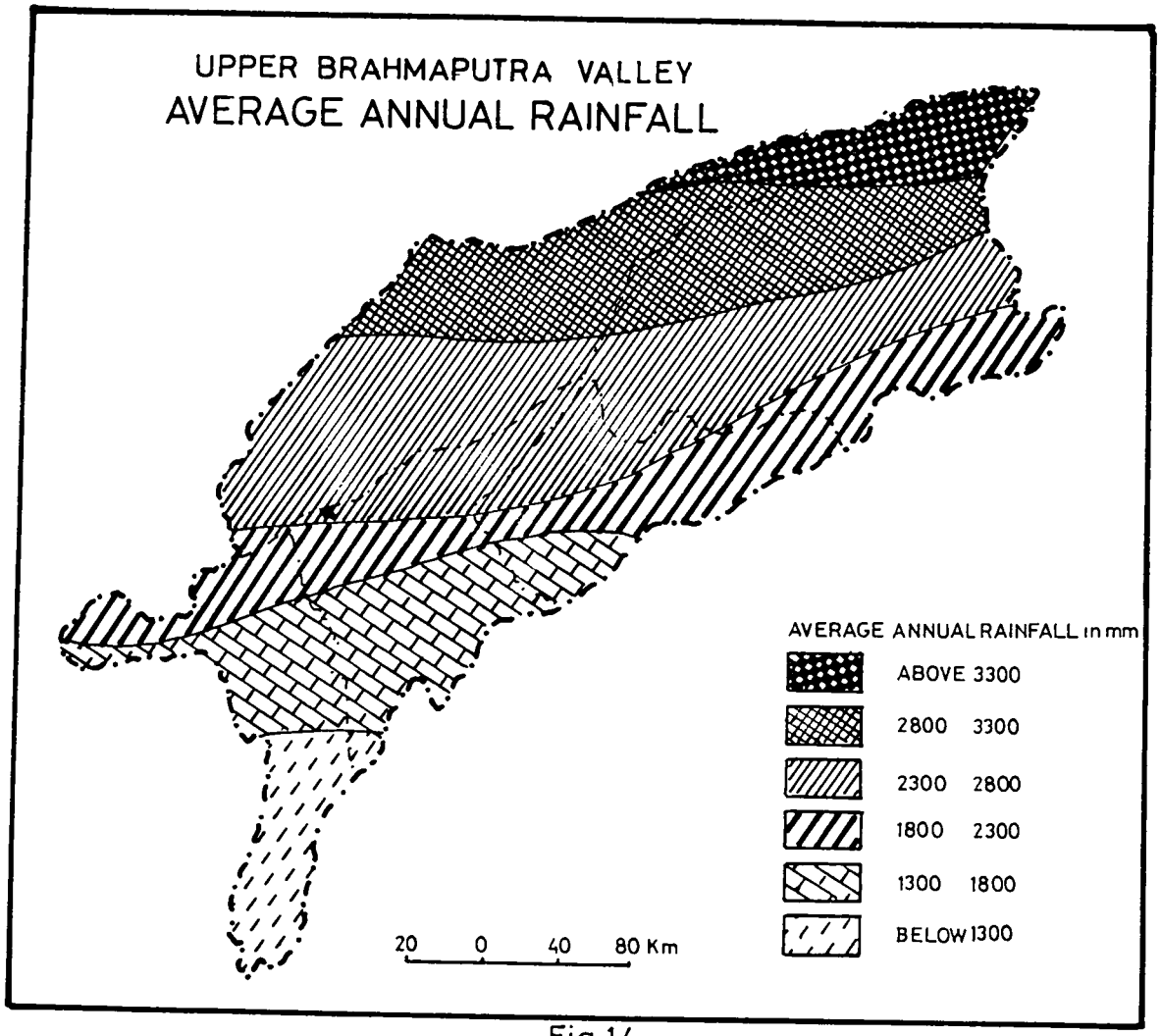
UPPER BRAHMAPUTRA VALLEY
AVERAGE ANNUAL RAINFALL
AVERAGE ANNUAL RAINFALL in mm
ABOVE 3300
2800 3300
2300 2800
1800 2300
1300 1800
BELOW 1300
20 0 40 80 Km

Fig.14

Table 2.3

Seasonwise Rainfall in Upper Brahmaputra Valley in 1987

(Figures in mm)

Districts	Monsoon season		Post monsoon		Winter season		Summer season		Total	
	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Actual	Normal	Actual
Lakhimpur	1636.0	2492.4	146.7	88.7	101.3	70.7	583.7	972.2	2467.7	3624.0
Dibrugarh	1636.0	1717.1	146.7	100.8	101.3	147.1	583.7	798.1	2467.7	2763.1
Sibsagar	1539.8	1382.1	173.4	75.8	99.9	61.8	590.7	883.2	2403.8	2401.9
Jorhat & Golaghat	1539.8	1423.2	173.4	94.7	99.9	72.0	590.7	560.0	2403.8	2149.9

Source : Directorate of Economics and Statistics, Assam

programme.

Based on the rainfall, terrain and soil characteristics, Assam has been broadly delineated into the following six agro-climatic zones :

a) The North Bank Plains
b) The Upper Brahmaputra Valley
c) The Central Brahmaputra Valley
d) The Lower Brahmaputra Valley
e) The Barak Valley
f) The Hills

The study area, the Upper Brahmaputra Valley, entirely belongs to Upper Brahmaputra Valley zone whose physiography is characterised by plains and foothills and subject to erosion. Soil is composed of both new and old alluvial and is highly acidic. In general, the climate is humid and pre-humid. The crops grown in the region are rice, sugar-cane, mustard, robi pulses and tea, etc.

This zone comprises the districts of Lakhimpur, Dibrugarh, Sibsagar, Jorhat and Golaghat with an area of 21.67 lakh hectares, accounting for 20.40 per cent of the total state's area and 25.96 per cent of the total population of the state. This zone has six important

Table 2.4

Agro-Climatic Zones of Assam and their Basic Characteristics

Zone	Physiography	Soil	Crops	Climate
1. Upper Assam (Dibrugarh, Lakhimpur and Sibsagar	Plain and Foothill subject to erosion	New alluvial (entisols) mostly neutral soil, old alluvial	Rice, Sugar Cane, Mustard in parts, Rabi pulses and tea	Pre-humid and humid
2. Central Assam (Darrang, Nowgong and Kamrup)	Plains and Foothills	New alluvium mostly flood-plains alluvium mountain valley upland, alluvium acidic to strongly acidic reaction	Rice, Jute, Wheat, Oilseeds, Pulses	Humid & sub-humid
3. Lower Assam (Goalpara & parts of Kamrup)	Plains, Hillocks and Foothills, Char areas	New alluvium, old alluvium of two types i.e., altisols and ultisols and inceptisols and altisols	Wet-land rice upland rice, Jute, large variety of Rabi crops, Wheat, pulses & potato	Humid & pre-humid
4. Southern Zone (Cachar)	Undulating scattered hillocks sub-mountain in parts	Mostly old alluvium, non-talerised red altisols and ultisols	Rice, Sugar Cane, Tea	Humid & pre-humid
5. Hill Zone (Karbi Anglong & North Cachar Hills	Hilly (upto 1800 mt.) gentle to steep slope, a very small part plain	Lateritic (altisols and ultisols) Red loams (ultisols) old alluvium (altisols and ultisols)	Rice, Maize, Cotton, Wet-rice & plain crops, Millets, Maize	Humid & sub-humid

Abstracted from "Field Manual for Rainfed Agriculture in Assam" by Borthakur et al.

fast flowing tributaries of the Brahmaputra. It is high rainfall zone with more than 2000 mm per annum and humidity is more than 80 per cent. The maximum temperature rises upto 27°C in July and August and the minimum falls to 5°C in January. Rice is the predominant crop whereas tea is grown extensively on the slopes.

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2. Ibid.
3. PASCO, Vol. II.

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III

EXISTING LAND-USE AND CROPPING PATTERN

3.1. Introduction

The landuse and cropping pattern mosaic of any region are the outcome of geographic features, climatic variables, pedological differences, historical processes and social and economic institutions. In a given physical milieu, man as an active agent modifies the landscape, and uses it to fulfil his needs with the technology within his disposal. Hence, it is obvious that different types of living which are represented by social values and certain institutional controls create different patterns of landuse within the limits imposed by different agro-physical controls.

The Ministry of Agriculture in 1950 recommended a standard classification and uniform defination of the different categories of land to be adopted by states all over India. The defination and expansion have been further revised by the committee on improvement in Agricultural Statistics for the sake of clarity and workability. The land areas geographically accessible for major uses are classified into nine broad categories:

1. Forests cover any land classed or administered as a forest under legal enactments. The area figure under grazing lands or crops within the forest are also included in the area under forests.

2. Area under non-agricultural use covers all lands occupied by settlement, road, railways, beds of streams, ponds and canals, etc.

3. Barren and uncultivable land and bare rocky outcrops of hills, plateaus, mountains, deserts etc. This land can under no conceivable circumstances be brought under cultivation, but at a very high cost, a very little proportion may be classed as uncultivable.

4. Permanent pastures and other grazing lands embrace all grazing land which may be permanent meadows and village common pastures.

5. Area under miscellaneous tree crops etc. covers all cultivable lands which are not included in the area sown, but is put to some agricultural use other than seasonal cropping.

6. Cultivable wasteland denotes land considered by present judgement as cultivable but actually not cultivated during the current year and the last few years or more in succession. It is left untilled on account of physical, social and economic limitations. But some proportion of it could be in no conceivable circumstances be brought under tillage without reclamations such as the water logged lands.

7. Current fallow means, the land left unsown during the current agriculture year only to regain fertility and also that which remained uncropped owing to economic reasons.

8. Other fallow lands comprise all lands which were taken up for cultivation, but are temporarily unsown for a period of not less than one year or not more than five years. The reason for long fallowing may may be manifold, but the significant ones are limited means of farmers, restricted and undependable supply of moisture and unremunerative character of agriculture.

9. The net sown area represents the extent of cultivated area actually sown during the agricultural year. It may be referred to as net cropped area also. This represents the differences between the total geographical area and the sum total of area under classes.

3.2. Landuse Classification

The forest area covers 25.27 per cent of the total geographical area of Assam. Though this figure is much higher than the national figure of 21.16 per cent, still it is much lower than the national target of 33.3 per cent to the total geographical area.

Net area sown in Assam was 27.05 lakh hectares in 1981-82 which has been steadily increasing since 1951-52. In 1951-52 and 1973-74 it was 18.9 lakh hectares and 24.58 lakh hectares respectively.

Again a considerable increase has been observed in area sown more than once. The area sown more than once was recorded 3.13 lakh hectares in 1951-52 which rises upto 7.54 lakh hectares in 1981-82. This may be due to the pressure on agriculture as population growth is very high against a little scope of further extension of arable land into cultivable land.

Table 3.1

Landuse Classification of Assam, 1981-82

Classification	Area in hectares	P.C.
1. Total Geographical Area	78,51,670	-
2. Forests	19,84,449	25.27
3. Land not available for cultivation		
(a) Land put to non-agricultural use	9,14,051	11.64
(b) Barren and uncultivable land	15,40,687	19.62
4. Other uncultivable land		
(a) Permanent pasture and other grazing land	1,84,164	2.43
(b) Land under miscellaneous tree crops	2,46,964	3.14
(c) Cultivable waste	1,03,610	1.31
5. Fallow land		
(a) Fallow land other than current fallow	83,642	1.06
(b) Current fallow	88,427	1.12
6. Net area sown	27,05,676	34.45
7. Total cropped area	34,60,082	44.06
8. Area sown more than once	7,54,406	9.60

Source : Statistical Hand Book of Assam, 1985

If the total 1.72 lakh hectares of fallow land and 1.03 lakh hectares of cultivable wasteland are brought under cultivation, the total net sown area can be extended upto 29.81 lakh hectares against the present

net area sown of 27.05 lakh hectares.

In the year 1981-82 the total cropped area of Assam was 34.60 lakh hectares including the areas sown more than once, against the 25.75 lakh hectares in 1965-66, 27.74 lakh hectares in 1960-70 and 30.76 lakh hectares in 1973-74.

The forests are covered 5.54 lakh hectares of the total 21.67 lakh hectares of geographical area of the Upper Brahmaputra Valley which is 25.6 per cent to the total area of the valley in the year 1981-82.

Table 3.2

Landuse Classification of Upper Brahmaputra Valley 1981-82

Classification	Area in hectare	P.C.
1. Total Geographical Area	21,67,320	-
2. Forests	5,54,954	25.60
3. Land not available for cultivation	5,78,191	26.71
4. Other uncultivated land	2,10,504	9.71
5. Fallow land	60,310	2.78
6. Net sown area	7,62,051	35.16
7. Total cropped area	9,43,397	43.52
8. Area sown more than once	1,81,348	8.36

Source : Statistical Hand Book of Assam, 1985

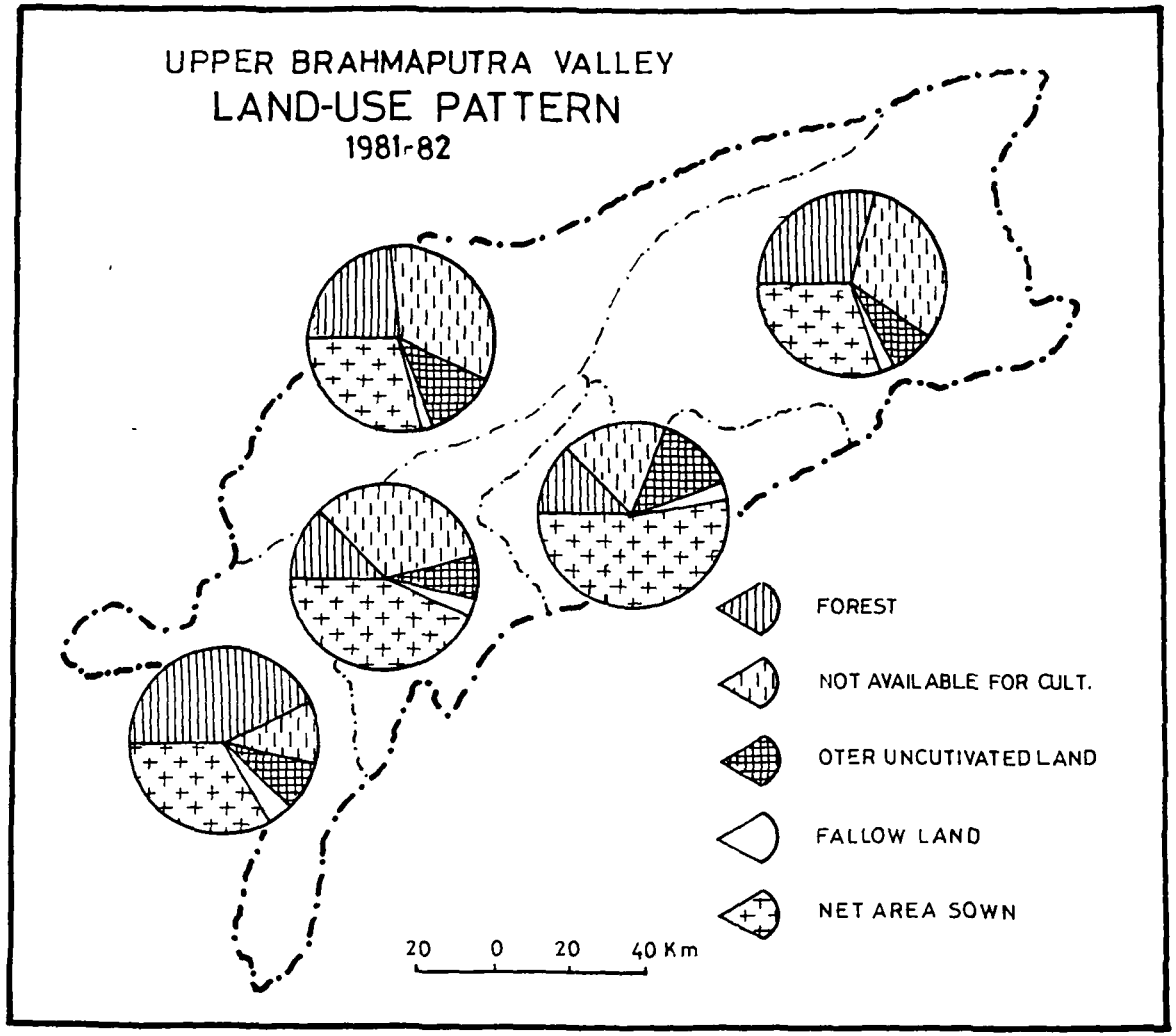
UPPER BRAHMAPUTRA VALLEY
LAND-USE PATTERN
1981-82
FOREST
NOT AVAILABLE FOR CULT.
OTER UNCUTIVATED LAND
FALLOW LAND
NET AREA SOWN
20 0 20 40 Km

Fig.15

Land not available for cultivation which includes (a) barren and uncultivated land, and (b) land put to non-agricultural use, accounted for 26.7 per cent to the total geographical area of the Upper Brahmaputra Valley.

Other uncultivable land which includes (a) permanent pasture and grazing land, (b) land under miscellenous tree crops and grooves, and (c) cultivable waste is 2.1 lakh hectares which is about 9.7 per cent to the total geographical area of the valley.

Land under fallow, both other than current fallow and fallow is 0.63 lakh hectares which is 2.7 per cent to the total area of the valley.

The net area sown in the Upper Brahmaputra Valley is 7.62 lakh hectares, which is 35.16 per cent to the total area of the valley. Though this figure is slightly higher than the state figure of 34.4 per cent, still it is far below than the national figure of 45.0 per cent.

If the other cultivated land including fallow land is brought under cultivation, the total cropped area could be extended upto 10.3 lakh hectares which would be 47.67 per cent to the total geographical area of the valley.

Table 3.3

Districtwise Landuse Classification of Upper Brahmaputra Valley, 1981-82

Classifications	Districts									
	Jorhat		Golaghat		Sibsagar		Lakhimpur		Dibrugarh	
	Area	P.C.	Area	P.C.	Area	P.C.	Area	P.C.	Area	P.C.
Total Geographical Area	286		359		260		565		702	
Forests	36	12.52	152	42.33	33	16.29	130	23.00	204	29.05
Land not available for cultivation	94	32.86	39	10.85	47	18.17	190	33.62	214	30.47
Other uncultivated land	23	9.02	31	8.62	34	13.07	68	12.02	56	7.97
Fallow land	10	3.48	15	4.17	7	2.68	13	2.29	17	2.41
Net sown area	124	43.35	121	33.70	139	54.46	165	29.20	213	30.34
Area sown more than once	34	27.41	12	9.91	30	21.58	51	30.90	54	25.35

Source : Statistical Hand Book of Assam, 1990

In the year 1981-82 the total cropped area of the Upper Brahmaputra Valley was 9.43 lakh hectares including the area sown more than once of 1.81 lakh hectares.

Districtwise maximum amount of forest cover is found in Golaghat which is 42.33 per cent to the total geographical area of the district followed by the district of Dibrugarh with 29.05 per cent to the total area in the year 1981-82. On the other hand district Lakhimpur recorded 23.00 per cent followed by Sibsagar with 16.29 per cent and Jorhat having the minimum forest cover which is only 12.52 per cent to the total land area of the district.

Net area sown to the total geographical area is maximum in the district of Sibsagar which is 54.46 per cent followed by Jorhat with 43.35 per cent. The net sown area is less in the district of Lakhimpur which is only 29.20 per cent in the year 1981-82.

But the amount of double cropping area is the highest in Lakhimpur district which is 30.90 per cent to the total net area sown. The area under double cropping is extremely less in Golaghat district which is only 9.91 per cent to the total net sown area in 1981-82.

Data available from Assam Remote Sensing Application Centre, Guwahati, which was taken at different seasons between 1986-87 through satellite imagery gives districtwise interpreted data for landuse and land cover statistics of Assam.

The landuse statistics for Upper Brahmaputra Valley is provided under following classifications :

According to satellite imagery data, forests, account for 11.83 per cent of the total geographical area of the Upper Brahmaputra Valley in the year 1986-87. A sharp decrease has been observed of forest cover over the last five years which was about 25 per cent of the total geographical area of the valley in the year 1981-82.

Districtwise, the proportion of forest cover is highest in Dibrugarh, accounting for 18.61 per cent to the total area. But the forest cover in the district was about 29.05 per cent to the total area in the year 1981-82. Within a period of just five years the forest cover has decreased from 29.05 per cent to 18.61 per cent. District Golaghat had the maximum amount of forest cover with 42.33 per cent to the total area of the district in the year 1981-82. But it has come down to 8.64 per cent within a short period of five years.

Table 3.4

Districtwise Landuse Classification of Upper Brahmaputra Valley, 1986-87

(in percentage)

Disctrics	Total area	Forest	Agri-cultural land	Waste land	Water bodies	Shift-ing cultn.	Grazing land	Mining	Built up land	Net sown area	Double cropped
Jorhat	291,470	9.48	70.10	0.75	16.25	0.74	2.54	-	0.13	47.49	31.70
Sibsagar	260,290	11.01	82.04	3.81	2.19	-	0.60	-	0.35	43.43	13.53
Golaghat	354,100	8.64	68.45	1.56	13.57	-	7.65	-	0.11	41.60	22.47
Dibrugarh	702,390	18.61	61.91	1.17	13.45	-	4.38	0.20	0.26	26.22	26.57
Lakhimpur	564,640	6.99	71.96	4.15	7.53	-	9.27	-	0.10	54.48	28.69

Source : Assam Remoted Sensing Application Centre, Guwahati

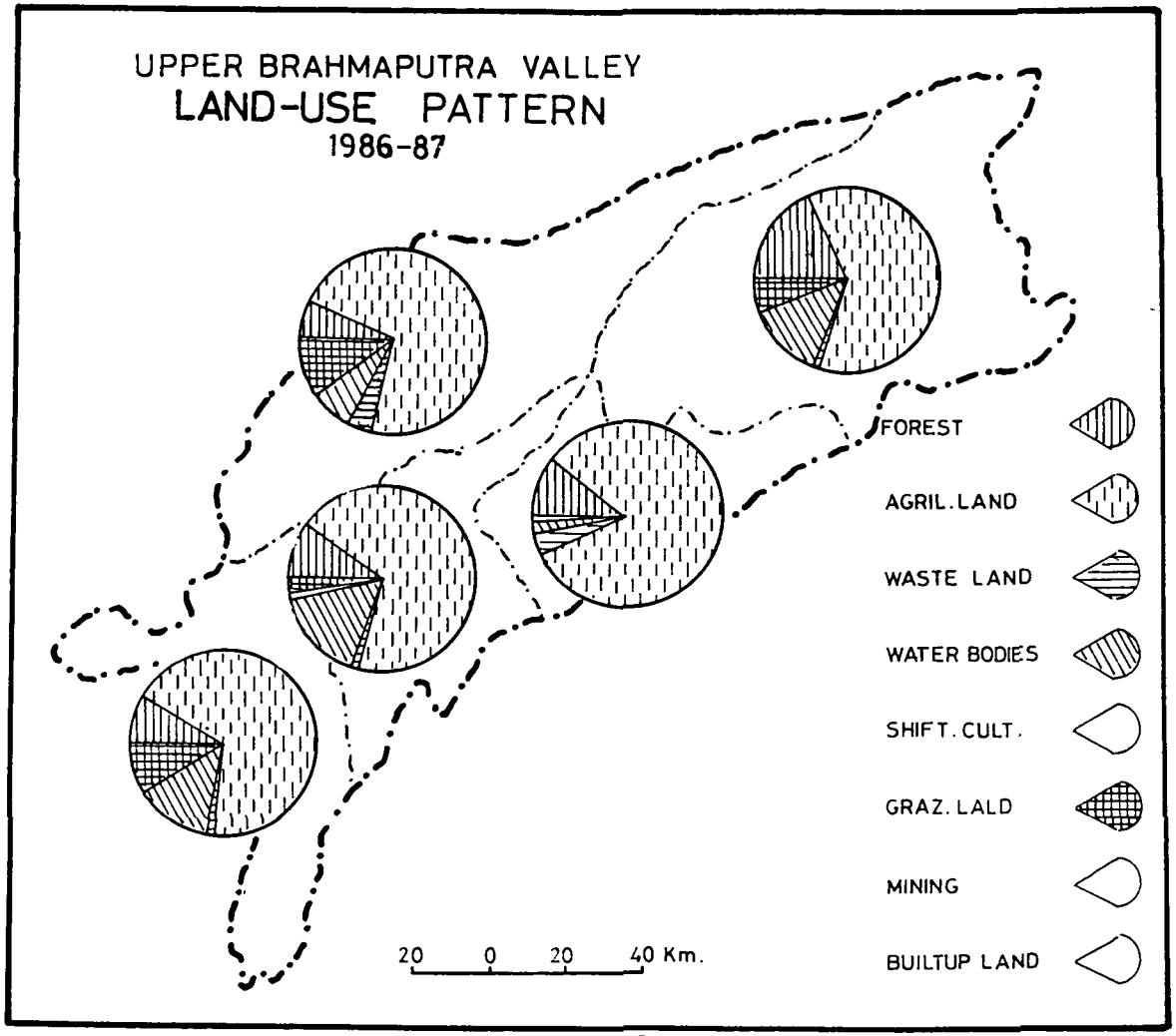
UPPER BRAHMAPUTRA VALLEY
LAND-USE PATTERN
1986-87
FOREST
AGRIL.LAND
WASTE LAND
WATER BODIES
SHIFT.CULT.
GRAZ.LALD
MINING
BUILTUP LAND
20 0 20 40 Km.

Fig.16

At present Lakhimpur represents as a district of lowest forest cover in the region with an amount of just 6.99 per cent to the total area of the district.

Agricultural land which includes cultivable waste, fallow and net sown area, accounts for 69 per cent to the total geographical area of the valley. The district of Dibrugarh has the lowest proportion of agricultural land which accounts for 61.91 per cent to the total area of the district. The proportion of agricultural land is highest in Sibsagar district which is 82.04 per cent to the total area of the district.

The net sown area of the valley as a whole, is 40.98 per cent to the total area. The proportion of net sown area is highest in Lakhimpur district which is 54.48 per cent in 1986-87 with an increase of about 50 per cent within a period of 5 years. Almost in all the districts of the region, the net sown area has increased to some extent. The overall increase of net sown area in the region is about 6 per cent over the last 5 years.

Area sown more than once has increased by 2 per cent over the last five years in the valley. But the districts of Sibsagar and Lakhimpur show a negative increase in double cropping area where area sown more than once has decreased by 8.05 and 2.21 per cent

Table 3.5

Districtwise Landuse Classification of Upper Brahmaputra Valley, 1986-87

District	Total area	Forest	Agril. land	Waste land	Water bodies	Shiftg. cultn.	Grazing land	Mining	Built up land	Net sown area	Double cropped
Jorhat	291,470	27,624	204,320	2,189	47,377	2,147	7,409	-	404	138,405	43,886
Sibsagar	260,290	28,657	213,537	9,912	5,721	-	1,539	-	924	113,042	15,304
Golaghat	354,100	30,605	242,381	5,537	48,082	-	27,100	-	395	147,297	33,102
Dibrugarh	702,390	130,733	434,835	8,200	94,496	-	30,815	1,428	1,883	184,201	48,950
Lakhimpur	564,640	39,445	406,300	23,414	42,544	-	52,391	-	546	307,591	88,260
Total	21,72,890	257,064 (11.83)	15,01,373 (69.09)	49,252 (2.26)	238,220 (10.96)	2,147 (0.09)	1,19,254 (5.48)	1,428 (0.06)	4,162 (0.19)	890,536 (40.98)	229,502 (25.77)

N.B. Figures within bracket represent percentage to state's total

Source : Assam Remote Sensing Application Centre, Guwahati

respectively over the last five years.

3.3. Cropping Pattern

Assam grows a large number of crops but only a few of them are significant in the aggregate level. Data for 1987-88 shows that there are 25.94 lakh hectares of land under foodgrains out of the total 39.58 lakh hectares of land under crops.

Among the various foodgrains, rice is the main crop of Assam and it is grown almost in all the districts. Generally, three varieties of rice are grown in Assam. They are winter rice (Sali and Bao), summer rice (Ahu) and autumn rice (Boro). Among these three, winter rice is grown extensively.

Total area under rice in Assam in 1950-51 was 15.1 lakh hectares and it is increased upto 19.74 lakh hectares in 1970-71, 22.75 lakh hectares in 1980-81, 23.24 lakh hectares in 1984-85 and finally 39.58 lakh hectares in the year 1987-88.

From table 3.6 it is evident that area under rice cultivation has been increasing steadily since 1950-51 in Assam.

Table 3.6

Total Foodgrain (Cereals + Pulses)
1987-88, Assam

Districts	Area (in hect.)	Production (in tonnes)	Yield (kg/hect.)
1. Goalpara	110,842	102,191	-
2. Dhubri	160,254	134,784	773
3. Kokrajhar	167,668	140,472	659
4. Barpeta	113,362	147,369	698
5. Kamrup	126,920	135,685	895
6. Nalbari	178,969	185,252	709
7. Darrang	194,712	171,630	660
8. Sonitpur	138,553	186,582	864
9. Morigaon	70,571	54,263	660
10. Nagaon	243,237	336,651	866
11. Jorhat	94,002	119,891	914
12. Golaghat	72,086	96,452	969
13. Sibsagar	115,283	174,159	821
14. Lakhimpur	91,083	103,768	821
15. Dhemaji	100,077	113,996	808
16. Dibrugarh	88,178	98,454	783
17. Tinsukia	73,501	101,454	875
18. Hailakandi	43,335	66,752	878
19. Karimganj	74,298	11,442	879
20. Cachar	146,559	153,839	878
21. Karbi Anglong	122,021	146,185	736
22. North Cachar Hills	396,935	13,630	794
Total	25,94,696	18,99,163	800

Source : Directorate of Agriculture, Government of Assam.

Wheat is the second important foodgrain in Assam. But the area under wheat cultivation is confined to few districts of the state and it is very small. The figures of 1987-88 show that there are 0.98 lakh hectares of land under wheat cultivation as compared to 1.4 lakh hectares in 1984-85. The decrease in area under wheat cultivation may be due to the increase in area under rice cultivation over this period.

Mustard seed is the main oilseed crop and it is the second largest crop of Assam in terms of area. The area under mustard was 1.23 lakh hectares in 1950-51 and it increased to 3.19 lakh hectares in 1984-85 and 3.37 lakh hectares in 1987-88. Traditionally, it is grown in the riparian tracts of Brahmaputra where the soil is less acidic in reaction and light.

Jute is the main fibre crop of Assam. It is cultivated mainly in the low lying areas of the state. An interesting development in the cultivation of this crop is gradual decrease in area under cultivation since 1970-71. The area under jute cultivation in Assam in the year 1970-71 was 1.28 lakh hectares but decreased thereafter to 1.12 lakh hectares in 1980-81, and then further declined to 1.08 lakh hectares in 1984-85 and to 0.97 lakh hectares in 1987-88. This decline may be due

to uncertain price in market and increase in price of other cereal crops.

Beside these, other important crops cultivated in Assam are Maize, other cereals, gram, tur, other pulses, Linseed, Castor, Sesamum, Cotton, Mesta, Tobacco, Chillies, Sugar Cane, Potato, etc.

Agricultural landuse in the Upper Brahmaputra Valley is characterised by comparatively low percentage of cultivable land. The percentage of rice hectarage is very high compared to the total area sown but the intensity of crops and yields per unit area is very low.

A large number of crops are grown in the Upper Brahmaputra Valley of Assam. Foodgrains are the dominating crops in the region where it occupies as high as 77.5 per cent of the total cropped area in the region. Oil seeds are second dominating crops in the region where it occupies 14.0 per cent of the total cropped area and area under miscellaneous crop is 8.0 per cent to the total cropped area.

Among the various crops in the Upper Brahmaputra Valley rice is the dominating crop and it is extensively cultivated in all the districts of the region. According to the figures available for the year 1987-88,

there is 5.91 lakh hectares of land under rice cultivation which is as high as 72.3 per cent to the total cropped area in the valley.

Table 3.7

Area Under Different Crops in 1987-88

(Area in hectare)

Area under foodgrains	Area under oil seeds	Area under fibre crops	Area under misc. crops	Area under Total
634,235 (77.5)*	114,930 (14.0)*	3,922 (0.57)*	65,181 (8.0)*	818,268

* Figures within brackets represent percentage

Source : Statistical Hand Book of Assam, 1990.

Generally, three varieties of rice are grown in the region. They are winter rice (Sali and Bao), summer rice (Ahu) and autumn rice (Boro). The winter rice is grown extensively in the region by the transplantation method. The summer rice locally known as 'Ahu' is sown in the month of February to April and harvested in August to September. The autumn rice is sown by transplantation method provided water is available, during the month of May or June, and harvested in September or October.

Table 3.8

Cropping Pattern in Upper Brahmaputra Valley, 1987-88

(Area in hectare)

Crops	Area	Crops	Area
Rice	591,976 (72.3)*	Chillies	2,166
Wheat	13,503 (1.6)*	Sugar Cane	16,611 (2.05)*
Maize	3,581	Potato	12,732 (1.5)*
Gram	162	Sweet Potato	1,620
Tur	614	Small Millet	506
Other Pulses	23,893 (2.9)*	Banana	8,706 (1.1)*
Mustard	112,418 (13.7)*	Papaya	773
Linseed	46	Tapioca	107
Castor	680	Tumeric	2,679
Sesamum	1,826	Onion	799
Cotton	213	Arcenut	17,772 (2.2)*
Jute	3,501 (0.4)*	Coconut	595
Mesta	208	Tobacco	581

Total Area = 818,268

* Figures within brackets represent percentage

Source : Statistical Hand Book of Assam, 1990

Among the five districts of the valley Lakhimpur district ranks first having 30 per cent of the total area under rice cultivation in the valley. Dibrugarh district ranks second with 25.2 per cent and Golaghat district with only 11.08 per cent.

Wheat is the second important foodgrain in the valley but the area under its cultivation is negligible with only 1.6 per cent to the total cropped area of the valley.

Mustard seed is the second large crop in the region as far as area is concerned. The area under this crop is 1.12 lakh hectares which is about 13.7 per cent to the total cropped area of the valley.

Among the fibre crops, Jute is the most important; but the area under jute cultivation is very low with only 0.4 per cent to the total cropped area.

Other important crops in the valley are Arecanut (2.2 per cent), sugar cane (2.03 per cent), potato (1.5 per cent) and banana (1.1 per cent).

Besides these crops, other crops cultivated in the valley are maize, gram, tur, various pulses, linseed, castor, sesamum, cotton, mesta, tobacco, chillies, sweet potato, small millet, papaya, tapioca, turmeric, onion, coconut, etc.

Table 3.9

Cropping Pattern in the Upper Brahmaputra Valley, 1988-89

(Area in hectare; Productivity in tonnes; Yield in kg/hectare)

District		Rice	Maize	Wheat	Pulses	Rape & Mustard	Banana	Arecanut	Sugar Cane	Potato
Jorhat	A	85,951	42	3,235	4,615	14,390	1,470	1,874	369	2,032
	P	96,322	21	4,728	1,628	9,154	19,596	1,687	13,004	16,778
	Y	1,121	500	1,462	353	636	3,331	166	35,241	8,257
Golaghat	A	79,647	462	2,737	2,391	15,942	2,295	3,483	13,320	1,265
	P	1,12,165	249	3,618	970	9,459	31,818	3,081	5,61,225	9,010
	Y	1,408	539	1,322	405	593	13,864	131	41,206	7,123
Sibsagar	A	1,09,258	47	2,837	1,351	7,074	1,000	5,050	214	1,282
	P	1,53,199	24	2,161	505	2,192	14,227	2,855	6,396	7,795
	Y	1,402	511	762	374	310	14,227	132	29,888	6,080
Lakhimpur	A	1,76,913	1,005	4,719	6,165	49,145	3,161	3,055	668	5,640
	P	1,91,958	570	6,410	2,332	25,123	41,005	6,882	20,597	45,929
	Y	1,085	567	1,358	378	511	12,972	211	30,834	8,143
Dibrugarh	A	1,39,152	1,833	3,900	4,058	19,200	2,256	4,803	2,493	2,660
	P	1,91,027	972	4,915	1,681	10,426	29,569	4,429	1,25,441	17,395
	Y	1,373	530	1,260	414	543	13,107	162	50,317	6,506

Source : Directorate of Economics and Statistics, Assam

IV

EXISTING LANDHOLDING PATTERN

4.1. Introduction

An operational holding for the purpose of agriculturala census is defined as the land which is used wholly or partilly for agricultural production and is operated as a single technical unit by one person alone or with others, without regard to title, legal form and size. An operational holding managed by the person of the same household is considered as an individual holding and the member of the household who is mainly responsible for managment of the holding is considered as holder. When two or more persons jointly share the economic and technical responsibility for the

operation of an operational holding, each of them is treated as the holder if they belonged to different household and the holding is considered as a joint holding.

The landholding structure of any agrarian country is generally complex and dynamic and its degree of dynamism primarily depends on the country's socio-cultural and political systems.

In the light of new strategy adopted by the Government of India during 1966-67 for agricultural development, the individual operational holdings assumed special significance in India as units of decision-making. It became more important on account of changed socio-economic conditions. The conduct of agricultural census centred around the operational holdings in India.

At present, in almost all the states of the country including Assam, the landholding structure is characterised by maximum individual ownership, tenant system and, to a large extent, large-scale estate like private ownership.

4.2. Land Tenure System in Assam

There is no reliable written records on land tenure system in Assam befor the Ahoms came into the

region and ruled it. The Ahoms ruled Assam for about six hundred years from the early 13th Century and very lately they started introducing certain definite land tenure system.[1] For the first time Paik system of revenue administration was introduced during the reign of King Pratap Singha in 1607 A.D.[2] Accordingly each Paik was allotted two puras (1.02 hectare) of rupit land (paddy land) and land for housing and gardening called bari.

Instead of salaries, the officers appointed by the kind were provided with the services of the paiks. The paik had to cultivate the land allotted to the officers for required grains.[3] Moreover, the officers were given rent-free land. The king also granted land for religious and charitable purposes to institutions as well as individuals and these were treated as private properties.

Assam was brought under the domain of British empire in the year 1826, and the Britishers gradually began to frame certain land regulations. An agency for collection of land revenue was brought into force in the year 1833, and each district was divided into some mouzas and numbers of commission agent called mouzadars were appointed for collection of tax from all the residents of the mouzas.[4]

The Assam Land Revnue Regulation 1886, for the first time defined the rights to be attached with the owners of different classes of estates or interest in land.[5] The main classes of estates or interest in land may be grouped as follows : (i) Lakhiraj ('la' means free and 'khiraj' means revenue) estates; (ii) Free-Simple estates; (iii) Permanently settled estates; (iv) Acknowledge estate; (v) Temporarily settle khiraj estates held direct from the Government under periodic lease and (vi) Temporarily settled khiraj estates held direct from Government on annual lease.[6]

The Assam Land Revenue Regulation, 1886 is the general revenue law of Assam and it is still in force. However, depending upon the rights and previleges enjoyed by the landholders, the land tenure system prevalent in the plain districts of Assam may be distinguished into two types; Zamindari and Ryotwari systems. In the zamindari system, revenue was collected by the zamindars who acquired the status of landlord. But under the Ryotwari system, the occupiers of relatively small independent holdings paid revnue directly to the Government.

The tribal-dominated hills districts of Assam viz., Karbi-Anglong and North Cachar Hills have neither

been cadastrally surveyed, nor put under a system of land revenue assessment except for some parts of it which were formerly parts of Nowgong and Sibsagar districts at the time of its formation in 1951.[7]

4.3. Land Reform Measures

After Independence, a number of land reform measures have been adopted by the State Government in order to remove the defects in the existing land tenure system. The main objectives of such reformative measures were abolition of intermediaries, redistribution of land for optimum allocation of resources, protection of tenants from evition, restriction of sub-letting, etc.[8] The following are the important measures undertaken at different times for achieving these objectives.

(i) The Assam State Acquisition of Zamindari Act, 1951

A bill for abolishing the zamindari system prevalent in certain parts of Assam (Goalpara and parts of Cachar district) was passed in the State Assembly in March 1948 and it became an Act in 1951, called the Assam State Acquisition of Zamindari System Act, 1951. This Act aimed to establish direct relationship between the tenants and Government abolishing the right of the

Zamindars. Already the rights of all proprietors in respect of 3,638 estates and tenure holders in respect of 4,333 number thereof covering an area of 6.7 lakh hectares have been acquired and as a resualt the rayats (tenants) of the earstwhile Zamindars came to hold their land directly under the Government.[9]

(ii) The Assam Fixation of Ceiling on Landholding Act, 1965

With the aim reducing the glaring inequalities in the ownership of land and to satisfy the desire of the landless to possess land, this Act fixed 150 bighas (20 hectare) as the maximum limit of the holding. Since 1965, the Act has been amended several times. The last amendment, reducing the ceiling limit to 50 bighas (6/.66 hectares) was made in 1975.[10]

(iii) The Assam Consolidation of Holding Act, 1960

This Act seeks to consolidate the fragmented holdings and to prevent further fragmentation for better cultivation in the plain districts. A scheme for the work of consolidation was taken up in Rani area of Kamrup district on an empirical basis. But owing to various constraints the Act is yet to see its full implementation.[11]

(iv) The Assam (Temporarily Settled Areas) Tenancy Act, 1971

In order to regulate the relations between the landlords and tenants in the temporarily settled areas of Assam, the Assam (Temporarily Settled Areas) Tenancy Act, 1971 was enacted. This Act recognises two types of tenants, viz., occupancy and non-occupancy tenants. It reduced the length of the time for acquiring the right of occupancy to 3 years instead of 12 years under ceiling regulations. According to the Act, the occupancy tenant can acquire the right of ownership over land by depositing an amount of 50 times more than the annual land revenue payable. Under the provision of the Act, the Government launched a programme for updating the records of right of the tenants. Initially 3.03 lakhs persons were recorded as tenants, the figure came down to 2.78 lakhs in 1986 due to the settlement of tenanted land to the tenants themselves.[12]

(v) The Assam Bhoodan Act, 1965

Under this Act, of the total of 4,774 hectares of land donated by the people, 341 hectares have been distributed among a section of landless cultivators of the State.[13]

All the policies of land reform discussed above influenced the landholding structure of the state to

arrive at the present existing pattern.

4.4. Size of Operational Holding

Assam is one of those states where comprehensive system for maintenance of land records have been in vogue for long time. Except for two Hill Districts, i.e., Karbi Anglong and North Cachar Hills, essential informations for each survey number is available in the land records.

The rural settlements in Assam are surrounded by innumerable operational holdings of different shapes and sizes. According to 1985-86 census (the latest year for which holding data is available) there were 23.94 lakhs operational holdings accounting for 31.61 lakhs of operated area in Assam. The number of operational holdings in 1985-86 as compared to 1975-76 has gone up by 6.74 lakhs and the percentage increase is to the tune of 28.17. The operational area has increased by 81.86 thousand hectares which is only 2.58 per cent over the last 10 years of time.

The average size of an operational holding in Assam is as small as 1.37 hectare (according to 1985-86 census), much below the national average of 2.71 hectares. Moreover, there are more than 752 tea

Table 4.1

Number and Area of Operational Holding, Assam 1975-76/1985-86

Size Class (in hectare)	Number of holding		P.C. variation	Operated Area		P.C. variation
	1976-77	1985-86		1976-77	1985-86	
Below 1	13,43,700 (59.62)	14,42,183 (60.23)	6.82	5,93,600 (19.28)	6,00,344 (18.98)	1.12
1-2	5,09,800 (22.62)	5,46,458 (22.82)	6.70	7,18,100 (23.32)	7,61,450 (24.08)	5.69
2-4	2,25,900 (10.02)	3,16,230 (13.20)	6.42	8,08,400 (26.25)	8,74,109 (27.64)	7.51
4-10	96,400 (4.28)	84,211 (3.51)	14.47	5,27,200 (17.12)	4,80,912 (15.21)	-9.62
Above 10	7,800 (0.34)	5,699 (0.23)	-36.86	4,32,300 (14.04)	4,44,648 (14.06)	2.77
Total	22,53,600	23,94,775	28.17	30,79,600	31,61,463	2.58

Source : Statistical Hand Book of Assam, 1990

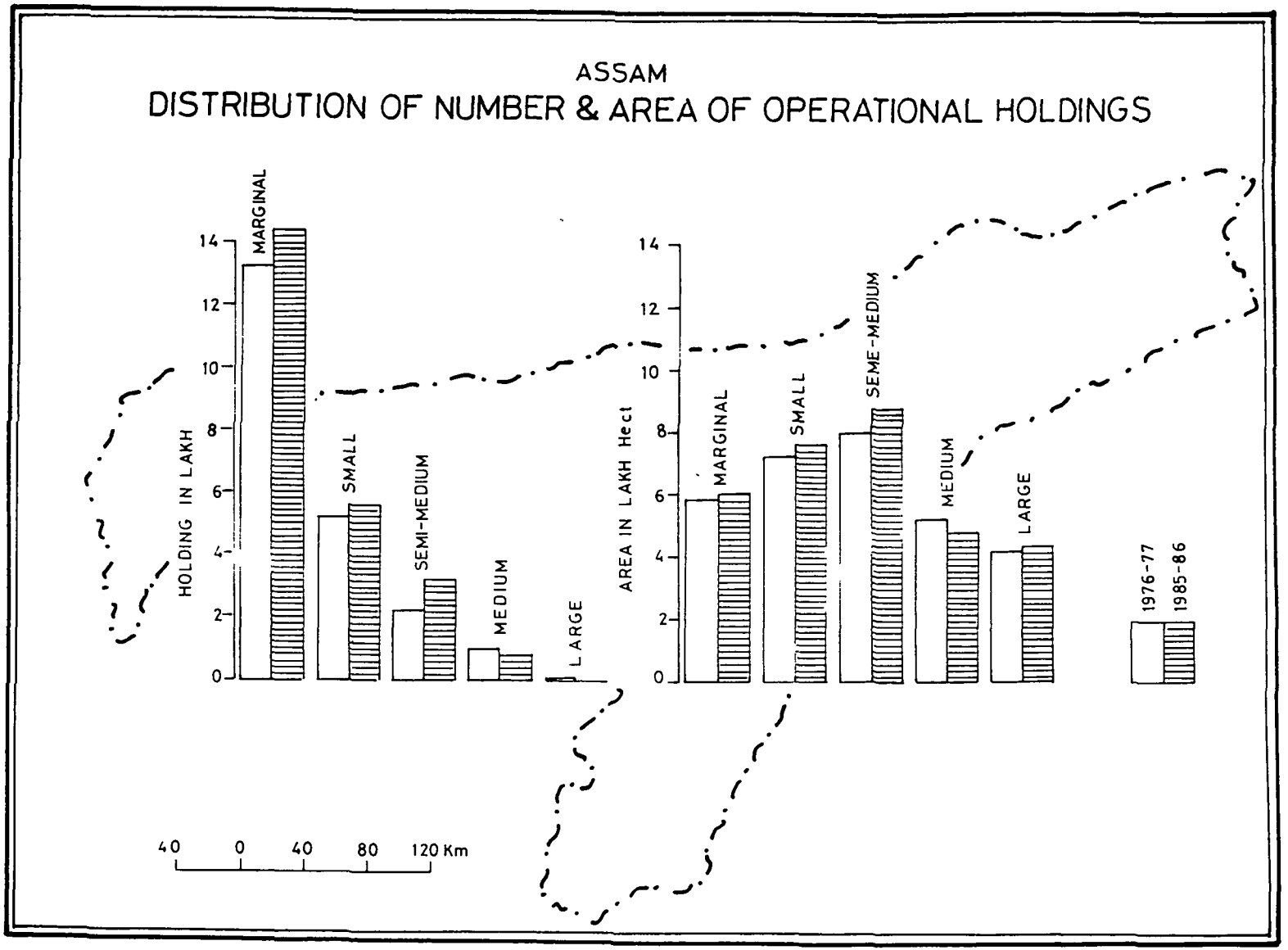
ASSAM
DISTRIBUTION OF NUMBER & AREA OF OPERATIONAL HOLDINGS
HOLDING IN LAKH
MARGINAL
SMALL
SEMI-MEDIUM
MEDIUM
LARGE
AREA IN LAKH Hect
MARGINAL
SMALL
SEME-MEDIUM
MEDIUM
LARGE
1976-77
1985-86
0
2
4
6
8
10
12
14
40 0 40 80 120 Km

Fig.17

gardens in Assam which are included in operational area. Therefore, the actual average size of holding in peasant agricultural sector may be much smaller than what is stated above.

It is also interesting to note from the table 4.1 that in the medium (4-10 hectares) and large (above 10 hectares) categories, there was decrease in number with the percentage variation of -14.47 and -36.86 respectively over the last 10 years. This variation in number in case of medium size class also affects its area which has gone down by -9.62 per cent. Such changes ultimately affected the small size categories where both number and area have slightly increased over the period.

It is evident from table 4.2 that nearly 60 per cent of the holdings in Assam are marginal holding, i.e., holding below 1 hectare. But it covers only about 19 per cent of the total operated area of the state. Nearly 23 per cent of the state's total holdings are small holdings (1-2 hectares) which covers about 24 per cent of the total operated area of the state. Semi-medium holdings (2-4 hectare) which is 13 per cent of the total holding, occupies 27 per cent of the total operated area. Medium size holding (4-10 hectares)

Table 4.2

Percentage Distribution of Number and Area of Operational Holding, Assam 1976-77/1985-86

Size Class (in hectare)	P.C. of number of holding				P.C. of operated area			
	1976-77	Cf	1985-86	Cf	1976-77	Cf	1985-86	Cf
Below 1	59.6	59.6	60.3	60.3	19.3	19.3	18.9	18.9
1-2	22.6	82.2	22.8	83.1	23.3	42.6	24.1	43.0
2-4	13.1	95.3	13.2	96.3	26.2	68.8	27.6	70.6
4-10	4.3	99.6	3.5	99.8	17.1	85.9	15.2	85.8
Above 10	0.4	00.0	0.2	00.0	14.1	00.0	14.2	00.0
Total	100.0		100.0		100.0		100.0	

Source : Statistical Hand Book of Assam, 1990

covers about 4 per cent of the total holdings with an area of 15 per cent. On the other hand, large size category of holding (above 10 hectares) shared only 0.2 per cent of the total holdings but comparatively with a large amount of land which is about 14 per cent of the total operated area of the state. In the overall distribution, the share of medium holdings both in terms of number and area has decreased over the last 10 years.

It may be mentioned that more than 80 per cent of the total landholding in Assam is below 2 hectares, which is underestimation of the most important consideration of economic viability or non-viability of farm size. Khusro has pointed out that from the economic point of view 2 hectares size of holding is floor level.[14] Such a smal size of holding suffers from various problems like size-disability, tenurail uncertainty and available human and animal labour.

Another notable feature is that in Assam the holding pattern is not equally distributed. More than 60 per cent of the total holdings covered only 19 per cent of the total operated area. The disparities remained more or less unaltered over the last 10 years.

The two Lorenz Curves so obtained reveal that the distribution of holding for both the years are more or

less similar and show highly concentrated nature of landholding pattern. From the above situation it may be concluded that by and large, landholding system in Assam is dominated by small size holdings. The number of large farms or large holdings are comparatively less (Gini's Co-efficient in Appendix).

The study region - Upper Brahmaputra Valley - which is at present comprised of five plain district of Assam is a region of high agricultural potentiality. According to 1985-86 Agricultural Census there are 6.19 lakhs of operational holdings occupying 9.63 lakhs hectare of land area in the study region. The percentage variation of holdings in the valley over the last 10 years is +8.32 with +2.53 per cent increase in case of total area. The average size of farm in the valley is 1.55 hectares which is slightly higher than the state's average of 1.32 hectare. Out of the total, more than 57 per cent belongs to the marginal farm size (below 1 hectare) group. But areawise this size class group covered only 17 per cent of the total operated area. Notable point is that, though large size class group (above 10 hectares) which constitutes only 0.37 per cent to the total holdings, covered as high as 24.0 per cent of the total operated area with an average farm

size of 102.68 hectares. The reason is already mentioned, as there are large number of tea gardens in the entire districts of the valley. If the plantation estates are excluded, from the total holdings, the average sise of holding will go down to 1 hectare in the valley. Like other parts of Assam, the landholding pattern in Upper Brahmaputra Valley is also highly concentrated as more than 80 per cent of the total holdings cover only 38 per cent of the total operated area.

Table 4.3
Number and Area of Operational Holding
Upper Brahmaputra Valley, 1985-86

Size Class (in hectare)	No. of holding	P.C.	Area	P.C.	Ave-rage
Below 1	356,707	57.57	161,588	16.77	0.45
1-2	148,370	23.95	208,519	21.64	1.40
2-4	86,252	13.92	224,254	23.27	2.59
4-10	25,975	4.19	135,382	14.05	5.21
Above 10	2,277	0.37	233,819	24.27	102.68
Total	619,590	100.00	963,562	100.00	1.55

Source : Directorate of Economics and Statistics, Government of Assam, 1990.

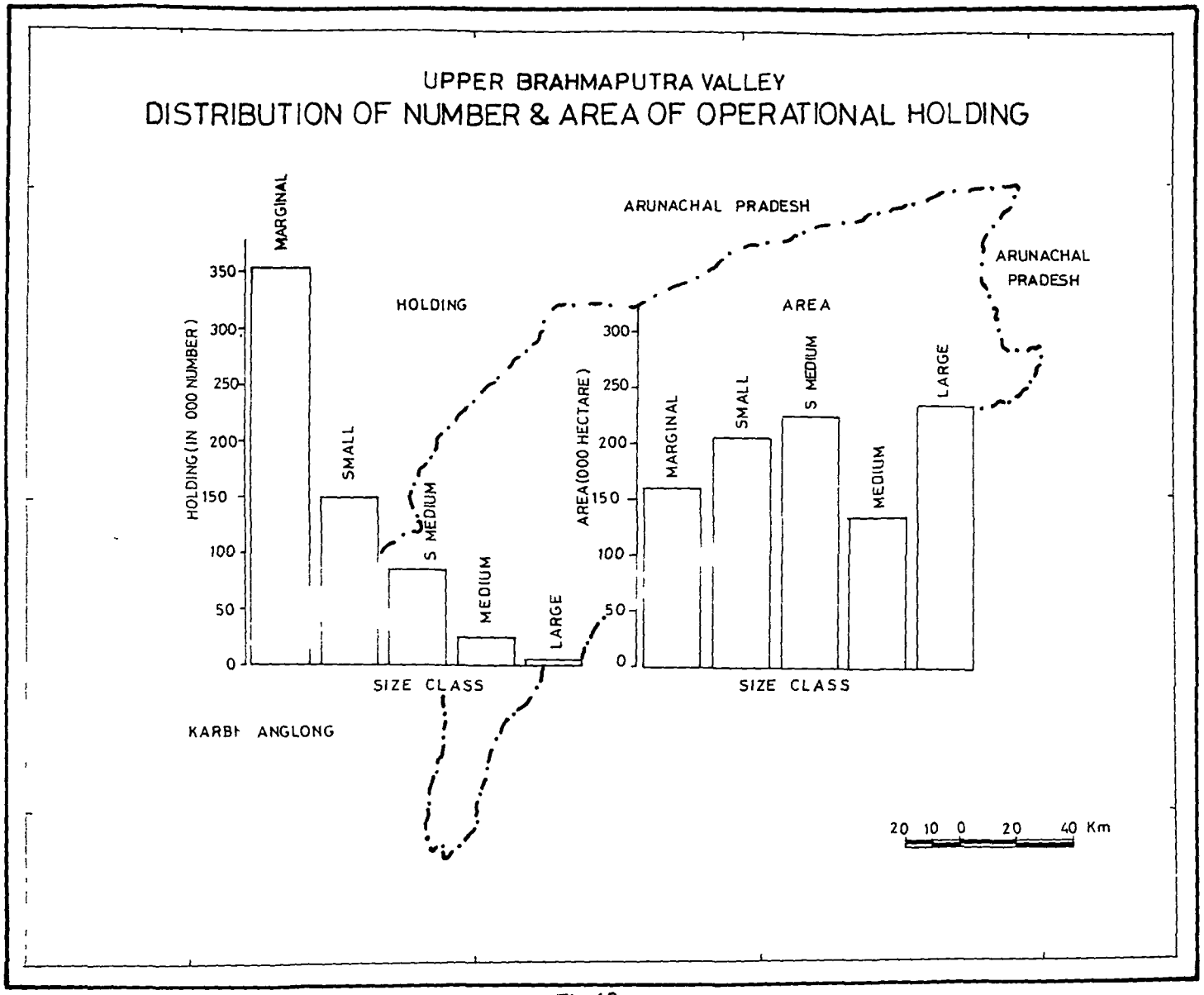
UPPER BRAHMAPUTRA VALLEY
DISTRIBUTION OF NUMBER & AREA OF OPERATIONAL HOLDING
HOLDING (IN 000 NUMBER)
350
300
250
200
150
100
50
0
MARGINAL
SMALL
S MEDIUM
MEDIUM
LARGE
HOLDING
SIZE CLASS
AREA (000 HECTARE)
300
250
200
150
100
50
0
MARGINAL
SMALL
S MEDIUM
MEDIUM
LARGE
AREA
SIZE CLASS
ARUNACHAL PRADESH
ARUNACHAL PRADESH
KARBI ANGLONG
20 10 0 20 40 Km

Fig 18

Table 4.4

Percentage Distribution of Number and Area of Operated Holding - Upper Brahmaputra Valley, 1985-86

Size Class (in hectare)	P.C. of holding	Cf	P.C. of Area	Cf
Below 1	57.57	57.57	16.77	16.77
1-2	23.95	81.52	21.64	38.41
2-4	13.92	95.44	23.27	61.68
4-10	4.19	99.63	14.05	75.73
Above 10	0.37	100.00	24.27	100.00
Total	100.00		100.00	

Source : Statistical Hand Book of Assam, 1990

4.5. Castewise Distribution of Land Holding

As a whole Assam's landholding distribution is dominated among the non-tribal and non-Scheduled Castes holders. Out of the total 23.94 lakhs of holdings in Assam only 4.78 per cent holder belongs to Scheduled Castes with a 4.09 per cent of the total operated area. But notable point is that the total percentage of Scheduled Castes population is 6.2 as a whole for Assam. On the other hand, Scheduled Tribes holder in Assam stands for 13.14 per cent with a 14.06 per cent of the total operated area against the 11 per cent of the total population in Assam. The percentage of non-tribal and

Table 4.5

Castewise Distribution of Number and Area of Operational Holding in Assam, 1985-86

Size Class (in ha.)	Scheduled Castes		Scheduled Tribes		Others	
	Number	Area	Number	Area	Number	Area
Below 1	69,172	33,969	146,829	75,687	12,26,227	490,688
1-2	27,955	39,116	93,517	123,945	424,984	598,389
2-4	15,731	44,252	66,125	116,468	282,746	582,743
4-10	1,633	9,944	7,770	45,837	26,434	215,775
Above 10	81	1,768	565	11,075	5,049	431,805
Total	114,527 (4.78)	129,049 (4.09)	314,806 (13.14)	443,012 (14.06)	19,65,442 (82.07)	25,89,400 (82.19)

Source : Directorate of Agriculture, Assam

higher caste holder in Assam is as high as 82 per cent to the total holding with equal amount of land.

All the plain districts of Assam are marked by high percentage of landholders, other than Scheduled Castes and Scheduled Tribes groups. Jorhat and Sibsagar districts rank top with 90.77 and 90.76 per cent, respectively, in non-tribal holder and Lakhimpur district is the lowest with 68.43 per cent. On the other hand, the two hill districts, i.e., North Cachar Hills and Karbi Anglong are highly dominated by tribal holders with 99.06 and 74.26 per cent respectively.

The whole landholding pattern in the Upper Brahmaputra Valley is dominated by non-tribal and non-Scheduled Castes holders. Number of Scheduled Castes holders in the valley is very less, which is only 4 per cent to the total number of holders. The area occupied by Scheduled Castes holder is also extremely less which is only 3 per cent of the total operated area of the Upper Brahmaputra Valley. Scheduled Tribes farmers constitute nearly 11 per cent with an equal proportion of operated area in the valley. More than 84 per cent farmers of the valley are non-tribal with 87 per cent of the total operated area.

Table 4.6

Castewise Percentage Distribution of Number and Area of Operational Holding Assam, 1985-86

Districts	Holding			Area		
	S.C.	S.T.	Others	S.C.	S.T.	Others
Dhubri	3.40	16.26	80.32	2.93	21.97	75.09
Kokrajhar	3.36	16.16	80.47	2.99	17.89	79.11
Goalpara	3.36	16.16	80.47	3.01	17.87	79.10
Barpeta	3.86	12.39	83.74	3.80	14.19	82.00
Nalbari	3.58	12.38	83.76	3.79	14.18	82.01
Kamrup	3.58	12.38	83.76	3.87	14.31	81.81
Darrang	2.63	10.02	87.33	3.15	12.91	83.92
Nagaon	9.64	10.52	79.83	8.35	10.03	81.61
Sonitpur	2.63	10.02	87.33	3.15	12.91	83.92
Jorhat	3.68	5.53	90.77	2.37	4.99	92.63
Sibsagar	3.68	5.54	90.76	2.37	5.02	92.60
Dibrugarh	4.64	8.54	86.81	3.16	5.96	90.86
Lakhimpur	4.62	26.94	68.43	3.67	32.51	63.80
Karbi Anglong	1.24	74.26	24.48	1.20	74.37	24.41
North Cachar Hills	0.63	99.06	0.29	0.45	98.98	0.56
Cachar	9.55	2.94	87.49	5.79	2.19	92.00
Karimganj	9.55	2.96	87.47	7.24	2.70	90.04

Source : Directorate of Agriculture, Assam

Table 4.7

Castewise Distribution of Number and Area of Operational Holding in Upper Brahmaputra Valley, 1985-86

Size Class (in hectare)	S.C.		S.T.		Others	
	Number	Area	Number	Area	Number	Area
Below 1	15,699	7,420	30,395	15,170	3,01,556	1,39,101
1-2	6,431	8,855	20,769	28,297	1,21,179	1,71,367
2-4	2,952	7,888	12,171	32,589	71,129	1,89,777
4-10	692	3,573	4,249	22,725	21,034	1,10,590
Above 10	18	243	184	2,374	2,075	2,32,202
Total	25,792 (4.16)	27,979 (2.90)	67,768 (10.9)	1,01,155 (10.4)	5,25,973 (84.9)	8,42,037 (87.38)

Source : Directorate of Agriculture, Assam

Table 4.8

Districtwise Number and Area of Operational Holding in Assam, 1985-86

(Area in hectare)

Districts	Number of holding	P.C.	Area	P.C.
Dhubri	100,265	4.19	114,481	3.63
Kokrajhar	153,112	6.39	197,280	6.26
Goalpara	104,616	4.36	118,756	3.76
Barpeta	157,042	6.56	184,634	5.86
Nalbari	92,127	3.85	108,765	3.45
Kamrup	217,716	9.09	252,491	8.02
Darrang	161,697	6.75	176,925	5.62
Nagaon	300,224	12.54	346,842	11.01
Sonitpur	243,424	10.16	269,179	8.54
Jorhat	219,069	9.15	321,164	10.19
Sibsagar	89,077	3.72	130,182	4.13
Dibrugarh	180,335	7.53	332,419	10.55
Lakhimpur	131,109	5.47	180,695	5.73
Karbi Anglong	47,395	1.98	82,182	2.60
North Cachar Hills	14,914	0.62	23,199	0.73
Cachar	135,350	5.65	230,246	7.30
Karimganj	47,605	2.00	80,790	2.56
Total	394,775	100.00	3,150,230	100.00

Source : Statistical Hand Book of Assam, 1990

The districts of Jorhat, Sibsagar and Dibrugarh are highly dominated by non-tribal farmers whereas in the district of Lakhimpur, more than one-fourth of the total farmers belong to Scheduled Tribes groups.

It is interesting to note that out of the total 25,792 Scheduled Castes farmers in the valley, there are only 18 farmers who have land of more than 10 hectares.

4.6. Districtwise Distribution of Landholding Pattern

Out of the total of 23.94 lakh holdings in 1985-86, the plain districts of Assam with 96.67 per cent of the state's total area possesses 97.40 per cent of the total number of holdings. When we look at the district level, variation is found in Brahmaputra Valley in terms of both number of holdings and operated area. In the districts of lower and middle Brahmaputra Valley, the proportion of opeated area were found to be leeser than their respective proportion of number of holdings. But the districts of Upper Brahmaputra Valley with relatively low population density had more proportions of area operated than the proportion of number of holdings in relation to the state's total. Similarly, the two hill districts also exhibited the same picture.

The relatively large average size of holding in Dibrugarh, Cachar, Sibsagar and Jorhat districts is

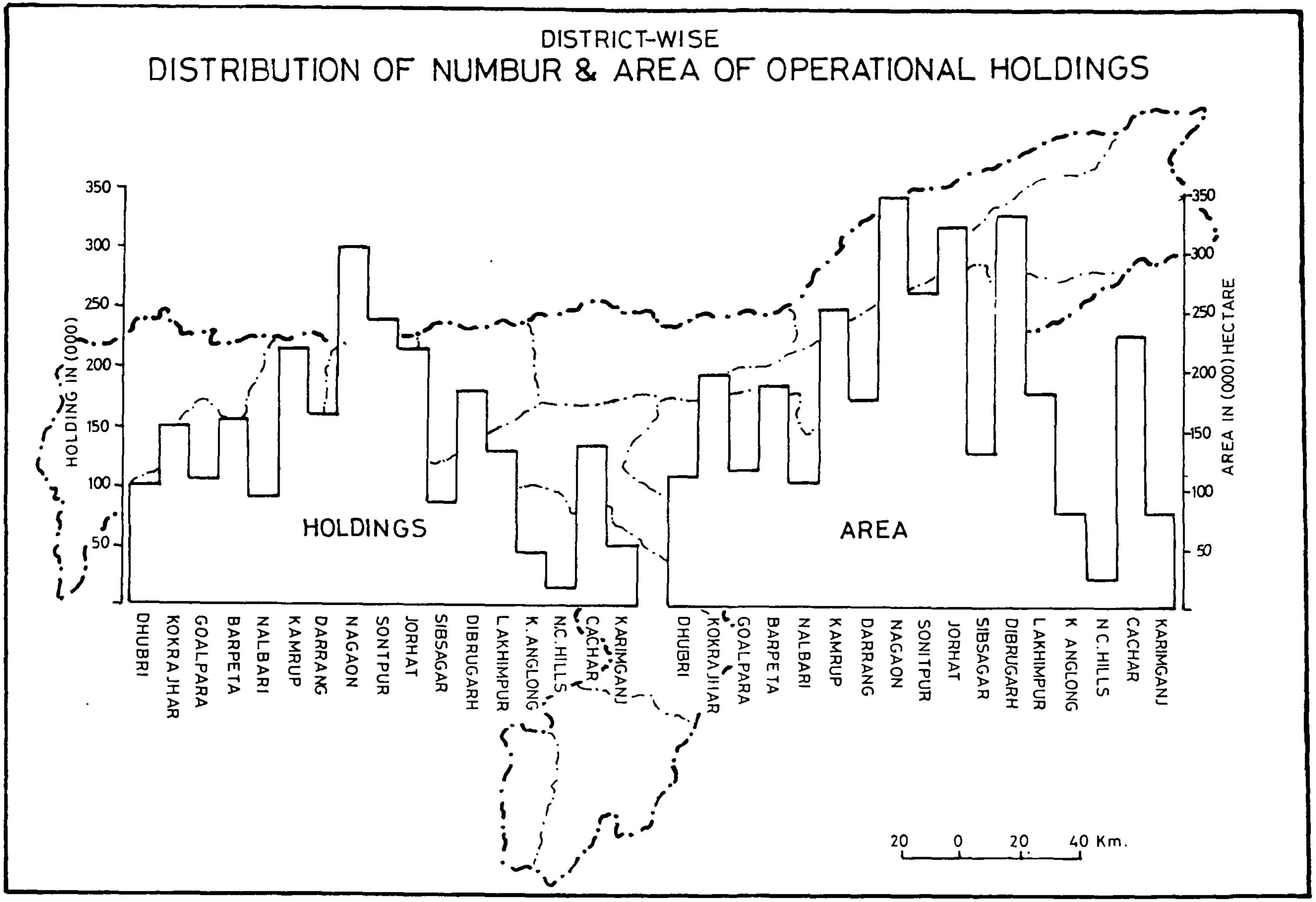
DISTRICT-WISE
DISTRIBUTION OF NUMBUR & AREA OF OPERATIONAL HOLDINGS
HOLDING IN (000)
350
300
250
200
150
100
50
HOLDINGS
DHUBRI
KOKRAJHAR
GOALPARA
BARPETA
NALBARI
KAMRUP
DARRANG
NAGAON
SONTPUR
JORHAT
SIBSAGAR
DIBRUGARH
LAKHIMPUR
K. ANGLONG
N.C. HILLS
CACHAR
KARIMGANJ
AREA
AREA IN (000) HECTARE
DHUBRI
KOKRAJHAR
GOALPARA
BARPETA
NALBARI
KAMRUP
DARRANG
NAGAON
SONITPUR
JORHAT
SIBSAGAR
DIBRUGARH
LAKHIMPUR
K ANGLONG
N C. HILLS
CACHAR
KARIMGANJ
20 0 20 40 Km.

Fig. 19

Table 4.9

Districtwise Average Farm Size in Assam
1985-86

Districts	Number of holding	Area (in hectare)	Average Farm size
Dhubri	100,265	114,481	1.14
Kokrajhar	153,112	197,280	1.29
Goalpara	104,316	118,756	1.34
Barpeta	157,042	184,634	1.18
Nalbari	92,127	108,756	1.18
Kamrup	217,716	252,491	1.16
Darrang	161,697	176,925	1.09
Nagaon	300,224	346,842	1.16
Sonitpur	243,424	269,179	1.11
Jorhat	219,069	321,164	1.47
Sibsagar	89,077	130,182	1.46
Dibrugarh	180,335	332,419	1.84
Lakhimpur	131,109	180,659	1.38
Karbi Anglong	47,395	82,182	1.73
North Cachar Hills	14,914	23,199	1.56
Cachar	135,350	230,246	1.70
Karimganj	47,605	80,790	1.70
Total	2,394,775	3,150,230	1.32

Source : Statistical Hand Book of Assa, 1990

mainly due to the existence of big size holdings under tea plantation. On the other hand, the high average size of holding in two hill districts of Assam, i.e., Karbi Anglong and North Cachar Hills is due to the introduction of plantation agriculture and the gradual change of agricultural practice from Jhuming (shifting cultivation) to sedentry, which had raised the average size of holdings in the districts.

Table 4.10

Districtwise Number and Area of Operational Holding in Upper Brahmaputra Valley, 1985-86

(Area in hectare)

District	No. of holding	P.C.	Area	P.C.
Jorhat and Golaghat	219,069	35.35	321,164	33.29
Sibsagar	89,077	14.37	130,182	13.49
Dibrugarh	180,335	29.10	332,419	34.46
Lakhimpur	131,109	21.16	180,695	18.73
Total	619,590	100.00	964,460	100.00

Source : Statistical Hand Book of Assam, 1990

Out of the total 6.19 lakh holdings of the study region, the Jorhat and Golaghat districts (combined) with 33.29 per cent of the valley's total area possess 35.35 per cent of the total number of holdings. On the

other hand, the district of Dibrugarh with 29 per cent of the total holdings in the valley accounts for highest i.e., 34.46 per cent of the total operated area. This is due to the existence of large number of plantation estates in the district.

Table 4.11

Districtwise Average Farm Size of Upper Brahmaputra Valley, 1985-86

(Area in hectare)

District	No. of holding	Area	Average farm size
Jorhat and Golaghat	219,069	321,164	1.47
Sibsagar	89,077	130,182	1.46
Dibrugarh	180,335	332,419	1.84
Lakhimpur	131,109	180,659	1.38
Total	619,590	964,460	1.53

Source : Statistical Hand Book of Assam, 1990

The average size of farm in the valley is 1.53 hectare which is slightly higher than the state's average of 1.37 hectare in the year 1985-86. The average size of farm is lowest in the district of Lakhimpur which is only 1.38 hectare. On the other hand, the highest average of farm size is found in the district of Dibrugarh with an average size of 1.84

LORENZ CURVE

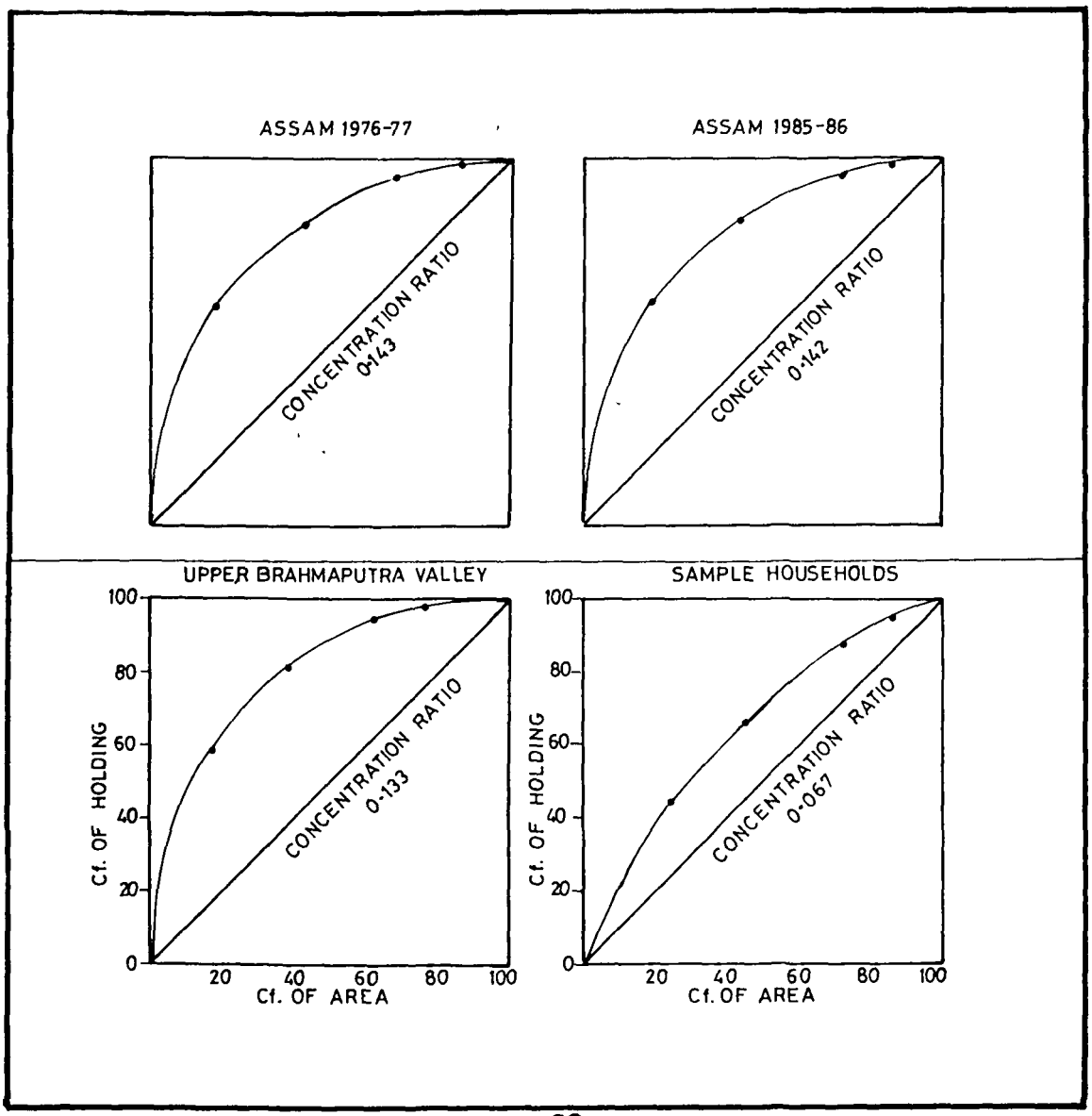

Fig. 20

hectare followed by Jorhat and Golaghat with 1.46 hectare.

In view of the non-availability of data on landholding at lower than district level, the landholding structure of the region is discussed with the sample households data in chapter-VI.

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V

EXISTING AGRICULTURAL PRODUCTION

5.1. Introduction

The agriculture in Assam is on subsistence level and land is by and large below marginal. Though the Upper Brahmaputra Valley and the Barak Valley of Assam are two of the fertile regions of the country, the average yield of crops is much lower than some of its regions. Still the state is not self-sufficient in foodgrains, though more than 77 per cent of the working population of the state is engaged in agriculture as their main source of livelihood. Every year the state has to import foodgrains from other states of the country to meet its domestic need.

5.2. Crop Output

Varieties of crops are grown in the Upper Brahmaputra Valley in different seasons in varied land and climatic situations. Among these various crops, foodgrains are the important crops which are cultivated in all the districts of the region.

Rice : Rice is the main crop of Upper Brahmaputra Valley and it is cultivated in three different seasons of the year. Sowing, transplanting and harvesting time for these three seasons is given in Table 5.2.

Production of total rice in Upper Brahmaputra Valley in the year 1987-88 was 7.78 lakh tonnes which is 29.40 per cent to the total rice production of Assam. The average yield of rice in the valley was 1,296 kg. per hectare, which is slightly higher than the state average of 1,025 kg. Out of five districts (undivided) of the valley, the highest amount of rice output was recorded in the district of Lakhimpur which is 26.8 per cent to the total output of the region. But average yield of rice is lowest in Lakhimpur district which is only 1,030 kg. The maximum yield rate was recorded in the district of Sibsagar which is 1,654 kg.

Table 5.1

Area, Production and Average Yield of Foodgrains during the Year 1987-88 (Upper Brahmaputra Valley)

(Area in hectare; Production in tonnes and Yield in kg./hectare)

District		Autumn rice	Winter rice	Maize	Tur	Summer rice	Wheat	Small millet	Rabi pulses	Gram
	A	35,354	142,562	1,032	213	402	3,458	396	7,720	50
Lakhimpur	P	26,580	181,920	585	152	529	4,410	210	3,358	20
	Y	764	1,296	567	717	1,315	1,276	529	435	410
	A	21,895	127,327	2,230	333	8	3,139	105	6,575	67
Dibrugarh	P	24,309	168,221	1,172	242	11	3,133	53	2,736	31
	Y	1,128	1,341	526	728	1,315	998	500	416	472
	A	12,000	75,724	38	8	17	1,800	-	4,408	5
Jorhat	P	9,895	106,736	19	5	22	1,609	-	1,603	2
	Y	838	1,431	503	650	1,315	894	-	363	400
	A	5.685	105,356	51	12	16	2,092	5	2,041	25
Sibsagar	P	9,649	161,371	26	8	21	2,251	3	820	10
	Y	1,725	1,555	515	621	1,315	1,076	526	401	386
	A	8,480	75,333	230	48	150	3,014	-	3,149	15
Golaghat	P	9,479	79,720	124	33	200	5,130	-	1,754	6
	Y	1,136	1,420	538	682	1,315	1,702	-	557	400
	A	83,414	507,969	3,581	614	593	13,503	506	23,893	162
Total	P	79,912	625,968	1,926	440	783	16,533	266	7,248	159
	Y	1,118	1,408	529	680	1,315	1,189	518	434	414

Source : Directorate of Economics and Statistics, Assam

Table 5.2

Rice of Upper Brahmaputra Valley

Rice Crop	Month of		
	Sowing	Transplanting	Harvesting
1. Winter (Sali)			
Normal	April-May	June-July	Oct.-Dec.
Late	June-Aug.	Aug.-Sept.	Nov.-Jan.
2. Autumn (Ahu)			
A. Direct seeded			
i. Early	Feb.-March	-	Early Jun-Jul.
ii. Regular	Mar.-April	-	July-mid Sep.
B. Transplanted			
i. Regular	Mar-April	Apr.-May	July-Aug.
ii. Early	February	Mar.-April	June-July
3. Summer (Boro)			
Regular	Nov.-Dec.	Dec.-Jan.	Apr.-May

Source : Directorate of Agriculture, Assam

It is observed that the winter rice (Sali) and summer rice (Boro) had low productivity growth in the Valley. The productivity rate of autumn rice is significantly high in the valley though area under this crop is very low. This is only because of introducing high yielding varieties of seeds with proper irrigation facilities. It may be mentioned that the scope for bringing more area under this crop is very high in the valley in view of the fact that most of the land under

winter rice (Sali) could be practised double cropping.

Table 5.3

Rice Production in Upper Brahmaputra Valley, 1987-88

Districts	Area (in hectare)	Production (in tonnes)	Yield (kg/hectare)
Jorhat	87,743	116,631	1,283
Golaghat	65,630	89,205	1,278
Sibsagar	111,057	171,020	1,654
Dibrugarh	149,230	192,530	1,235
Lakhimpur	178,316	208,500	1,,030
Total	591,976	777,886	1,296
Assam	22,82,633	26,45,622	1,025

Source : Directorate of Economics and Statistics, Assam

Table 5.4

Area, Production and Yield of Three Different Types of Rice

Rice	Area (in hectare)	Production (in tonnes)	Yield (kg./hect.)	P.C. of Growth
1. Autumn	83,414	231,634	1,118	277
2. Winter	507,969	697,974	1,408	137
3. Summer	595	783	1,315	131

Source : Directorate of Economics and Statistics, Assam

Wheat : The production of wheat in Upper Brahmaputra Valley is very negligible and the area under this crop is also very small. Rice is the staple food for the people of the region and the consumption of wheat and other wheat preparation is low. The area under wheat in Upper Brahmaputra Valley was only 13.5 thousand hectare and the total production was 12.56 thousand tonnes which is only 11.8 per cent to the total production of the region in the year 1987-88. Districtwise, Golaghat produces maximum amount of wheat in the valley. The total wheat production in the district in the year 1987-88 was 4.3 thousand tonnes which was 35 per cent of the total production of the valley.

Table 5.5

Wheat Production in Upper Brahmaputra Valley, 1987-88

District	Area (in hectare)	Production (in tonnes)	Yield (kg./hectare)
Jorhat	1,800	1,609	894
Golaghat	3,014	5,130	1,702
Sibsagar	2,092	2,251	1,076
Dibrugarh	3,139	3,133	998
Lakhimpur	3,458	4,410	1,276
Total	13,503	12,564	1,189
Assam	98,276	1,05,770	1,076

Source : Directorate of Economics and Statistics, Assam

Mustard Seed : Beside foodgrains, a large number of oil-seeds are grown in the Valley. Mustard is the principal oil-seed and also it is the second largest crop of the region in terms of area (Table 5.6).

Table 5.6

Area, Production and Average Yield of Oil-Seed in Upper Brahmaputra Valley, 1987-88

(Area in hectare; Productivity in tonnes; Yield in kg./hectare)

District		Linseed	Castor	Sesamum	Rape & Mustard
Lakhimpur	A	27	505	835	49,442
	P	10	219	287	21,849
	Y	373	433	343	442
Dibrugarh	A	8	26	659	22,885
	P	4	10	302	13,319
	Y	500	393	434	582
Sibsagar	A	9	32	70	5,893
	P	3	11	28	3,901
	Y	450	330	405	662
Jorhat	A	-	40	60	15,287
	P	-	15	27	8,805
	Y	-	380	470	567
Golaghat	A	2	77	202	18,911
	P	1	30	95	19,138
	Y	300	490	470	1,012
Assam	A	8,756	2,138	15,362	3,37,542
	P	3,768	937	7,674	1,67,523
	Y	430	438	499	496

Source : Directorate of Economics and Statistics, Assam

The area under mustard cultivation was 1.12 lakh hectares in 1987-88 which is 13.7 per cent to the total cropped area of the valley. The total production of mustard in the valley was 670 thousand tonnes in the year 1987-88 which is 40 per cent to the total production of Assam. The average yield of the crop in the region in 654.8 kg./hectare which is much higher than the state average of 496 kg. Districtwise, Lakhimpur having the highest amount of land under this crop with a low yield of 442 kg. On the other hand, though land under mustard in the Golaghat district is lowest among all, the yield rate is highest in this district with 1012 kg./hectare.

Sugar Cane : Area under Sugar Cane in the valley is only 16 thousand hectares which is only 2.03 per cent to the total cropped area. The total production of Sugar Cane in the region was 6.6 lakh tonnes in the year 1987-88, which is 35.7 per cent to the total production of the state.

Among the five districts of the valley, Golaghat recorded maximum amount of land under this crop and also the production is high. This is due to the establishment of a Sugar Mill in the district which encourages people to produce more Sugar Cane in the district.

Table 5.7

Area, Production and Yield of Miscellaneous Crops in Upper Brahmaputra Valley, 1987-88

(Area in hectare; Production in tonnes; Yield in kg./hectare)

District		Potato	Sugar Cane	Sweet Potato	Banana	Papaya	Tapioca
Lakhimpur	A	5,340	1,149	682	2,455	143	38
	P	27,908	63,121	2,087	31,839	2,166	144
	Y	5,226	31,438	3,059	12,969	15,152	3,772
Dibrugarh	A	3,100	3,101	538	2,195	268	33
	P	13,157	92,974	1,625	28,683	4,107	133
	Y	4,244	29,982	3.021	11,068	15,325	4,041
Sibsagar	A	1,187	368	105	702	97	11
	P	7,409	9,450	344	9,989	1,474	44
	Y	6,242	25,681	3,275	14,229	15,200	4,028
Jorhat	A	2,050	537	55	1,904	175	-
	P	21,457	20,826	155	25,381	2,702	-
	A	10,467	38,782	2,814	13,330	15,400	-
Golaghat	A	1,055	11,456	240	1,450	90	25
	P	7,214	5,05,782	720	20,090	1,438	98
	Y	6,838	44,150	3,000	13,855	15,974	3,917
Assam	A	54,011	43,155	8,558	32,350	4,830	2,100
	P	328,797	18,62,785	27,363	411,728	76,174	9,178
	Y	6,088	43,628	3,197	12,727	15,771	4,370

Source : Directorate of Economics and Statistics, Assam

Besides these crops, large number of other pulses and varieties of miscellaneous crops are grown in all the districts of the valley (Tables 5.8 and 5.9).

Table 5.8

Area, Production and Yield of Fibre Crops in Upper Brahmaputra Valley

(Area in hectare; Production in tonnes: Yield in kg./hectare)

Districts		Jute	Mesta	Cotton
Lakhimpur	A	1,817	182	127
	P	16,374	689	54
	Y	1,622	682	73
Dibrugarh	A	213	10	41
	P	1,919	40	18
	Y	1,622	721	110
Sibsagar	A	108	3	14
	P	973	14	6
	Y	1,622	845	70
Jorhat	A	208	-	5
	P	973	-	2
	Y	1,622	-	67
Golaghat	A	1,155	13	26
	P	12,134	43	11
	Y	1,891	600	72
Assam	A	97,932	9,394	2,942
	P	8,82,254	44,079	1,372
	Y	-	-	-

Source : Directorate of Economics and Statistics, Assam

Table 5.9

Area, Production and Yield of Miscellaneous Crops in Upper Brahmaputra Valley, 1987-88

(Area in hectares; Production in tonnes; Yield in kg./hectare)

District		Chillies	Tobacco	Turmeric	Onion	Arecanut	Cocanut
Lakhimpur	A	978	364	1,095	360	2,826	127
	P	543	266	687	933	2,226	468
	Y	555	728	627	2,593	163	51
Dibrugarh	A	496	60	631	132	4,898	66
	P	297	36	340	348	4,026	492
	Y	599	602	538	2,633	152	55
Sibsagar	A	225	20	268	60	5,050	115
	P	113	13	165	120	3,975	470
	Y	500	650	616	1,992	130	51
Jorhat	A	240	62	228	105	1,708	107
	P	127	27	143	225	1,070	1,001
	Y	550	656	625	2,147	118	66
Golaghat	A	227	75	457	142	3,290	180
	P	148	53	299	440	2,226	1,488
	Y	650	703	654	3,099	150	67
Assam	A	11,427	3,377	9,153	5,233	58,726	9,087
	P	6,672	2,147	5,599	2,037	61,421	7,985
	Y	584	635	612	10,660	174	75

Source : Directorate of Economics and Statistics, Assam

5.3. Factors Affecting Agricultural Productivity in the Upper Brahmaputra Valley

The agricultural production has been handicapped by many factors of varied nature in Upper Brahmaputra Valley. All these can, however, be conveniently classified under three broad heads, viz., Physical and Biological factors, Socio-Economic-Cultural complexes and Technology.

5.3.1. Physical and Biological Factors :

Agricultural productivity, to a great extent, depends on the physical and biological factors of natural environment. In a backward region like Upper Brahmaputra Valley, the poor farmers are badly exposed to some of the worse types of natural calamities as they are almost untouched by modern science and technology. The conditions that surround the region's agriculture are, in their net effect, unfavourable to rapid growth of production.

5.3.1.(a) Flood : Assam as a whole and Upper Brahmaputra Valley in particular, is a chronically flood-affected region. The entire valley is subjected to annual floods by the Brahmaputra and its tributaries. As a result, there is heavy loss in terms of life and property and extensive damage to standing crops. Traditionally, the

farmers of the region mainly cultivate Kharif crops and unfortunately these crops are the main victims of summer floods.

According to the Department of Agriculture, Assam, chronically flood-affected area of the valley is 98.8 thousand hectares. The districtwise distribution of chronically flood-affected area of the region are Lakhimpur 64.50, Dibrugarh 5.80, and Sibsagar 28.50 (undivided) thousand hectares.

The toral area affected and damaged by flood in the valley during the year 1974, are shown in Table 5.10.

Table 5.10

Affects of Flood in different Districts of Upper Brahmaputra Valley, 1974

District	Total area affected (in km^2)	Cropped area affected (in lakh hectares)	Population affected (in thousand)	Human life lost
Lakhimpur	3,000	0.06	375	2
Dibrugarh	2,000	0.02	75	1
Sibsagar (undivided)	4,500	0.32	550	3
Total	9,500	0.40	990	6

Source : Revenue Department, Government of Assam

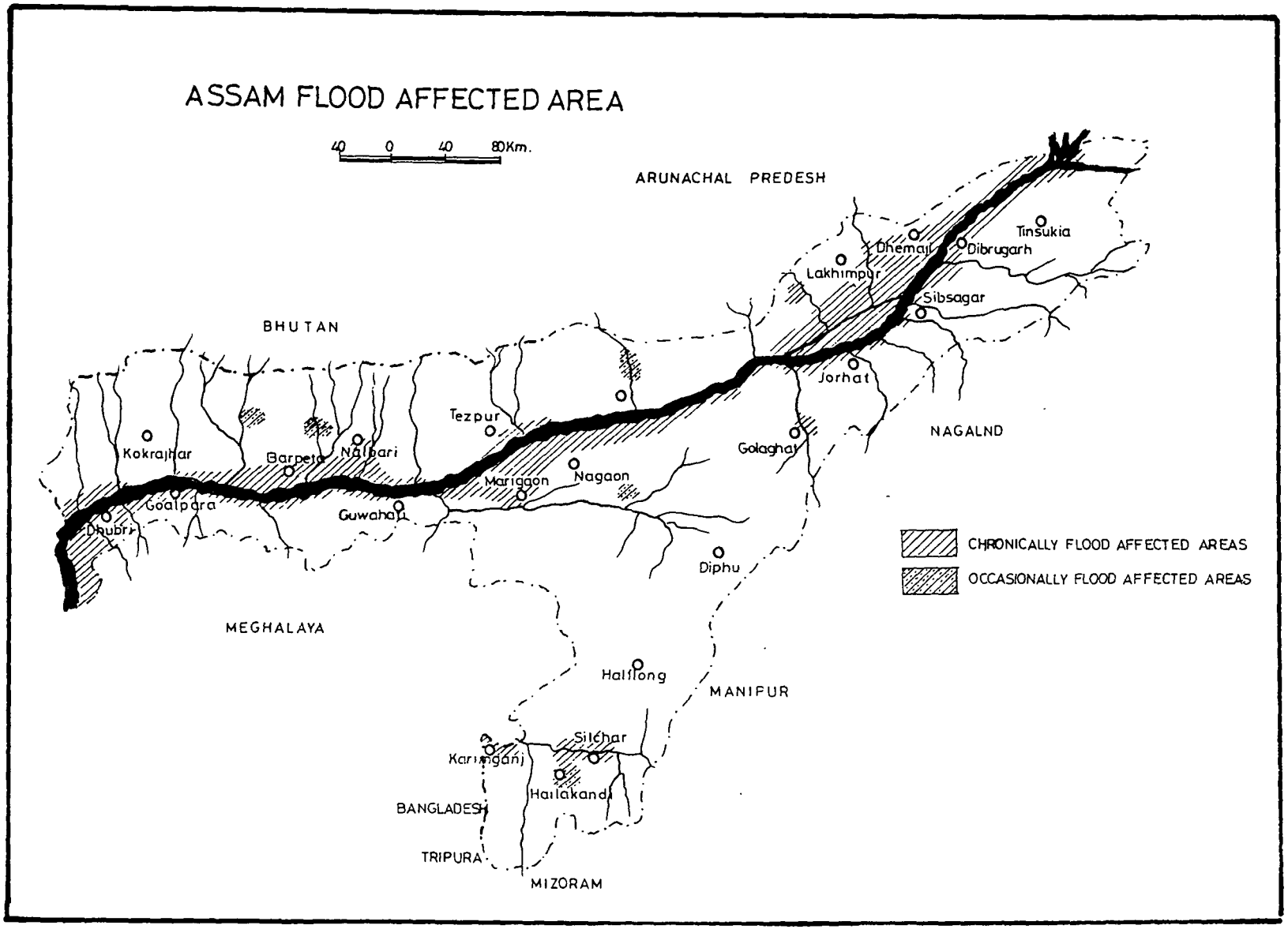
ASSAM FLOOD AFFECTED AREA
40 0 40 80Km.
ARUNACHAL PREDESH
Tinsukia
Dhemaji
Dibrugarh
Lakhimpur
Sibsagar
BHUTAN
Jorhat
Tezpur
NAGALND
Kokrajhar
Barpeta
Nalbari
Golaghat
Mariagon
Nagaon
Goalpara
Guwahati
Dhubri
Diphu
CHRONICALLY FLOOD AFFECTED AREAS
OCCASIONALLY FLOOD AFFECTED AREAS
MEGHALAYA
Hallflong
MANIPUR
Silchar
Karimganj
Hailakandi
BANGLADESH
TRIPURA
MIZORAM

Fig. 21

Every year the valley experiences three types of flood, depending upon the pattern and amount of rainfall, viz., early flood, normal flood and late flood.

The damages caused by early flood is not very high in the valley as it occurs in the months of April and May which is not a regular feature. Usually, this flood causes damage to the summer paddy (Ahu) in the flood prone areas of the valley.

During the months of June, July and August, the region experiences regular floods in the flood-prone areas. This is the period of heavy rainfall in the valley. Normal floods during this period causes extensive damage to the winter paddy (Sali).

The occurrences of late flood is of somewhat rare occasion in the valley, but it is the most dreadful flood in the region which occurs during the months of September and October. Any damage to crops during this period is totally irrepairable as winter paddy attains the mature stage in the region during this period.

According to the Department of Agriculture, Assam, chronically flood affected area of the state is 247.9 thousand hectares. The districtwise

distribution of chronically flood affected areas in Upper Brahmaputra Valley is Lakhimpur 64.5, Sibsagar 28.5 and Dibrugarh 5.8 thousand hectares (old districts).

Table 5.11
Damages Caused by Flood in Assam

Year	Area affected (in lakh)	Value of crops (in crores Rupees)	Population affected (in lakh)	Total loss (in crores Rupees)
1976	14.19	8.65	14.63	11.90
1977	10.24	26.64	45.49	31.08
1978	3.06	3.93	9.17	4.27
1979	6.73	26.14	23.51	28.16
1980	11.60	32.37	33.59	39.80
1981	4.57	7.01	13.58	7.40
1982	68.85	4.69	14.24	4.88
1983	6.95	10.32	21.21	11.06
1984	15.16	48.99	36.83	200.00*

* Provisional estimate

Source : Draft Seventh Five-Year Plan, 1985-90, Assam, Government of Assam, p.30.

According to Mahanta[1] (1979), 245 thousand hectares of land are chronically flood affected in Assam; besides 90 thousand hectares being occasionally

flood affected.

5.3.1.(b) Soil Erosion : Soil erosion is another severe problem faced by the farmers of the region. Problems of fluvial erosion are very severe along the river Brahamputra and its tributaries. Because of severe flood and heavy rainfall, areas along the rivers are affected by soil erosion every year. Large amount of cultivable land as well as dwelling areas are eroded due to landslides every year along the banks of the Brahmaputra and its tributaries. Majuli, the river island, is the worse sufferer of soil erosion and most of the farmers are rehabilitating in the grazing lands of the region every year.

5.3.1(c) Drought : Drought is another inhabitory physical factor affected farmers in the region. Drought has become a common phenomena to the region at present. Irrigation in the valley has progressed at a very low rate. Therefore, the whole farming operation in the valley depends on rain water, which is seasonal and very much erratic. More than 70 per cent of rainfall in the valley is concentrated during the summer months. Even during the monsoon season, there are wide fluctuations of rainfall from time to

time. Summer drought affects agriculture in the valley more seriously. Due to summer drought seedling for winter rice (Sali) is delayed. Even transplantation of winter rice is also delayed due to drought which affects the proper growth of crops.

5.3.1.(d) *Aniamals, Pests and Diseases of Crops* : In Upper Brahmaputra Valley like in all other agricultural regions of the country, crops are damaged not only by floods, soil erosion and drought but also by insects, pests, diseases, weeds and animals. The actual damage caused by these factors have not been calculated so far.

It is estimated that 15 per cent of the total agricultural crops in India is destroyed annually by insects, pests and diseases, amount to a loss of Rs. 4500 million per annum.[2] On the basis of the above estimate, the total losss of crops in Upper Brahmaputra Valley may be counted as 2.7 lakh tonnes in the year 1987-88. Insects like locust, caterpillar, the rice grasshopper, the army worm, the paddy steamer, the rice hisper and the rice bug are responsible, in varying degrees, for the low yield of rice.

The humid-tropical climate of the region with excessive relative humidity prevailing over a long period provided an ideal conditions for the growth of insects. Rodents also cause severe loss of crops during the pre-harvest and post-harvest period. It is estimated that atleast one-fifth of the crops produced are damaged by rats both in the fields and storages.

Besides these, domestic as well as wild animals are also responsible for the damage of crops to a large extend. Among the wild animals birds and elephants are most important. The extent of damages caused by wild elephants is very severe and every year all the districts are suffering from this problem. This may be due to the severe deforestation in the state as well as in the neighbouring states, as a result of which, wild elephants generally in groups come down to the plains in serarch of their food and damage the standing crops.

Domesticated cattles and goats also damage crops to a large extent in the region. Most of the crop fields are open without proper fencing in the region. It is also difficult to raise fencing in the fragmented plots of agricultural fields of the farmers. Also due to the poor economic condition,

farmers cannot erect permanent enclosures to protect their standing crops.

Weeds are also another problem in the region which lower the agricultural production. The varied species of weeds lowering the production in the region are Rumesmaridimus, Oryza fatua (wild rice) in the winter paddy fields and Cynadon dactylon, Cyperus rotundus in the summer paddy fields. Apart from these weeds of arable land, aquatic weeds like water hyacinth (Eichorina crassipes) is also a serious problem in the low lying areas where "Bao" rice "Sali" rice and jute are cultivated extensively. It is estimated that 10 to 12 per cent of the summer rice and 8 to 10 per cent of the winter rice are damaged by weeds of various kinds in the region.

5.3.1.(e) Poor health of the farmers : The farmers in the region usually live in villages. Due to the unhealthy conditions of living, malnutrition and climatic condition, they easily fall into various diseases. The diet taken by majority of farmers is not adequate to the required quantity or requisite quantity. They usually take rice as diet which is treated as an nferior cereals with little amount of pulses. Amount of green vegetables taken by farmers

is very less. Milk, ghee, egg, fish, meat, etc. which contains high caloric value are taken very rarely by the farmers. As a result, the health of farmers is very poor with little resistance of diseases. Medical facilities provided by the Government to the farmers are not adequate as most of the Government's Health Centres are located in the urban areas and most of the people die in the rural areas without detection of the diseases.

5.3.1.(f) Poor health of the draught animals : Draught animals are the main power to traditional unmechanised agriculture in the region. Oxen and buffalo are the important work force used for ploughing. In 1972 the total bovine population in the valley was 15,62,702 which was 24.9 per cent to the total bovine population of the state.

Compare to the number of drought animal the existing grazing lands in the region is very low. At the same time very little proportion of the arable land is devoted to fodder crops due to the increasing demand for foodgrains.

In general farmers in the region take little care in feeding their cattle. Cows are generally let

loose or allowed to graze in the grazing grounds. During the winter season, which is the rest period for cattle, they do not get sufficient food as the grazing lands are barren. The only fodder for cattle during this period is dry rice straw. During summer also most of the grazing lands are fully covered with "Sali" rice. Road sides, slopes and bank of embankments and playgrounds are the only grazing land for cattle in the summer season. As a result cattle are under-fed and ill-fed and most valuable cattle population suffers and dies from various diseases and epidemic in large number.

5.3.2. Socio-Economic-Cultural Complexes :

There are many social aspects which have a direct bearing on agricultural development in a particular region. Being an underdeveloped region, the farmers of Upper Brahmaputra Valley has been working under various socio-economic-cultural constraints which are being discussed here.

5.3.2.(a) Population pressure : Due to the rapaid growth of population, there is an excess pressure of population on the agricultural sector of the region. The traditional bound people and the historically

given old attitudes of apathy and neglect towards the present lives, are big hurdles in the say of progressive agriculture. Among the different sectors of the economy, agriculture accounts for the largest percentage of the working population in the region. Due to the low rate of industrial development, excess number of unemployed poeple engaged in the agricultural sector which is much more than the actual requirement, causing severe waste of valuable manpower in the region.

The total population of the Upper Brahmaputra Valley is 57.88 lakh which is 25.96 per cent to the total population of Assam according to 1991 census. The decenial growth of population in the valley was +27.63 per cent against +34.95 per cent of the state as a whole during the period of 1961 to 1971. But during the period of 1971 to 1991, the growth rate of population goes upto +44.13 per cent against +52.44 per cent of the state as a whole.

The entire Upper Brahmaputra Valley is thickly populated. The density of population in the valley was recorded at 295 persons per sq. km. against the state figure of 284 persons sq. km. in the year 1991. The density of population in the valley was 207

persons per sq. km. according to 1971 census. But over the last 20 years it increased upto 295 persons per sq. km. But over this period the changes in net sown area and area sown more than once remained more or less unchanged with slight increase. The net sown area increased by 6.44 per cent and area sown more than once increased by 2.2 per cent over the last 5 years in the valley.

Districtwise maximum growth rate of population was recorded in the district of Lakhimpur with +55.91 per cent over the last 20 years against the state figure of +55.44 per cent. The growth rate of population was +55.09 per cent in Golaghat district over the last 20 years which is next to the district of Lakhimpur. The lowest growth rate of population is found in Jorhat district which is +32.68 per cent over the last 20 years.

5.3.2.(b) Peasant Society : The way of life of the farmers in the rural society in the region is the outcome of various cultural, legal, economic and political factors. The farming system carried out by farmers in the valley is more a way of life than an economic proposition.

Table 5.12

Districtwise Distribution of Population, Sex-Ratio Growth Rate and Density of Population in Upper Brahmaputra Valley

District	Population 1991			Sex Ratio Female per '000 males		Density of Population		Growth Rate of population	
	Persons	Males	Females	1971	1991	1971	1991	1961-71	1971-91
1	2	3	4	5	6	7	8	9	10
Lakhimpur	12,21,858	632,409	589,449	895	932	211	329	+43.39	+55.91
Golaghat	801,740	417,234	384,506	883	922	150	229	+30.85	+53.09
Jorhat	868,445	453,001	415,444	886	917	230	305	+17.47	+32.68
Sibsagar	895,112	467,610	427,502	887	914	245	330	+19.47	+36.80
Dibrugarh	20,01,266	10,52,844	948,422	865	900	198	280	+26.97	+42.18
Total	57,88,421	30,23,098	27,65,323	883	917	207	295	+27.63	+44.13
Assam	2,22,94,362	1,15,79,693	1,67,14,869	896	925	186	284	+34.95	+52.44

Source : Provisional Population Tables, Census of India, 1991; Series 4, Directorate of Census Operation, Guwahati.

Most of the farm families in the valley live in villages and are dependent on agriculture and only a few of them depend on secondary and tertiary sectors of the occupation. The villages consist of an average household of 100 numbers. Villages are mostly surrounded by agricultural fields. In some cases, farmers are away from their villages. These farms are usually newly operated and mostly dominated by crops other than rice.

The social structure that comprises the village community in the region can be divided into following groups :

i) Farmers with own land who have hereditary right of tenancy and who fully or partly cultivate their land;

ii) Sharecroppers with little own land;

iii) Land-less farmers;

iv) Persons in professional services, and

v) Others.

The farmers belonging to first two groups cultivate their land with the help of family labour and in some cases with the help of hired labours.

They are usually busy with winter rice cultivation for six months and the remaining six months of the year is rest period for them, except for few farmers who cultivate also summer rice. The agriculture which they practise is of subsistence type with little or no surplus. They try to produce sufficient grain for the satisfaction of the requirement like to feed his family and his domesticated animals, to meet their liabilities, to spend on social and religious festivals and functions and to educate their children etc.

The third group, consisting mostly land-less agricultural labourers, is the poorest section of the community. They work on wage basis and during the off season they engage in other activities.

The fourth section of the people are those who are engaged in various professional services besides agriculture, and are economically well-off but a few in number.

Beside these, some people in the villages are also engated in occupation like shop-keepers, village artisans, money lenders, businessmen, contractors, etc.

It is already mentioned that villages are surrounded by rice fields in rural areas and these are usually high and dry land, free from flood. Farmers keep some amount of this dry and high land around their houses for the cultivation of crops other than rice which is locally known as "Bari". It varies from 0.5 hectares to 1 hectare in its size. Farmers cultivate varieties of crops in these lands like betel nuts and betel leaves, cytra fruits, vegetables, etc. Usually farmers are busy in cultivating these crops when they are free from rice cultivation.

For the farmers who have little surplus or no surplus from the rice cultivation, these high land crops are the main source of their earnings for their every day expenditure. Usually they sell these products in nearby markets by themselves or through middlemen.

The economic condition of farmers in rural areas is very poor. They hardly have cash savings. When they are in need of money, may be for medical aids or for educating their children, expenditure for various social and religious functions and ceremonies, may be for buying agricultural tools, drought animals or to build a house etc. go to the middlemen and money

lenders with whom they have business relation. In return they have to dispose off their agricultural products to them without getting reasonable price.

5.3.2.(c) Law of inheritance : The laws of inheritance and successions are governed by the social institution of joint family in rural societies. The Hindu as well as Muslim laws of inheritance ensure equal distribution of ownership of whatever small share of land is available among all the male children of the family. No doubt, this trend creates a rural society consisting of independent and self-respecting farmers but a little scope for capital accumulation, large-scale of enterprise and high rate of savings. The most dangerous effect of law of inheritance in the region is the excessive fragmentation of landholdings as the holdings are already too small and fragmented. Even if persons of a family who are in non-agricultural occupation, are also entitle to get the share of paternal land at equal porpotions with their other cultivated brothers. Thus the law of inheritance is responsible for the creation of unfavourable scattered tiny plots of agricultural land in the region.

5.3.2.(d) Religious attitudes : Religious attitudes of farmers also affects economic growth and development of agriculture in the region. More than 72 per cent of the total population in the Valley is Hindu and 24 per cent is Muslim.

Farmers are mostly dominated by superstitions, mystery, faith, taboos and resignation. The Hindu farmers are greatly affected by a variety of religious rituals and beliefs. A large number of holy days prohibiting ploughing and other agricultural activities has reduced the total working days even sometimes in the peak seasons. The money they received by selling some surplus crops after hard work are spent in various religious functions making their economic conditions worse.

5.3.3. Technology :

Technology is a principal contributor to the development of agriculture. Full utilization of the potentials of land in the valley cannot be achieved only by human and animal power with traditional method of farming. Due to the lack of technological change, agriculture in the valley is still in subsistence level and farmers are economically very poor.

5.3.3.(a) Fertilizer : Data on use of fertilizer in the Upper Brahmaputra Valley for field crops are inadequate. Since the valley has a large area under tea plantation fertilizer sold in the region does not reflect actual quantity used in crops other than tea.

Agriculture in the valley is characterised by low consumption of chemical fertilizer. Consumption of fertilizer per hectare is only 1.59 kg. which is extremely low as against 53.28 kg. in Punjab, and 3.15 kg. in Tamil Nadu. The per hectare consumption of fertilizer for the state as a whole is only 1.09 kg. during 1974-75.

Table 5.13

Fertilizer Consumption in Upper Brahmaputra Valley 1975-76

District	Consumption (Kg. per hectare)
Sibsagar (undivided)	1.79
Lakhimpur	0.80
Dibrugarh	3.09
Total Average	1.89
Assam	1.09

Source : Directorate of Agriculture, Assam

The low amount of fertilizer used by the farmers in the Valley may be ascribed to :

i) large numer of small and marginal farmers unable to purchase fertilizer at high price;

ii) lack of irrigation facilities during rabi crop season;

iii) inadequate supply arrangement of fertilizer to rural farmers, and

iv) ignorance of the farmers.

5.3.3.(b) HYV seeds : The High Yielding Variety (HYV) seeds can bring miraculous result in the field of agriculture, if irrigation is provided simultaneously. The Green Revolution in some states of the country was essentially the outcome of the extensive use of HYV seeds. Such a technological breakthrough is possible there because of the provision of assured water supply and because of the emergence of the big capitalist farmers. But Assam is deprived of all such advantages.

Among the HYV crops, only the HYV of rice became popular among the farmers of the Upper Brahmaputra Valley. HYV of rice such as IR-8, IN-1, "Monohar Sali" (locally developed), "Pusa" and "Jaya" are grown in the Valley.

Table 5.14

Districtwise Consumption of Fertilizer in Upper Brahmaputra Valley

(Figures in tonnes)

District	1983-84				1984-85			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
Lakhimpur	198	83	112	393	233	114	226	573
Jorhat & Golaghat	190	240	1,003	3,233	1,169	192	667	2,028
Sibsagar	180	77	115	372	185	80	53	318
Dibrugarh	1,713	380	980	3,073	538	297	449	1,284
Total	2,281	780	2,210	7,071	2,125	683	1,395	4,203
Assam	10,438	2,660	4,206	17,304	7,538	2,937	3,423	15,898

Source : Directorate of Agriculture, Assam

Table 5.15

Area under HYV/Improved Paddy in Upper Brahmaputra Valley, 1987-88

(in hectare)

District	Autumn paddy	Winter paddy	Total	P.C. to the total paddy area in the districts
Lakhimpur	22,055	49,340	71,395	40.0
Dibrugarh	12,977	59,167	72,144	48.0
Sibsagar	3,862	34,500	38,362	35.0
Jorhat	8,905	38,830	47,735	54.0
Golaghat	7,100	23,070	30,170	46.0
Total	34,899 (14%)	204,907 (29%)	259,806 (26%)	
Assam	248,200	714,400	962,600	

Source : Directorate of Agriculture, Assam

Table 5.15 shows the districtwise HYV paddy in the Upper Brahmaputra Valley during the period 1987-88. The total area under HYV rice in the Valley was 259,806 hectares, which is 26 per cent to the total HYV rice area in the states. Districtwise, Jorhat district has got maximum area under HYV rice which is 54 per cent to the total area under HYV rice of the valley. The location of the Assam Agricultural

University at Jorhat and a relatively high rural literacy in the district facilitates the diffusion of this type of innovation in the district.

5.3.3.(c) Mechanical Techniques : Mechanical techniques in agriculture are labour-saving, capital-intensive and land-augmenting. A large number of workers engaged in agriculture can be taken away from land without any effect on production. But the displacement of labours should not stand in the way of agricultural mechanization. In such case proper manpower planning is quite necessary.

Large number of small landholdings and limited economic resources hindered in the use of modern implements in the agricultural field in Upper Brahmaputra Valley of Assam. The use of primitive agricultural tools, drought animals with wooden plough in particular, is one of the manifold inefficiencies of agriculture in the region. Table 5.16 shows the distribution of density of wooden plough per 100 hectares of cultivation area in different districts of the valley. Districtwise, Sibsagar has recorded the highest number of wooden plough accounting for a density of 98 ploughs per 100 hectares of cultivated area, while Lakhimpur district recorded the lowest

number with a density of only 34.

Table 5.16

Number of Wooden Plough used per 100 Hectares of Gross Cropped Area, Upper Brahmaputra Valley

District	No. of wooden plough per 100 hectares	State Average
Lakhimpur	34	
Dibrugarh	54	
Sibsagar	98	51
Jorhat	96	
Golaghat	95	

Source : Directorate of Agriculture, Assam

5.4. Infrastructural Needs

The economic condition of Assam till Independence was not at all satisfactory. The colonial rulers were interested in tea, oil and coal industry of the state and tried to discourage agriculture to obtain labourers for the industries. The development of roads, railways and waterways in the state was undertaken to cater to the needs of the tea and oil industry and also for the administrative purpose. Thus after Independence, Assam started undertaking development programmes in a traditional

agriculture.

Infrastructure is most essential for the modernization of agriculture through technological innovation. Due to the lack of proper infrastructural facilities the agriculture of Assam as a whole and Upper Brahmaputra Valley in particular is still in subsistence level.

5.4.1. Irrigation :

Irrigation is the most important infrastructural need in the development of agriculture and package of practices for intensive cultivation. High dependency on natural moisture and rainfall for growing crops means high degree of instability in agricultural production.

The rainfall situation in the Valley has already been described earlier in the second chapter. The whole Valley is characterised by high rainfall and high humidity during the period of monsoon. Rainfall is extremely low during the winter months. Therefore, Rabi crops cultivation is very difficult in the region without irrigation. Slow progress in adoption of multiple cropping by the farmers in the valley can be attributed mainly to the absence of reliable and controlled source of water supply.

If rice production in the Valley is to be increased and double and multiple cropping is to be extended, irrigation would be the most essential infrastructure. With proper irrigation facilities, we can expect to grow a substantial second rice crop during "Ahu" rice season.

Data on irrigation in Assam is very confusing. Out of the total gross cropped area of 30.06 lakh hectares, only 2.06 lakh hectares or 6.85 per cent was irrigated in Assam upto 1970-71. Table 5.17 shows the sourcewise distribution of irrigated area in different districts of Assam. It is seen from the table that most of the irrigated areas are located in Lower Brahamaputrâ Valley of Assam. The entire Upper Brahmaputra Valley was neglected in respect of this vital infrastructural need.

Upto 1981-82, the Department of Irrigation had completed 379 minor irrigation projects of which, 156 were surface lift and 87 were ground water lift.

There are high potentialities of lift irrigation schemes in the Valley as it has a network of rivers which are sources of lift irrigation.

Table 5.17

Sourcewise Spatial Variation of Irrigated Area in Assam

(Area in '000 hectare)

District	Source of Irrigation					Total	Irrigated area as % of the total area in the state
	Canal	Tank	Tube well	Well	Others		
Goalpara	47.02	0.14	0.03	0.03	0.58	47.79	23.20
Kamrup	54.67	0.15	-	-	2.36	57.19	27.76
Darrang	69.86	0.09	-	0.02	2.99	72.96	35.41
Nowgong	6.40	0.28	0.07	-	0.36	7.12	3.45
Cachar	1.68	0.16	0.18	0.03	0.09	2.14	1.04
Karbi Anglong	3.50	0.01	0.01	-	12.68	16.19	7.81
N.C. Hills	1.96	-	-	-	0.01	1.98	0.96
Sibsagar	0.25	-	0.09	-	0.34	0.68	0.33
Lakhimpur	-	-	-	-	-	-	-
Dibrugarh	-	-	-	-	0.01	0.01	0.02
Assam	185.34	0.09	0.38	0.08	19.42	206.06	100.00

Source : World Agricultural Census, Assam

Table 5.18

Districtwise Target and Achievement in Creation of Additional Irrigation Potential during 1984-85

(Potential/Area in hectare)

District	Target for 1984-85			Achievement during 1984-85		
	Minor	Medium	Total	Minor	Medium	Total
Lakhimpur	2,000	-	2,000	2,035	-	2,035
Jorhat and Golaghat	3,000	-	3,000	4,291	-	4,291
Sibsagar	1,500	-	1,500	2,210	-	2,210
Dibrugarh	2,500	-	2,500	2,607	-	2,607
Total	9,000	-	9,000	11,143	-	11,143
Assam	27,200	7,500	34,700	34,829	11,577	46,406

Source : Directorate of Economics and Statistics, Assam

The Valley has got a high potentiatlity of ground water lift irrigation scheme. In Jorhat district there were 42 deep tube-well but unfortunately, most of the tube-wells are not functioning due to variety of reasons.

A study on the impact of Indo-British Fertilizer Education Project in Mazgayagaon in Jorhat district by Buragohain (1985)[3] showed that due to the proper utilization of deep tube-well irrigation the farmers took the double cropping with HYV "Ahu" and average yield of "Ahu" paddy was 5171 kg. per hectare.

Certain drawbacks of deep tube-well irrigation were also observed in the region. Due to the unproper instllation, sand is deposited on the field. Presence of iron in water in the entire region creates the problem of iron toxicity.

5.4.2. Agricultural Marketing :

Agricultural marketing in the region has been carried on by two types of markets, viz., free market and state controlled market. In the free market village trades or agents of wholesellers and millers operate in the village and village market locally called hat. The wholsellers and millers operate in

the 'terminal market' usually in the urban centres where produce is sold locally or sent to other centres.

Marketable surplus of agricultural produce is the theoretical surplus available with the producer, left after his genuine requirements for disposal.

Assam is highly deficient in the production of cereals as well as in pulses and oilseed.[4] Most of the districts show a deficit in cereal production in Assam. But the Upper Brahmaputra Valley shows a considerable surplus in cereals in the year 1971-72. Other two hill districts show surplus, while Kamrup and Darrang are marginally surplus districts.

The region is also highly deficient in pulses and oilseeds. Almost all the pulses produced are consumed by farmers themselves. Formerly the farmers extracted oil from their own production with the help of Ghani (an indigenous small device for pressing oilseed with the help of hand or bullock). At present this traditional practice has almost disappeared and oilseeds are sold to the millers (mostly non-Assamese) at very low price and edible oil is purchased by farmers at very high price.

Table 5.19

Districtwise Marketable Surplus of Cereals in Assam (undivided) - 1971-72

District	Available amount of cereals in tonnes	Requirement per annum in tonnes	Surplus or deficit in tonnes
Goalpara	235,268.80	261,494.08	26,225.28(-)
Kamrup	301,123.26	300,042.09	181.17(+)
Darrang	216,705.22	206,767.90	9,937.32(+)
Nowgong	167,938.37	197,540.55	29,602.18(-)
Cachar	200,129.28	214,036.97	13,907.69(-)
Karbi Anglong	63,281.92	55,146.75	8,135.17(+)
N.C. Hills	13,743.81	9,230.06	4,513.75(+)
Upper Brahmaputra Valley	471,966.98	450,893.27	21,073.71(+)
Assam	17,00,277.70	17,11,983.60	11,705.90(-)

Source : Directorate of Economics and Statistics, Assam.

5.4.2.(a) Free Market : In the free market, the marketed produce of the farmers goes from the rural areas to urban centres though a number of middlemen. These markets are not at all favourable to the farmers of the region as they do not get reasonable prices for their crops.

After the harvest period, the middlemen collect crops from villages at a very cheap price and sell it during the lean season, when prices rise.

Sometimes, the poor farmers take loan from the middlemen, locally known as Bepari when they need money. In return, after harvest the middlemen realise their loans in terms of agricultural products at low prices.

It is observed from the sample villages that most of the farmers go to nearby weekly markets only to purchase their essential commodities. A few farmers sell their products in the market by themselves. Most of the farmers dispose their marketable surplus at the source to Beparis. This is mainly because of lack of patience, transport facilities and fear of being cheated in the market places and they gladly offer their produces to berparis at a cheap price.

5.4.2.(b) State controlled markets : Marketing of agricultural produces continued to be in the hands of middlemen and traders. The marketing of paddy, the most important crop came under state control in 1960 when the Government established the Assam Co-Operative

Apex Marketing Society. This institution played a vital role in the procurement of paddy from 1960 to 1969. In the year 1969, the State Trading in paddy was abandoned. But, it was reimposed in the form of state takeover of the wholesale trade in paddy in November, 1973. It was accompanied by organisation of 665 Gaon Sabha level co-operative societies. These co-operative societies were entrusted with the task of procurement of paddy as the agents of the Food Corporation of India (FCI). The FCI and ACAMS took up the marketing of paddy in the state.

Inspite of such widespread coverage of paddy and rice marketing by the Government agencies, the open market has been playing a vital role in the procurement and distribution of crops. The performance of these institutions are not satisfactory because of high price of crops prevailing in the free markets than the Government controlled markets. As a result the procurement is not adequate for distribution among the consumers and, therefore, they depend heavily on the free markets where the price is much higher.

Thus it is observed that the quantity of crops sold to Government by farmers is almost negligible.

This is due to low price offered by Government and also farmers are bound to sell their crops to the traders to repay their loans.

5.4.2.(c) Agricultural Credit : The agricultural credit facilities to farmers through various Government agencies is not adequate and encouraging in the region. Rather it is mostly available in the secondary sectors. Whatever money is available as credit from any source the farmers spend it in purchasing other things than agricultural inputs. This is because of poor economic conditions of the farmers. Farmers are very needy and their needs are mostly unproductive such as purchase of food stuffs, build and repair house, repay the old debts, spend for medical treatment and for education of their children, meet the expenses of various social and religious festivals, etc.

The supply of rural credit is provided by both Government and private agencies. A village survey of Basagaon in Jorhat district reveals that 52 per cent of total loans were taken from the traders, 26 per cent from the the village money lenders and the remaining from other sources. No loan was available from any Government or Co-operative agencies. The

farmers are compelled to dispose their agricultural products at a very low price in order to repay the loan just after their harvest of crops.

Survey on sample households in the region show that village money lenders, traders and co-villagers and relatives are the main sources of credit for the farmers. In all the villages, farmers are not getting any loan from government and other agencies.

Therefore, it is most essential to set up proper organised system of rural credit which must drive away the present defective credit system.

Moreover, need of rural electrification for assured and abundant cheap power for irrigation, mechanical service centres for technological innovation and proper transport and communication system is necessary for the rapid growth of agriculture in the region.

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VI

FARM SIZE AND PRODUCTIVITY

6.1. Introduction

Relationship between the size of holding and productivity has been a controversial issue in Indian agriculture. While some economists argue in favour of 'iverse' relationship between the size of holding and productivity, others attribute such a conclusion only certain 'statistical traps' and in turn suggest that, there exists no consistent relationship between productivity and size of operational holdings. There are still others who feel that the relationship tends to become positive, particularly in those areas receiving the impact of green revolution. Since the relationship between the size of holding and

productivity has an important bearing on various policies concerning agricultural planning adopted at the state or national level, it would be useful to utilize the latest data for testing various hypotheses.

As the impact of green revolution in India was highly localized and emphasis on mere productivity had introduced acute socio-economic disparities, particularly in terms of land distribution among various segments of the population and in terms of changes in cropping pattern.

The problem, perhaps, arises from the fundamental differences in the agricultural ecology of the sub-continuent which allows differential relationship between agricultural holdings and productivity. An attempt in this chapter, therefore, has been made to understand the relationship in a green ecological milue of Upper Brahmaputra Valley of Assam.

In the preceding chapters, the agricultural production patterns, its factors and the agro-ecological conditions have been described. But agricultural production and productivity are the functions of various inputs. Therefore, production

function approach of the study would be very much helpful for understanding the production increase in relation to its various factors. Such factorial approach would also be in position to explain the significant degree of production factors influence by which the important results related to the operation of production process may be drawn for the balanced development and self-sustained growth of agriculture.

In fact, agro-ecological conditions and the size of land occupancy are the important basis for operations of the agriculture production processes because environmental conditions have direct impact on crop-yield. Secondly, the size of landholding which is occupied by the farmers is also important to note because land is the piece of resource which are being utilized by the farmers.

6.2. Literature Survey

The focus of production response to price in the Indian literature has been nearly matched by the economic analysis, which has been taken from the findings of the Farm Management Studies (for Uttar Pradesh, Madhya Pradesh and Andhra Pradesh during mid-fifties) that an inverse relationship existed between farm size and productivity per acre. This

relationship which has an obvious bearing upon the policy issues pertaining to lead ceiling and land grouping under co-operative farming and other forms of agrarian organisations, has led to the explanations by Khusro, Majumdar and Sen and further empirical work by Hannumantha Rao and A.P. Rao and others.

We may note at the outset that much of the important statistical evidenc that is available point rather strongly towards the existence of an inverse relationship between farm size and productivity. The Farm Management Studies have indeed, yielded this relationship, whether grouped by size classes or taken on an individual farm basis as Hannumantha Rao has done for Bombay. Independent survey of Andhra Pradesh by Rao has also revealed similar results.

A.M. Khusro writes, "of particular interest has some generalisation about the relationship between farm size and efficiency which are based upon a remarkable repetitiveness of some phenomena almost everywhere among the area studied", later mentioned as one of the generalisations, "as farm size expands, gross output per acre declined".[1]

Similarly, A.K. Sen listed three results found to be broadly valid in Indian Agriculture. One of

these was "by and large productivity per acre decreased with the size of holding".[2]

Dipok Majumder in his turn wrote, "the data presented by the Farm Management Survey of India have added another example to phenomena observed in many parts of the under-developed world, viz., that in peasant agriculture, as the farm size decreased the output per acre increased".[3]

Saini wrote, "by and large the inverse relationship between farm size and productivity as a confirmed phenomena in Indian Agriculture and statistical validity is adequately established by an analysis of the disaggregated data".[4]

Hannumantha Rao made such a generalisation not only for yield per acre but also some of the factors associated with it. Thus, "in all the districts studies, the percentage of cultivated to uncultivated area, crop more than once decreased sharply with increase in the size of holdings. This is because among the factors the percentage of holdings irrigated invariably declines with increase in the size of holdings".[5]

We may now turn to another side of the debate. A.P. Rao has fitted a logarithmic function to farm

level data, all belonging to the same village. His conclusion was "contrary to the findings of the Farm Management Studies, according to which, the productivity remained constant over all holding sizes in all villages, which indicates that holding size has no effect on productivity."[6]

Rao's conclusions were confirmed by A. Rudra who also used disaggregated data referring to the farms within the same village. He tested a large number of observations and statistical methods, which he thought were superior to the regression method used by all others.

Usha Rani was more cautious and her conclusions were exemplified by the following establishments :

a) "one can even conclude that yield per acre remains constant over different size groups of farms".

b) "no farm generalisation can be made about the variation of intensity of cropping over different size groups of farms".

c) "it can be said, there are no significant variations in the inputs per acre over the different size groups of farms".[7]

The Farm Management of India carried out "the study in the economic of the Farm Management" in the year 1968 to 1971 in the district of Nowgong of Assam. The whole district was divided into three agricultural zones according to the cropping pattern, rainfall and location etc. Altogether 150 farm families in 15 villages comprising of three zones had been taken up for investigation.

The indicators of net receipts of each received through sale of crops per hectare shows no definite relationship with the size of holdings. But it is seen that net receipts for the small sizes of holding is extremely small compared to other sizes of holdings. On the other hand, the receipts for large holdings are also not proportionately large, making it difficult to draw any definite relationship between sizes of holdings and productivity.

The situation in Nowgong district is, therefore, more complex than any perhaps be apparent. In the context of a backward economy, and dominated by highly fragmented holdings of small size of an essentially peasant economy perhaps has not allowed any strong relationship to emerge.

The above survey only makes the complexities clear about the relationship between the two variables. It is clear from the survey that the received studies do not reach at any conclusive results and their findings are extremely divergent. Part of such divergent findings owe their origin to the varying ecological and social milieu, regionally differentiated over the broad spectrum of the Indian sub-continent. The size and diversity of the sub-continent defies predictably any ubiquitous experience and this perhaps demands studies at a micro level scale without aiming at any generalised picture to be obtained.

6.3. Methodology

For analysing farm size and productivity relationship specially for Upper Brahmaputra Valley, the production data of each of the principal crops and data related to the various inputs like labour, animal forces and technology are required. Data for cropping pattern and agricultural produftivity are available at district level but not available at farm size level. Similarly data for various inputs are also not available at the same level. Therefore, 200 farm families have been selected to various farm size

classes for detailed elaborations of farm size and productivity relationship.

6.3.1. Selection of Sample Households and Collection of Data :

All total 200 farm families have been taken into consideration of different farm size classes selecting 40 farm families from each 5 districts of the region.

A field survey was carried out with the help of comprehensive questionnaire by house to house enumeration basis of selected 200 farm families. After data collection, tabulation was done and landholding sizes classified into 5 different groups. This classification of landholding conforms to the land classification prescribed by the Farm Management Survey of India.

6.3.2. Methods used :

For interpreting the results of production operations and to establish the relationship between farm size and productivity, the output of principal crops have been considered for preparing the productivity index. Agricultural productivity per hectare is calculated by converting the total

production of various crops into its money value. Similarly, three major inputs viz., labour, draught animals and non-land capital (Agricultural Technology) have also been calculated by converting into money value.

The relationship between the two, i.e., inputs and outputs, have been calculated by using "Multiple Regression Model" of the following form :

$$Y = \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \alpha$$

where,

Y is production per hectare

X_1 X_2 X_3 are input variables

β_1 β_2 β_3 are the co-efficient of the model

and

α is the origin point of line.

The regression results have been also tested by using linear co-relation method between farm size and productivity with three different inputs separately, viz., farm size and labour inputs, farm size and animal input and farm size and non-land capital inputs.

On the other hand, the distribution of production attributes and input variables are also

depicted by the scatter diagrams.

6.4. Farm Size

Agriculture economy of a region depends much on the land distribution pattern and economic efficiency of the faming units depend much on the size of landholding.[8] The questions pertaining to farm size, fragmentation and tenurial systems are inextricably interlocked with the extent of productivity. It is, therefore, imperative to bring to focus the nature of their relationship with productivity as structure forces and examine their influences on the specific situation under study. While it must be remembered that these three factors are themselves interrelated, acting upon each other - the following account separately analyses each of these, only to have a clear understanding of the part.

There exists a strong relationship between inputs and outputs of a farm specially in relation to size of holding. One of the proposition which attracted considerable notice and has continued to record in discussion is the alleged inverse relationship between yield (i.e., value of outputs) per hectare and the size of holdings.[9] Even if such an inverse relationship holds, it does not provide a

significant basis to judge the relative potentialities of the different size groups nor to predict the future pattern of size distribution that might emerge. Despite these limitations, the inverse relationship acquired some significance as it could provide some rationale for arguing that small farms are superior to large ones on purely economic grounds.[10] Explanation that have been advanced so far in favour of superiority of small farms fall into three categories:

a) differences in the techniques, the small holders using technically superior methods of production;

b) qualitative differences in factor endowment; either land or labour on small farms is intrinsically of superior quality, and

c) more intensive application of other co-operant inputs like labour, bullock power or irrigation.[11]

In the background of the above generalities it may be worthwhile to understand the distribution of farms in the sample villages as a prelude to understand its relationship with productivity.

The total area occupied by 200 farms of the sample villages, is 431.2 hectares with average farm

size of 2.2 hectares which is significantly higher than the state average of 1.73 hectares. The table below shows the distribution of farms, cultivated area and average size of farms by farm size groups of the sample households.

Table 6.1

Distribution of Farms, Cultivated Area and Average Size of Farms by Farm Size Groups

(Area in hectare)

Farm size (Hectare)	No. of farms	P.C. of total No. of farms	Total cultivated area	P.C. of cultivated area	Average size of farms
0.01-1.82	88	44	102.8	23.8	1.2
1.83-2.43	44	22	93.2	21.6	2.1
2.44-3.24	44	22	114.6	26.6	2.6
3.25-4.45	14	7	54.4	12.6	3.9
Above 4.45	10	5	66.2	15.4	6.2
Total	200	100	431.2	100.0	2.2

Source : Field Survey

It is clear from the above table that the smallest farm size category (0.01-1.82 hectare) has as many as 88 farms but occupies only 23.8 per cent of the total cultivated area with an average size of 1.2 hectare.

The farm size category of 2.44-3.24 hectare contains 44 farms (22 per cent) with highest amount of area of about 114.6 hectares having average size of 2.6 hectares.

Table 6.2

Percentage Distribution of Number and Area of Operational Holding, 1990-91

(Area in hectare)

Sample villages Size class	No. of holding		Operated area	
	P.C.	Cf.	P.C.	Cf.
0.01-1.82	44.0	44.0	23.8	23.8
1.83-2.43	22.0	66.0	21.6	45.4
2.44-3.24	22.0	88.0	26.6	72.0
3.25-4.45	7.0	95.0	12.6	84.6
Above 4.45	5.0	100.0	15.4	100.0
Total	100.0		100.0	

Source : Field Survey

It is evident from the above discussion that the large size of farms are generally small in their number, but they do occupy considerable proportion of the total cultivated area amounting to nearly a quarter of it. In fact, the largest two categories *(above 3.25 hectares) of farm sizes account for a*

little less than 30 per cent of the total cultivated area while in terms of their number, they account for a meagre 12 per cent. On the other hand, the smaller holdings are too many in number but the account for an insignificant proportion of the total cultivated area.

The situation arising out of it inevitably leads to the question of fragmentation.

6.5. Fragmentation

The fragmentation of holdings in cultivated area is one of the most deteriorated factor in farm operations. Large number of small plots in cultivated area lead to considerable work of different inputs, viz., land labour and other important farm resources. According to Bhagawati (1964), the poorer productivity of land on large holdings to the possibility that they may be characterised by higher degree of fragmentation of the plots constituting the holding.[12] Such fragmentation of cultivated land are scattered over distances adversely affects the productivity per hectare.

However, the intensity of fragmentation by the number of fragments per hectare, goes on decreasing with the increase in farm size.[13] Thus farms of

bigger sizes are in a more disadvantageous position than the smaller farms as the former possess bigger fragments than the later.

The number of fragments per farm and per hectare of sample farms is given in the following table by farm size groups. It reveals that overall intensity of fragmentation per farm and per hectare is 3.33 and 1.17 respectively in the sample farms.

Table 6.3

Number of Fragments per Farm and Per Hectare
(Area in hectare)

Farm size group	per farm	per hectare
0.01-1.82	2.69	2.02
1.83-2.43	3.31	1.48
2.44-3.24	3.72	1.33
3.25-4.45	2.28	0.87
Above 4.45	4.17	0.71
All farms	3.33	1.71

Source : Field Survey

It is interesting to note that the number of fragments per farm is inversely related to farm size

groups. This means that the number of fragments per farm is higher in the case of smaller farm sizes and is less in the larger farm size categories. But conversely, the number of fragments per hectare shows to be higher in the case of larger farm holdings and less in the smaller farm size holdings. Thus it may be concluded that the smaller holdings have greater fragmentation level per hectare but fewer fragmentation per farm. The case is reversed in the case of larger farm size.

6.6. Ownership of Farms

Tenurial conditions in India vary markedly from region to region and within region. Holdings can be classified broadly as wholly owned, partially rented and fully rented holdings. The intensity of cultivation, input costs, the cropping pattern, etc. are highly affected by the tenurial system.

A purely owned cultivator can undertake the provision and maintenance of irrigational facilities permanently, where a partial rented or fully rented cultivator may not be willing to do so. In other words, wholly owned farmers mostly working on their own fields, generally take greater interest in performing their task and in better management.[14]

Tenurial system may also have considerable influence on cropping pattern. The share-rented lands have a higher percentage area under food crops and less under cash crops as compared with owner cultivated and fixed-rented holdings.. "It is possible that a sharecropper is reluctant to venture into the more profitable, but risky crops, which, incidently, also generally require a high level of inputs since he has to share the profits with the land lords".[5]

The ownership of sample farms can be divided into two broad categories, viz., (i) purely owner cultivated, and (ii) share cultivated farms. It is found that out of the total cultivated areas about 95 per cent is owned by the farmers in the sample farms. Out of 200 farm families covered in the study as much as 97 per cent are purely owners cultivators. Only 3 per cent of the holders come under the category of tenant cultivator.

There are only 6 families available in the sample villages who work as share cultivators. Among these 6, categorywise lease from first tow size class groups (0.01-1.82 and 1.83-2.43), 3 from size group of 2.44-3.24 hectares and 1 from large group, i.e., 3.25-4.45 hectares.

Table 6.4

Distribution of Farms, Areas, with Reference to Category of Ownership and Farm Size Groups

(Area in hectare)

Farm size	Categories of ownership				Total	P.C. of owned to total
	Purely owned		Share-cropping			
	No.	Area	No.	Area		
0.01-1.82	87	101.0	1	1.8	102.8	98.24
1.83-2.43	43	91.0	1	2.2	93.2	97.63
2.44-3.24	41	99.0	3	15.6	114.6	86.38
3.25-4.45	13	52.5	1	1.9	54.4	96.50
Above 4.45	10	66.2	0	0.0	66.2	100.00

Source : Field Survey

It may be presumed from the above analysis that most of the families belong to owner cultivator category with small size of landholdings and everything remaining constant they must be taking requisite interest in cultivating their own lands. This brings the topic of cropping pattern to be analysed to understand how the land is put under use.

6.7. Landuse and Cropping Pattern

The qualitative differences in input, so far they exists, would be most predominantly reflected in

the cropping pattern and intensive use of land. Then, differences in value productivity thus finally boil down to differences in intensity of landuse and cropping pattern.[16] Apart from intensive landuse, cropping pattern also contributes to the relative higher value productivity in smaller farms. Intensive use of land, in turn, involves the application of other inputs to land.

Table 6.5

Average Cultivated Area, Cropped Area and Intensity of Cropping

(Area in hectare)

Farm size (in hectare)	Average net cultivated area	Average gross cultivated area	Intensity of cropping
0.01-1.82	1.2	1.22	101.6
1.83-2.43	2.1	2.17	103.3
2.43-3.24	2.6	2.66	102.3
3.25-4.45	3.9	3.94	101.0
Above 4.45	6.2	6.67	107.5
Total	2.2	2.21	100.5

Source : Field Survey

In cropping pattern, along with the intensity of cropping may explain a number of relations observed

between input uses and the average size of holding which appears to hold for total crop production. The intensity of cultivation in general, however, shows a "significant inverse relation to size of holding, declining sharply on large holdings. This probably explains the significant inverse relation between value productivity per hectare and the size of holding despite the higher value cash on large holdings."[17]

It is evident from the Table 6.5 that the intensity of cropping in the sample villages is very low and it is lowest in the small size categories. On the other hand, interestingly, the intensity of cropping is high in case of large holdings. This indicates that small farmers in the region in most cases do not use their small plot of land intensively.

But this may not sufficiently indicate as to an inverse relationship between size of holding and productivity which is a product of more complex factors. Therefore, it is necessary to supplement this vital clue with other indicators such as farm assets and income earned through sale of agricultural products.

6.8. Farm Assets

The various assets of farms can be divided as (i) animal input, (ii) labour input, and (iii) non-land inputs, viz., machineries and implements, seeds, manure and fertilizers, irrigation and others.

In the economy of crop production bullock labour plays an important part. Bullock has a multiple-purpose use for cultivators. It is a source of draught, a power used extensively in ploughing, irrigation, harvesting and transport operation. It is also a source of supply of manure to the farmers.

The figures for value of implements and machineries, as well as then for "fixed capital" (which includes residences, wells, farm buildings, etc.) are very shaky. Implements can be mainly classified as "traditional" and "improved".

6.8.1. Value of Animal Inputs :

It is found that use of improved implements in agriculture is quite negligible in the sample farms. Out of total 200 farms, only two farms used mechanical implements, i.e. 'power tiller' in farm operation. Bullocks are the source of power for farm operation for the rest of the cultivators. There were in all bullocks in action in 200 farms in the sample

villages, with an average of 2.9 bullocks per farm. It is also found that the average number of bullock is gradually increasing with the increase in farm size from 2.2 to 5.2 (Table 6.6).

Table 6.6

Categorywise Use of Draught Animals in the Sample Farms

(Area in hectare)

Category	No. of holding	No. of bullock	Average
0.01-1.82	88	192	2.2
1.83-2.43	44	136	3.1
2.44-3.24	44	152	3.5
3.25-4.45	14	60	4.3
Above 4.45	10	52	5.2
Total	200	592	2.9

Source : Field Survey

The overall value for the animal input in the sample farms is worked out at Rs. 369,500 with an average per hectare value of Rs. 865.9. It is observed from the table 6.6 that the per hectare value for animal input is highest in the lowest farm size

group (0.01-1.82 hectare) which is decreasing with the increase in farm sizes and it is lowest in case of large size group which is only Rs. 490.00. This trend is quite obvious as big farms always get the adgantage of using implements intensively at a same operation cost.

Table 6.7

Categorywise Use of Animal Inputs in Money Value

(Area in hectare)

Category	No. of holding	Area	Input (in Rs.)	Agerage value (Rs./hec.)
0.01-1.82	88	102.8	120,000	1,167.3
1.83-2.43	44	93.2	85,000	912.0
2.44-3.24	44	114.6	95,000	828.9
3.25-4.45	14	54.4	37,000	689.3
Above 4.45	10	66.2	32,500	490.0
Total	200	431.2	369,500	856.9

Source : Field Survey

6.8.2. Value of Labour Input :

Two types of agricultural labourers is found in the sample farms, viz., (i) family labour, and (ii) hired labour. The whole farming operation in sample

villages is characterised by large number of family labour. Table 6.8 reveals that out of the total number 438 labour employed, family labour is 327 in number which is about 85 per cent to the total labourers employed in the sample farms. Usually the number of labourers employed in agriculture (both family and hired labour) mainly depends on the total number of family members available for agricultural work. But it is observed that use of agricultural labourers depend upon the economic condition of the farmers in the sample farms. Large number of family member employed in agriculture particularly in small size farms are due to the poor economic condition of the farmers. It is also observed in the sample villages that most of the family labourers employed in small size farms are of lower age group. Mostly they are students and assisting their parents in agriculture beside their studies. It is also noticed from the table that though large number of labourers (85%) engaged in small size farms, but per hectare use of labour is increasing with the increase in farm sizes. The per hectare use of labour in case of small farms (0.01-1.82 hectare) is only 1.7 persons. On the other hand it is 3.4 persons in case of large group (above 4.45 hectare). The high average of per hectare

Table 6.8

Categorywise Use of Hired and Family Labour in Samply Farms

(Area in hectare)

Category	No. of holding	No. of family labour	No. of hired labour	Total	Average per farm
0.01-1.82	88	124	26	150	1.7
1.83-2.43	44	72	34	106	2.4
2.44-3.24	44	80	34	114	2.6
3.25-4.45	14	28	6	34	2.4
Above 4.45	10	22	12	34	4.4
Total	200	327	112	438	2.2

Source : Field Survey

labour use in case of large farms are due to the comparatively good economic condition and also most of the family members of these farmers are engaged in secondary and tertiary activities. The average per hectare use of labour in agriculture for all the sample villages is 2.2 persons which can be regarded as more than actual requirement. It is obvious from the fact that, the whole agricultural system of the state is over populated i.e., the number of people

engaged in agriculture is more than the actual requirement, which is a severe waste of manpower resources.

Table 6.9

Categorywise Use of Labour Input in Money Value

(Area in hectare)

Category	No. of holding	Area	Input (in Rs.)	Value per hec. (in Rs.)
0.01-1.82	88	102.8	600,000	5836.5
1.83-2.43	44	93.2	424,000	4549.3
2.44-3.24	44	114.6	455,000	3979.0
3.25-4.45	14	54.4	136,000	2500.0
Above 4.45	10	66.2	136,000	2054.3
Total	200	431.2	1,751,000	4060.7

Source : Field Survey

The overall value of labour input in the sample farms is worked out at Rs.1,751,000 with an average per hectare value of Rs. 4,060.70. It is observed from Table 6.9 that value for per hectare labour input is gradually decreasing from small farms to large farms. In case of size group of 0.01-1.82 hectare, the value is Rs.5836.50 and in case of large size group (above

4.45 hectare), it is Rs.2,054.30. It is due to the engagement of more number of family labour in agriculture.

6.8.3. Value of Non-Land Capital Input :

The value of non-land input in the sample farms is very low in comparison to other inputs. Table 6.10 shows that the total value of non-land input for all the 200 farms is only Rs.38,000 with an average of Rs.88.00 only per hectare.

Table 6.10

Categorywise Use of Non-Land Capital Input in Money Value

(Area in hectare)

Category	No. of holding	Area	Input (in Rs.)	Average (in Rs./ hectare)
0.01-1.82	88	102.8	8,800	85.6
1.83-2.43	44	93.2	6,600	70.8
1.44-3.24	44	114.6	8,800	76.7
3.25-4.45	14	54.4	5,800	106.6
Above 4.45	10	66.2	8,000	120.8
Total	200	431.2		88.1

Source : Field Survey

This only proves the traditional methods of farming system that is being practised by farmers in the sample villages lack of all modern techniques. The value of non-land input is lowest in the lower farm size group and gradually increasing with the farm sizes which is Rs.120 in case of biggest farm size group.

It was observed during field investigation in the sample villages that modern irrigation is totally nil in all 200 farms and whole farm operation is depending on rain water. The amount of fertilizers used in the farms is also extremely low. Most of the HYV seeds for paddy used by the farmers are locally developed. Wooden ploughs are the only implements and bullocks are the only draught power in the sample farms. Only two power tillers were used for farm operation in the sample farms which belong to the two large farmers.

Comparatively high amount of non-land input value in case of big farms is only due to the use of more chemical fertilizers, insecticides and pesticides.

6.8.4. Totala Value of Inputs :

The average value of inputs per hectare is Rs.4693.3 for all 200 farm families in the region (Table 6.11).

Table 6.11

Value of Input per Hectare

(Area in hectare)

Farm size	Animal input	Labour input	Non-Land Capital input	Total
0.01-1.82	1,167.3	58,361.5	85.6	7,088.9
1.83-2.43	912.0	4,549.3	70.8	5,531.8
2.44-3.24	828.9	3,979.0	76.7	4,884.6
3.25-4.45	689.3	2,500.0	106.6	3,295.9
Above 4.45	490.0	2,054.3	120.8	2,665.1
Total	856.9	4,060.7	88.1	4,693.3

Source : Field Survey

An inverse relationship is clearly visible in respect of investment for all types and size of holdings. Thus the picture obtained by using per farm data is negated when the data per hectare is used.

6.9. Agricultural Production

In most regions of India, small farms seem to cultivate their lands more intensively in the sense

that they employ more labour and non-labour material inputs per hectare. Among the factors that permit small farmers to undertake more intensive effort are the cheap family labour, indivisibilities of capital, superior quality of land, quality of management that can be applied to a smaller farm, etc. Another factor is that most of the poor peasant family mainly depend upon small piece of land without having any alternative means of income. Therefore, they try to maximise the output from the available piece of land.

However, a poor peasant by his very position is at a disadvantage compared to the bigger farmer in so far as his capacity to apply capital and other monetised inputs are concerned. As such even after all the efforts he can undertake, output per hectare on his farm may not be larger than on the farm of bigger farmers.

The value of cash receipts in rupees from the sale of crops of the sample farms of the Upper Brahmaputra Valley has been analysed as an indicator of the efficiency of farm to understand the relationship between the size of holdings and productivity. The net receipts will indicate the value of the total inputs by farms as well as the

economic status of the sample households.

6.9.1. Value of Crops by Farm Size and Per Hectare :

As far as the size of holdings are concerned, it is observed that the cash receipts from the value of crops per holding sharply increases from small to bigger farm size groups in the sample farms (Table 6.12). It is quite obvious that gross cash from the value of crops will be more in big holdings as they produce more crops. But percentagewise, the value of production is more in case of small farms as they are more in number.

Table 6.12

Distribution of Cash Receipts from the Sale of Crops Farm Size Groups

(Area in hectare)

Size Class	Total value (in Rs.)	Value per holding	P.C.
0.01-1.82	616,080	7,000.9	23.5
1.83-2.43	522,720	11,880.0	19.9
2.44-3.24	700,020	15,905.5	26.7
3.25-4.45	322,800	23,057.1	12.3
Above 4.45	459,480	45,948.0	17.5
Total	26,21,100	13,105.0	100.0

Source : Field Survey

But if we see the situation of cash receipts from the value of agricultural produce per hectare, it is interesting to note that there is proportionate increase. From the following table we can see that there is no such significant variation of cash receipts among the different farm size groups.

Table 6.13

Value of Crops per Hectare in Rupees

(Area in hectare)

Farm size	Average size of farm	Average receipt per hectare
0.01-1.82	1.2	5,992.9
1.83-2.43	2.1	5,609.5
2.44-3.24	2.6	6,108.3
3.25-4.45	3.9	5,933.8
Above 4.45	6.2	6,940.7
Total	2.2	6,078.6

Source : Field Survey

Both the small and big frams sell surplus products. There is a tendency of slight increase of cash receipts with the increase of farm size but it is only because of high average size of farms in large categories and not because of higher productivity. It

is also noticed that in big holding, i.e., size group of 3.24-4.45 hectare there is a tendency of decreasing of cash receipts.

It may be concluded that it is a tendency for cash receipts per hectare of land to decrease or to increase or to remain unchanged as farm size increases. The chapter provided an account of the various factors that contribute towards a relationship existing between sizes of holding and productivity. It is imperative at this concluding stage to reaccount the broad observations made at several stages with the help of some quantitative techniques.

6.10. Efficiency of Farms

Human labour, animal labour and, to some extent, technology are the major inputs in the traditional agriculture. As the expression "productivity efficiency" implies making the best use of all inputs, it is important that productivity be measured in terms of all these inputs. These indices of productivity used in this study are labour input (both family and hired), animal inputs and non-land inputs (tractor, power-tiller, irrigation, fertilizer, HYV seeds, etc. or agricultural technology). The value of the agricultural output based on three major

crops, i.e., rice, sugar cane and mustard. Together, these three account for more than 95 per cent of the total cropped area in the sample farms. To aggregate the output of three different crops, these were converted into money value, using regional farm harvest prices. The index of productivity is defined as the market value of output of three crops per hectare of area.

6.11. Findings

In order to reveal the pattern of net input and productivity the data on per hectare and per farm of cultivated area in terms of money value are utilised. It is seen from the table 6.14 that the productivity per farm increases as the farm size increases. As the size of 3.24 hectare is reached, the productivity per hectare increases to more than Rs.6,000.00, but it is indeed much below than the standard size of productivity per hectare which is estimated to be Rs.8,000.00 for Assam on the basis of minimum recognised standard of living. This clearly indicates that a farm deriving a productivity per hectare of Rs. 8,000.00 is not economically viable. The table also shows that the per hectare labour input and animal input increases as the farm size decreases which

Table 6.14

Categorywise per Hectare Productivity and Inputs in Money Value

(Figures in Rupees; Area in hectare)

Size Class	No. of holding	Area (in hectare)	Average Production (per hectare)	Average Labour input (per hectare)	Average Animal input (per hectare)	Average Non-land capital Input (per hectare)
0.01-1.82	88	102.8	5992.9	5836.5	1167.3	85.6
1.83-2.43	44	93.2	5609.5	4549.3	912.0	70.8
2.44-3.24	44	114.6	6108.3	3979.0	828.9	76.7
3.25-4.45	14	54.4	5933.8	2500.0	689.3	106.6
Above 4.45	10	66.2	6940.7	2054.3	490.0	120.8
Total	200	431.2	6078.6	4060.7	856.9	88.1

Source : Compiled from Field Survey

clearly suggests a negative correlation with the farm size group and productivity value. On the other hand, increase of non-land input per hectare with the increase of farm size suggests a strong association between this two. In the farm size groups of the sample household the standard deviation values for variables-productivity, labour input, animal input and non-land capital input are respectively, 443.86, 1,276.73, 225.88 and 18.799 which confirm large scale differences within the variables.

The variations of land productivity in relation to various size of operational holdings indicate that agricultural productivity is increasing with the diminishing rate when the size of landholding is increased. But the degree of variation among the distribution in the various size of holdings increased with the increase of the size of landholdings. Increase in productivity with respect to increasing size may be due to induce technology which is being intensified at larger size of landholdings, while the small landholders are operating their piece of land with animal and labour forces.

The productivity and labour input relationship shows that there is a negative relationship between

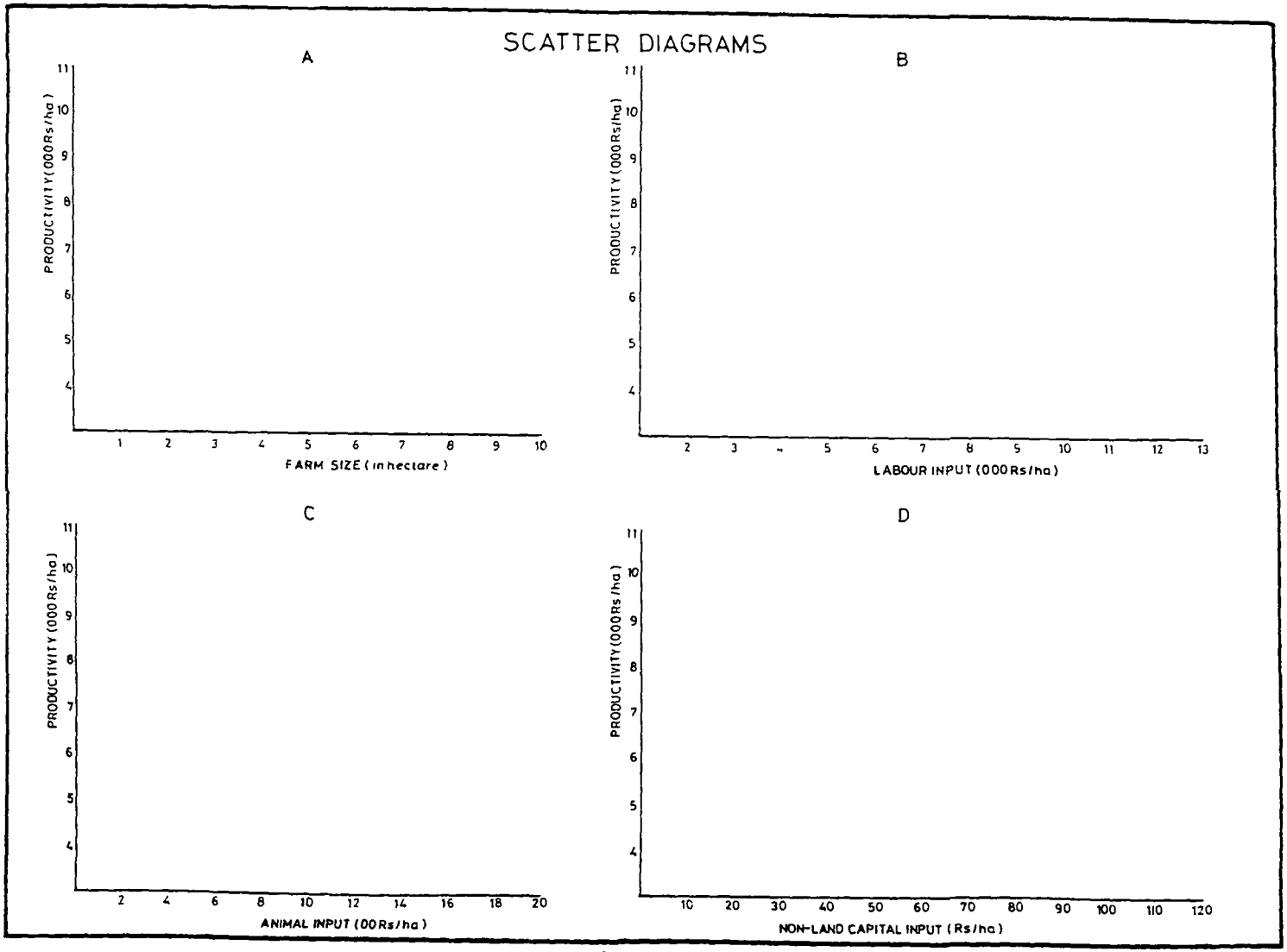
SCATTER DIAGRAMS
A
PRODUCTIVITY (000Rs/ha)
FARM SIZE (in hectare)
B
PRODUCTIVITY (000Rs/ha)
LABOUR INPUT (000Rs/ha)
C
PRODUCTIVITY (000Rs/ha)
ANIMAL INPUT (00Rs/ha)
D
PRODUCTIVITY (000Rs/ha)
NON-LAND CAPITAL INPUT (Rs/ha)

Fig 22

them. The output and animal inputs relation are also insignificant in each and every sample farms.

The scatter diagram which is drawn by taking output and non-land capital attributes of agricultural production reveals that there is a positive relationship with a clustered distribution of the points of samples. However, in the few selected samples, the output per hectare is recorded low inspite of the intensive use of non-land capaital inputs.

In order to have a more clear picture of productivity and input pattern, analysis of correlation and regression is essential which were processed at the Computer Centre of Geography Department, North-Eastern Hill University, Shillong. In the first place, the Pearsonian Correlation Co-efficient between per hectare productivity as dependent and labour input, animal input and non-land capital input as independent variable is found to be 0.9004 (Multiple Correlation Co-efficient R^2 = 0.9004). This is tested for significance at 5 per cent level of confidence by student's 't' test and found to be 3.22 against 3.18 of tabulated value which is higher for the correlation to be significant.

Thus, it is proved that there exists a significant correlation between the productivity and different input values.

In the second place, a bivariate analysis of correlation between the variables are tested in order to experiment the degree of association. The table 6.15 showing correlation co-efficient between the variables reveals that high degree of correlation exists only in between productivity and non-land capital input where with increase in non-land capital input productivity increases. Although another high degree correlation between animal put and labour input is found, in practice this is said to be spurious in the field of productivity analysis.

Table 6.15

Correlation

	y	x_1	x_2	x_3
y	1	-0.6004	-0.6737	0.7846
x_1		1	0.9799	-0.7798
x_2			1	-0.7404
x_3				1

Correlation : $(yx_1) = -0.6004$; $(yx_2) = -0.6737$;
$(yx_3) = 0.7846$; $(x_1x_2) = 0.9799$;
$(x_1x_3) = -0.7798$; $(x_2x_3) = -0.7404$

This analysis firmly proved that agricultural productivity can only increase when the importance and investment in agricultural technology get the priority, i.e., rapid increase of non-land input may increase agricultural productivity at the same rate.

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VII

SUMMARY AND CONCLUSION

Assam is rich in various natural resources and has a strong agro-climatic base. But its economy in general and agriculture in particular is not showing satisfactory performances. A low level progress in the primary sector of this region has resulted in many socio-economic problems. Agriculture is the principal source of livelihood for a majority of the people in the rural Assam. The agricultural sector is so important to the state's total economy that it alone contributed more than 55 per cent of the state's total income as compared to 45 per cent for India as a whole. It also acts as the main absorber of working population as it engages as high as 77 per cent of the

total working population in the state. The study, therefore, is undertaken with a view to reveal the existing landholding pattern with its related problems and to examine the various socio-economic problems along with the physical landscape of the region which are closely related to the existing agricultural productivity.

Agricutlure is concerned not only with the growing of crops, it is also a form of applied ecology. Agriculture is directly dependent on the immediate natural environment which can be changed only at heavy cost.

The study area is characterised by variety of physiographic features offering potentialities for agricultural development. But at the same time it is also imposing barriers to manpower efforts with unhealthy climatic condition, uncultivable hilly and wasteland, myriads of shifting water chanels, extensive flood plain, etc. In such situation, without proper planning, easy development of agriculture is a difficult task.

The high population pressure on agriculture is another constraint in the development of agriculture in the region. Because of low-level development in

the secondary and tertiary sectors, the ever-increasing population in the region is bound to be absorbed in the agricultural sector, which resulted in the severe waste of manpower resources. The region has remained industrially backward inspite of being endowed with rich natural resources, where only 5 per cent of the total workers are engaged in the secondary sectory.

The total land area available for cultivation was only 34.45 per cent in Assam and 35.16 per cent in Upper Brahmaputra Valley in the year 1981-82, with a limited scope for physical expansion. Area sown more than once is extremely low which is only 9.6 per cent in Assam and 8.36 per cent in Upper Brahmaputra Valley to the total area.

The cropping pattern in the region is characterised by high percentage of rice hectareage, low average yield rate and low intensity of cropping. More than 77 per cent of the total cropped area is occupied by foodgrains and rice alone occupied 72.3 per cent to the total cropped area in the Upper Brahmaputra Valley in the year 1987-88. Mustard is the second large crop in the region as area is concerned. The total area under mustard was about

13.7 per cent of the total cropped area.

There are no reliable written records on land tenure system in Assam before the Ahoms came into the region. During their six hundred years of ruling, very lately they introduced certain land tenure system. When Assam was brought under the domain of British empire in the year 1826, they began to frame certain land regulations. The Assam Land Revenue Regulation 1886, is the general revenue law of Assam and for the first time it defined the rights to be attached with the owners of different classes, which is still in force. However, the land tenure system prevalent in the plain districts of Assam may be classified into two types; Zamindari and Raiyatwari system. In the Zamindari system, revenue is collected by the Zamindars who acquired the status of a landlord. But uner the Raiyatwari system, the occupiers paid revnue directly to the Government.

After Independence, a number of land reform measures have been taken by the State Government in order to remove the defects in the existing land tenure system. Among them, the Assam State Acquisition of Zamindari Act, 1951, the Assam Fixation of Ceiling on Land Holding Act, 1965 and the Assam

(Temporarily Settled Areas) Tenancy Act, 1971, are most important. The Assam State Acquisition of Zamindari Act, 1951, aimed to establish direct relationship between tenants and Government abolishing the right of Zamindars which prevailed in certain parts of Goalpara and Cachar districts of Assam.

The Assam Fixation of Ceiling on Landholding Act, 1965, aimed at reducing the glaring inequalities in the ownership of land. In the last amendment in 1965, it reduced the ceiling limit of land to 6.6 hectares.

The Assam (Temporarily Settled Areas) Tenancy Act was enacted in the year 1972. This Act recognises two types of tenants, viz., occupancy and non-occupancy tenants. It reduced the length of time for acquiring the right of occupancy to 3 years instead of 12 years under ceiling regulations. According to this Act, the occupancy tenants can acquire the right of ownership over land by depositing an amount of 50 times more than the annual land revenue payable.

Three types of land tenure system have been prevalent in Assam viz., (i) the 'Ratyatwari' system, (ii) land lord tenure called 'Zamindari' system and (iii) land without any legal ownership in the two hill

districts of Assam viz., North-Cachar Hills and Karbi Anglong.

The rural settlement in Assam as well as in the Upper Brahmaputra Valley is surrounded by innumerable operational holdings of different shapes and sizes. The average size of landholding in Assam is only 1.37 hectare and it is 1.55 hectare in Upper Brahmaputra Valley. The slightly higher average of landholding in Upper Brahmaputra Valley is only due to the existence of large number of tea gardens in the region. If the plantation estates are excluded from the total operated area, the actual average size of farms will go down to below 1 hectare in the region. The concentration of a large proportion of agricultural land in the hands of a minority of land owners, leaving more than 81 per cent of bottom holdings (below 2 hectares) to spread over only 41 per cent of the total operated area.

The whole landholding pattern in the region is dominated by high caste people, i.e., other than Scheduled Tribes and Scheduled Castes groups. Interestingly, the percentage of Scheduled Castes farmers in the valley is only 4 per cent which is less than the actual percentage of the Scheduled Caste

population. It reveals that, among the farmers, the number of land-less Scheduled Castes farmers are more in the region. There are only 18 farmers who have land more than 10 hectares out of the total 12,792 farmers in the valley.

The intensity of cropping in the valley is exrtremely low. The average yield of rice in the valley is 1,296 kg. which is slightly higher than the state's average of 1,025 kg. Though winter rice (Sali) is the dominating crop in the valley, the productivity rate is lower than the Autumn rice (Ahu). But area under Autumn rice is significantly low. This is only because of introducing high yielding varieties of seeds with proper irrigated facilities. Therefore, scope for bringing more area under Autumn rice is very high in the valley in view of the fact that most of the land under winter rice (Sali) could be practised double cropping. In the traditional method of farming in the valley, higher output can be obtained by adopting crop-rotation. Since the region is dominated by Sali paddy, introduction of crop-rotation would be best suited with Autumn rice fields.

The small farmers in the region are almost untouched by modern methods of agriculture and

technology. As a result of which, farmers are badly affected by some worse natural calamities. The entire valley is chronically flood affected region. As a result, there is heavy loss in terms of life and property and extensive damage to standing crops.

Draught is becoming a common phenomena to the region. Irrigation in the valley is insiginificant and whole farming operation is dependent on rain water. Summer draught affects agriculture in the valley more seriously as more than 70 per cent of rainfall in the valley is concentrated during the summer season.

The agriculture is also affected by diseases, insects, weeds and domestic as well as wild animals in the valley. The humid-tropical climate of the region with excessive relative humidity prevailing over a long period provided an ideal condition for the gorwth of insects, diseases and weeds. Domesticated animals as well as wild animal damage to a large extent as most of the crop fields are open without proper fencing in the reion. It is difficult to raise fencing in the fragmented and scattered small fields and also due to the poor economic condition, farmers cannot erect permanent enclosures to protect their

standing crops. Besides wild animals, birds also cause damage to the crops as the number of bird population is high in the region. The damage caused by wild elephants is more severe in the region as all the districts of the valley are touched by the foothills of neighbouring hill states of the region.

Due to the unhealthy condition of living in the villages of the region, farmers easily fall into various diseases. Generally, food taken by the farmers are not adequate and inferior. The free medical facilities provided by the Government is not adequate as most of the Government health centres are located in the urban areas.

Due to the poor health of draught animal, the agriculture suffers in the region. Compare to the number of draught animals, the existing grazing lands in the region is very low. On the other hand, farmers take little care in feeding their cattle. Cattle are generally let loose to graze. During the winter season, which is the rest period for cattle, they do not get sufficient food as grazing lands are almost dry and barren. During summer season also most of the grazing lands are fully covered with winter crops (Sali). Roadsides, slopes and bank of embankments and

playgrounds are the only grazing land for cattle in the summer season. As a result cattle are under-fed and ill-fed and the most valuable cattle population for poor farmers suffers and dies from various diseases and epidemic in large number making the farmers' economic condition worse.

Farmers in the valley live in villages, fully depending on agriculture. A few of them depend on secondary and tertiary sectors of occupation. The social structure that comprises the village community in the region can be divided into four groups. Farmers, belonging to the first group cultivate their own land with the help of family labours and in some cases with the help of hired and contract labours. They are usually busy with winter rice cultivation for six months and the remaining six months of the year is rest period for them except for few farmers who cultivate also summer rice. They try to produce sufficient grain for the satisfaction of the requirement like to feed their family, to meet their liabilities from the sale of surplus grain. The second group of farmers with little own land, share others' land for cultivation to fulfill their required demands of foodgrains. The third group consisting mostly of land-less labourers, the poorest section of

the community. They work on wage basis in the paddy field and during off season they engage themselves in other activities. The fourth group of people are those who engage themselves in various professional services, besides agriculture, and are economically well-off but of few in number. Besides these, some people in the villages are also engaged in occupation like shopkeepers, village artisans, money lenders, businessmen, contractors, etc. Besides the paddy fields, village are characterised by some amount of high land for each farmer in which farmers build their houses with cultivation of various cash crops, mainly betel nut, betel leaves, cytras fruits, vegetables, etc. Usually farmers are busy in cultivating these crops when they are free from rice cultivation. For the farmers who have little or no surplus from rice cultivation these high land crops are the main source of their earnings for their day to day expenditure.

The economic condition of the farmers in the rural areas is very poor. They hardly have cash savings. When they are in need of money, may be for medical aids or for educating their children, expenditure of various social and religious functions and ceremonies, may be for buying agricultural tools, draught animals or to repair their houses, etc. they

go to the middlemen or traders or money lenders. In return, they have to dispose off their agricultural products to them immediately after the harvesting without getting reasonable price.

The law of inheritance ensures equal distribution of land property among the all male child of the family in the rural society of Assam. The most dangerous effects of law of inheritance are the excessive fragmentation of landholdings in the region.

More than 72 per cent of the total population in the valley is Hindu and 24 per cent in Muslim. Farmers are mostly dominated by superstitions, mystery, faith and taboos. The Hindu farmers are greatly affected by a variety of religious rituals and beliefs. A large number of holidays prohibiting ploughing and other agricultural activities has reduced the total working days even in the peak seasons.

Without technology, the full utilisation of the potentials of land in the valley cannot be achieved only by human and animal power with traditional methods of farming. Due to the lack of technological change, the agriculture in the valley is still in subsistence level.

The consumption of chemical fertilizers in the valley is extremely low which is only 1.9 kg. per hectare, against 53.28 kg. in Punjab and 35.15 kg. in Tamil Nadu.

The use of HYV seeds can bring miraculous result in the field of agriculture, if irrigation is provided simultaneously. Among the HYV crops, only HYV rice becomes popular among the farmers in the region. But due to the lack of irrigation facilities, the farmers could not fully achieve the benefits of it.

Large number of small landholdings and limited source of economy hinder the use of modern implements in the agriculture in the region. Bullocks and wooden ploughs are the main agricultural tools in the region. The average density of wooden plough per 100 hectares in the region is 75.4 against the state average of 51.0 number.

Infrastructure is most essential for the modernisation of agriculture through technological innovation. Due to the lack of infrastructural facilities the agriculture in the region is still in subsistence level. Irrigation is the most important infrastructural need in the development of agriculture

and package of practices for intensive cultivation. The artificial irrigation in the valley is negligible. The whole valley is characterised by high rainfall and high humidity during the summer season. Rainfall is extremely low in the winter season. Therefore, rabi crops cultivation and multiple cropping is almost absent due to the absence of reliable and controlled source of water.

The marketing system in the region is dominated by free markets. The marketable surplus of the farmers goes from rural areas to urban areas through a number of middlemen. After harvesting, the middlemen collect crops from villages at a very cheap price and sell it during the lean season, when price rises.

The agricultural credit facilities in the region through various government agencies is not adequate and encouraging. Because of poor economic condition of the farmers, whatever money is available from any source they spend it in other purposes than buying agricultural inputs. Survey of sample households in the region shows that village money lenders, traders, co-villagers and relatives are the main sources of credits to the farmers. A village survey at Basagaon in Jorhat district reveals that 52

per cent of the total loan were taken from the traders, 26 per cent from the village money lenders and the remaining from their relatives and other sources. Therefore, it is most essential to set up proper organised system of rural credit which must drive away the present defective credit system.

Moreover, the need of total rural electrification for assured and abundant cheap power for irrigation, mechanical service centres for technological innovation and proper transport and communication system is necessary for the rapid growth of agricultural sector in the region.

Agriculture economy of a region depends much on the land distribution pattern and economic efficiency of the farming units depend much on the size of landholding. The questions pertaining to farm size, fragmentation and tenurial systems are unextricably interlocked with the extent of productivity. A micro-level study of 200 farm families in the region through field survey reveal a better land distribution pattern with an average farm size of 2.2 hectares. The average farm size in the marginal group is 1.2 hectare, with 88 farms and in large farm size group it is 6.2 hectare with 10 farms.

In the sample households smaller holdings have greater fragmentation level per hectare but fewer fragmentation per farm. The case is reversed in the case of large holdings.

Tenurial conditions in India vary markedly from region to region and within region. The intensity of cultivation, input costs, the cropping pattern, etc., are highly affected by tenurial system. Out of the total 200 farmers of the sample households, 97 per cent of them are purely owner cultivators. Therefore, farmers can avail themselves of the advantage for better management of their own field.

The intensity of cropping in the sample farms is very low, which is only 100.5 and it is lowest in the marginal size category. This indicates that small farmers in the region in most cases do not use their small plot of land intensively.

Improved implements in agriculture in the sample farms is quite negligible. Only two farmers used 'power tiller' in farm operation. Bullocks are the main source of power for the rest of the farmers. The average value for animal input per hectare in the sample farms is Rs. 856.00 which is highest in marginal category with Rs. 1,167. Small farmers are

in most disadvantageous position in animal input as minimum two bullocks are required for farm operation, whatever the amount of land may be.

The whole farming operation in the sample farms is characterised by large number of family labour employed. Large number of family labours employed in agriculture particularly in small farms are due to poor economic condition for farmers and due to lack of other alternative works. It is also observed that most of the family labours are of small age group. They are mostly students and assisting their parents in farming besides studies.

Value of non-land inputs is extremely low in sample farms. Modern irrigation facilities is totally nil in all 200 farms. Use of chemical fertilizer is extremely low and most of the HYV seed used by the farmers are locally developed.

In the sample farms the big farms, i.e., above 2.44 hectares showing slightly better performances in terms of per hectare productivity than the small farms. The smallest category of farm, i.e., below 1.82 hectare showing loss in terms of input and output relation where other categories of farms show marginal profits. The reason behind low efficiency of small

farms is no doubt due to the expenditure incurred on animal inputs and family labours which is much more higher than the actual requirement.

CONCLUSION

Finally, the study may be concluded with the following suggestions :

1) Raising production by putting more and more land under agriculture is not at all encouraging if emphasis is not given on raising productivity. Horizontal expansion of arable land is limited in the region and further expansion at the costs of natural environment should be restricted. Efforts should be made to intensify the use of available land in order to achieve higher productivity of land.

2) For that, the most important task will be to motivate the rural farmers to adopt scientific mode of cultiation. To motivate the rural farmers towards modern agriculture wide range of publicity and effective plans and programmes are most necessary. All the service centres related to agriculture should be decentralised and located in rural areas. At the same time government should also make some concrete and definite rules. Double cropping or multiple

cropping should be made compulsory. Farmers who are not willing for the second crop, the land should be handed over to other landless and willing farmers for the second crop.

3) The existing tiny and scattered landholding distribution in the region is hindering the implementation of modern tools and machineries in agriculture. The only solution to this problem will be to consolidate the scattered landholding in every village under voluntary co-operative societies and government should provide free infrastructural facilities to these societies.

4) Irrigation is the key of success of all developmental efforts in agriculture. For the rapid growth of agriculture in the region, the installation of network of irrigation projects should get top priority. For the adoption of improved agricultural practice, specially for cultivating HYV paddy in the winter months, provision of irrigation facilities is extremely necessary. If the irigation facilities is made available, double or multiple cropping could be adopted and farmers in the flood-affected areas can opt for crops that can be grown during flood-free winter months.

5) The agricultural operation in the region is over-populated resulting in waste and under-utilization of manpower resources. The deficit in input-output relation in the case of small farms in the region is due to the excess number of family labours employed and higher expenditure in animal input. It is very much necessary to divert excess number of agricultural workers to other occupations such as cottage industries, weavings, poultry, other small-scale food-processing units, providing them proper infrastructural facilities.

6) Poor health of farmers and draught animals is another constraint in the development of agriculture in the region. As more than 90 per cent of the total population of Assam live in rural areas, most of the government's free health centres should be shifted to the rural areas. Likewise, all the Veterinary Hospitals of the states should be transferred to the rural areas of the region.

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G L O S S A R Y

Ahu	:	Autumn and summer rice
Bao	:	Lowland winter rice standing in the field for about ten months from the time of its broadcast in the month of February and March
Bari	:	A compound
Bepari	:	Trader
Bigha	:	A land amount of 0.13387 hectare
Beel	:	A small lakelet
Ghani	:	An indigenous small device for pressing oil-seeds with the help of hand or a bullock
Jhuming	:	Shifting cultivation
Khiraj	:	Revenue
Lakhiraj	:	'La' means free and 'khiraj' means *revenue*
Mouza	:	A division of a district in Assam under a Collector of Revenue called 'mouzadar'
Mouzadar	:	A fiscal officer-in-charge of a mouza
Paik	:	A common 'rayat' in the days of the Ahom kings whose duty was to render service to the king and the state
Puras	:	A land amount of 1.02 hectares
Rayat	:	A tenant
Rupit	:	Fit for lowland paddy cultivation

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APPENDICES

APPENDIX-I

Upper Brahmaputra Valley

Size Class	X_1Y_{1+1}	$X_{1+1}Y_1$
Marginal	1245.81	401.64
Small	557.31	301.22
Semi-Medium	195.57	57.50
Medium	101.69	5.19
Large		

$$G = \frac{1}{100 \times 100} \times 1334.79$$

$$G = \underline{0.133}$$

Sample Households

Size Class	X_1Y_{1+1}	$X_{1+1}Y_1$
Marginal	950.4	523.8
Small	585.2	475.2
Semi-Medium	277.2	186.2
Medium	107.8	63.0
Large		

$$G = \frac{1}{100 \times 100} \times 672.4$$

$$G = \underline{0.067}$$

$$G = \frac{1}{100 \times 100} \left| X_1 Y_{1+1} - X_{1+1} Y_1 \right|$$

Assam 1976-77

Size Class	$X_1 Y_{1+1}$	$X_{1+1} Y_1$
Marginal	1390.33	436.11
Small	593.77	233.66
Semi-Medium	171.54	112.39
Medium	60.09	5.82
	2215.73	787.98

$$G = \frac{1}{100 \times 100} \times 1427.75$$

$$G = \underline{0.143}$$

Assam 1985-86

Size Class	$X_1 Y_{1+1}$	$X_{1+1} Y_1$
Marginal	1404.56	433.12
Small	599.02	317.85
Semi-Medium	225.98	97.01
Medium	49.28	3.49
Large		
	2278.84	851.47

$$G = \frac{1}{100 \times 100} \times 1427.37$$

$$G = \underline{0.142}$$

APPENDIX-II

SCHEDULE FOR VILLAGE SURVEY ON AGRICULTURAL PERFORMANCE

1. Name of the District : _____
2. Block : _____
3. Name of the village : _____
4. Name of the head of the family : _____
5. Total number of family member : _____
6. Religion : _____
7. Caste : _____
8. Age : _____
9. Sex : _____
10. Educational qualification :

No.	L.P.	M.E.	High	College	University	Others

11. Occupation : _____ 12. Other occupation: _____
13. Total area of landholding : _____
14. Mode of cultivation :

Own land* Share cropping*

Rented land*

15. Area/Production, etc.

Crops	Area	Production	Date of sowing	Date of harvesting
Rice				
HYV				
Local				
Maize				
Wheat				
Gram				
Jute				
Sugarcane				
Others				

16. Input supplied :

Inputs	Expenditure
Fertilizer	
Pesticides	
Weedicides	
Others	

Implements	No.	Estimated costs
Wooden plough		
Tractor		
Thresher		
Herdestor		
Bullocks		
Others		

18. Irrigation facilities :

Means of irrigation	Area covered	Estimated costs
Tube-well		
Well		
Tank		
River		
Stream		
Others		

19. Total return in quantity :

Crops	Quantity	Sowing capacity of land
Rice		
Wheat		
Maize		
Gram		
Sugarcane		
Others		

20.	Surplus	Deficit
Rice		
Wheat		
Maize		
Gram		
Sugarcane		
Others		

21. Labour Use :

Kinds of labour	Nos.	Wage rate	Total
Family labour			
Hired labour			
Contract labour			
Others			

22. Financial difficulties : _____

23. Source of finance :

Bank* Money lenders* Others*

24. Dissatisfaction, if any : _____

25. Nearest Market and Distance : _____

26. Landuse pattern:

Total area : _____

Land not available for cultivation :

(a) Land put to non-agricultural use : _____

(b) Barren and uncultivated land : _____

Forest :

Other uncultivated land excluding fallow :

(a) Permanent pasture and grazing land : _____

(b) Land under Miscellaneous crops : _____

(c) Cultivable waste : _____

Net area sown : _____ Total cropped area _____

Area sown more than once : _____

27. Cropping pattern :

Crops cultivated	Area under crops
1.	
2.	
3.	
4.	
5.	
6.	

28. Method of cultivation in past years :

1 year back :
2 years back :
3 years back :
4 years back :
5 years back :
10 years back :

29. Government help :

Department	Kinds of help
1.	
2.	
3.	
4.	
5.	

30. Any problem facing by the farmers :

APPENDIX-III

Number and Area of Operational Holding
Upper Brahmaputra Valley, 1985-86

(Scheduled Castes)

Size Class (hectare)	No. of holding	P.C.	Area	P.C.
Below 1	15,699	60.86	7,420	26.51
1-2	6,431	24.93	8,855	31.64
2-4	2,952	11.44	7,888	28.19
4-10	692	2.68	3,573	12.77
Above 10	18	0.06	243	0.86
Total	25,792	100.00	27,979	100.00

Number and Area of Operational Holding
Upper Brahmaputra Valley, 1985-86

(Scheduled Tribes)

Size Class (Hectare)	No. of holding	P.C.	Area	P.C.
Below 1	30,395	44.85	15,170	14.99
1-2	20,769	30.64	28,297	27.97
2-4	12,171	17.95	32,589	32.21
4-10	4,249	6.26	22,725	22.46
Above 10	184	0.27	2,374	2.34
Total	67,768	100.00	1,01,155	100.00

Number and Area of Operational Holding
Upper Brahmaputra Valley, 1985-86

(Others)

Size Class (Hectare)	No. of holding	P.C.	Area	P.C.
Below 1	310,556	59.04	139,101	16.51
1-2	121,179	23.03	171,367	20.35
2-4	71,129	13.52	189,777	22.53
4-10	21,034	3.99	110,590	13.13
Above 10	2,075	0.39	231,202	27.45
Total	525,973	100.00	842,037	100.00

APPENDIX-IV

Number and Area of Operational Holding
Assam, 1985-86

(Scheduled Castes)

Size Class (Hectare)	No. of holding	P.C.	Area	P.C.
Below 1	69,172	60.35	33,969	26.32
1-2	27,955	24.40	39,116	30.31
2-4	15,731	13.73	44,252	34.29
4-10	1,633	1.42	9,944	7.70
Above 10	81	0.07	1,768	1.37
Total	114,527 (4.78)	100.00	129,049 (4.09)	100.00

Number and Area of Operational Holding
Assam, 1985-86

(Scheduled Tribes)

Size Class (Hectare)	No. of holding	P.C.	Area	P.C.
Below 1	146,829	46.64	75,687	17.08
1-2	93,517	29.70	123,945	27.97
2-4	66,125	21.00	186,468	42.09
4-10	7,770	2.46	45,837	10.34
Above 10	565	0.17	11,075	2.49
Total	314,806 (13.14)	100.00	443,012 (14.06)	100.00

Number and Area of Operational Holding
Assam, 1985-86

(Others)

Size Class (Hectare)	No. of holding	P.C.	Area	P.C.
Below 1	12,26,227	62.38	490,688	18.94
1-2	4,24,984	21.62	598,389	23.10
2-4	2,82,746	14.38	582,743	32.93
4-10	26,434	1.34	215,775	8.33
Above 10	5,049	0.25	431,805	16.67
Total	19,65,442 (82.07)	100.00	25,89,400 (82.19)	100.00