AGRICULTURAL LAND USE AND PRODUCTIVITY PATTERN OF LOWER BRAHMAPUTRA VALLEY

(1970-71 and 1994-95)

ABSTRACT

BY

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SUBMITTED IN THE PARTIAL FULFILMENT
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Introduction:

Agriculture is the backbone of human civilisation as well as development. It is an extensive form of human occupation and more than half of the world's population depends on it for their livelihood. Agriculture Geography deals with the spatial organisation of crops and their concentration. It provides an interesting field in which geographers can play a vital role for the development of society.

Agriculture is the most dominant sector of the Indian economy and the crop production occupies the most important place. The agriculture sector was mostly neglected during the British Colonial Rule. After independence, the agricultural sector became important sector and Government emphasised upon it through five-year plans to increase food production on a priority basis, to feed the over growing population.

Development of agricultural sector without structural changes is a difficult task. This difficulty is highly prevalent in the countries with high population pressure on land like India, which results in regional imbalances or regional disparity due to the imbalance of food production and population growth. The macro level studies or macro-economic magnitudes and approaches do not provide proper insights in relation to the problems of agricultural development. Therefore, proper planning should be extended at micro-level units.

Agriculture is the primary source of livelihood for the majority of the people in the rural areas of Assam. This sector is most important to the state economy, as it alone contributes more than half of the total state's income. It acts as the main absorber of the working force. In fact, the average yield of cereals and non-cereals in the study region is much lower as compared to other states. The existing agricultural potentiality is highly under-utilised and has immense scope to improve it.

In last few decades, the agricultural sector has undergone a drastic transformation. The transformation scenario has jumped from subsistence agriculture to a modern and technologically advanced counterpart in many areas, caused by increasing demands of food in order to eradicate the problem of hunger, under nutrition and mal-nutrition. Further, the tremendous population pressure on arable land, the growing demand for food and agricultural raw material are the present day problems. Human beings have already reached the frontier of arable land at maximum limit. So, the production as well as productivity can only be raised through the intensification of land use, multiplication and diversification of crops by adopting latest technical know-how.

The scientific and systematic studies related to agricultural geography have originated very recently, that is, during the second half of the present century and taken the momentum of the real work of this particular branch of geography. During the inter-war period, O.E. Baker, Olaf Jonasson, Clarence F. Jones, Samuel Van Valkenburg and Griffith Taylor, carried out pioneer work in agricultural regionalisation. The recent method and approach of agricultural geography have been benefited because of 'Quantitative Revolution' of fifties and it opened a new era of research possibilities. One of the most important approaches, that is, model building towards the study of agricultural activities, was initiated by the German scholar J.H. Von Thunen during early 1826. This was the first attempt to explain the agricultural land use pattern in economic term, based on the concept of economic rent. This model could draw attention to some of the scholar's like- Hoover, Losch and Dunn. Leontief and developed a model called as 'Input-Output', a method of analysing natural economics. Chetterjee (1962) suggested certain measures to plan the agricultural sector in North-east India, taking into consideration of geographical diversity.

The information related to agricultural development and studies have reflected that the crop output and the productivity growth in Assam, over past years is not satisfactory. The works in the field of agricultural geography in Assam are still at a very initial stage. Though various works are being carried out, most of the studies are partially or fully dealt with only at micro level to understand the problems in the rural areas. Saha (1975) carried out the first study on agricultural development in Assam between 1950-51 and 1973-74.

Das (1984), presented a structural analysis of the peasant agriculture in Assam and discussed in detail about the spatial as well as temporal patterns of peasant agriculture in Assam and the complex process related with it from the structural point of view. Besides, an ecological oriented study was also carried out by Taher (1975). Further, the inverse relationship between farm size and agricultural productivity also acquired some significant, as it could provide some rationale view for the argument that small farms are superior to the large ones, on purely economic grounds.

Statement of the Problem:

The agricultural sector in Assam in general and Lower Brahmaputra Valley in particular, experiences various problems, that is, the cultivable land is highly limited because of physisographic conditions, subsequently effecting the intensity of cropping pattern as well as the yield pattern. The agricultural yield pattern is not only affected by monsoons, flood and drought, but also by the technological and socio-economic factors. Therefore, the agricultural growth is very low. Hence, the farmers are victimised by various ill-effects like- poverty, leading to indebtedness and illiteracy.

In fact, the agro-ecological conditions and the size of land holdings are an important base for the agricultural production processes, as the agro-ecological conditions have a direct bearing upon the agricultural productivity. Moreover, the size of land occupancy plays an important role on the agricultural crop yield, as land as a resource is being utilised by the farmers for the production processes.

In spite of the efforts being undertaken by the Government during the five-year plans since independence, the agricultural production/productivity is still not in a position to cope up with the increasing demand. This may be contributed by the traditional method of agricultural production. Moreover, various constraints like socio-economic, technological and natural calamities have handicapped the agricultural sector in Assam. This sector needs a radical change in production. To maximise the productivity pattern, there must be optimum utilisation of soil with viable technology and scientific method of production.

The present study examines the agricultural land use and productivity pattern in Lower Brahmaputra Valley in particular and in Assam in general. There is a lack of proper agricultural land use management, hence it is lagging behind, accordingly reflected upon the productivity pattern. The Lower Brahmaputra Valley, with an almost uniform topography, dominated by flood plain and alluvial soil as well as flood prone area, needs to be studied diligently to acquire correct information for the proper management and the development of the area, in relation to land use and productivity pattern. There are numerous constraints to land use management. Due to limited size of land holdings by the individual farmers, an effective land use is not possible. The problem of land use management is primarily with the indigenous farmers. The farmer does not take much interest in agricultural activities due to its traditional and cultural system. Normally, the indigenous farmers cultivate one crop in a year. But if we look at the farms owned by the migrants, the agricultural fields are multi-cropped in an agricultural year. Accordingly, the production pattern shows a different picture, as compared to the land owned by the indigenous farmers. Therefore, the agricultural production/productivity pattern is comparatively low.

There are certain factors responsible for the low productivity and improper agricultural management. These factors are- the uncertain monsoon rains on which the farmers mostly rely for their seasonal crops, heavy rains which causes floods and damages to the standing crops. There is a lack of irrigation facilities, which in turn, does not encourage multi-cropping. Fragmented land holdings do not support mechanisation and improvement of land. Still, within these limiting factors, there is scope to improve the existing land use as well as production/productivity pattern in the Lower Brahmaputra Valley.

Objectives:

There are very few studies carried out relating to agricultural land use and productivity so far in the North Eastern region of India. The land use and the land holding system are very different here, from the rest of the country. Therefore, the present study has been undertaken based on the following principal objectives:

(1) To study the agricultural land use and cropping pattern in relation to the agro-ecological parameters of the study region.
(2) To examine the nature and extent of unequal distribution of land holding pattern among various segments.

(3) To examine the role of institutional parameters governing the agricultural land use and productivity of the study region.

(4) To examine the inclined factors closely related to the agricultural productivity according to agro-climatic conditions.

(5) To examine the specific relationship, as it exists between the agricultural land use and the productivity behaviour.

(6) To develop insights for an alternative plan for the agricultural land use, with a view to increase productivity without disturbing the existing agro-ecological conditions.

Hypotheses:

The study is concerned mainly with the changing pattern of agricultural land use and productivity pattern in the Lower Brahmaputra Valley of Assam (1970-71 and 1994-95). The following hypotheses are proposed and tested in the present study:

(1) In the Lower Brahmaputra Valley, the farm size and agricultural productivity will show an inverse relationship.

(2) In the Lower Brahmaputra Valley, the Agricultural Land Use is Food Crop Based, Results low level Commercialisation of Agriculture.

(3) The level of agricultural productivity will vary along with the nature of environmental constraints, stringent environmental constraints will lead to lower productivity and vice-versa.

Identity of the Study Region:

The present Study confines to the Lower Brahmaputra Valley of Assam, which is one of the flood plain regions. It includes seven plain districts viz., Goalpara, Dhuburi, Kokrajhar, Bongaigaon, Nalbari, Barpeta and Kamrup. The mighty river Brahmaputra and innumerable tributaries criss-cross the study region.

The study area extends from 25°28' to 26°54' North Latitude and 89°42' to 92°11' East Meridian. Bhutan lies to the North, on the East it is surrounded by Darrang and Morigaon districts, on the South by the state of Meghalaya and Bangladesh and the state of West Bengal on the western part of the study region.

The total geographical area of Lower Brahmaputra Valley is 20,148 km², accounting for about 25.6 percent to the total area of the state. The total population of the study region was 80,10,915 persons, inhabiting 35.74 percent to the total population of Assam according to the 1991 census. During the period between 1971 to 1991, the decadal growth rate of population, in the Valley, increased to 58.59 percent as against the state growth rate of 52.44 percent, which is much higher.

Data Base:

I. **Secondary Data Source:**

: District Statistical Hand Book, Assam,

: Agricultural Statistics of India,

: Department of Agriculture, Government of Assam,

: Agriculture Situation of India, Ministry of Agriculture, Government of India,

: Basic Statistics of North-East India, NEC, Shillong,

: Agricultural Censuses of India,

: Un-published Government Records and Reports on Agriculture,

: Books, Magazines, Brochures as well as private publications.

II. Primary Data Source:

For primary information, personal observation of the agricultural situation, interviewed through prepared scheduled questionnaires for village as well as household levels. 160 (One Hundred and Sixty) farms have been taken into consideration with varying operational holding size and 40 (forty) families from four districts. On the basis of the agro-ecological conditions, 14 farm families from foothill zone, 66 from flood plain and 80 from the alluvial soil zone have been selected from the Lower Brahmaputra Valley for the purpose.

The field survey is being carried out with comprehensive questionnaires surveyed from house to house in the selected 160 farm families. Information collected, then tabulated according to agro-ecological conditions and land holding sizes. The classification of land holding size is being made, as prescribed by the Directorate of Economics and Statistics.

Methodology:

Though Assam in general is rich in various mineral and other resources but the state's economy is primarily based on agriculture. Assam is one of the best agricultural regions of our country but the agricultural sector is still at subsistence level and the farmers are economically poor.

Despite the existence of an Agricultural University on operation in the state and a number of research work, planned programmes and schemes being undertaken, still there is a gap between the farmers and the agricultural reformers. Therefore, it is important to have an analytical view of the very structure of the whole system, before taking any kind of innovative measures.

The systematic methodology is the ultimate source of research, as it has a direct bearing upon the research findings. In respect of agricultural and social research, it is imperative to have an essential standard procedure, which is designed for a particular practice.

Keeping this in view and to achieve the objectives, the present work has been completed through survey, direct observation, collection of secondary information from books, district headquarters and other reliable sources, besides planned outlays, and has been designed within the agro-ecology and socio-economical framework. The present study is being divided into four distinct parts. The part-one includes Chapter-

II, discusses the agro-ecological settings i.e. geology, physiography, drainage system, soils, climate and agro-climatic conditions of the study area, which influences the existing agricultural system.

The part two contains Chapter-III and IV, deals with the existing land tenure and land holding pattern including land reform policies undertaken from time to time. Land use and cropping patterns are the principal institutional factors affecting agriculture in the study region.

Part three includes Chapter-V, which is concerned with the existing agricultural productivity (based on secondary source of data) and the determinants affecting agricultural productivity and also discusses the various infra-structural needs for the over all agricultural development of the Lower Brahmaputra Valley region.

Finally, part four comprises of Chapter-VI and VII, which deals with the agricultural productivity pattern according to agro-ecological conditions and the relationship between various production functions along with agricultural production. Here an attempt is being made to discuss the debated issues of the inverse relationship between agricultural productivity behaviour according to farm size and agro-ecological zones separately in Lower Brahmaputra Valley region.

Chapter Scheme:

The present research work relating to the agricultural land use and the productivity pattern in Lower Brahmaputra Valley. The chapter scheme of present study is being designed as follows:

The Chapter-One is the introductory chapter and it's starts with the statement of the problem associated with the objectives as well as the hypotheses, which were tested in the course of the study. It also incorporates the relevant literature survey at the international, national, regional and state levels. The identity of the study region along with the geographical location and area with demographic characteristics has also been discussed. The sources of data and information relating to the work have also been incorporated and finally a methodology adopted in the present research has been consolidated.

The Chapter-Second deals with the agricultural environmental framework, begins with the assessment of the physiographic background along with the geology, relief features, soils, drainage system of the study region. The climatic factors on agricultural operations are the implicit phenomena within the agro-climatic conditions, prevailing over the Lower Brahmaputra Valley have also been incorporated. A brief elaboration of agro-ecological condition also thrust on.

The Chapter-Third emphasised the existing land tenure system. The land reform measures have been taken into consideration since independence. The present land holding pattern including caste based have also been incorporated in relation to the region, as well as its district wise pattern in the study region.

The Chapter-Fourth discusses the existing general land use pattern along with its changing pattern over last twenty-two years in Assam. The general land use pattern in the Lower Brahmaputra Valley also incorporated along with its changing pattern since 1970-71 to 1995-96. Further the cropping pattern along with its changing pattern is also discussed in brief in Assam as well as in Lower Brahmaputra Valley.

The Chapter-Fifth is concerned with the agricultural production/productivity. The entire chapter is based on secondary sources of data collected from the Department of Agriculture, Government of Assam. This particular chapter is restricted to the yield pattern of various crops as well as its changing pattern over the last twenty-five years, not only in Assam but also in Lower Brahmaputra Valley. Here, an emphasis is laid upon the determinants of agricultural production too.

The Chapter-Sixth deals with the production processes according to agro-ecological conditions and attempt has also been made to establish an inter-relationship between the production along with its production functions on an agro-ecological basis in Lower Brahmaputra Valley. The entire chapter is based on primary information, as it was collected from 160 farm families during field survey. It also incorporates the inter-relationships between production along with its production functions like-labour, non-land capital and animal power.

The Chapter-Seventh is concerned with the farm size attributes. This chapter is also based on essentially primary data. In this particular chapter thrust on agricultural production/productivity, general land use, cropping pattern, cropping intensity, as well as input structure according to farm size. Here, an attempt is being made to create an inter-relationship between production along with its production functions according to standard land holding sizes, as prescribed by the Directorate of Economics and Statistics, Government of India.

The Chapter-Eight (last chapter) is essentially restricted to the summary and conclusions of the overall work with certain recommendations.

Summary:

The agricultural system of Assam in general and Lower Brahmaputra Valley in particular, is found to be experiencing various problems and the system seem to be highly sympathetic in nature, where the farmers are considering it as the way of life instead of livelihood.

The study region is enriched with less diversified physiographic features, and thus provides a high level potentiality for agricultural development. On the other hand, the region is suffering from natural calamities like floods and droughts, as the farmer depends solely on monsoons.

The study region is very fortunate to have a very high concentration of either new or old alluvial soils. The land use pattern is characterised with a high percentage devoted to cereal crops, especially rice hectareage, with a low average yield and also low intensity of cropping. More than 82 percent of the total cropped area is occupied by food grains and rice alone occupied 79.03 percent to the total cropped area in Assam during 1995-96. The Lower Brahmaputra Valley occupies 74.17 by cereals with 69.27 rice hectareage.

The existing land tenure system is the result of the past, the maximum population pressure on arable land resulting in fragmentation of land holdings. The law of inheritance ensures equal distribution of land among the sons, which leads for further fragmentation of land holdings. The small land holdings are highly uneconomic in nature and stands as a barrier for the implementation of modern and advanced technology in the field of agriculture.

Though various land reform measures have been undertaken since independence in order to diversify the land ownership, but more is to be done in this sector. The rural settlement of the valley is surrounded by innumerable operational holdings with varying shapes and sizes. The average farm size is recorded 1.27 hectare in 1992-93 in Assam and 1.12 hectare in Lower Brahmaputra Valley. This low average farm size is the result of high population pressure on arable land that leads for further fragmentation. The small farms are economically not viable for the introduction of modern technology.

The economy of Assam is essentially based on agriculture and is fortunate to have about 35.41 percent of the net sown area during 1992-93, with about 14.65 percent of doubled-cropped area. This is mainly due to the high population pressure on land that compels the farmers to utilise the soil intensively. In Lower Brahmaputra Valley, the net sown area is occupied with 45.67 percent of the total area during 1992-93, with 21.54 percent of double-cropped area. The forest cover is depleting over the years because of high population pressure on land, leading for the depletion of forest cover, as it required for settlement as well as other requirements, thus leaving very limited scope for the further expansion of the land under plough. Expansion may be possible only at the cost of forest cover, which is 26.50 percent, or barren land of 7.10 percent.

The small farmers in the study region are almost untouched by modern and advanced methods of agriculture. Consequently, farmers are adversely affected by natural calamities. The entire region is chronically flood affected, causing heavy loss of life and property as well as extensive damage to standing crops every year. Drought is also another significant calamity, as the irrigation facility in the valley region is extremely insignificant and the farmers rely on monsoon for overall system. Basically, summer drought affects agriculture very seriously, as more than 75 percent of rain is concentrated during the kharif crop season.

In the absence of modern and advanced technology, the ultimate utilisation of the potentialities of soil cannot be achieved, since the farmers practice the agricultural operations with the help of man and animal power alone, through the traditional method. The consumption of fertiliser per hectare of land in the study region is also very low. The artificial supply of water into the agricultural field in the valley is also low, as rainfall is very low during winter season. Further, the introduction of HYV seeds in the field of agricultural is too limited. Its introduction may give marvellous yield, if water is provided at required level.

The agricultural production system is based on infrastructure and the factors of production, i.e. land, labour, non-land capital and animal. The agricultural system can be modernised as soon as all the factors of production functions are inter-linked in a balanced nature.

It is fact that a big share of family labour is employed in agricultural practices in the study area, where flood plain areas have the highest intensity of family labour.

In such, the farmer wants to engage the entire family members into the farming system, i.e. production-surplus. As a result, the farmers are cultivating their lands at the subsistence level; to fulfil their family needs only. The existing mode of production with a high share of family labour stands as a fundamental constraint upon the economic development of the farmers and is an important characteristic of agriculture in Assam. The radical transformation of this system is possible only when a farmer is made free from the obligation of employing family labour. In the foothill zone, where the ratio of hired labour with family labour is recorded as the highest (i.e. 90 percent).

The marginal product of non-land capital investment is recorded as very high in the flood plain and alluvial soil areas. It means that there is a need of changing the agricultural operation system from labour intensive to non-land capital extensive. It reflects that the productivity or average yield of the crops can only be raised through using the packages of green revolution technology. This would be helpful to raise labour productivity and also increase the marginal productivity of labour. The animal productivity is low, however the marginal productivity is significantly high in this area.

The marginal productivity is significantly high in respect of animal input in flood plain and alluvial soil areas. However, the animal input is low in this area and the seasonal flood conditions, lowers the productivity level.

The marginal productivity of farm in money term, which is the conversion of average yield, considering market price. In Lower Brahmaputra Valley, the land productivity is assessed at Rs. 8,534.00 per hectare and it varies from Rs. 23,000.00 per hectare in the small marginal size farms to Rs. 5,743.00 per hectare in very large farm sizes. It reveals that there is a gradual decrease in production from marginal to large farm sizes.

There is a recorded variation in average productivity in different agro-ecological zones. Productivity was recorded as very high with an average of Rs. 9,526.00 per hectare in the flood plains, followed by Rs. 8,929.00 per hectare in the alluvial soil areas. But in the foothill areas of Lower Brahmaputra Valley it was the lowest. There is another peculiar characteristic of distributional pattern, that is, there is a decrease of land productivity by sizes, in all-different agro-ecological conditions, however, the decreasing tendency is faster in flood plain areas.

Labour productivity is the most important measurement for agricultural activities in the area, because labour is the diminishing production factor here. In general, labour productivity is recorded at Rs. 4,399.00 per worker in the Lower Brahmaputra Valley. Employment of labour force per hectare in high and very high sizes of land holding are less. Labour productivity figures are recorded as very high in the high and very high sizes of land holdings, that is, more than Rs. 6,000.00 per worker. On the contrary, there is intensive employment of labour in marginal sizes, though land productivity is high but labour productivity is recorded very low even less than Rs. 2,000.00 per worker in semi-marginal sizes of land holdings.

The highest level of labour productivity in all small size of holdings is Rs. 4,626.00 per worker, while the trend tends to increase productivity is almost similar in all agro-ecological conditions. In the foothill areas, the average productivity is recorded at Rs. 3317.00 per worker, while it decreases at large and very large sizes of land holdings.

The increase of capital productivity in rupees is evident, while investing Rs. 100.00, the turnover is Rs. 10,980.00 per hectare in Lower Brahmaputra Valley. Surprisingly, it tends to decrease as the holding size of farm increases. This result does not tally with the general results and it reflects that the capital productivity increases, as the sizes of land holding increases, but it diminishes in high and very high sizes of land holdings, in each and every agro-ecological zone. This may be because of the declining of land productivity in the high and very high sizes, but not because of less investment of capital in the region. The capital productivity is recorded as slightly higher in the flood plains, that is, Rs. 13,628.00 per Rs.100 of investment and is very low in the foot hill areas, i.e., Rs. 5,773.00 per Rs100.00 investment.

The animal input is an equally important factor for the agricultural production system and its productivity is recorded as essentially higher, which is Rs. 5,080.00 per pair of draught animal in the Lower Brahmaputra Valley and its trend increases as the land holding sizes increases. In the high and very high land holding sizes, animal productivity is recorded at more than Rs. 7,000.00 per pair of draught animal, where in marginal size it is only Rs. 115 per pair of draught animal. The average figure of animal productivity shows that the productivity of animals is higher in the alluvial soil areas and it gradually increases with an increase of land holding size.

If the productivity of all these four factors are compared, then the physical factors of land is still found to have control over the agricultural operation, where land productivity is recorded comparatively higher than other inputs. There is a sufficient scope for the investment of non-land capital in agricultural practices, since capital productivity is highest. The unlimited supply of labour in the agricultural production processes, which lowering the labour productivity. Higher productivity can be achieved by substituting modern technology and investment of more non-land capital in the Lower Brahmaputra Valley.

Recommendations:

The detailed study of the agricultural land use and production/productivity pattern in Assam in general and Lower Brahmaputra Valley in particular, leads one to conclude the present work with following recommendations:

Since the scope for further expansion of arable land is highly limited, therefore an emphasis is to be laid on the intensive use of land resources at their maximum level, in order to achieve the goal of higher production/productivity in the agricultural sector.

The agricultural landscape is characterised with scattered innumerable small agricultural holdings of varying shapes and sizes, surrounded by rural settlements. The small-scattered agricultural holdings are not economically viable; therefore the consolidation of fragmented, small, innumerable holdings is a must, by creating village co-operative land management society. Certain steps are to be undertaken in stages like: - further fragmentation of land holdings should be restricted, individual cultivators should not pose any agricultural land other than 'Bari', but it is to be considered as the village common property.

The agricultural land use is characterised with extra-ordinarily high rice hectareage, showing a low-level commercialisation of agricultural sector. The commercialisation of agricultural sector is a must in order to raise the living standard, by taking into account the market price/economy, so as to make agriculture economically viable, by considering it as livelihood to satisfy the over growing demands.

The cropping intensity over the last twenty-five years is found to be increasing but at a slow pace, as it is due to the high population pressure on arable land. The cropping intensity is therefore to be increased through the application of modern package technology (Green Revolution Technology). The transformation of traditional farming technology, supported by required infra-structural necessities is an urgent need. The cropping intensity should increase, by choosing well-equipped scientific method of agriculture instead of population pressure on land.

It is revealed that since 1970-71 to 1994-95, there is a slow growth in agricultural productivity and yield pattern in Assam in general and in Lower Brahmaputra Valley in particular. Therefore, emphasis should be on both yield and agricultural productivity, through the means of inter-crop-culture, crop rotation and crop diversification. Agricultural productivity can also be raised by human engagement through a wide variety of ways. For instance: - intensification of cropping, increased use of manure/fertilisers, improved/HYV seeds, proper control of pests and diseases and the identification of more profitable crops as well as practices, depending upon the market price/economy.

Essentially the study region is a flood prone area and experiences flood every year. Therefore, flood control is a must and measures must be undertaken by the Government. In the flood prone areas during the pre-flood season, the early-matured crop should be sown in order to harvest it before the onset of flood. On the other hand, during the post-flood period, suitable crops should be grown depending upon the soil characteristics as well as the climatic conditions. Therefore, the Government and allied agencies should take the initiative to distribute good quality seeds to the farmers of the flood prone areas, at a subsidised rate.

Besides floods, droughts are another determinant in agricultural operation. In the study region the facility to supply water into the agricultural field is quite negligible. Therefore, the Government should take measures and initiatives to regulate water management programme (Water Supply Scheme), into the agricultural field, as its requirement is undeniable. By considering floods and droughts as the constraints to agricultural productivity during the growth period, emerged uncertainty to the standing crops at desired level, therefore Government should undertake certain plan to insure the standing crop to assure the certainty of assumed agricultural return.

Crop protection is also another aspect of agricultural system, but it is beyond the capacity of the farmers in the study region. Therefore, the Government should make viable schemes for the adequate and regular supply of herbicides, pesticides and insecticides at a subsidised rate, by which the poor farmers would be capable for the procurement of these required crop protection chemicals. Moreover, the Government and allied agencies should extend a proper agricultural credit system to the farmers for higher proportionate investment for better/ higher returns.

The development of the tertiary sector is essential, as the level of industrialisation is insignificant in the Lower Brahmaputra Valley region. The agricultural sector is characterised with undue pressure and over-population. Therefore, there is the need for the extra-man-power or human resources, to be engaged in the tertiary sector, by opening up of new small scale and cottage industries in the rural areas. Moreover, the agriculture sector is considered, as a way of life, as such, there is an urgent need to transform this sector into an economically viable industrial sector, which can engage surplus manpower into it.

On the basis of the above-mentioned synthesis, one can conclude with a common statement that the agricultural sector basically consists of small farmers. They are unable to support the over growing demands of their requirements in the days to come; therefore, there is a need for radical change in the agricultural sector.

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I Dipak Chandra Das, hereby declare that the subject matter of the thesis is the record of the work done by me, that the contents of this thesis did not form basis of the award of my previous degree to me or to the best of my knowledge to anybody else; and that the thesis has not been submitted by me for any research degree in any other university/institute.

This is being submitted to the North Eastern Hill University for the degree of Doctor of Philosophy in Geography.

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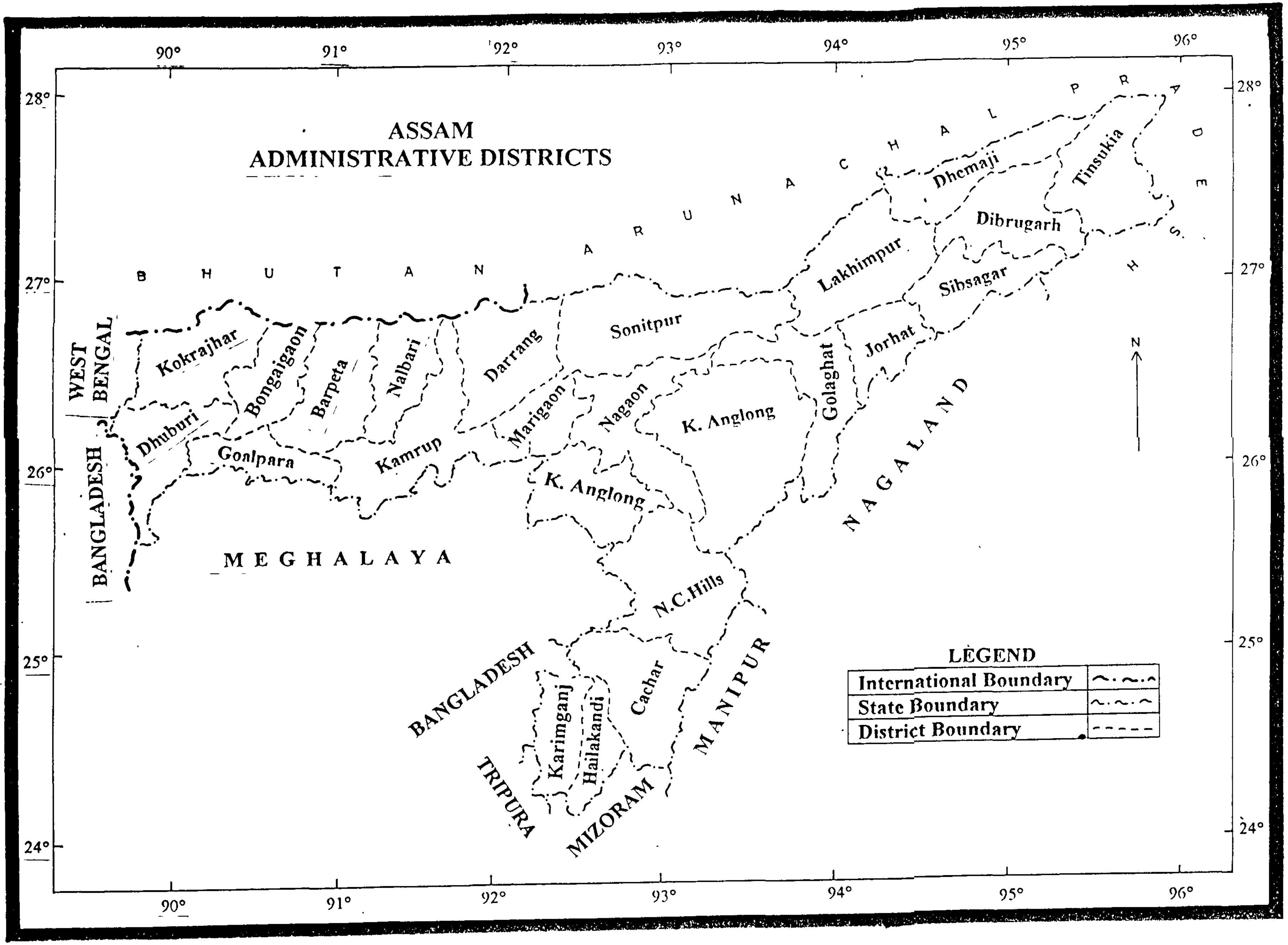
INTRODUCTION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BANGLADESH
MEGHALAYA
NAGALAND
MANIPUR
MIZORAM
TRIPURA
Kokrajhar
Dhuburi
Bongaigaon
Goalpara
Barpeta
Nalbari
Kamrup
Darrang
Marigaon
Sonitpur
Nagaon
K. Anglong
K. Anglong
N.C.Hills
Cachar
Karimganj
Hailakandi
Golaghat
Jorhat
Sibsagar
Lakhimpur
Dhemaji
Dibrugarh
Tinsukia
N
LEGEND
International Boundary
State Boundary
District Boundary
90°
91°
92°
93°
94°
95°
96°
24°
25°
26°
27°
28°

Figure-1.01

1.1 Statement of the Problem:

Agriculture is the backbone of human civilisation as well as development. It is an extensive form of human occupation and more than half of the world's population depends on it for their livelihood. Agricultural Geography deals with the spatial organisation of crops and their concentration. Moreover, it is an interesting field upon which geographers can play a vital role for the economic development of a society.

Agriculture is the most dominant sector of the Indian economy and crop production occupies most important place. Agricultural sector was mostly neglected during the British Colonial rule. After independence, agriculture became an important sector and Government emphasised upon it during five-year plans to increase food production on a priority basis to feed the over growing population. Agricultural sector in Assam in general characterised with high rice hectareage to satisfy the over growing demands, therefore, farmers are emphasised more on food production.

Development of agricultural sector without structural changes is a difficult task. This difficulty is highly prevalent in countries with high population pressure on land like India, which results in regional imbalances or regional disparity due to the imbalances of food production and population growth. The macro level studies or macro-economic magnitudes and approaches do not provide proper insights in relation to the problems of agricultural development. Therefore, proper planning needs to be extended at micro-level units.

In the last few decades the agricultural sector has undergone a drastic transformation. The transformation scenario has jumped from the subsistence mode of agriculture to a modern and technologically advanced one. This was caused due to the increasing demand for food to eradicate the problem of hunger, under- nutrition and malnutrition. Presently, the problem of tremendous population pressure on arable land, coupled with the growing demand for food and agricultural raw material. Therefore, it is to be solved by increasing production as well as productivity through the intensification of land use, multiplication and diversification of crops by adopting recent technological know-how.

Agriculture is the primary source of livelihood for the majority of people in the rural sector of Assam. This sector is most important, as it alone contributes for more than half of the total state's income. It acts as the main absorber of the working force. In fact the average yield of cereals and non-cereals in Assam is much lower as compared to other states. Even in Lower Brahmaputra Valley has low agricultural productivity per hectare of land. The existing agricultural potentiality is highly under-utilised and has immense scope to improve upon.

The agricultural sector in Assam in general and Lower Brahmaputra Valley in particular is suffering from certain problems, i.e. the cultivable land is markedly limited because of physiographic conditions. Consequently effecting the intensity of cropping and the yield. The agricultural yield is not only affected by the monsoons and other calamities, like floods and droughts, but also by the technological and socio-economic factors. Therefore, the agricultural growth is very low. As a result the farmers are victimised by various ill effects like-poverty, debts and illiteracy.

In fact, the agro-ecological conditions and the size of land holdings are the important base for the agricultural production processes, as it has direct bearing upon the agricultural productivity. Moreover, the size of land occupancy also plays an important role on agricultural crop yield, as land is a resource is being utilised by the farmers for the production processes.

In spite of the efforts undertaken by the Government during five-year plans since independence, the agricultural production/productivity is still not in a position to cope up with the increasing demand. This occurrence is attributed by the traditional method of production. Moreover, various types of constraints like socio-economic, technological and natural calamities have handicapped the agricultural sector in Assam. Thus, to maximise the production/productivity pattern, the full utilisation of soil with technologically possible growth of production is a must. However, it needs a radical change in the mode of production.

The study examines the agricultural land use and productivity pattern in Lower Brahmaputra Valley of Assam. The proper agricultural land use management in the valley is lagging behind, accordingly hampers the productivity pattern. With diverse topography and floodplain as well as flood prone area like Lower Brahmaputra Valley, needs to be studied to acquire the correct information in relation to land use and productivity pattern for the proper management and the development of the area. There are numerous constraints in land use management. Due to limited land holdings by the individual farmers, a proper or effective land use is not possible. The problem of land use management is basically with the indigenous farmers. The farmer does not take much interest in agricultural activities due to its traditional and cultural system. Normally the indigenous farmers cultivate one crop in a year. But if we look at the farms owned by the migrants, the agricultural fields are multi-cropped in an agricultural year. Accordingly the production pattern shows a different picture, compared to those the land owned by the indigenous farmers and land is under utilised. Therefore, the productivity pattern is comparatively low.

The agricultural productivity in Lower Brahmaputra Valley is low. There are certain factors responsible for the low productivity and improper agricultural management. There are factors like uncertain monsoon rains on which farmers mostly rely for their seasonal crops, heavy rains which causes flood and damages to standing crops. Lack of irrigation facilities, which do not encourage multi-cropping. Fragmented land holdings doesn't support mechanisation and the improvement of soil. Still, within these limiting factors there are scopes to improve the existing land use and productivity pattern in the Lower Brahmaputra Valley.

1.2 Objectives of the Study:

There are very few studies relating to agricultural land use and productivity conducted so far in the North-Eastern Region of India. Agricultural land use and the land holding pattern in Lower Brahmaputra Valley are very much different from the rest of the country. Therefore, the present study has been undertaken based on the following principal objectives:

(1) To study the agricultural land use and cropping pattern in relation to the agro-ecological parameters of the study region,

(2) To examine the nature and extent of unequal distribution of land holding patterns among various segments,

(3) To examine the role of institutional parameters governing the agricultural land use and productivity of the study region,

(4) To examine the factors closely related to the agricultural productivity according to agro-climatic conditions,

(5) To examine the factors closely related to the agricultural productivity according to farm size,

(6) To examine the specific relationship, as it exists between the agricultural land use and the productivity behaviour, and

(7) To develop insights for an alternative plan for the agricultural land use with a view to increase productivity without disturbing the existing agro-ecological conditions.

1.3 Hypotheses:

The study is primarily concerned with the changing pattern of agricultural land use and productivity in Lower Brahmaputra Valley of Assam during 1970-71 and 1994-95. In order to achieve the above mentioned objectives, the following hypotheses are proposed as well as an attempt has been made to examine these hypotheses in the course of research work:

(1) In the Lower Brahmaputra Valley, the farm size and agricultural productivity will show an inverse relationship.

(2) In the Lower Brahmaputra Valley, the agricultural land use is food crop based, results low commercialisation of agriculture.

(3) The level of agricultural productivity varies along the nature of environmental constraints, leads to lower productivity and vice-versa.

1.4 Review of Literature:

The scientific and systematic studies related to agricultural geography have originated very recently, during the second half of the present century and has taken the momentum of real work of this branch of geography. During the Inter-War period, the work made by pioneer scholars like O.E. Baker, Olaf Jonasson, Clarence F. Jones, Samuel Van Valkenburg and Griffith Taylor are of significance towards agricultural geography (Baker-1926, Jonasson-1925-26, Jones-1928-30, Valkenburg-1931-36 and

Taylor-1930) Much of these works are mainly related to agricultural regionalisation in order to establish the spatial pattern Further Redfield (1956) comments that "Agriculture is a livelihood and a way of life, but not a business for profit"

In the recent past, scholar's like- W Bunge, Buchanan, Blaut, Brookfield, Franklin, Reed and Redfield influenced the conceptual approach towards agricultural problems related to theoretical Agricultural Geography (Reed-1964). The method and approach of agricultural geography have been benefited because of the "Quantitative Revolution" of nineteen fifties and opened a new era of research possibilities

One of the important approaches is model building towards the study of agricultural activities, initiated by the German scholar J.H. Von Thunen (Thunen-1826) This was the first attempt to explain the agricultural land use patterns on economic terms, based on the concept of *Economic Rent*, i.e. the decline of locational rent of land according to the distance from the market place. Based on it, he predicted a concentric series of agricultural zones around the central city. J.H. Von Thunen's *Concentric Zonation model* could draw attention to some of the scholars such as Hoover, Losch and Dunn, who used its framework as a base for the *Normative Model* J.C. Weaver's *Crop Combination* is an outstanding model of agricultural geography, attempted to frame a quantitative technique for the classification of an agricultural region (Weaver-1954). Leontief also developed a model called "Input-Output", which was used for analysis of natural economics and afterwards used by Peterson and

Heady for the analysis of agricultural activities (Leontief-1953). "The Diffusion and Innovation" model of T. Hagerstrand, developed a technique for stipulating the patterns of diffusion and innovations over space (Hagerstrand-1967).

Besides these models, modern and sophisticated techniques being used by the present geographers in the field of agricultural geography. The advanced techniques and conceptual models have further been developed in respect of specialised studies in plantation and peasant agriculture. In these contexts, the work of H.F. Gregor on "Plantation Agriculture" and the work of S.H. Franklin on "Peasant Agriculture" are noteworthy (Gregor-1965, Franklin-1969).

Besides above, a line of approach towards the study of agricultural geography by the more recent geographers is to find out the most logical and meaningful structure, which will help to categorise and represent the variations of agricultural practices on a global scale. J.E. Spencer and N.R. Steward have attempted to recognise the generic forms and kinds of agriculture and their potential values and bases for the differentiation of the world's agricultural systems.

The work in the field of agricultural geography carried out in India is not intensive in spite of its pressing necessities. M. Shafi has categorised the work of Indian geographers with respect to agriculture under different forms (Shafi-1972). These are:

(a) Regional Agriculture,

(b) Food and Commercial Crops,

(c) Agricultural Patterns and Planning, and

(d) Food Supply and Population

Various works carried out on agricultural regionalisation by P. Dayal is noteworthy (Dayal-1950). A.B Mukherjee carried out a micro level study on agricultural regionalisation in selected four villages of Meerut district, Uttar Pradesh, asserted carefully the importance of food crops, commercial crops and land tenure systems (Mukherjee-1965) Besides, S P Chettarjee (1962), M Shafi (1962), S.S Bhatia (1967) and B. Benarjee (1974) had brought out few interesting research papers on agricultural problems and planning during the beginning of the sixties to early seventies (Chetterjee-1962, Shafi-1962, Bhatia-1967 and Benarjee-1974). Chetterjee suggested certain measures for planning agricultural sectors in Northeast India, particularly on the basis of geographical diversity.

The information related to agricultural development and studies have reflected that crop output and the productivity growth in Assam over the past years is not satisfactory. The works in the field of agricultural geography in Assam is still at an initial stage The Indian Council of Social Science Research (ICSSR), a study on North East India by P.C. Goswami and U Phukon (1982), mentioned that the studies on agricultural ecology of Assam is limited in number Most of the studies partially or fully dealt with the micro level problems, which provide valuable information to understand the problems in the rural areas The studies completed by Agro-Economic Research Centre (Assam Agricultural University) for the North-Eastern Region has helped in comprehending the agro-economic problems The Assam Agricultural Commission (1980-81), has examined the progress of agricultural production behaviour in Assam and could come to a conclusion that the method of cultivation by and large is still traditional and has increased its production by increasing its total area under plough

N Saha (1975) carried out the first study on agricultural development in Assam since 1950-51 to 1973-74 and the data obtained from the Directorate of Economics and Statistics, Government of Assam, and other reliable agencies Further a district wise study carried out on agricultural development by Phukon, Gogoi and Neog (1980) from 1950-51 to 1975-76, provides valuable information about agricultural economy of Assam

"Peasant Agriculture in Assam" a structural analysis of the peasant agriculture in Assam by M.M Das (1984), who earned the fame of being the pioneer agricultural geographer of the study region He discussed in detail about spatial as well as temporal patterns of peasant agriculture in Assam and its complex processes from structural point of view He tried to frame a normative model for the regional development of the agricultural sector in Assam. He was individually involved with the peasant society as well as its problems faced by the cultivators in Assam. The study related to economy and farm management in Nagaon district was carried out by P.C. Goswami and C.K. Bora (1977), that provides basic information about input and production in Nagaon district of Assam. The ecology-oriented study carried out by M.Taher (1975), who could analyse successfully the physical base about agricultural planning in the Brahmaputra Valley of Assam and could co-relate the cropping pattern according to various sectors of it.

L. Nath (1984) carried out the detailed micro level study about the agricultural development in Mangoldoi area. B.K. Kakoti (1985) could trace the pattern of adoption of agricultural innovation and its effects upon the agrarian change in Bajali block of Barpeta district of Assam. Further S. Chattaraj (1983) in his Ph.D. thesis, "Emerging Pattern of Agricultural Land use in Kamrup district" could highlight the existing pattern of unequal distribution of land holding and land utilisation in six small villages of Kamrup district of Assam. R. Sahu (1982) carried out the study "Diffusion and Distributional Pattern of High Yielding Varieties of rice according to various farm sizes of Lower Brahmaputra Valley of Assam". He studied the diffusion pattern and its performances of HYV of rice according to land holding sizes, and could ascertain the influence of physio-socio-economic factors to the spread of HYV rice.

B.S. Mipun (1987) carried out the study "Immigrants and the Agricultural Changes in the Lower Brahmaputra Valley". The study was confined to the impact and extent of influence of immigrants on farms of Lower Brahmaputra Valley and was able to examine the impact of immigrants towards the distribution on output in the agricultural sectors. H. Saikia (1992), in his study "Pattern of Landholding and Agricultural Productivity in Upper Brahmaputra Valley of Assam" emphasised upon the distribution of land holding system among the various segments with agricultural productivity in the Upper Brhamaputra Valley in particular. He also stressed upon the impact of land holding system upon productivity efficiency in the agricultural sector.

In fact, the agro-ecological conditions and the size of land holdings are the important base for the agricultural production processes; the agro-ecological conditions have the direct bearing upon the agricultural productivity. The size of land occupancy also plays an important role on agricultural crop yield, as land is a resource, which is being utilising by the farmers for the production processes. The economic analysis based on price in agricultural production has been achieved into the findings for the farm management studies (for Uttar Pradesh, Madhya Pradesh and Andhra Pradesh during mid-fifties) that there is an inverse relationship between farm size and agricultural productivity. The explanation made by A.M. Khusro, N.Majumder and Sen and the works of Hannumantha Rao, A.P. Rao and others reveals that it has an obvious impact on policy framing, leading to land grouping that has taken the shape of co-operative farms and other farms in the agrarian society.

' A.K. Sen (1962) worked out three important results found to be more valid in Indian agriculture One of the findings is that "By and large productivity per acre decreases with the increase of the size of land holdings"

Hannumantha Rao (1966) generalised not only crop yield but also its associated factors Thus, "in all the districts studies, the percentage of cultivated to the uncultivated area, the percentage of crop area more than one, decreases sharply with the increase of land holding size, this is because of the percentage of irrigated holdings invariably declines with the increase of the land holding size"

A.P. Rao (1967) has explained a logarithmic function of farm level data, belonging to some village He concluded the work stating, "contrary to the findings of the farm management studies, the productivity remained constant in all land holding size, reflects that the size of land holdings has no impact on agricultural productivity"

A.M Khusro (1968) wrote, "the particular interest has some generalisations about the relationships between the farm size and its efficiency, which are based upon a remarkable repetitiveness of some phenomena almost every where among the area studied". Later on he pointed out one of the generalisation saying that, "as the farm size expands, gross output per acre declines".

N Majumder (1965) described in reverse, "the data presented by the farm management survey of India have added another example to the phenomena observed in many parts of the under developed world, viz , in peasant agriculture, as the farm size decreases, the output per acre increases"

Usha Rani (1971) was more cautious and made the conclusions in a simplified manner, that-

(a) Agricultural yield per acre remained constant over different size group of farms
(b) The cropping intensity varies according to the size of group of farms
(c) There are no significant variations in the inputs per acre of the land over different size group of farms

According to K Bharadwaj (1974), there exists a strong relationship between input and output of the farms in relation to the size of land holdings One of the prepositions could attract considerable notice and continued discussions in the alleged inverse relationship between the yield (i e , value of output) per hectare and the size of land holdings

The inverse relationship acquires some significance, as it could provide some rationale view for the argument that small farms are superior to the large ones on

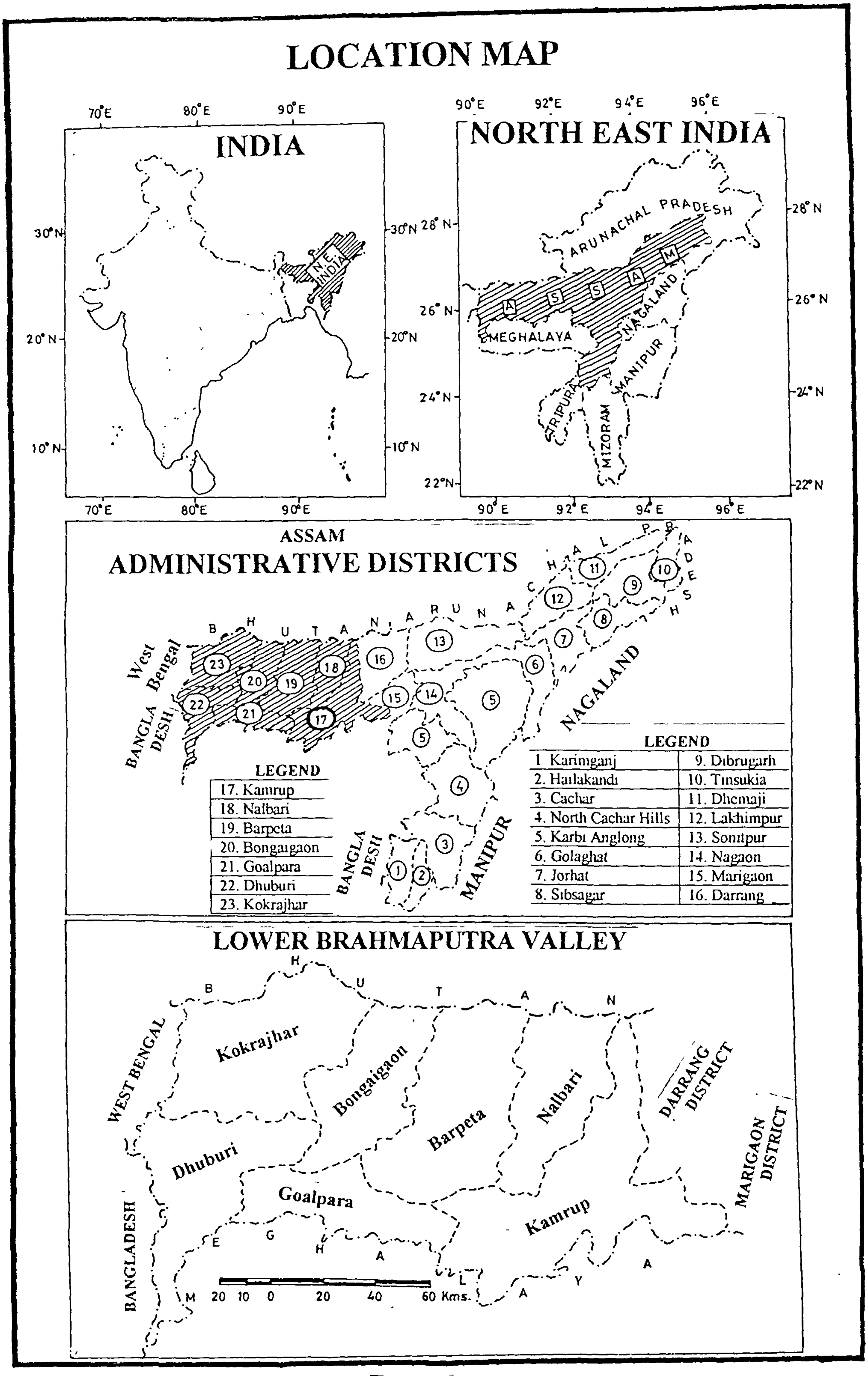
LOCATION MAP
INDIA
N.E. INDIA
70°E
80°E
90°E
30°N
20°N
10°N
NORTH EAST INDIA
ARUNACHAL PRADESH
ASSAM
MEGHALAYA
NAGALAND
MANIPUR
TRIPURA
MIZORAM
90°E
92°E
94°E
96°E
28°N
26°N
24°N
22°N
ASSAM
ADMINISTRATIVE DISTRICTS
BHUTAN
ARUNACHAL PRADESH
West Bengal
BANGLA DESH
NAGALAND
MANIPUR
LEGEND
17. Kamrup
18. Nalbari
19. Barpeta
20. Bongaigaon
21. Goalpara
22. Dhuburi
23. Kokrajhar
LEGEND
1. Karimganj
2. Hailakandi
3. Cachar
4. North Cachar Hills
5. Karbi Anglong
6. Golaghat
7. Jorhat
8. Sibsagar
9. Dibrugarh
10. Tinsukia
11. Dhemaji
12. Lakhimpur
13. Sonitpur
14. Nagaon
15. Marigaon
16. Darrang
LOWER BRAHMAPUTRA VALLEY
BHUTAN
WEST BENGAL
BANGLADESH
Kokrajhar
Bongaigaon
Barpeta
Nalbari
Dhuburi
Goalpara
Kamrup
DARRANG DISTRICT
MARIGAON DISTRICT
MEGHALAYA
20 10 0 20 40 60 Kms.

Figure-1.02

purely economic grounds In favour of the superiority of small farms categorised into three, these are-

(a) Differences in techniques, the small farms are 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 and irrigation.

1.5 Identity of the Study Region:

The present Study is confined to the Lower Brahmaputra Valley of Assam, which is almost flood plain, includes seven plain districts particularly, Goalpara, Dhuburi, Kokrajhar, Bongaigaon, Nalbari, Barpeta and Kamrup. During 1970-71 there were only two districts namely- Kamrup and Goalpara in Lower Brahmaputra Valley but at present there are seven districts. The mighty river Brahmaputra passes through the study region by making it very fertile.

The Lower Brahmaputra Valley region extends from 25°28' to 26°54' north latitude and 89°42' to 92°11' east meridian (Figure-1.02). Bhutan surrounds it in the north, on the east by Darrang and Marigaon districts, on south by Meghalaya and on the west by Bangladesh and West Bengal. The total geographical area of Lower

Brahmaputra Valley is 20,148 km^2 accounting for 25.6 percent of the total area of the state.

The total population of the study region was 80,10,915 persons with 41,59,547 males and 38,51,368 females, inhabiting 35.74 percent to the total population of Assam according to 1991 census. The decadal growth rate in the Valley was 42.51 percent against 34.95 percent of the State during the period 1961 to71. But during the period of 1971 to 1991 the growth rate of population went up by 58.59 percent against the state growth rate of 52.44 percent, which is much higher.

1.6 Data Base:

I. **Secondary Data Source:**

: District Statistical Hand Book, Assam,

: Agricultural Statistics of India,

: Department of Agriculture, Govt. of Assam,

: Agriculture Situation of India, Ministry of Agriculture, Government of India,

: Basic Statistics of North-East India, NEC, Shillong,

: Agricultural Census of India,

: Un-published Govt. Records and Reports on Agriculture,

: Books, Magazines, Brochures as well as private publications.

II. Primary Data Source:

For primary information, personal observation of the agricultural situation, interviewed through prepared scheduled questionnaires for village as well as household levels. 160 (One Hundred and Sixty) farms have been taken into consideration with varying operational holding size and 40 (forty) families from four districts. On the basis of the agro-ecological conditions, 14 farm families from foothill zone, 66 from flood plain and 80 from the alluvial soil zone have been selected from the Lower Brahmaputra Valley for the purpose.

The field survey is being carried out with comprehensive questionnaires surveyed from house to house in the selected 160 farm families. Information collected, then tabulated according to agro-ecological conditions and land holding sizes. The classification of land holding size is being made, as prescribed by the Directorate of Economics and Statistics.

1.7 Methodology:

Though Assam in general is rich in various mineral and other resources but the state economy is primarily based on agriculture. Assam is one of the best agricultural regions of our country but the agricultural sector is still at subsistence level and the farmers are economically poor.

Despite the existence of an Agricultural University on operation in the state and a number of research work, planned programmes and schemes being undertaken, still there is a gap between the farmers and the agricultural reformers. Therefore, it is important to have an analytical view of the very structure of the whole system, before taking any kind of innovative measures.

The systematic methodology is the ultimate source of research, as it has a direct bearing upon the research findings In respect of agricultural and social research, it is imperative to have an essential standard procedure, which is designed for a particular practice.

Keeping this in view and to achieve the objectives, the present work has been completed through survey, direct observation, collection of secondary information from books, district headquarters and other reliable sources, besides planned outlays, and has been designed within the agro-ecology and socio-economical framework. The present study is being divided into four distinct parts. The part-one includes Chapter-II, discusses the agro-ecological settings i.e. geology, physiography, drainage system, soils, climate and agro-climatic conditions of the study area, which influences the existing agricultural system.

The part two contains Chapter-III and IV, deals with the existing land tenure and land holding pattern including land reform policies undertaken from time to time.

Land use and cropping patterns are the principal institutional factors affecting agriculture in the study region.

Part three includes Chapter-V, which is concerned with the existing agricultural productivity (based on secondary source of data) and the determinants affecting agricultural productivity and also discusses the various infra-structural needs for the over all agricultural development of the Lower Brahmaputra Valley region.

Finally, part four comprises of Chapter-VI and VII, which deals with the agricultural productivity pattern according to agro-ecological conditions and the relationship between various production functions along with agricultural production. Here an attempt is being made to discuss the debated issues of the inverse relationship between agricultural productivity behaviour according to farm size and agro-ecological zones separately in Lower Brahmaputra Valley region.

1.8 Chapter Scheme:

The present research work relating to the agricultural land use and the productivity pattern in Lower Brahmaputra Valley. The chapter scheme of present study is being designed as follows:

The Chapter-One is the introductory chapter and it's starts with the statement of the problem associated with the objectives as well as the hypothesis, which were tested in the course of the study. It also incorporates the relevant literature survey at the international, national, regional and state levels. The identity of the study region along with the geographical location and area with demographic characteristics has also been discussed. The sources of data and information relating to the work have also been incorporated and finally a methodology adopted in the present research has been consolidated.

The Chapter-Second deals with the agricultural environmental framework, begins with the assessment of the physiographic background along with the geology, relief features, soils, drainage system of the study region. The climatic factors on agricultural operations are the implicit phenomena within the agro-climatic conditions, prevailing over the Lower Brahmaputra Valley have also been incorporated. A brief elaboration of agro-ecological condition also thrust on.

The Chapter-Third emphasised the existing land tenure system. The land reform measures have been taken into consideration since independence. The present land holding pattern including caste based have also been incorporated in relation to the region, as well as its district wise pattern in the study region.

The Chapter-Fourth discusses the existing general land use pattern along with its changing pattern over last twenty-two years in Assam. The general land use pattern in the Lower Brahmaputra Valley also incorporated along with its changing pattern since 1970-71 to 1995-96. Further the cropping pattern along with its changing pattern is also discussed in brief in Assam as well as in Lower Brahmaputra Valley.

The Chapter-Fifth is concerned with the agricultural production/productivity. The entire chapter is based on secondary sources of data collected from the Department of Agriculture, Government of Assam. This particular chapter is restricted to the yield pattern of various crops as well as its changing pattern over the last twenty-five years, not only in Assam but also in Lower Brahmaputra Valley. Here, an emphasis is laid upon the determinants of agricultural production too.

The Chapter-Sixth deals with the production processes according to agro-ecological conditions and attempt has also been made to establish an inter-relationship between the production along with its production functions on an agro-ecological basis in Lower Brahmaputra Valley. The entire chapter is based on primary information, as it was collected from 160 farm families during field survey. It also incorporates the inter-relationships between production along with its production functions like-labour, non-land capital and animal power.

The Chapter-Seventh is concerned with the farm size attributes. This chapter is also based on essentially primary data. In this particular chapter thrust on agricultural production/productivity, general land use, cropping pattern, cropping intensity, as well as input structure according to farm size. Here, an attempt is being made to create an inter-relationship between production along with its production functions according to standard land holding sizes, as prescribed by the Directorate of Economics and Statistics, Government of India

The Chapter-Eight (last chapter) is essentially restricted to the summary and conclusions of the overall work with certain recommendations

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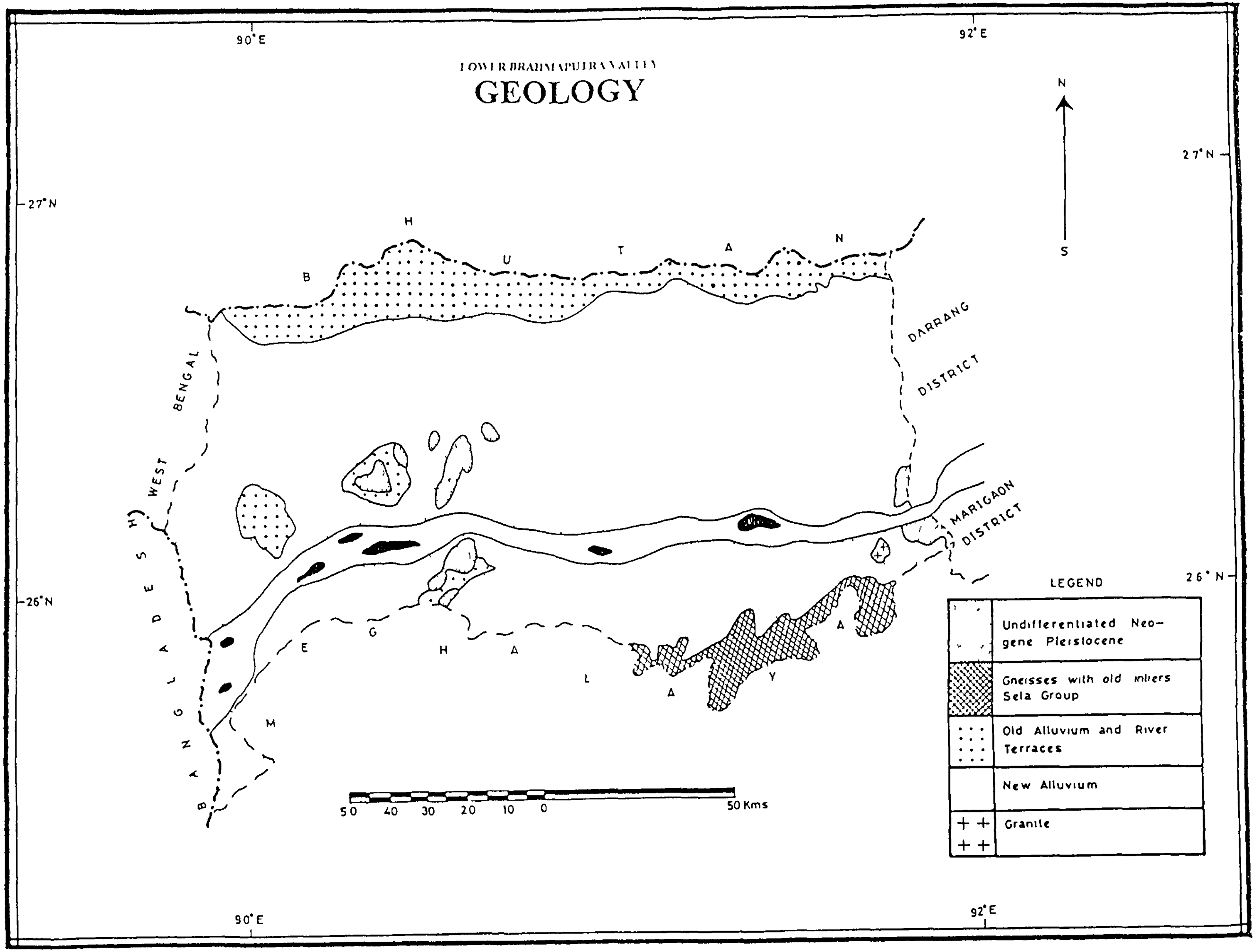
CHAPTER II

AGRO-CLIMATIC ENVIRONMENT

2.1 Introduction:

Agriculture is the primary source of livelihood for the majority of the rural population of Assam. The agricultural sector is very important for the state's economy. Agriculture is not only the means of utilising soil to grow crops but also it is the basic industry of mankind and backbone of the economy of the state. Agriculture largely depends upon the immediate physical environment. The environmental factors play an important role in shaping the agriculture in the region. These physical factors though they don't act in a deterministic fashion, but they lay down broad controls over it. However, in order to give a clear picture of agriculture of a region, a brief account of the physical environment is indispensable. These factors are known as agro-climatic conditions in agricultural science.

The agro-climatic factors may be divided into geology, physiography, drainage system, climate, soil etc. They are clearly interrelated with one another and the role of these factors in agricultural complex is undeniable. Moreover, physiography has great impact upon agricultural land use because of varying elevations as well as ruggedness. Therefore the chapter proceeds with a detail description of the following principal elements.



LOWER BRAHMAPUTRA VALLEY
GEOLOGY
90°E
92°E
27°N
26°N
N
S
B H U T A N
DARRANG DISTRICT
MARIGAON DISTRICT
WEST BENGAL
BANGLADESH
M E G H A L A Y A
50 40 30 20 10 0
50 Kms
LEGEND
Undifferentiated Neogene Pleistocene
Gneisses with old inliers Sela Group
Old Alluvium and River Terraces
New Alluvium
Granite

2.2 Geology:

Geologically, the rock formations of Assam valley varies from the oldest group of the rocks to the youngest one, i.e. from the archean, pre-cambrian to the lower and upper tertiary and finally quarternary (Misc. Pub. – 1974). The archaen group of rocks in the form of metamorphic complex of gneisses and schists intruded by younger acidic and basic rocks are scattered in isolated inselburgs along the northern and southern banks of mighty river Brahmaputra in Goalpara and Kamrup. The archean group of rocks consists of banded composite, biotite, biotite hornblend, silliminite, gneisses as well as schists associated with feldspatic biotite, pyroxene, hornblend, granulities, calegranulites, aplites and younger coarse to fine grained granite. Gneisses intruded by massive periphytic and coarse biotite granites, pegmatite's and quartz veins (Misc. Pub. – 1974). Archean group of rocks in the south bank mainly consists of biotite and biotite hornblend, gneisses with bands of granulite and bosses of intrusive granites, quartz, veins and minor quartzite, perphyrites, granites are exclusively found in Kamakhya hills. It also runs parallel to the foliation of country rocks, cross-country relation with older gneisses found in south of Kamakhya hills, Sunderpur and at some other places (Figure-2.01). The rocks are much broken, as it seems that it had suffered from the convolutions of earthquakes and other natural disturbances. But these were occasioned by the passage of basaltic and other volcanic veins of which, these tracks are both in the valley and in the bordering Meghalaya plateau (Goswami- 1960).

The Lower Brahmaputra Valley comprises of seven plain districts of Lower Assam. Viz., Dhuburi, Goalpara, Nalbari, Bongaigaon, Kokrajhar, Barpeta and Kamrup. The geological history is related to two long narrow subsiding trough (Geosyncline) was lying on either side of the old rigid continental shield called as foreland (Steers-1988). Geologically this foreland was the continuation of the Shillong and Mikir plateau. Towards north of the mainland was an ancient central geosynclinal sea, called as Tethys and this sea invaded Assam from the south during the cretaceous period. At the beginning of the tertiary era, the Tethys Sea extended further south-east and submerged a greater part. Due to occasional or temporary retreat of the sea, the marine condition prevailed until the miocene period. Very thick sediments were deposited on the foreland as well as in the geosynclines. As a result, its floor began to sink slowly but continuously.

The Assam region went on a series of intermittent earth movements and it was accentuated during the post pliocene period and the piles of the sediments were severely compressed, accordingly uplifted into the form of lofty Himalayas as well as Naga, Lushai and other associated hill ranges in the south. Erosional work washed away hundreds of meters of material from this rising area and the depositional work continued over the foreland areas of Assam valley, presumably continued till the last Dihing period. Alluvium deposits thus conceal the geology of the entire region. The geological survey proved that under the recent deposits, there are hundreds of meters of tertiary sediments, which lies over an archean basement complex.

The upper tertiary sandstone associated with clay alternation found along the foothills of Bhutan. It is light grey buffs and whitish grey in colour, medium grey, generally compact, soft, and massive, micaceous and in some places it is well defined. The upper tertiary sandstone comprises clay at the bottom upwardly into siltstone. At the top it is mixed with fine-grained sandstone, medium grained micaceous and soft type sandstone and finally pebbles.

The bhangar or old alluvium deposited at the final stage of the Himalayan orogency comprises reddish to brownish alluvium with coarse sand, unsorted pebbles and it is less fertile. The khadar or new alluvium consists of indurate yellowish to brownish or radish clay sands, silts, gravel boulder deposits covers a large area of this region existing along the Brahmaputra river (Figure-2.01). The thickness highly varies due to the underlying rock structure approximately ranging from 200 to 300 metres.

2.3 Physiography:

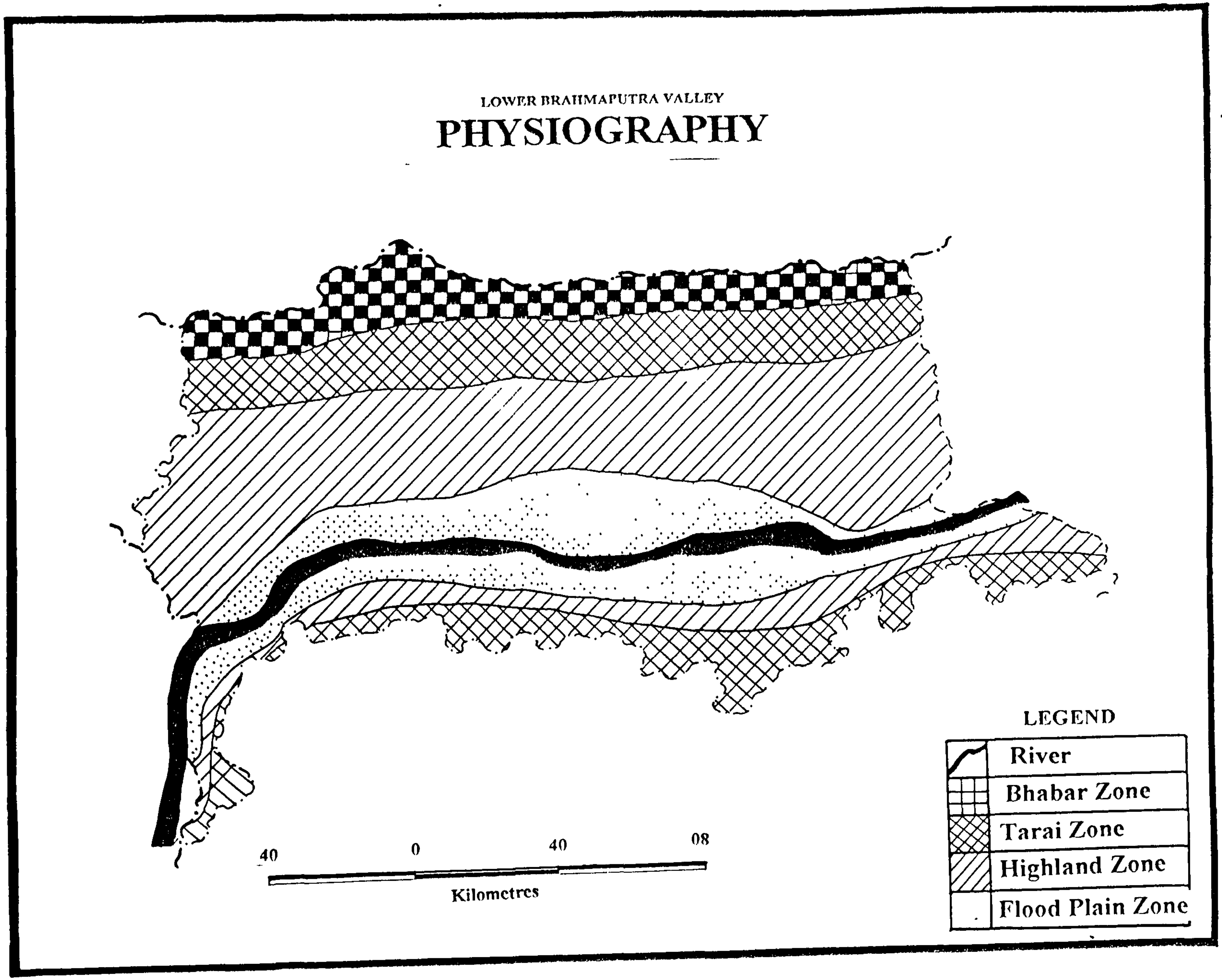
Physiographically, the Lower Brahmaputra Valley is a part of the Brahmaputra Valley, covering an area of 20,148 km² and accounting for 20.15 lakh hectares, representing 25.69 percent of the total geographical area of Assam. The Lower

Brahmaputra Valley is essentially an alluvial plain criss-crossed with numerous rivers and waterways and dotted with 'Beels' and 'Swamps' The Brahmaputra Valley occupies an area of 56,339 km², representing 72 percent of the total geographical area of Assam The Lower Brahmaputra Valley is divided into two segments by the mighty river Brahmaputra as it is passes through The aggradational work caused by the river Brahmaputra and its tributaries have deposited approximately 1,500 metres thick alluvium upon sag formed, since the period of the rise of Himalayas. The valley is wide, ranging from 70-80 kms, the contour line of 150 metres separates the valley from the surrounding hilly areas The general height of the valley ranges from 115 metres in the east to 30 metres in the west, slopes from north-east to south-west. On the other hand, in the north bank the slope is from north-east towards west with a fall of 12 5 cms per km As the rivers are sluggish, characterised with low gradient, results innumerable almond shaped river islands called 'char' or 'chaparis' which are caused due to the deposition of sediments in the middle of the river course Most of the chaparis are washed away by heavy flow during summer rainy season, while new chaparis are also formed subsequently. This is an important aggradational feature caused due to the low slope of the region. Another important physiographical feature of Lower Brahmaputra Valley is that it is dotted with 'isolated hillocks' or 'residual hills'.

There is a remarkable physiographic difference between north bank with the south bank of river Brahmaputra. In the north bank, innumerable tributaries running down from Bhutan and Arunachal Himalayas fall abruptly to the main valley and form a series of alluvial fans. The north bank tributaries are big in size and have a wide catchment area They create menacing floods every year because of shifting of their courses following continuous heavy rainfall during summer days coupled with melting ice On the other hand, the south bank tributaries originates in Meghalaya plateau, Karbi Anglong, Naga Hills and Patkai range and flows on a relatively gentle slope, which are rainfed. The shifting of river courses and intensity of floods are less predictable in the south bank tributaries The tributaries have conspicuous meandering courses leading to the formation of 'Ox-Bow' lake and huge 'Marshy Tract' as well as elongated 'Beel'.

On the basis of the physiographic diversity, the Lower Brahmaputra Valley region can be delineated into five distinct physiographic divisions, running parallel or sub-parallel to the river Brahmaputra.

1. The Northern Foot Hill Region,
2. The middle Plain in the North,
3. The active Flood Plain and Char or Chaparis,
4. The Middle Plain in the south bank, and
5 The South Foothill Region



LOWER BRAHMAPUTRA VALLEY
PHYSIOGRAPHY
LEGEND
River
Bhabar Zone
Tarai Zone
Highland Zone
Flood Plain Zone
40
0
40
08
Kilometres

Figure-2.02

2.3.1 The Northern Foothill Region:

The northern foothill region is comparatively high but narrow 'Bhabor' zone and a flat 'Tarai Belt', coalescence of alluvial cones at the edges of the Himalayas, gives rise to the formation of highlands. This zone is made up of un-assorted material, streams fall suddenly to the plain, water percolates down due to unconsolidated soil structure, and the streams re-appears again of few kilometres downward. Bhangar soil zone is a fairly narrow zone bordering northward with tarai region in the north, a plain of damp soil supports tall grass or trees. It is inferred to note that the water seeps out from bhabor region, gives rise to many small tributaries of river Brahmaputra. This zone narrows in the north-eastern part and the human settlement is sparse.

2.3.2 The Middle Plain in the North:

The middle plain lies between tarai zone in the north and the active flood plain in the south, a relatively high but extensive plain spreading east-west. It runs parallel of river Brahmaputra, is fairly wide in the western flank and narrower to the east and turns wide again in the western edge within the Lower Brahmaputra Valley (Figure-2.02). This zone is the main artery of transport and communication in the state. Roads as well as railways passes through this built up highland region. The middle plain in the north is the most densely populated with productive rice fields.

2.3.3 The Active Flood Plain Region:

This particular region lies south of middle plain in the north bank and is an extensive and active flood plain on both the banks of the river Brahmaputra. The almond shaped island called 'Char' or 'Chaparis' are also included in this belt. The flood plain is broken within the Lower Brahmaputra Valley by isolated hillocks and incipient lakes, numerous beels and water logged areas and intersected by innumerable tributaries. In the northern bank it is widest i.e. in Barpeta district. The active flood plain is very rich for Jute cultivation and practised largely in three districts specifically in Dhuburi, Goalpara and Kamrup and also favours rice cultivation specifically the varieties of 'Ahu' and 'Bao'. This region is subjected to flood every year.

2.3.4 The Middle Plain in the South Bank:

The middle plain in the south is a very narrow lateral strip because it jutting out of the Meghalaya plateau and is very near to the bank of river Brahmaputra. In Goalpara district the plain to a certain extent is wide, as Garo hills recede southwards with a sharp bend from Salmara to the north-west. This plain region is an important rice belt.

2.3.5 The South Foothill Region:

The south foothill zone is a very narrow zone and comprises of the foothills of Meghalaya, complexes of 'isolated hillocks' or 'residual hills', erosional plains and 'beels' as well as 'swamps' The foothill of south bank is also an uneven surface, which has been converted into occasional rice fields

2.4 Drainage System:

The mighty River Brahmaputra and its innumerable tributaries control the entire drainage system of the region. The river Brahmaputra originates in the Kailash range at an altitude of 5,150 meters above mean sea level The upper course of the river in Tibet is known as "Tsangpo" (Gopalakrishnan-1996), which flows towards south from the Kailash range and reaches Manasarovar Lake and moves towards east till 'Namcha Barwa'. It then takes a sharp turn towards south to enter Arunachal Pradesh where it is known as Dihang Near Sadiya, the river Dihang joins with Lohit and Disang and takes the name of Brahmaputra and flows towards west There are innumerable tributaries, water channels and water bodies or 'Beels' and 'swamps' in the study region The distributional pattern of the rivers and divergent channels reveals that Assam as a whole is a riverine state, subjected to frequent floods and soil erosion every year Guwahati, Goalpara and Dhuburi are less prone to erosion because these areas exist on out crops and resistant rocks. The river carries a large amount of silt and sand and deposits these sediments on the river-bed, leading to the formation of almond shaped 'River Island' called as 'Char' or 'Chaparis'. The river Brahmaputra turns immediately south after Dhuburi around the natural spur of the Garo hills and flows through Bangladesh plains

LOWER BRAHMAPUTRA VALLEY

DRAINAGE SYSTEM

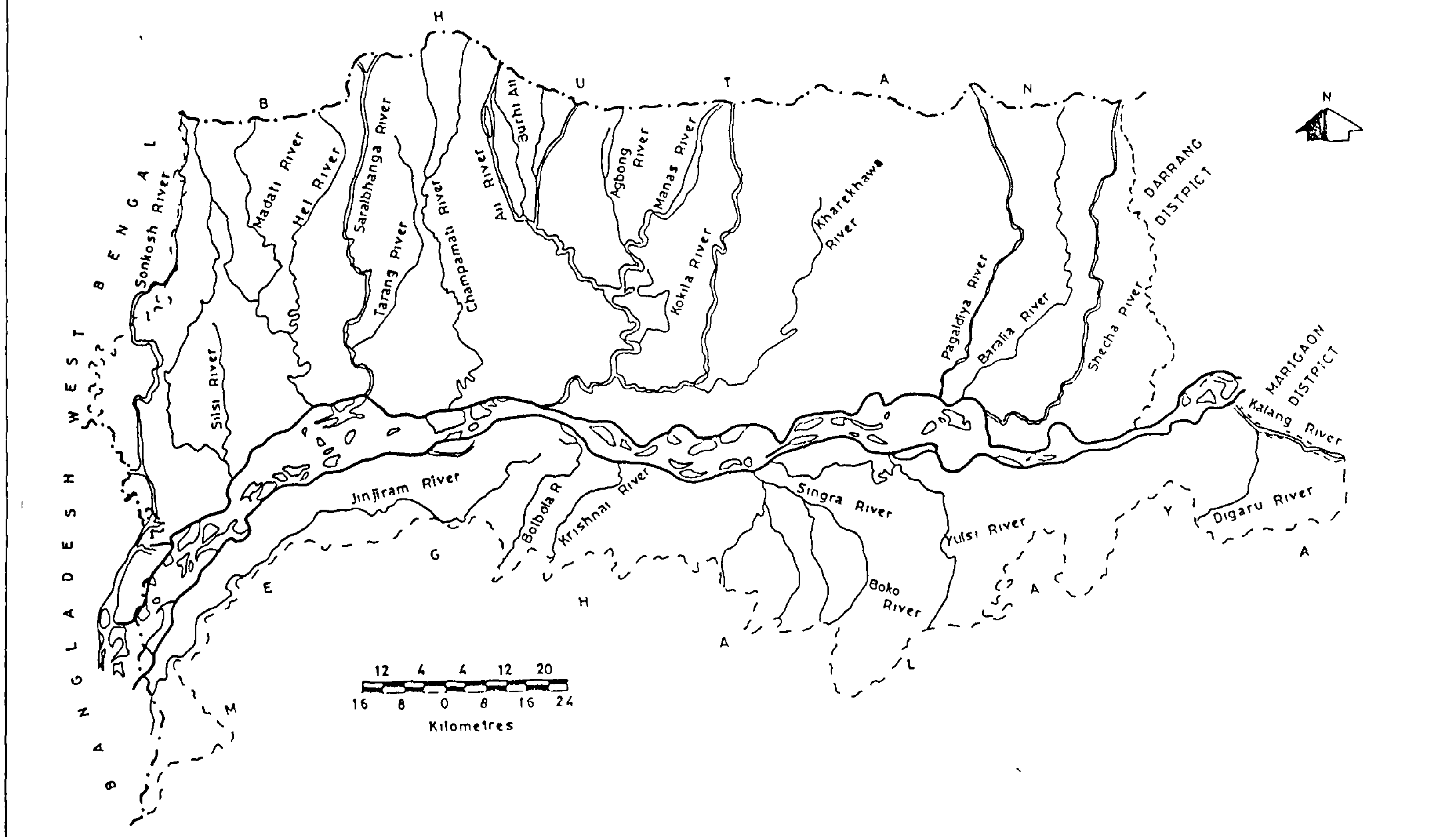


Figure-2.03

and confluence with the river Padma and finally merges into the Bay of Bengal after taking the name Meghna

During monsoon rainy season, rain coupled with melting ice from the Himalayas, leads to devastating floods in the north bank of the river Active bank erosion starts, fills the river-bed with sand and silt, ultimately loses the water holding capacity These conditions make the river swell, resulting into inundation in a vast area every year On the other hand, the south bank tributaries originate in the heavy rainfall occurring areas of Meghalaya plateau and causes floods occasionally during summer days These rivers are seasonal torrents and have less meandering courses than that of the north bank tributaries A few of these tributaries are however navigable throughout the year During monsoon rainy season, floods are frequent which results in heavy damage of life and property as well as standing crop in the study area

The principal tributaries of the north bank are Barnadi at the border of Kamrup district, followed by Sesha, Puthimari, Boralia, Pagaldiya, Chowl Khowa, Manas, Aii, Gauranga, Sonkosh and Gangadhar (Figure-2 03) These tributaries originate in the Bhutan Himalayas, fed with heavy rainwater, supplemented by melting ice resulting in a tremendous volume of water and heavy silt discharge by the river, which shallows the river-bed, the tributaries get choked up, results inundation Since, tributaries are lies in the seismic zone are enables of shifting their courses, run as a meandering river

Moreover heavy discharge of river Brahmaputra affects its tributaries in their water profile.

The major tributaries on south bank are Kalang at the border of Kamrup district, followed by Um-thana, Um-shri, Um-shayothi, Deosila, Dudhnoi, Khrishnai, Bolbola, Kulshi and Jinjiram. Besides these, there are numerous minor water inlets as well as streams. Some of the important one's are Sajang, Tangamari, Taki Nadi, Takel Nadi, Agra Nadi, Simbhu Nadi etc. Many small streams dry up during dry winter season. There are numerous beels and swamps scattered over the Brahmaputra Valley. Some of these are fairly large and deep, remains water throughout the year, while others are shallow and turn into muddy puddles during dry season (Taher-1978). The areas occupied by beels are agriculturally less important.

2.5 Soils:

The soils of Assam are essentially dominated by alluvial. The alluvial soil may be divided into new alluvial and old alluvial soil, which occurs in the plains on both sides of the river Brahmaputra. The history of the origin of the soil of Lower Brahmaputra Valley, apart from the northern and southern slim margins, the whole region is covered with alluvial soil. The river Brahmaputra and its innumerable tributaries cover about thirty percent of the study area with huge deposits of sands and silts to a great depth. Thus obscuring the original surface at varying depths in different parts, depending upon

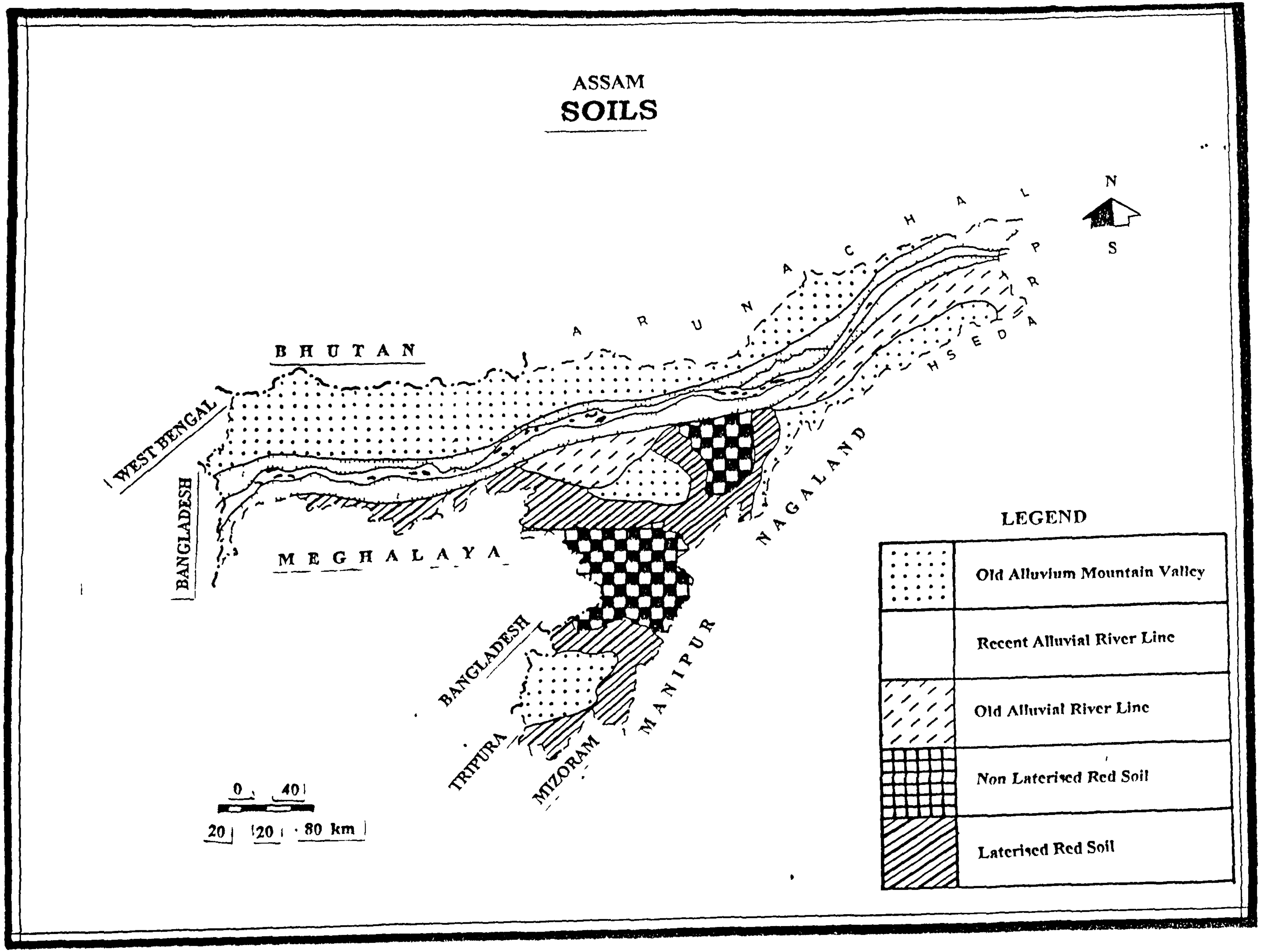

ASSAM
SOILS
ARUNACHAL PRADESH
BHUTAN
WEST BENGAL
BANGLADESH
MEGHALAYA
NAGALAND
MANIPUR
MIZORAM
TRIPURA
BANGLADESH
N
S
LEGEND
Old Alluvium Mountain Valley
Recent Alluvial River Line
Old Alluvial River Line
Non Laterised Red Soil
Laterised Red Soil
0 40
20 20 80 km

Figure-2 03

the rate of deposition. In some areas retains their original features and soil owing to higher location in comparison to the adjoining areas. This is due to the resistance of rock or other physical checks.

An elongated narrow patch of old alluvial soil occurs along the northern as well as southern margin of the plain spreading from east to west. Another elongated patch occupies the soil of submontane tract in the north bank bordering with Bhutan, stretching from east to west. Small patches of hill soil essentially red loams and laterite exists in the south bank of the river Brahmaputra, adjoining to the Meghalaya plateau.

Soils are the ultimate asset and its quality is the limiting factor in agricultural production system, therefore soil needs to be kept in good health. As a whole, the soils of Assam are of acidic character with a satisfactory content of nitrogen and organic matter. However, the soils of the hills are more acidic in nature (Techno-Economic Survey of Assam-1963).

The soils of the Lower Brahmaputra Valley can be categorised into the following four major groups, among which the first three covers the entire valley and the last one is prominent only in the southern part of the region adjacent to the Meghalaya plateau (Figure-2.04). These are:-

i) New Alluvial Soil,

ii) Old Alluvial Soil,

iii) Soil of Submontane Tract, and

iv) Hill Soil

2.5.1 New Alluvial Soil:

The recent riverine alluvial soils are confined to the low-lying tracts of the flood plains in which new silts are deposited every year The frequent occurrence of flood causes great variation in mechanical composition and chemical properties, depending upon the parent materials in their respective catchment areas The texture of the upper most layers varies from sandy loam to silt loam, characterised with low acidic contents, enriched with available phosphate, potash and exchangeable calcium The lower most horizons mostly vary from sandy to loamy sand and the texture becomes lighter with depth, less acidic and often neutral or slightly alkaline As a whole, the new alluvial soil is rich in lime and potash but deficient in phosphoric acid and nitrogen The ground water table is from 01 to 03 metres in some areas The new alluvial soil is suitable for the cultivation of rice, pulses, mustard, jute and vegetable

2.5.2 Old Alluvial Soil:

The old alluvial soils are formed from the materials deposited by the river Brahmaputra and its innumerable tributaries in the historical past and are found at relatively elevated tracts, which are free from floods and are more or less parallel to new alluvium and hill soils to the south This group of soil are more acidic in nature with low to high nitrogen content and texture varies from sandy to clayey loam and dark coloured with kankary composition The ground water table is comparatively deeper than the new alluvial soil dominated areas The old alluvial soils are favourable for rice, sugarcane, and fruit cultivation but not conducive for pulses and mustard.

2.5.3 The Soil of Submontane Tract:

The soils of submontane tract exist in the northern most part of the valley, along the foothills of Himalayas, bordering with Bhutan, stretching from east to west Towards higher elevation, the predominance of jungle increases The soil of this region is clayey in nature The general slope of the land is steep, therefore the surface water is more quickly drained away and stands as an important obstacle for successful agriculture

2.5.4 The Hill Soil:

This group of soil occurs in a narrow strip of the southern most part adjoining to Meghalaya plateau. The hill soils are mainly red loams and laterite soil characterised with high level weathering and leaching due to heavy rainfall. These soils are built of alluvial material washed down from the hill slopes. The soil surface is compact and very sticky and the texture becomes heavier along with depth These are generally dark coloured fertile loams and can give better agricultural production if scientifically managed This soil is suitable for the cultivation of cotton, rice, maize, coarse millets, pulses, potatoes, vegetables and tropical fruits i e oranges, and pineapples This kind of soil is deficient in nitrogen, phosphoric acid, humus and lime

2.6 Climate:

Climate is an important agro-environmental condition, which reflects directly upon the land use pattern, extensions and characteristics of crops and the agricultural productivity pattern The Lower Brahmaputra Valley characterised with relative coolness and dry during winter and extreme humid and heavy summer rainfall during summer season The climate of the study area is relatively dry in the east and wet towards west In the Lower Brahmaputra Valley, more than 80 percent of the people are directly dependent upon agriculture for their livelihood, therefore its economy is controlled by the amount of rainfall received as well as its distribution through out the region

The climate of Lower Brahmaputra Valley is Monsoonal, experienced with periodic climatic change, characterised by long rainy season (i.e. June to September) associated with high temperature and high relative humidity. The mean annual temperature is about 21 33°C with mean relative humidity with 76 percent

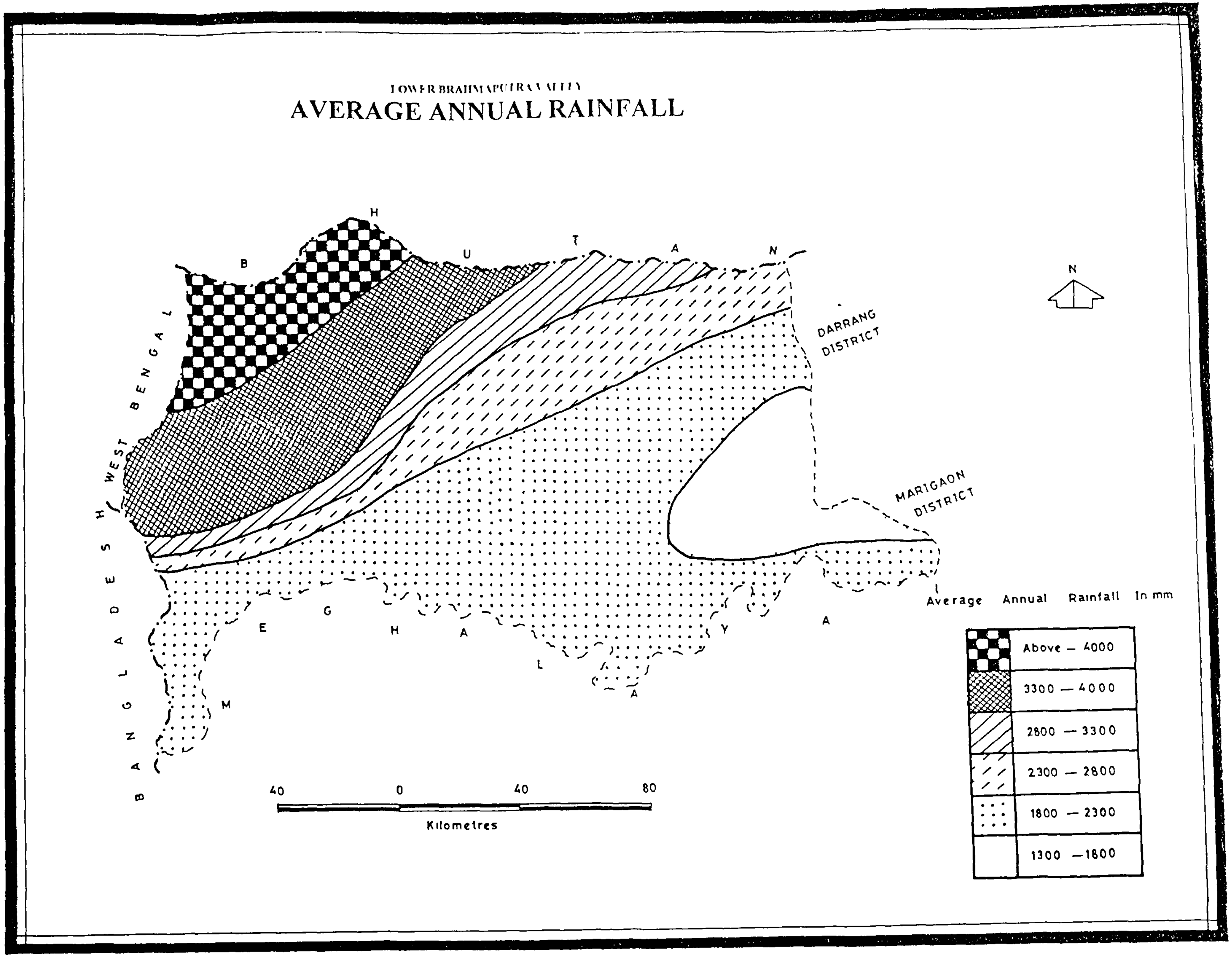

LOWER BRAHMAPUTRA VALLEY
AVERAGE ANNUAL RAINFALL
B H U T A N
WEST BENGAL
BANGLADESH
M E G H A L A Y A
DARRANG DISTRICT
MARIGAON DISTRICT
N
40 0 40 80
Kilometres
Average Annual Rainfall In mm
Above — 4000
3300 — 4000
2800 — 3300
2300 — 2800
1800 — 2300
1300 — 1800

Figure-2.05

The high and lofty Himalayan Mountain in the north stands as an important barrier in the direction of cold air, which blows from Tibet towards the valley during the months of January and February Moreover the Himalayan mountain section provides a suitable condition for the occurrence of orographic rain There is a remarkable impact of the fast moving eastward upper air current called as western disturbance and the local mountain and valley winds upon the weather and climate of the Valley region. The mountain and valley winds, which moderate the temperature so that hardly any heat wave experienced in the valley region. During winter, mornings are very foggy, and it remains for about 60-70 days in the northern bank and 90-100 days in the southern bank of river Brahmaputra. This is due to the availability of moisture, which evaporates from the river as well as from the marshy and swampy lands.

Rainfall is not uniform throughout the valley An average rainfall varies from 1,435 to 4,028 mm., which increases from south-east to north-west (Figure-2.05). There is a low rate of evaporation from the rich alluvial soil. About 74 percent of the total annual rainfall concentrated to the months of June, July, August and September, while December, January and February months are almost rainless (1.00 mm.). This type of climatic condition helps to grow two distinct types of crops, such as kharif crops during summer and rabi during winter and also provides an ideal condition for the growing of a variety of tropical and sub-tropical crops/fruits in the study region.

Table-2 01 **Season Wise Rainfall in Lower Brahmaputra Valley, 1995**

Station	Winter Season (Dec to Feb)		Summer Season (Mar to May)		Monsoon Season (Jun to Sept)		Post Monsoon Season (Oct to Nov)		Annual Rainfall Normal	Actual
Dhuburı	33 3	22 4	624 0	624 0	2156 1	4027 6	158 2	150 1	4829 1	2971 6
Kokrajhar	33 3	36 7	624 0	1107 0	2156 1	3714 4	158 2	221 4	5079 5	2971 6
Bongaıgaon	33 3	35 0	624 0	733 1	2156 1	3292 8	158 2	184 5	4245 4	2971 6
Goalpara	33 3	26 6	624 0	732 5	2156 1	2059 0	158 2	87 9	2906 0	2971 6
Barpeta	45 7	36 3	554 5	462 1	1418 9	1989 1	108 2	58 9	2546 4	2177 2
Nalbarı	45 7	50 7	554 5	773 3	1418 9	1435 3	108 2	127 8	2393 1	2177 2
Kamrup	45 7	34 3	554 5	565 5	1418 9	1504 6	108 2	119 7	2224 1	2177 2
Average	38 6	34 6	594 2	713 9	1840 2	2574 7	136 8	135 8	3460	2631 1
Percent	11 42	1 00	35 37	20 64	50 58	74 44	2 63	3 92	100 0	100 00

Source Directorate of Agriculture, Government of Assam, Guwahati, 1997

It is also prominent from the Table-2 01 that 21 percent of rainfall concentrated during summer and only 4 percent of rainfall occurs in post monsoon season in the year 1995 As far as the normal rainfall is concerned, about 51 percent of rainfall concentrated during monsoon rainy season, 35 percent in summer, 11 percent in winter and only 3 percent of rainfall in post monsoon season in Lower Brahmaputra Valley For better understanding, Guwahati is selected as identical station to show various weather elements like- rainfall, temperature and relative humidity

Table-2 02 reveals that high level rainfall starts from May and it continued to October and June is the rainiest month with 350 mm of rainfall, which favours efficient agricultural growth even without irrigation facility Rainfall decreases from November and December was the rainless month in the year 1995 (Figure-2 06)

Table-2.02. **Maximum and Minimum Temperature, Rainfall and Relative Humidity in Guwahati, 1995**

Elements	J	F	M	A	M	J	J	A	S	O	N	D
Tempt-Maxi	27.8	28.3	35 8	35.9	38 1	36.8	37.3	37.0	35.7	33.8	30.3	26.6
Tempt-Min	8.8	10.3	12 3	17.7	36.5	22.6	24.0	24.0	21.4	17.8	12.4	9.0
Rainfall	19.4	30.0	123.8	156.4	164.9	349.8	199.8	317.8	28.2	141.5	6.6	--
R/Humidity (8.30)	87	80	75	74	74	85	82	84	79	85	85	88
R/Humidity (17.30)	67	54	56	62	68	80	76	82	79	81	77	74

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

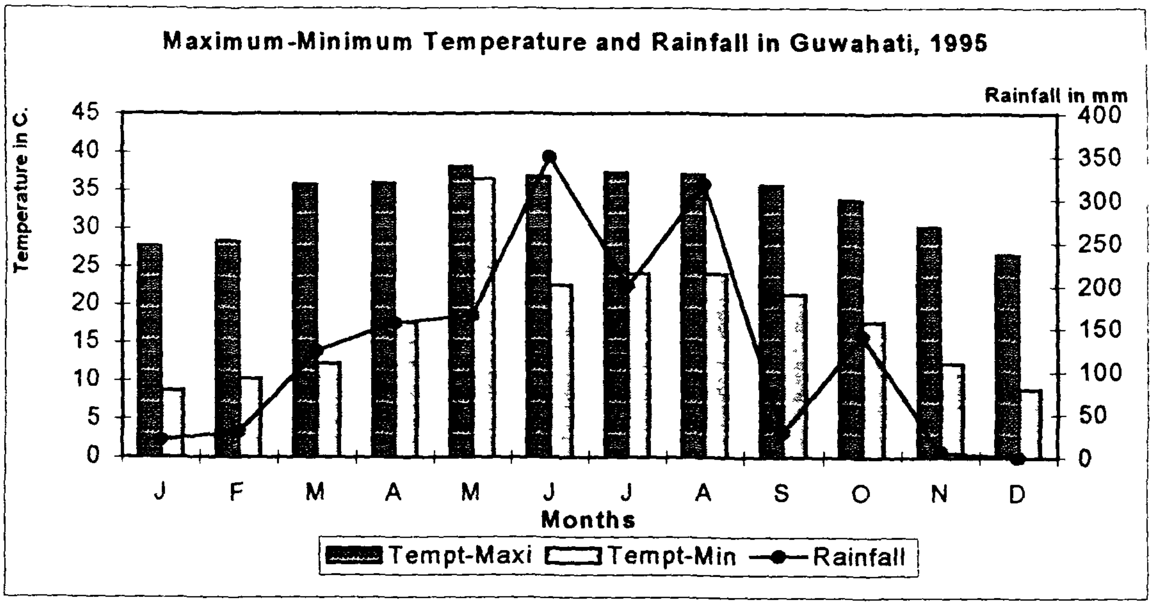


Figure – 2.06

On the basis of the diversification of temperature, rainfall, relative humidity and wind direction, the year has been subdivided into four defined seasons These are:-

(1) Cold weather season,

(2) Hot weather season,

(3) Monsoon rainy season, and

(4) Retreating monsoon season.

2.6.1 Cold Weather Season:

The cold weather season sets at the end of November and continues up to the end of February, characterised with an almost absence of rainfall, the average rainfall with 19 cm. (monthly), cool weather with low temperatures and frequent morning fog. The temperature is low and January is the coldest month having an average monthly temperature of above 12.8°C. Sometimes the small quantity of rainfall received by the valley may be due to the western disturbances. During summer the whole region comes under the influence of high pressure, which develops in the north west of India and a feeble, low-pressure develops over the Bay of Bengal. During this season, even though wind blows towards low-pressure zone, in Lower Brahmaputra Valley it blows westerly because of relief of the valley. The rainless days provides an ideal condition for the harvest of winter rice, though the growth of rabi crops hampered.

2.6.2 Hot Weather Season:

The hot weather season commences by early March and continues till May. The season is characterised with a gradual increase of temperature coupled with occasional thundershowers, relatively low humidity and clear skies. The average rainfall is about 198 cm (monthly), with an average temperature of 23°C and diurnal range of temperature is about 6.1°C. This season characterised with occasional strong winds prevails in Lower Brahmaputra Valley. The occasional rain during this season provides an ideal condition for summer rice and jute cultivation.

2.6.3 Monsoon Season:

The monsoon rainy season generally commences in the middle of June and continues up to the end of September. A low-pressure trough develops in the valley and attracts the monsoon currents. The summer is characterised with a high relative humidity, heavy rainfall, cloudy skies and sultry weather due to the high humidity content in the air and high temperatures. The average temperature in this season increases up to 27°C with a diurnal range of temperature more than 6°C (R.L. Singh-1971). The hottest month of the year is August and its temperature ranges from 30°C to 37°C. The rainfall in this season is very high ranging from 250 to 646 mm. (460 average, monthly) and rainfall continues for about 8 to 20 days. As a result temperature reduces during the month of July, August, and September. As a result of the maximum rainfall received within a short period, the rivers are unable to accommodate the water and cause floods. The monsoon season is the most important period from the agricultural point of view, as winter rice is grown.

2.6.4 Retreating Monsoon Season:

The retreating monsoon season starts in the end of September and continues until November end. The monsoon withdraws in the end of September and the beginning of October, after which fair weather starts. During this time the monsoon

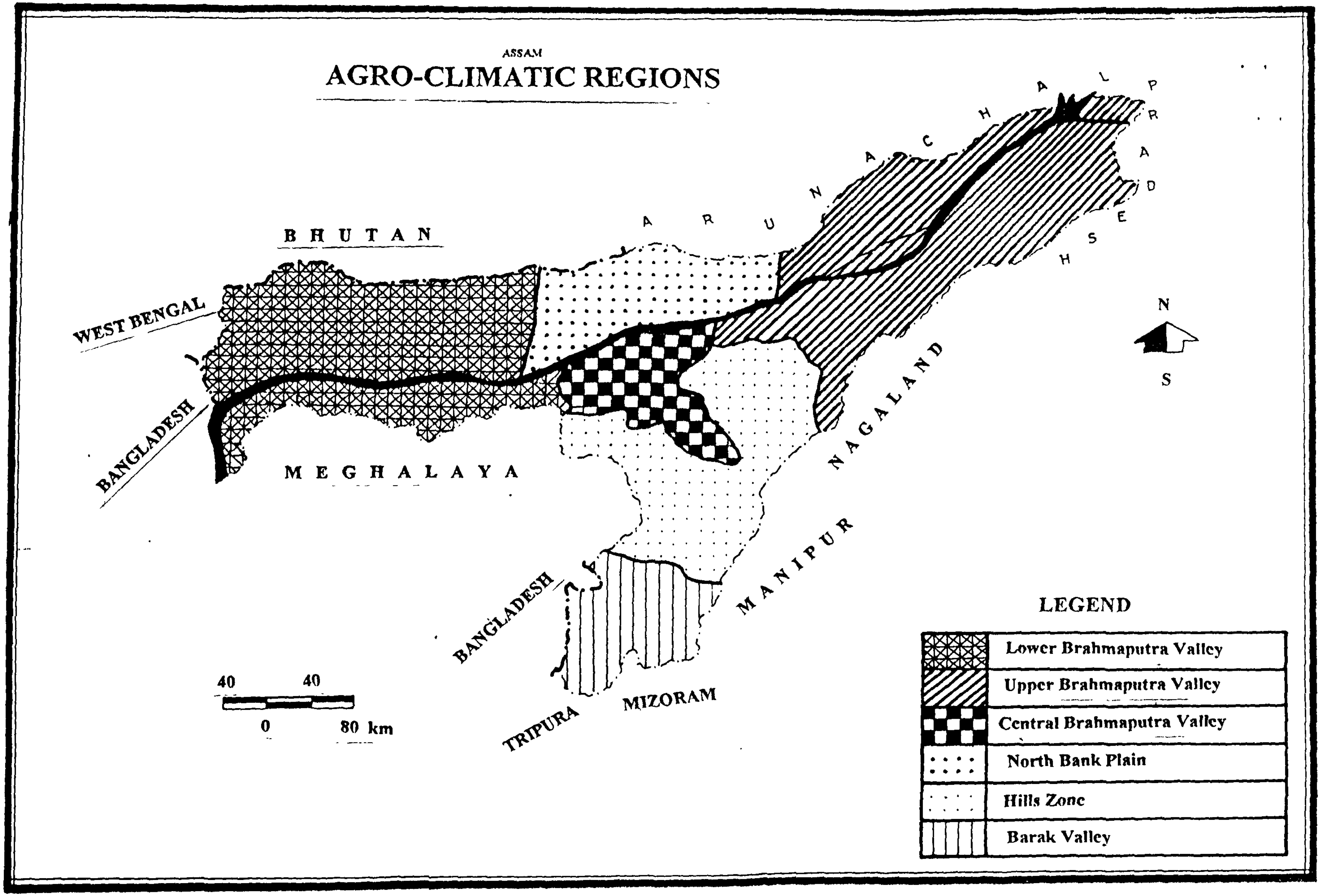

ASSAM
AGRO-CLIMATIC REGIONS
BHUTAN
WEST BENGAL
BANGLADESH
MEGHALAYA
ARUNACHAL PRADESH
NAGALAND
MANIPUR
MIZORAM
TRIPURA
BANGLADESH
N
S
40
40
0
80 km
LEGEND
Lower Brahmaputra Valley
Upper Brahmaputra Valley
Central Brahmaputra Valley
North Bank Plain
Hills Zone
Barak Valley

Figure-2.08 7

weakens and the temperature falls at a slower rate Due to sudden decrease of rainfall, the temperature remains high during the month of October and the region experiences extreme hot temperatures This typical condition is known as 'October Heat' (B S Parakh-1996) The retreating monsoon season is characterised with morning fog and mist for a short duration Diurnal temperature ranges between 2 8°C to 5 6°C and rainfall in this season is about 112 mm with rainy days varying between 07 to 09 days during October and from 01 to 03 days in November The moderate autumn rainfall is highly beneficial for sowing rabi crops

2.7 Agro – Climatic Condition:

The delineation of specific agro-climatic zone is very important for further planning programmes in the field of agriculture, specifically land use and crop improvement On the basis of physiography, climatic condition and soil characteristic, Assam has been broadly sub-divided into six agro-climatic regions (Figure-2 07) These are:-

(1) The North Bank Plains,

(2) Upper Brahmaputra Valley,

(3) Central Brahmaputra Valley,

(4) Lower Brahmaputra Valley,

(5) The Barak Valley, and

(6) The Hill Zone,

Table No 2 03 **AGRO-CLIMATIC ZONES OF ASSAM AND THEIR BASIC CHARACTERISTICS**

Zones	Physiography	Soil	Crops	Climate
Upper Assam (Dibrugarh, Jorhat, Lakhimpur, Dhemaji, Sibsagarh, Golaghat, Tinsukia Districts)	Plains and Hills subjected to erosion	New alluvial (Entisols) mostly neutral soil, old alluvial	Rice, Sugarcane, Mustard in parts, Rabi pulses and Tea	Pre-Humid and Humid
Central Assam (Darrang, Nagaon, Marigaon and Sonitpur Districts)	Plains and Foot Hills	New Alluvial flood plains, Alluvial mountain valley upland, Acidic alluvial to strongly acidic reaction	Rice, Jute, Wheat Oil Seeds and Pulses	Humid and Sub-Humid
Lower Assam (Goalpara, Nalbari, Bongaigaon, *Kamrup*, *Kokrajhar*, *Barpeta and* Dhubari Districts)	Plains, Hillocks, Foot Hills and Char areas	New Alluvial, Old Alluvial of two types i e Altisols & Ultisols & *Interseptisols and Altisols*	Wet land Rice, Up land Rice, Jute, large variety of Rabi crops, Wheat, Pulses and Potato	Humid and Pre-Humid
Southern Zone (Cachar, Karimganj and Hailakandi districts)	Undulating scattered hillocks, sub mountain in parts	Mostly Old Alluvial, Non-Laterite Altisols and Ultisols	Rice, Sugarcane and Tea	Humid and Pre-Himid
Hill Zone (*Karbi Anglong and North Cachar* Hills Districts)	Hilly (up to 1800 Mts) Gentle to steep slope, a very small part of plain	Laterite (Altisols & Ultisols), Red Loams (Ultisols), Old Alluvial (Altisols & Ultisols)	Rice, Maize, Wet land Rice and plain crops and Millets	Humid and Sub-Humid

Source: Borthakur, B C , Das, G R , Baruah, A.R . and Dutta, T C . (1958) 'Filed Manual for Rainfed Agriculture in Assam'. Assam Agricultural University, Jorhat

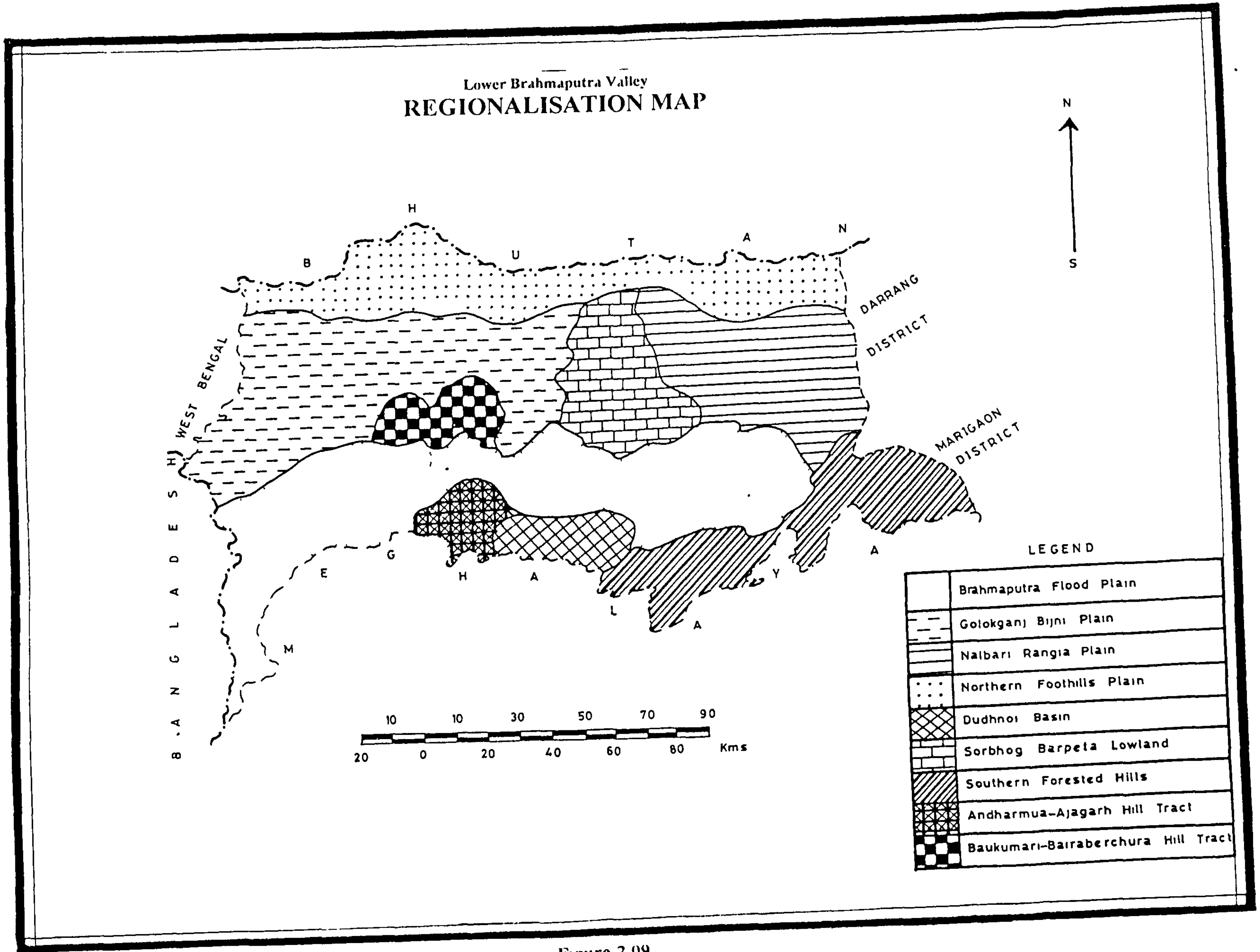

Lower Brahmaputra Valley
REGIONALISATION MAP
N
S
B H U T A N
DARRANG DISTRICT
MARIGAON DISTRICT
WEST BENGAL
B. A N G L A D E S H
M E G H A L A Y A
10 10 30 50 70 90
20 0 20 40 60 80 Kms
LEGEND
Brahmaputra Flood Plain
Golokganj Bijni Plain
Nalbari Rangia Plain
Northern Foothills Plain
Dudhnoi Basin
Sorbhog Barpeta Lowland
Southern Forested Hills
Andharmua-Ajagarh Hill Tract
Baukumari-Bairaberchura Hill Tract

Figure-2.08

It is evident from Table-2.03 that the Physiography is characterised by plains, isolated hillocks, foothills and charlands, subjected to erosion as well as deposition. Soil is composed of new alluvium and old alluvium and characterised with high acidic content. The climate is pre-humid during summer, dry in the winter season and subjected to cause flood every year. The crop practised in the region are- wet land rice, up land rice, jute, variety of rabi crops like- pulses, mustard, potato and cash crops like- tea and rubber to a certain extent.

2.8 Regionalisation of the Study Region:

The Lower Brahmaputra Valley is a part of Brahmaputra Valley of Assam and is located in the extreme west. On the basis of topography, geology, soil, forest, climate, natural vegetation, Lower Brahmaputra Valley can be categorised into eight micro regions (Atlas of Assam-1971). It is prominent from the Figure-2.08, accordingly describes below:-

2.8.1 The Northern Foothill Zone:

The northern foothill zone covers the northern part of the region accounting for an area of 2,673 km^2. The region belongs to the foothill topography of the eastern Himalayas (Bhutan Himalaya). The region is entirely rural covered with grasses, reeds, bamboo, simul and sal forest. The important tributaries are Saralbhanga, Hel, Bhur, Manas and Bar Nadi which flows through the region and makes the boundary in the east as well as west draining from north to south. This river emerges from the

Bhutan range and ends on its way to the river Brahmaputra. The geology is of mainly alluvial origin, excluding tipam and surma groups of rocks.

2.8.2 Golokganj – Bijni Plain:

The Golokganj-Bijni plain cover an area of 3,665 km² and it's a flat alluvial plain. The tributaries passing through the region are most unstable and meandering in nature. Besides Manas, Saralbhanga and Sampamati are the important tributaries of Brahmaputra and flows from north to south. The geology of the region is of alluvial origin excluding some khasi green stone massive rocks and provides an ideal condition for rice cultivation.

2.8.3 The Brahmaputra Flood Plain:

This region covers an area of 6,296 km² existing on both sides of the river Brahmaputra. The region is flat alluvial plain formed by the river Brahmaputra and its tributaries and is subjected to flood every year and dotted with some residual hills here and there. Some of the hills attain high altitude, which is covered by green vegetation, grass and reeds. The important tributaries of the region are- Champamati, Kujia and Hari Pani. There are number of 'Beels' in the zone. Geographically, the plain is dotted with hills, which are composed of metamorphic rocks. The river Brahmaputra flows from east to west. On the other hand, the plain is of alluvial origin.

2.8.4 Andharmua – Ajagarh Hill Tract:

The region is entirely rural and covers an area of 621 km^2 This region belongs to hilly topography, which is in fact an off-shoot of the Meghalaya plateau The important tributaries of the region passing through are Jinjiram, Bolbola on the south bank of river Brahmaputra Khasi green stone and granite rocks dominates the geology of the region

2.8.5 The Dudhnoi Basin:

The Dudhnoi basin spaced over the south central part of the Lower Brahmaputra Valley covers an area of 702 km^2. The zone is extremely plain excluding some of the scattered hills The Khrishnai and Dudhnoi are the principal tributaries, which flows and falls into the river Brahmaputra from the south bank The region is covered with grass, reeds, bamboo and sal trees and the geology is of alluvial origin

2.8.6 Sorbhog – Barpeta Low Land:

The Sorbhog-Barpeta low land is spread over the central part of the Lower Brahmaputra Valley region and covers an area of 1,805 km^2. The region is low land and more or less is marshy and is subjected to inundation during summer rainy season There are numerous 'beels' and 'marshy tracts' covered with grass in the southern part of the region and this is the zone favourable for the jute and rice cultivation. The geology of the region is of alluvial origin.

2.8.7 Nalbari – Rangia Plain :

This region is spread over the eastern part of the Lower Brahmaputra Valley and covers an area of 2,407 km^2. The topography is alluvial plain excluding some of the hills in the south-eastern corner near Guwahati. The Pagaldiya and Barnadi are the principal tributaries of the river Brahmaputra and have the tendency to change their courses because of high velocity of water originates from the eastern Himalayas and the geology is mostly alluvial origin also favours rice cultivation.

2.8.8 The Southern Forested Hills:

The region covers the south-eastern part of the study area with 2,047 km^2. The region is dominated by hills. The southern forested hills consist of Khasi hills spurs and few other isolated hills are seen dotted in the plain in the south of the river Brahmaputra, especially in Guwahati area. The geology is of khasi green stone massive rocks such as sillimanite, gnesses, pyroxene granites which are found in this micro region.

It reveals in the above analysis that plain areas of alluvial origin dominate Lower Brahmaputra Valley. The Lower Brahmaputra Valley region constitutes seven plain districts of lower Assam with an area of 20.15 lakh hectares, accounting for 25.69 percent to the total area of the state, while accommodating 35.74 percent of people to the total population of Assam. The region has around 17 fast flowing tributaries of the river Brahmaputra. This is a high rainfall occurring area receiving more than 2,000 mm. of precipitation per annum and relative humidity is of more than 80 percent during summer and approximately 60 percent during winter season. The maximum temperature rises up to 39.6° C during the month of July- August occasionally and the minimum declines to 8° C during the month of January. Rice is the principal crop, as it is the staple food for the majority of people. There are other crops, mainly oil seeds, pulses, jute in the low-lying areas and tea in the hilly slopes.

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CHAPTER III

INSTITUTIONAL FRAMEWORK IN AGRICULTURE

3.1 Introduction:

Agriculture is the most intensive form of human occupation and it is practised world-wide Not only Physical factors but also socio-economic and cultural factors govern largely upon the agricultural production system The agricultural production and cropping patterns are completely demand based The pragmatic land tenancy and size of land holdings have great impact upon the agricultural productivity and it contributes in agricultural development to generate a substantial increase in farm productivity A reformed land tenancy system may contribute to the development by increasing the feasibility by realising the advantages embodied in new farming techniques, method of farm organisation and management depending upon the resource availability at the farmer's disposal

The land holding structure in any agrarian economy is a complex and dynamic in nature and its degree of dynamism depends on country's socio-economic and political systems The Government of India during 1966-67 adopted a new strategy for the agricultural development, emphasised on individual operational holdings for the better management and decision-making At present, almost all the states of our country including Assam, the land holding structure is being characterised with maximum individual ownership of farms and tenant system and large areas are in private ownership

3.2 Evolution of Land Tenure System in Assam:

The land tenure is the ownership/proprietary right of land by which ownership's are governed It embraces the economic, legal, political and social customs of the society Thus the land tenure system involves the overall relationship between man and land. The land tenure system affects the form of organisations in significant ways, having far-reaching impact upon the land use as well as the productivity pattern. Farmer plans the agricultural land in relation to the amount and the nature of investment, keeping in view of the rights and the possession of duration on land Different communities/societies have different types of land tenure system

Before the annexation of Assam province by British ruler in 1826, most part of the Brahmaputra valley was under Ahom kingdom[1] (Mali-1984) Ahom wanted to enjoy the right not only over a portion of production as revenue but also on the soil and the subjects The landowners were the rulers and they remained satisfied with poll or plough tax (house or hearth tax), as their needs were few and all required commodities supplied to them and also rendered personnel services (Gait-1984)

The land cultivated by the first settlers was conceived the joint property of the group or khet[2] who occupied it In certain cases, the land was either revenue free or at

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[1] Ahom originally belong to the Taichan state of Burma. entered Assam in the third decade of thirteen century i.e. 1228 A.D. and founded their kingdom

[2] Khet: Rice Land.

a very low rate of revenue The *paiks*[3] were allotted revenue free i e , *bari*[4] or *rupti*[5] lands, as they rendered personnel services to the rulers The available land was settled with the agriculturist at a very low rate of revenue

After the adoption of Hinduism by Ahom king and tried to patronise the nobles, priests, and other officials of the state, rewarded gifts of land as rent-free The land allotted to the temples, religious and charitable institutions were made free grants, such gifts and grants, king alienated the proprietary right in favour of the grantees, afterwards recognises themselves as la-khirajdar, the tenure devoting to a class of people exempted from the payment of land revenue

Before the occupancy of Goalpara district by British were under Mughal rule The Mughal emperors left the administration with the Chieftains[6], who paid nominal tributes to them The British rulers treated the lands under the occupation of chieftains for all practical purposes and permanently settled with them, the chieftains were consequently titled as 'Zaminder', or 'Proprietor' of land

The existing land tenure systems of Assam are the legacies of the Pre-British colonial rule The land tenure systems were not uniform throughout the state and it can

[3] Paiks: Male working forces available for service
[5] Rupti: Paddy Land
[6] Chieftains: Chief of Clan

be categorised into four distinct divisions according to different land tenure systems Such are -

(i) Independent single tenure, which is described as raiyatwari system in the temporarily settled districts of Assam,

(ii) The landlord tenure, which is called as zamindari system in the permanently settled area of Goalpara district,

(iii) Landlord tenure in the permanently settled area of Cachar district, and

(iv) Land without any legal ownership in two hill districts

After the annexation of the Assam province by British in 1826, their administration gradually introduced the present land settlement and revenue system in the plains of Assam At the very beginning, the British introduced poll or plough tax instead of personnel services rendered to the rulers British administrators, each and every district was divided into different parts which referred 'Mouza' and locally influenced person was appointed as 'Mouzader' in each mauza, entrusted to collect regular land revenue instead of poll/plough tax according to the quality of land (Bhagabati-1990) Consequently the raiyatwari land tenure system was preferred as compared to the zamindari system In the beginning of British rule in Assam formed Goalpara and Sylhet[7] (Srihatta) districts and it was the part of Bengal presidency As soon as the permanent settlement was introduced in Bengal, then these two districts

[7] At Present in Bangladesh

also were came under this system. Therefore, the permanent settlement was prevalent in Goalpara district.

Thus the land tenure system involves the overall relationship between man and land, from the agricultural point of view. The land tenure system falls broadly into two categories, occupying ownership and tenancy. Most of the agricultural land comes under one or other form of land tenure system i.e., the occupying ownership is the system of land holding, where the peasant himself is the sole owner of the agricultural land practices. But the land tenancy system differs from occupying ownership and it concerns with the legal contract by which owner of the land gives it out for the use by other person. There are various forms of tenancy system depending upon the mode of rent payment and the degree of control exercised by the landlord and owner on land. Rent was paid either in cash or kind or in services, rendered to the landlord.

The existing land tenure system of the valley region of Assam can be delineated into two broad heads i.e. zamindari and raiyatwari. In the zamindari system, settlement of land was held permanently by the holders and the land revenue was fixed proportionately. Fee simple estates (la-khiraj) were originally revenue free for the encouragement of tea plantation, but in 1948 such lands were made assessable under the Assam Assessment of Revenue Free Waste Land Grant Act, 1948.

3.2.1 La-Khiraj Tenure:

In the greater part of the Lower Brahmaputra Valley, the native rulers made considerable grants of land to be held revenue free for religious or charitable purposes The different classes of la-khiraj or rent-free estates were as follows -

1 *Brahmattar* - Lands given to Brahmins by Hindu kings,

2 *Dharmottar*- Lands for the support of Hindu religious institution, and

3 *Devottar* -Lands for the maintaining the worships of the goods

3.2.2. Nisf-Khiraj Tenure:

Among the nisf-khiraj or lightly assessed tenures are as follows -

1 *Rirpal* Lands granted for the support of Muslim religious institutions, and

2 *Nankar* Grants to Hindus for the state services and other reasons Nankar lands were granted to sudras in the same manner as brahmattar to brahmins The nisf-khiraj estates are heritable, the proprietary right belonging to the holder and not the state

Under this system, the holders of the land were the intermediates between the state and the actual cultivators for the collection of land revenue In the raiyatwari land tenure system, the land was held in simple independent holdings on periodic basis and the holders were responsible for the payment of land revenue In this system, landholders were at liberty to sublet their land under their terms and conditions and enjoyed the permanent right of tenancy as long as they paid the land revenue. The zamindari system did appear in this system and tenancy cultivation was also common in the raiyatwari land tenure system.

Under the British colonial rule, British administration accepted the theory of absolute state ownership of land and made an agreement by 1832, a land assessment system in the plain districts of Assam. By this system, land was settled every year and tax collected through an agency of commission agents called 'Choudhury', 'Mouzadar', and 'Kakati'. The land was divided into four principal categories. Such as: -

(1) Basti (Homestead land)

(2) Rupti (Land on which transplanted paddy is grown)

(3) Bao Tali (Low- lying land grows "Spring" and "Bao" rice)

(4) Faringhati (Inferior quality high growing land)

In nineteenth century there was abundance of fertile soil in Brahmaputra valley and the cultivators preferred annual leases as compared to periodic leases. In order to encourage the cultivators to undertake periodic leases, Government declared the settlement rule of 1870. This settlement rule was the first public declaration from the Government part regarding rights on land posed by cultivators. This act recognised a permanent, heritable and transformable right on land, wherever took periodic leases from the Government but the rulers conferred no such rights who took out only annual leases for the fluctuating/jhum cultivation

The Assam land and revenue regulation act 1886 was the common revenue law of Assam and still is in practice This regulation granted legal sanction to the existing settlement rules in 1870. All the landowners were categorised into three classes, are -

(a) Proprietors including the owner of revenue free estates and permanently settled estates,

(b) Land holding including the settlement holders of land held directly from the government under leases for a period of exceeding 10 years and who had held the land for ten years continuously prior the regulation came into force, and

(c) Settlement holders other than land holders including persons holding land directly from the Government under yearly leases, the terms of leases which was less than ten years, periodic leases ordinarily issued when the land has been taken up for dwelling houses or for permanent cultivation

The yearly leases granted for one year only and it confers no such right of inheritance, transformation and sub-letting (Das-1984). Such lease valid from one land settlement operation to the other Afterward, tenancy act like, the Goalpara tenancy act, 1929 governed the rights and obligations of the tenants and it was applicable in the permanently settled areas of Goalpara district The Assam (*Temporarily Settled*

Districts) Tenancy Act, 1935, applicable through out the plain districts of Assam, this tenancy act was amended during 1943 The Goalpara tenancy amendment act improved the position of under raiyats and also fixed the maximum rent payable by the land-holders The Assam tenancy act further amended in 1953 giving substantial rights to tenants

The tribal dominated hill districts of Assam i e 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 Nagaon and Sibsagar districts at the time of its formation during 1951 (Das-1984)

3.3 Land reform measures:

Since independence a number of land reform measures have been taken into consideration in order to remove the problems of land tenure system in Assam by the Government The main objectives of land reform measures are

(1) To remove the impediments upon agricultural production which are raised from the characteristics of agrarian structure

(2) To create an ideal condition for speedier development of agrarian economy for high level efficiency and productivity,

The land reform measures have been undertaken undei the five-year plans at different time in order to achieve the following targets -

(a) Abolition of intermediaries,
(b) Tenancy reform designed to low rent and to tenants rights subject to the landlords right to revenue land up to a limit for personal cultivation within time limit,
(c) Fixation of ceiling of land, and
(d) Re-organisation of agriculture including consolation of holdings, prevention of fragmentation of land holdings and development of co-operative farming and co-operative village management

After independence the Government of Assam decided to abolish zamindari system to protect the interest adhiars (Share-Croppers) Before the announcement made by planning commission of land reform measures under the five-year plans, a bill was presented to the state legislative assembly in 1948 for the regulation of interest adhiars The subsequent land reform policies have been based upon the principles laid down by the planning commission The land reform policies have been amended from time to time for the greater interest of the cultivators Considering the genuinity of its objectives, the following land reform policies have undertaken at different times since independence by state Government

3.3.1 The Assam Adhiars Protection and Regulation Act, 1948:

This acts seeks to regulate land-lord adhiars (Share-Cropper) in order to provide security of tenure of the adhiars to fix maximum rent payable by the adhiars and to establish conciliation bound for the settlement of disputes between the adhiars and the land-lords

3.3.2 The Assam State Acquisition of Zamindari act, 1951:

A bill was passed in order to abolish the zamindari system prevailed in certain parts of Assam (Goalpara and parts of Cachar Districts) in state assembly by March'1948 and it became an act in 1951, referred as Assam State Acquisition of Zamindari System Act, 1951

This act aimed to establish the direct relationship between state Government and the tenants by abolishing the rights of zamindars in order to simplify existing land tenure system (C.M Secretariat-1976) The rights of all proprietors numbering 3,638 estates and tenure holders numbering 4,333 covering an area of 6.7 lakh hectares have been acquired, as a result of the raiyats (tenants) of erstwhile zamindars came into hold land directly from the Government. Due to the abolition of feudal interest of the state, the land holding system in the erstwhile permanently settled areas was the beginning to approximate the characters of the system in the interest of the raiyats (tenants) of the state of Assam

3.3.3 The Assam Consolidation of Holding Act, 1960:

The Assam consolidation of holding act aimed to consolidate the fragmented holdings in order to prevent further fragmentation for better agricultural management in the plain district areas A scheme for the work of consolidation was undertaken in Rani Block area of Kamrup district on an experimental basis Unfortunately, the scheme owing to various constraints and is yet to see its full implementation (Bhagabati-1990).

3.3.4 The Assam Fixation of Ceiling on Land Holding act, 1965:

The Assam fixation of ceiling on land holding seeks to impose a limit on the amount of land that held by a person (person include a family, a company and a body co-operative). The aim was to reduce inequalities in the ownership of land to satisfy the desire of the land-less farmers And also to encourage co-operative farming societies among the land-less cultivators According to this act the maximum limit of holding is fixed with 150 bighas (20 hectares) of each individual. Since 1965 the act has been amended several times to reduce the ceiling limit and at last the limit has been fixed at 50 bighas (6.66 hectares) in 1975 (Bhagabati-1990).

3.3.5 The Assam Bho-dan Act, 1965:

Under the Assam 'Bho-dan' act, a total of 35,661 bighas (4,774 hectares) of land donated by the people, out of which 2,547 bighas (341 hectares) of land were distributed among the section of land less cultivators in the state (Bhagabati-1990).

3.3.6 The Assam *(Temporarily Settled Areas)* Tenancy Act, 1971:

This act seeks to regulate the relationship between the landlords and the tenants in the temporarily settled areas of Assam This act recognises two types of tenants particularly occupancy and non-occupancy It reduces the length of the tenure of acquiring the right of occupancy to three years instead of twelve years According to it, the occupancy of tenant can acquire the rights of ownership over land by disposing fifty times more revenue of the annual revenue payable Accordingly, Government launched a programme for updating the records of rights of the tenants Initially 3 03 lakh persons were recorded as tenants but it came down to 2 78 lakh persons in 1986 because of the settlement of tenanted land to the tenant's themselves

Another bill was passed for the acquisition of land holding belonging to religious and charitable institutions to establish the direct relationship between the state and the tenants of these institutions This was done in order to distribute the unoccupied lands among the land-less cultivators

The land reform policies whichever being discussed are having a close bearing upon the land holding structure, land use pattern as well as agricultural productivity pattern In the lower Brahmaputra valley also having similar land tenure system to that of Assam

3.4 Land Holding Pattern in Assam:

The rural settlements of Assam are surrounded by innumerable land holdings with varying shapes and sizes The present land holding pattern is the ultimate result of the socio-economic conditions along with the method of agricultural operation The size of land holding varies accordingly because of pressure of population upon arable land and the law of inheritance. These two factors have a close bearing for the splitting of large size holdings into smaller one and more or less widely scattered plots of land fails to confirm any reasonable economic accessibility The sub-division and fragmentation of land holdings continues generation after generation The uneconomic sizes of land holdings, inequality in ownership and land-lessness are some of the serious hindrances in the development of agriculture in Assam.

The land ceiling act 1956 came into force to fix the limit of land ceiling at 150 bighas (20 25 ha) for all kinds of land, irrespective of size of the family, quality of soil, this share of land by another 30 bighas (4.05 ha) for the permanent orchards Consequently the ceiling was reduced to 75 bighas (10.12 ha) by 1970 and then to 50 bighas (9.67 ha) in 1973. The surplus land has been vested by the Government of Assam and distributed to the land-less cultivators. It was also reported that, after ceiling of land up to June 1976, the total 4,03,289 bighas (53,988 ha) of surplus land was distributed to 1,07,044 land-less families Since then no such steps are being undertaken till now. After achieving all these, the holding system in Assam is far from satisfactory.

Table-3 01 **Category of Land Holding in Assam, 1970-71 and 1992-93**

(Area in hectare)

Size Class	Operated Area 1970-71		Operated Area 1992-93		Growth Rate	Operated Area 1970-71		Operated Area 1992-93		Growth Rate
	Holding	%	Holding	%	70-71 & 92-93	Holding	%	Holding	%	70-71 & 92-93
Below 01	1120480	57 04	1520833	60 27	135 73	509351	17 67	607121	18 75	119 20
01 ---- 02	466539	23 75	559863	22 18	120 00	661551	22 94	784080	24 47	118 52
02 ---- 04	275602	14 03	342555	13 58	124 29	757828	26 29	917997	28 64	121 14
04 ---- 10	93897	4 78	94698	3 75	100 85	520016	18 04	491611	15 34	94 54
Above 10	7858	0 40	5430	0 22	69 10	433827	15 06	403941	12 80	93 11
Total	1964376		2523379		128 46	2882573		3204750		111 18

Source: World Agricultural Census, 1970-71, Directorate of Economics and Statistics, Government of Assam, Beltola, Guwahati, 1997

From the Table-3 01 shows that, about 60 percent of the holdings in Assam are marginal in size, i e , holding below one hectare, but it covers only 19 percent to the total operated area of the state About 22 percent of the states total holdings are in small category (01-02 ha), which covers 24 5 percent of the total operated area of the state In the semi-medium size of land holdings (02-04 ha) occupied about 14 percent and covered 29 percent of the total operated area Further, medium size holdings (04-10 ha) covering about 04 percent with an operated area of 15 percent In contrary, the large category of holdings (above 10 ha) occupied only 0 22 percent to the total holdings but shared comparatively large proportion i e 13 percent of operated area of Assam during 1992-93

The district wise distribution pattern of land holding is one of the important tasks for the present study By the year 1970-71, Assam possessed 19 64 lakh land holdings and it increased to 25 23 lakh holdings in 1992-93 increased 5 59 lakh extra land holding within a span of twenty-two years Out of the 25 23 lakhs land holdings by 1992-93, the plain districts of Assam possessed 97 36 percent land holdings occupying 96 50 percent of the total area of Assam There is a substantial variation in Brahmaputra Valley not only in number but also in operated area In Lower Brahmaputra Valley due to the high population pressure upon arable land, the proportion of operated area becomes less than number of holdings On the other hand, in Upper Brahmaputra Valley and the two hill districts having low population pressure on land and the arable land is more than the operational holdings.

During 1970-71, in Assam the average size of land holding was 1.47 hectares, which was much lower as compared to the Indian average of 2.71 hectares. In Assam there are 752 tea gardens occupying large size land holdings If the tea gardens were excluded then, the average size of operational holding in the present agricultural sector would have been much smaller to 1 47 hectares

During 1992-93, in Assam, the average size of operational holdings was only 1.27 hectare, which was much lower, compared to the 1970-71 where the average was 1.47 hectares. Assam was having ten districts during 1970-71, but in 1992-93 it become 23 districts. So, the district-wise changing pattern of the number of operational holdings, operated area and the average size of the holding will not give any synoptic view. The Table-3.02 represents a dismal picture of average size of land holding in each and every district within the state of Assam The large sizes of land holdings are in Cachar, Dibrugarh and Tinsukia, mainly due to the existence of large number of big sized holdings of tea gardens On the other hand, the high average size of land holding is also prominent in two hill districts particularly Karbi Anglong and North Cachar hills are because of the introduction of plantation agriculture and the gradual change of agricultural practice from shifting to sedentary cultivation, specifically in these two districts

Table-3.02: **District wise Number and Operational Holding in Assam, 1992-93**

(Area in hectare)

District	Operational (in Nos.)	Area Operated	Average Size of Holding
Cachar	62328	130450	2.09
Dibrugarh	89148	176258	1.98
Tinsukia	100178	181759	1.81
K.Anglong	49847	87573	1.76
Karimganj	48817	83050	1.70
Jorhat	103407	168492	1.63
N.C.Hills	15694	24509	1.56
Sibsagar	93459	138442	1.48
Lakhimpur	63041	89649	1.42
Hailakandi	70987	96466	1.36
Golaghat	129962	170154	1.31
Dhemaji	74327	95747	1.29
Kamrup	230642	269093	1.17
Barpeta	164918	186904	1.13
Kokrajhar	90737	101404	1.12
Dhuburi	105408	118392	1.12
Nalbari	98222	108632	1.10
Goalpara	112877	123843	1.09
Sonitpur	261915	285453	1.09
Darrang	170197	184973	1.08
Nowgaon	201085	211584	1.05
Marigaon	114917	103301	0.89
Bongaigaon	71266	68622	0.96
Assam	2523379	3204750	1.27

Source: Directorate of Economics and Statistics, Govt. of Assam, Guwahati, 1997.

3.5 Changing Pattern of Land Holding in Assam:

A prominent change is visible in the land holding pattern of Assam since 1970-71 to 1992-93. According to 1970-71 census, Assam recorded about 19.64 lakhs operational holdings and in 1992-93 it increased to 25.23 lakhs with a 128.46 percent increase. The operational area also increased from 28.83 lakh hectares to 32.05 lakh hectares showing a positive growth of 111.18 percent. Consequently the average farm size decreased from 1.47 to 1.27 hectares during 1970-71 to 1992-93 is because of high population growth.

The large category of land holdings (above 10 ha) shows a negative growth with a 69.10 percent, correspondingly the operated area also reveals negative with 93.11 percent over last twenty-two years. The negative growth of the large farm size affects the operated area of medium size category, which has gone down to 94.54 percent. On the other hand, in the semi-medium size shows the maximum growth in the land holdings with 124.29 percent correspondingly 121.14 percent of operated area. The small size of land holding also shows positive growth with 120.00 percent along with 118.52 percent in operated area. The highest growth is prominent in the category of marginal size with a maximum of 135.73 percent and correspondingly 119.20 percent growth of operated area (Table-3.03). It is evident that there is a negative growth in the larger sizes of land holdings as well as in operated area, affects consequently upon the small and marginal holdings, accordingly resulting positive growth in land holdings and operated area. It indicates that fragmentation of land holdings is still continuing in Assam is mainly because of inheritance and succession.

Table-.3.03: **Number of Operational Holding, Total Operated Area and Average Farm Size in Assam, 1970-71 and 1992-93**

(Area in hectares)

Unit	Operated Holding (in Nos.)		Operated Area		Average Farm Size	
	1970-71	1992-93	1970-71	1992-93	1970-71	1992-93
Assam	1964376	2523379	2882573	3204750	1.47	1.27

Source: World Agricultural Census, 1970-71,Directorate of Economics and Statistics, Govt. of Assam, Beltola, Guwahati, 1997.

The average farm size has decreased from 1.47 in 1970-71 to 1.27 hectare during 1992-93 within a period of twenty-two years. Further, more than 82 percent of land holdings in Assam is below 02 hectares which is under estimation and it is not economically viable from the agricultural efficiency point of view. A.M. Khusro has remarked in consideration to the economic point of view that 02 hectares size of holdings is at floor level (Khusro-1968). Basically small farm sizes suffers from various problem like- size-disability, tenural uncertainty, use of human and animal power as well as the utilisation of modern technology i.e. package technology helps to change the agricultural productivity pattern.

Another important factor to be pointed out is that land distribution pattern in Assam is not uniformly distributed. Nearly 60 percent of the total holdings are concentrated in the marginal size of land holdings, covering an operated area of about

19 percent. The unequal distribution of land holding pattern is almost unchanged over last twenty-two years. Accordingly, four separate 'Lorenz Curve' are being prepared in order to ascertain the degree of concentration. From it revealed that the land distribution for both the years, but does not show any significant change and shows a high level concentration of land holding in the small sizes of land holdings (detailed is in the end of the chapter). It may be concluded that the distributional pattern of land holding in Assam is completely dominated by small size of holdings. The degrees of concentration of large size of holdings are comparatively less (Figure-3.01).

3.6 Land Holding Pattern in Lower Brahmaputra Valley:

The study area, Lower Brahmaputra Valley comprises of seven plain districts of lower Assam valley with high agricultural potentiality. The average farm size has decreased from 1.24 to 1.12 hectares, which is much lower to the all India average of 2.71 hectares (Memoria-1972). It is evident from the Table-3.04 that, more than 61 percent of holdings come under marginal farm size (less than 01 ha), but it occupies only 24.28 percent to the total area of the study region with an average size of 0.44 hectare. Moreover it is important to point out that the large farm size (more than 10 ha) constitutes only 0.08 percent to the total holding and occupied 2.05 percent of the total occupational area in the study region with an average farm size of 28.80 hectares. It is also evident from the table that in the small size of land holding occupied 22 percent correspondingly occupied an area of 28 percent of the total area of Lower Brahmaputra Valley. The semi-medium size group occupied 12.85 percent of land holdings and 31 percent of operated area. The medium size of land holdings constitutes 3.19 percent of the total holdings, covered as high as 14.22 percent of the total operated area with an average size of farm of 5.09 hectares in the year 1992-93.

Table-3.04: **Number and Area of Operational Holding in Lower Brahmaputra Valley, 1992-93**

(Area in hectare)

Size Class	Holding (in Nos.)	%	Operated Area	%	Average size
Below ol	536666	61.40	237230	24.28	0 0.44
ol ---- 02	196449	22.48	274400	28.09	01.39
02 ---- 04	112349	12.85	303401	31.06	02.70
04 ---- 10	27861	3.19	141793	14.52	05.09
Above 10	695	0.08	20017	2.05	28.80
Total	874020	100.00	976841	100.00	1.12
1970-71	676948	129.11(GR)	944727	03.40 (GR)	1.24

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
GR: Growth Rate.

The district wise distribution pattern of land holding is one of the important phenomena in the present study. There is a wide disparity in the distribution of the operational holding under different size classes in Lower Brahmaputra Valley is shown in the Table-3.04.

For the better and clear understanding about the number of operated holding and area in Lower Brahmaputra Valley In particular, a district wise analysis is shown in Table-3.05, that the highest number of operated holdings are found in Kamrup district with 31.78 percent. Followed by Goalpara with 15.56, Dhuburi with 14.53 percent, Nalbari with 13.54, Kokrajhar with 12.50, Bongaigaon with 9.82 and the least is only 2.27 percent.

Table-3.05: **District Wise Distribution of Operational Holding in Lower Brahmaputra Valley, 1992-93**

(Area in hectare)

District	Holding (in nos.)	%	Operated Area	%	Av. Farm Size
Kamrup	230642	31.78	269093	27.55	1.17
Goalpara	112877	15.56	123843	12.68	1.09
Dhuburi	105408	14.53	118392	12.12	1.12
Nalbari	98222	13.54	108632	11.12	1.10
Kokrajhar	90737	12.50	101404	10.38	1.12
Bongaigaon	71266	9.82	68622	07.02	0.96
Barpeta	164918	22.73	186904	19.13	1.13
Total	725650	100.00	976890	100.00	1.12

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.

It is also revealed from the Table-3.05 that, the total area operated for cultivation is highest in Kamrup i.e. 27.55 percent. Followed by Barpeta with 19.13 percent, Goalpara with 12.68 percent, Dhuburi with 12.12 percent, Nalbari with 11.12 percent, Kokrajhar with 10.38 percent and the lowest is in Bongaigaon district with 7.02 percent in the year 1992-93.

It is also evident that the average farm size is higher in Kamrup district with 1.17 hectares and followed by Barpeta 1.13 hectares. (Table-3.05). The low average farm size is prominent in Bongaigaon district i.e. 0.96 hectare, which is much lower than the state average as well as study region's average. This is due to the existence of large number of tiny holdings.

Like other parts of Assam, the operational land holding pattern in Lower Brahmaputra Valley is also highly concentrated more than 83 percent of the total holding in the size group less than 02 hectares occupies only 52 percent of the total operational area in the study region (Table-3.04). It is prominent that the land fragmentation process is still continues and the proportion of fragmentation in the marginal and small land holdings are very high as compared to the large and medium size of land holding. It is mainly due to the high population pressure on land, leads further fragmentation.

3.7 Changing Pattern of Land Holding in Lower Brahmaputra Valley:

In the Lower Brahmaputra Valley included only two districts during 1970-71 particularly Goalpara and Kamrup, where the average size of landholdings was very low. It is indicates the general poverty of the farmers and the problem of the small size is because of maximum concentration of agricultural land upon the hands of minority. The following Table-3.06 shows the distribution of operational holdings during 1992-93 (Latest Data that is available).

In the year 1970-71 recorded the total of operated holdings were 6.77 lakhs and it rose to 8.74 lakhs in 1992-93 increased an additional of 1.97 lakh within a period of twenty-two years (Table-3.06). It shows a positive growth of 129.11 percent. Correspondingly, the operated area also increased from 9.45 to 9.77 lakhs hectares with an extra of 0.32 lakh hectares, shows a positive growth of 103.40 percent over the same period The average size of farms was 1.24 in 1970-71 and it decreased to 1 12 hectares during same period, which is much lower to the all India average of 2 71 hectares (Memoria-1972)

Table-3 06· **Number of Operational Holding, Area and Average Farm Size in Lower Brahmaputra Valley, 1970-71 and 1992-93**

(Area in hectare)

Unit	Holding (in Nos)		Operated Area		Average Farm Size	
	1970-71	1992-93	1970-71	1992-93	1970-71	1992-93
L. B. Valley	676948	874070	844727	976890	1.24	1.12

Source: World Agricultural Census, 1970-71, Directorate of Economics and Statistics, Government of Assam, Beltola, Guwahati, 1997.

In the Lower Brahmaputra Valley region where the average size of holding is much lower because of the concentration of agricultural land upon the hands of minority landowners This small size holding accounts for common poverty of the farmers

3.8 Caste Wise Distribution of Land Holding in Assam:

All the plain districts of Assam, dominated by non-scheduled castes and non-scheduled tribe landholders The two hill districts - North Cachar Hills and Karbi Anglong highly dominated by tribal landholders The clear picture for the distribution of land holding in Assam during 1990-91 is shown in Table-3.07

Table-3 07 **Caste Wise Percentage Distribution of Operational Holding in Assam, 1992-93**

(Area in hectare)

Districts	Scheduled Caste		Scheduled Tribe		Others	
Name	**Holding**	**Area**	**Holding**	**Area**	**Holding**	**Area**
Goalpara	3 73	2 81	15 57	18 09	80 69	79 10
Dhuburi	3 38	3 19	16 10	17 57	80 51	79 23
Kokrajhar	3 82	2 68	19 69	22 58	76 49	74 74
Bongaigaon	6 85	6 26	15 65	16 74	77 49	76 99
Kamrup	3 96	3 99	12 53	14 45	83 51	81 56
Nalbari	3 87	3 85	12 64	15 37	83 49	80 78
Barpeta	3 85	3 90	12 43	14 48	83 72	81 62
Darrang	2 64	2 82	10 03	13 41	87 34	83 77
Sonitpur	2 63	2 05	8 26	9 57	89 11	88 39
Lakhimpur	5 36	4 17	23 41	29 85	71 22	65 98
Dhemaji	5 57	6 24	30 10	34 44	64 33	56 32
Dibrugarh	4 63	2 87	8 53	5 57	86 83	91 56
Tinsukia	4 64	3 19	8 49	5 97	86 87	90 83
Jorhat	4 08	2 73	5 62	5 09	96 56	92 18
Golaghat	3 92	3 68	5 84	7 26	90 24	89 06
Sibsagar	3 82	2 49	5 49	5 22	90 68	92 29
Nagaon	5 84	5 78	7 37	7 74	86 79	86 48
Marigaon	13 08	11 49	15 03	18 75	71 89	69 76
Cachar	12 35	7 92	6 88	4 94	80 77	87 14
Karimganj	10 24	7 57	3 12	3 38	86 60	89 05
Hailakandi	6 75	6 79	0 18	0 31	93 07	92 89
K Anglong	1 27	1 33	74 23	74 00	24 50	24 67
N C Hills	0 64	0 49	99 07	99 05	00 29	00 46

Source: Directorate of Economics and Statistics, Guwahati, 1997
*Figures are Provisional

The highest percentages of land holdings by Scheduled Castes is in Marigaon with 13 08 percent, followed by Cachar with 12 35 percent, Karimganj with 10 24 percent and the least is prominent in North Cachar Hills with 0 64 percent Correspondingly, the percentage of area to the total cultivated area is highest in Marigaon with 11 49 and followed by Cachar with 7 92 percent, Karimganj with 7 57 and the lowest is in North Cachar Hills with 0 49 percent in the year 1992-93 (Figure-3 02)

The land holding of Scheduled Tribes is highest in North Cachar Hills with 99 07 percent Followed by Karbi Anglong with 74.23, then Dhemaji with 30 10 and the least is Hailakandi district with 0.18 percent only. The highest operated areas are with Scheduled Tribes in North Cachar Hills with 99.05 percent, followed by Karbi Anglong with 74.00 percent, Dhemaji with 34 44 percent and the least is in Hailakandi with 0 31 percent in the year 1992-93

The highest percentage of the operational holdings owned by other category is in Jorhat with 96.56 percent Followed by Hailakandi with 93 07, Sibsagar with 90.68 and 90.24 percent in Golaghat and in North Cachar Hills with 00.29 percent Scheduled Castes and Scheduled Tribes people The highest percentages of operated areas are Hailakandi with 92.89 percent, followed by Sibsagar with 92,29 percent, The Jorhat with 92.18 percent and the lowest is in North Cachar Hills with 00.46 percent.

The dominance of non-scheduled castes and non-tribal landholders is also similar in Lower Brahmaputra Valley, as prevailed in Assam. The percentages of scheduled castes holding land is very less, which is only 4 percent with 3.57 percent operated area The district wise analysis records highest percent of landholders is found in Bongaigaon with 6.85 percent and the remaining districts with nearer to 3 percent only (Table-3 07) The Scheduled tribe landholders constitute 14 34 percent in the Lower Brahmaputra Valley region with 16 56 percent of area Kokrajhar district recorded the highest with 19 69 percent of holding with 22 58 percent of area More than 80 percent of land holdings are non-scheduled castes and non-tribal landholders In Barpeta district is highest with 83 72 with an area of 81 62 percent and Kokrajhar is the lowest with 76 49 percent of land holdings and 74 74 percent to the total operated area of the district

Table-3.08 **Caste Wise Distribution of Land Holding and Operated Area in Lower Brahmaputra Valley, 1992-93**

(Area in hectare)

Districts	**Scheduled Caste**		**Scheduled Tribe**		**Others**	
Name	Holding	Area	Holding	Area	Holding	Area
Below 01	22480 (63.46)	10250 (28 09)	66558 (53.09)	33241 (19.67)	447628 (62.76)	193739 (23.77)
01 --- 02	8003 (22.59)	10982 (30.09)	32401 (25.84)	41572 (24.59)	156095 (21.88)	216846 (26.60)
02 --- 04	4134 (11.67)	10399 (28.49	20949 (16.71)	54800 (32 42)	87266 (12.23)	238202 (29.22)
04 --- 10	780 (2.20)	4207 (11.53)	5388 (4.29)	37940 (22.45)	21693 (3.04)	148429 (18.21)
Above 10	26 (0 07)	657 (1.80)	84 (0.07)	1457 (0.86)	585 (0 08)	17953 (2 20)
Total	35423	36495	125380	169010	713267	815169
Average	4.05	3.57	14.34	16.56	81.60	79.86

Source: Directorate of Economics and Statistics, Govt of Assam, Guwahati, 1997
*Bracketed figures are the percentages

The Table-3.08 shows that the holding occupied by scheduled caste in Lower Brahmaputra Valley is 86 percent with only 58 percent of area in the farm size below two hectares. The farm size above two hectares occupied only 14 percent correspondingly to a maximum of 42 percent of operated area The land holding distribution pattern is almost similar occupied by scheduled tribe as like scheduled caste i e 82 percent of holding with 44 percent of operated area in the farm size of below two hectares The land holding owned by other category also having extra ordinarily high i.e. 85 percent of holding correspondingly 55 percent of operated area in the farm size of below two hectares It is to be pointed out from the light of above mentioned table that extra ordinarily high percent of holdings are concentrated in the small size of farms correspondingly low percent of operated area

Considering the size of land holding as one of the major determining factor for the agricultural land use Due to non-availability of information regarding the land distribution patterns at micro level smaller to district level, the land holding structure of the region is being vividly elaborated, based on the sample household data is in the Chapter-VII.

Apart from the land tenure system, the small uneconomic sizes of land holdings also have a great impact not only upon the agricultural land use pattern but also on the efficiency as well as productivity of farm The agricultural sector is characterised with unfavourable man-land ratio, the law of inheritance and succession, attitude upon the traditional cultivating society and the unrestricted transfer of land A land is considered fragmented when it is sub divided by purchase and sale, by extinction of families in the absence of direct heirs and consequent division of land among a large number of distant relatives The law of succession also results in the sub division and fragmentation of holdings. When father dies, the land is equally divided among all the heirs of the deceased. Each heir insist on having a share of land from each and every piece of land, due to varying qualities and existed in different localities resulting into further fragmentation of land holdings. If one or two heirs employed other than agricultural occupations, even than they get proportionate share of parental land. Generation after generation such an irrational fragmentation of holding is still continuing. The disadvantages of the fragmentation of land holding which puts a large proportion of land outside the possibility of effective cultivation or economic development and also waste time to supervise as well as labour. The small plots of land are difficult to utilise modern technologies in order to solve this acute problem of fragmentation of land holding, therefore consolidation of land holding is urgent necessary.

3.9 Lorenz Curve:

The Lorenz curves in Figure-3.03, 3.04, 3.05 and 3.06 brings out the picture about the disparities in respect of land distribution in Assam, lower Brahmaputra valley as well as in the sample villages. The concentration values are being obtained by using the Gini's Co-efficient mentioned below:-

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

Durıng 1970-71 the land concentratıon ratıo came out to be G= 0 0433 (Fıgure-3 03) and the Co-efficient values resulted during 1992-93 is being G= 0 0317 in Assam (Fıgure-3 04) In the Lower Brahmaputra Valley also experienced similar picture i e G= 0 0353 during 1992-93 (Fıgure-3 05) This reflects that the diversification of land ownership upon the hands of land-less and small farmers because of the measure taken by the government through land distribution system As soon as abolished zamindari land tenure system and the introduction of land ceiling act, 1972 and other land reform measures, helped the land diversification of land ownership High percentage (i e 43 98) of land concentrated within the size group of 02-10 hectares There is very negligible percent of land holding (i e 0 22) found above the 10 hectares size Therefore, most of the land lords started self-agricultural operations with the help of hired labour

The Co-efficient value during 1970-71 was G= 0 0433 which indicated a moderate land concentration of land holding In the sample villages shows a different picture with the Co-efficient value of G= 0 0610 (Figure-3.06) The land holding structure of the study area is being elaborated with the help of sample houses in "Agricultural Land Use and Productivity", Chapter- VII

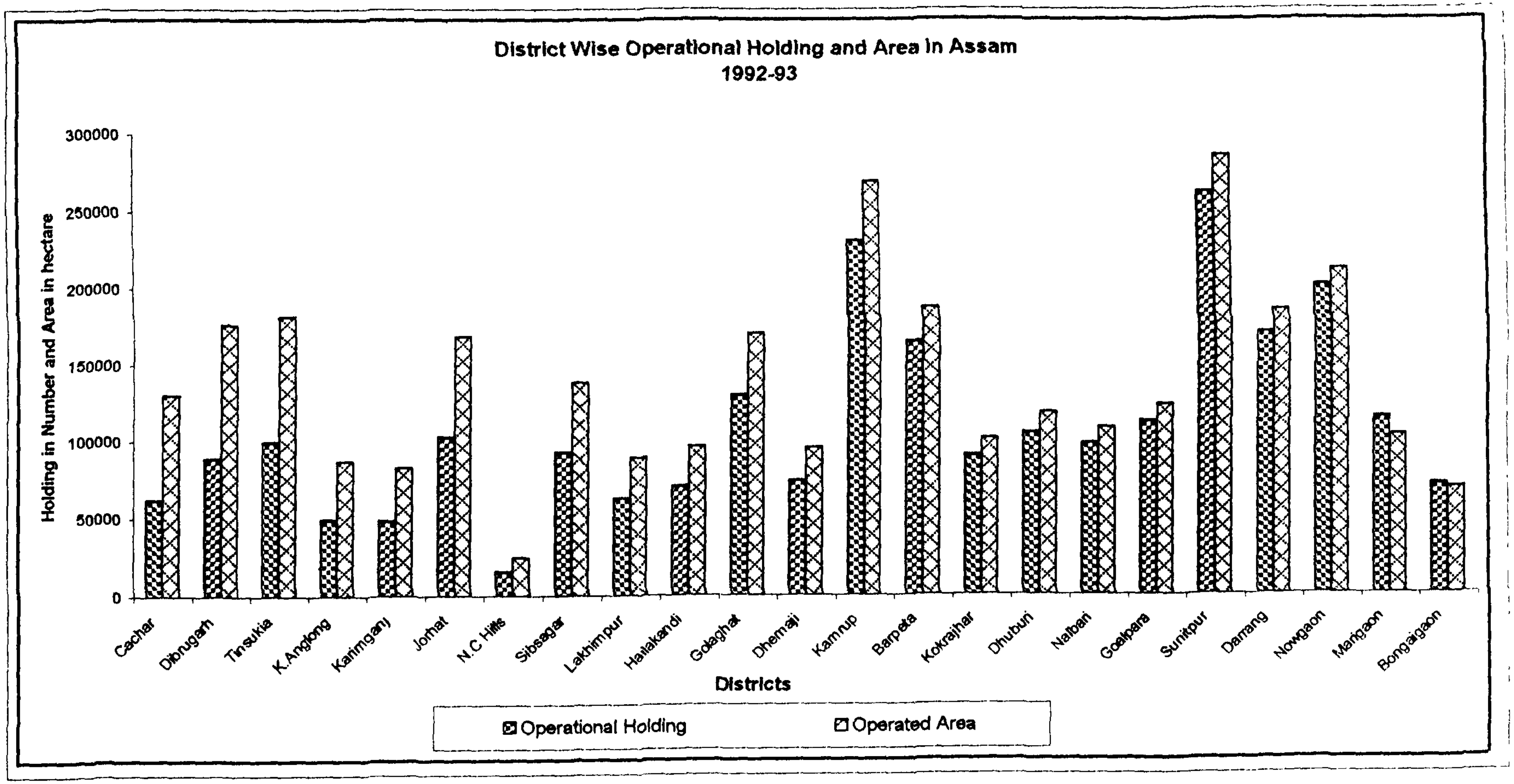
District Wise Operational Holding and Area in Assam
1992-93
Holding in Number and Area in hectare
300000
250000
200000
150000
100000
50000
0
Cachar
Dibrugarh
Tinsukia
K.Anglong
Karimganj
Jorhat
N.C Hills
Sibsagar
Lakhimpur
Hailakandi
Golaghat
Dhemaji
Kamrup
Barpeta
Kokrajhar
Dhuburi
Nalbari
Goalpara
Sunitpur
Darrang
Nowgaon
Marigaon
Bongaigaon
Districts
Operational Holding
Operated Area

Figure-3.01

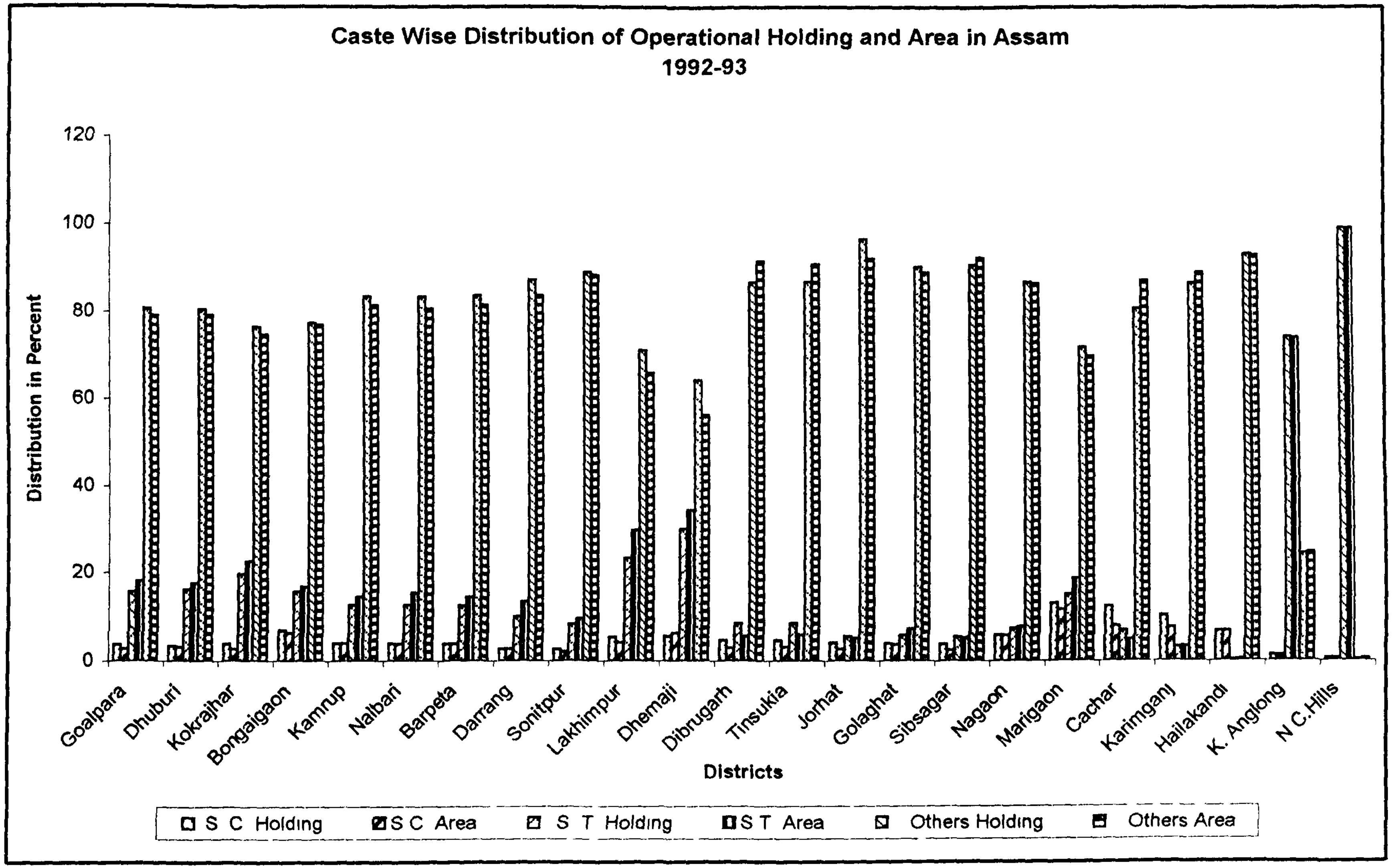
Caste Wise Distribution of Operational Holding and Area in Assam
1992-93
Distribution in Percent
120
100
80
60
40
20
0
Goalpara
Dhuburi
Kokrajhar
Bongaigaon
Kamrup
Nalbari
Barpeta
Darrang
Sonitpur
Lakhimpur
Dhemaji
Dibrugarh
Tinsukia
Jorhat
Golaghat
Sibsagar
Nagaon
Marigaon
Cachar
Karimganj
Hailakandi
K. Anglong
N C.Hills
Districts
S C Holding
S C Area
S T Holding
S T Area
Others Holding
Others Area

Figure-3 02

LORENZ CURVE

ASSAM, 1970-71

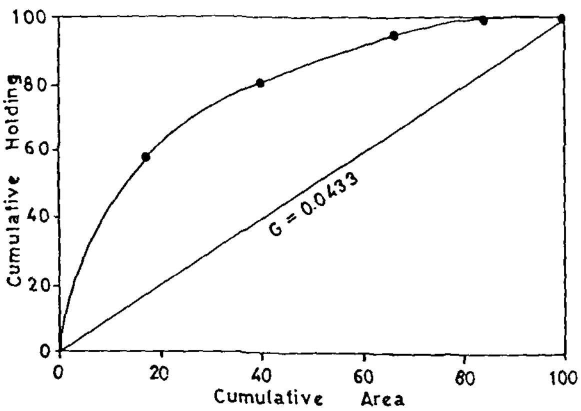

Figure-3.03

ASSAM, 1992-93

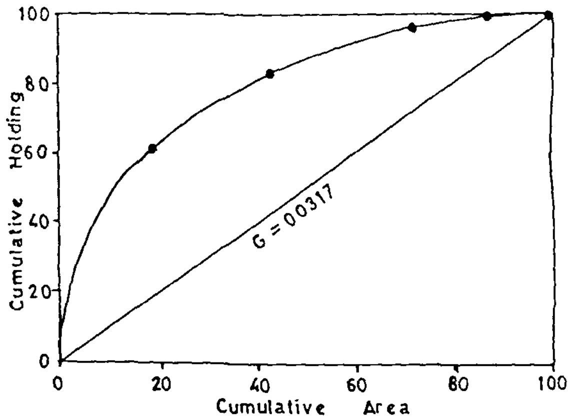

Figure-3.04

LOWER BRAHMAPUTRA VALLEY, 1992-93

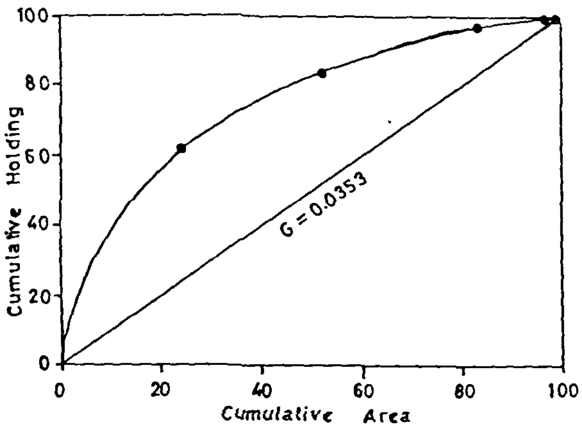

Figure-3.05

SAMPLE HOUSEHOLDS, 1998-99

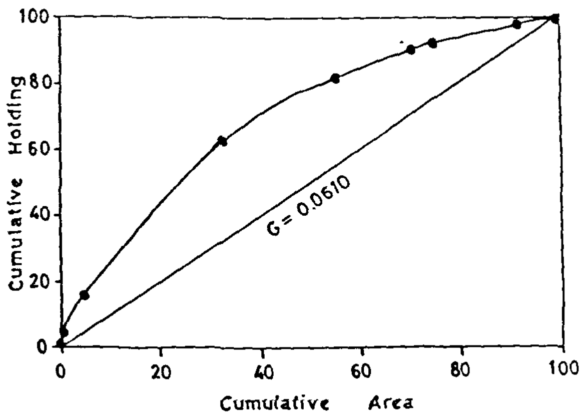

Figure-3.06

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CHAPTER IV

LAND-USE PATTERN

4.1 Introduction:

Land-use means the allocation of land under different classes to measure the magnitude of utilisation of land into various categories The land use and cropping mosaic of any region are the outcome of geomorphic features, climatic variables, soil conditions, historical processes and socio-economic institutions. In a given physical milieu, man as an active agent modifies the landscape and uses it to fulfil the requirements with the help of technology within his disposal. Moreover, the patterns of human behaviour plays an important role in the land use system of an area and it determines the land under which to be put according to his willingness. Different types of living conditions, social values and institutions create different patterns of land use within the limits imposed by different agro-physical controls. The impact of physical factors upon land use is undeniable and interwoven with socio-economic conditions of the society.

The rational classification of land of a country or of a state is of utmost necessity in order to have optimum utilisation. The Ministry of Agriculture, Government of India in 1950 recommended a standard classification and uniform definition of various land use categories to be adopted by all the states. Its definition and expansion have been further revised by the committee on improvement in agricultural statistics for its clarity and workability On the basis of this classification, land in Assam is categorised under nine broad classes (Memoria-1972)

(a) Forest cover includes the land classes or those administered as forest under legal enactment Its also includes grazing or tree crops within the forest cover

(b) Area under non-agricultural use covers all areas occupied by settlement, road, railways, beds of stream/river, ponds, canals etc.

(c) Barren and un-cultivable land includes barren rocky out crops of hills, mountains, plateau, deserts etc. These areas are not suitable for any productive activities, but it is possible to be brought under cultivation at very high cost.

(d) Permanent pasture and grazing land embraces all the grazing land; it might be either meadows or village common pastures

(e) Area under miscellaneous tree crops, which includes all the cultivable land are not included in net area sown, but put into some agricultural uses, i.e., tree crops other than seasonal cropping.

(f) Cultivable wasteland, where land considered by peasant as cultivable but not cultivated during the current agricultural year and last few years in succession. It might be left out on account of physical, social or economic limitations. Under certain circumstances some proportion of land may be brought under plough without reclamation even.

(g) Current fallow indicates the land left un-sown during the current agricultural year in order to regain its fertility and also may be remained un-cropped on account of economic limitations.

(h) The other fallow land comprises all the lands taken up for agricultural purposes but it is temporarily un-cropped for duration of one to five years. The reasons for a long fallow period may be manifold but the significant are:

(1) Inadequate supply of water into to agricultural field,

(2) Inability to cultivate due to lack of resources,

(3) Malarial climate,

(4) Un-economic/un-remunerable of farming system.

(i) The net sown area represents the extent of cultivated area sown during the current agricultural year. It indicates the difference between the total geographical area and the sum of the total area occupied by other classes.

4.2 General Land Use in Assam:

The forest covers an area of 19,84,548 hectares, i.e., 25.30 percent of the total geographical area of Assam in the year 1992-93. This share is much higher as compared to the national average of 18.28 percent (1988-89, Remote Sensing Data), but it is still lower than the national target of 33.3 percent. The land not available for cultivation includes barren and uncultivated land, as well as the land put to non-agricultural uses, which occupies an area of 24,73,104 hectares, i.e., 32.52 percent of the total area of Assam On the other hand. the other un-cultivated land, which includes permanent pasture and grazing land and the area under miscellaneous tree crops and groves as well as cultivable waste, occupies 4,71,768 hectares or about 6 01 percent The fallow land includes current and old fallow land, which covers an area of 1,41,727 hectares, which is 1 81 percent to the total area of the state in the year 1992-93

It is evident from the Table-4 01 that the net sown area covers 27,77,347 hectares i e 35 41 percent of the total geographical area in the year 1992-93, which has been increasing steadily since independence During 1951-52, the net sown area occupied 18 9 lakh hectares i e 24 09 percent in 1969-70, this became 22 26 lakh hectares i e 28 38 percent during 1980-81

There is a remarkable increase in multiple cropped area, recorded at 3 13 lakh hectares during 1951-52 i e 3 99 percent, and it rose to 5 48 lakh hectares which is 6 98 percent, during 1980-81 It increased to an area of 11.49 lakh hectares i e 14 65 percent in 1992-93 of the total geographical area of the state

Table-4 01 **General Land Use in Assam, 1970-71 and 1992-93**

Classification	**Area in hectare**		**Percentage**	
	1970-71	1992-93 (P)	1970-71	1992-93 (P)
Geographical Area	7851670	7843800		
Forest	2115	1984548	26 94	25 30
Not available for Cultivation	2536365	2473104	32 30	32 52
Other uncultivated Land a) Pt Pasture and Grazing	260746	163062	3 32	2 08
b) Under Misc Tree Crops	235859	219926	3 00	2 80
c) Cultivable Waste	179613	88780	2 29	1 13
Fallow Land a) Other Than current	165094	69938	2 10	0 89
b) Current Fallow	122919	71789	1 57	0 92
Net Sown Area	2235909	2777347	28 48	35 41
More Than once Sown	557294	1148796	7 10	14 65
Total Cropped Area	2793203	3926143	35 57	50 05

Source: Agricultural Census 1971, Directorate of Economic and Statistics, Government of Assam, Guwahati, 1997

P: Figures are Provisional

The general land use pattern of Assam is evident from the Table-4 01, where fallow land and cultivable wasteland is seen to have occupied an area of 2 31 lakh or 2 94 percent in 1992-93 If these lands are brought under cultivation then the total net sown area will be extended to 30 08 lakh hectares against the existing net sown area of 27 78 lakh hectares

4.3 Changing Pattern of General Land Use in Assam:

The transformations of general land use pattern have taken place in Assam It is evident from the Table-4 01 that within a span of twenty-two years the forest cover has decreased by 1 64 percent since 1970-71 to 1992-93 This is due to deforestation, emergence of new settlements, construction of roads etc

Though area not available for cultivation has increased but at a very slow pace, i e only 0 22 percent The other uncultivable land decreased by 2 60 percent of growth within a period of twenty-two years The fallow land also decreased from 3 67 percent in 1970-71 to 1 18 percent in 1992-93 (Figure-4 01) The permanent pasture and grazing land with 1.24 percent and land under miscellaneous tree crops with 0 20 percent and cultivable waste-land with 1 16 percent within the same period

The net area sown is increasing constantly at a slow pace and has risen from 28 48 percent in 1970-71 to 35 41 percent during 1992-93 with 6 93 percent extra within last twenty-two years This is due to soil reclamation and population pressure on arable land etc

From the Table-4 01 it is seen that, there is a considerable increase in multiple cropped area During 1970-71 the coverage was 7.10 percent and it increased to double within twenty-two years, it became 14 65 percent in 1992-93 This increase is because of population pressure on arable land

4.4 General Land Use in Lower Brahmaputra Valley:

The Lower Brahmaputra Valley includes seven plain districts of lower Assam, occupying 20.15 lakh hectares of land (25 69 percent) to the total geographical area of Assam Forest covers 5.34 lakh hectares of land (26 50 percent) to the total study region (Table-4.02)

Table-4 02 **General Land Use of Lower Brahmaputra Valley, 1970-71 and 1992-93**

Classification	Area in hectare		Percentage	
	1970-71	1992-93 (P)	1970-71	1992-93 (P)
Geographical Area	2026180	2014800	25 81	25 69
Forest	591410	534015	29 19	26 50
Not Available for Cultivation	418172	379569	20 64	18 84
Land not Available for Cultivation (a) Pt Pasture and Grazing Land	111287	66311	5 49	3 29
(b) Under Misc Tree crops	41212	46484	2 03	2 31
(c) Cultivable Waste	33380	21249	1 65	1 05
Fallow Land (a) Other Than Current	34960	19681	1 73	0 98
(b) Current Fallow	23641	22945	1 17	1 14
Net Area Sown	772118	920252	38 11	45 67
Area Sown More Than Once	282398	433989	13 94	21 54
Total Cropped Area	1054516	1254241	52 04	62 25

Source: Agricultural Census 1971, Directorate of Economic and Statistics, Agriculture Division, Guwahati, 1997

P: Figures are Provisional

The land not available for cultivation includes barren and un-cultivated land as well as the land put to non-agricultural uses covering an area of 3 39 lakh hectares (18 84 percent) to the total area of Lower Brahmaputra Valley in the year 1992-93 The land occupied by other un-cultivated land, which embraces- permanent pasture and grazing, land under miscellaneous tree crops and groves and cultivable waste, covers an area of 1 34 lakh hectares (6 65 percent) The fallow land includes current fallow and other than current fallow covers an area of 42 63 thousand hectares (2 12 percent) of the total area of the study region

The net area sown in Lower Brahmaputra Valley occupies 9 20 lakh hectares (45 67 percent) of land The percentage of net sown area is much higher in comparison to the state average (35 41) The multiple cropped area covers 4 34 lakh hectares (21 54 percent) of the study region in the year 1992-93, which is also much higher than the state average (14 65)

It is evident from the Table-4 02 that, the fallow land includes current and old fallow land and cultivable waste, which occupies an area of 63 88 thousand hectares (3 17 percent) If this land is brought under cultivation then the total net sown area may be extended to 9 84 lakh hectares against the existing net sown area of 9 20 lakh hectares To have a clear picture about the agricultural production system, a detailed land use pattern is a must

4.4.1 Forests:

The forested area represents an exclusive use of land occupying trees/shrubs The area under grazing land or crops within forest cover is also included in the area under forest Due to climatic conditions and high population pressure on land, the level and easily workable alluvial plain areas are occupied for settled agriculture The total area under forest in Lower Brahmaputra Valley recorded 5,34,015 hectares (26 56 percent) during 1992-93

The distribution of forest area in the study region is very uneven Kokrajhar district recorded the highest with 57 55 percent and the lowest in Nalbari with 8 47 percent of the total area under forest in Lower Brahmaputra Valley (Appendix) In remaining districts varies its proportion, Goalpara with 20 63 percent, Dhuburi with 14 56 percent, Bongaigaon with 21 59 percent, Kamrup with 26 22 percent and Barpeta with 26 24 percent of the total area of their respective districts In the southern part of the region adjacent to Meghalaya plateau and in the foothills of the Bhutan Himalayas, are the major-forested tracts in Lower Brahmaputra Valley region

4.4.2 Land Not-Available for Cultivation:

The land not available for cultivation can be classified into two sub-groups because of the different utilisation The area under non-agricultural use covers all the land occupied by settlements, roads, railways, embankments, canals, tanks, burial place, play ground, target shooting etc

The land put to non-agricultural use covers 11 76 percent in the Lower Brahmaputra Valley against 12 91 percent in Assam The high concentration of land put to non-agricultural use in Dhuburi with 19 73 percent, followed by Kamrup with 15 53 percent, Bongaigaon with 15 53 percent and Goalpara with 11 78 percent In the remaining three districts, i.e Barpeta with 6.36 percent, Nalbari with 6 86 percent and Kokrajhar with 5 81 percent (Appendix) The higher proportion of land is not available for cultivation or put to non-agricultural uses, reflects that the population pressure is comparatively high on land. Therefore devoting large proportion of area for non-agricultural uses.

4.4.3 Barren Land:

The Barren and uncultivable land and bare rocky outcrop of hills, mountains, and plateau, etc. are demarcated as barren land. These lands can be brought under cultivation at a high cost. But these are classified as uncultivable, whether such lands are isolated or within the cultivated holdings.

The Table-4.02 shows that, about 7.12 percent of the total area in Lower Brahmaputra Valley is barren land, generally less important from agricultural point of view, covers an area 18.62 percent to the state average. The highest proportion of barren land is recorded in Goalpara district with 17.90, followed by Bongaigaon with 14.90 percent. In district Nalbari it was 2.76 percent only, during 1992-93 (Appendix)

4.4.4 Other Uncultivated Land Excluding Fallow Land:

The other uncultivable land excluding fallow land includes permanent pasture and other grazing land, miscellaneous tree crops and groves and cultivable wasteland. The permanent pastureland includes meadows and grazing land within the forest cover area. The miscellaneous tree crops and groves grown in the area are not included in the net area sown All the cultivable land has been put into some agricultural use, but not included under net area sown The land under thatching grasses, bamboo, bushes and other groves, trees for fuel also included in this category The cultivable wasteland includes the land available for cultivation, but not taken up for cultivation or abandoned after a few years of cultivation For one reason or the other, such land may be covered with shrubs and jungles, but are not put into any use They may be assessed or un-assessed and may be isolated blocks or within the cultivated land (Singh-1974)

(A) Permanent Pasture and Grazing Land:

The permanent pasture and grazing land embraces all grazing land, which may be permanent meadows or village common pastureland The permanent pasture and grazing land in Lower Brahmaputra Valley covers an area of 66,311 hectares, which was 3.30 percent in 1992-93

The percentage of land under permanent pasture and grazing is highest in Nalbari with 7.23 percent, which is even more than the state (i.e.-2.08 percent) as well as study region average (3.29 percent), followed by Kamrup with 4.77 percent, Barpeta with 3.93 percent (Appendix) In Bongaigaon with 2.61 percent, Goapara with 1.93 percent, Kokrajhar with 1.27 percent and the least is in Dhuburi district with 1.06

percent The land under this category tends to decrease over the years because of population growth

(B) Land under Tree Crops and Grasses:

The land under miscellaneous tree crops and grasses covers an area of 46,484 hectares, representing 2.31 percent of the total area of Lower Brahmaputra Valley during 1992-93

The higher concentration of land under this category than the study region average (2.31 percent) is found in Kamrup with 5.76 percent, followed by Goalpara with 2 99 percent The district Barpeta with 1 37 percent, Kokrajhar with 1 27 percent, Bongaigaon with 01.00 percent, Dhuburi with 0.95 percent and the least is in Nalbari district with 0 76 percent of the total area of their respective districts in the year 1992-93 (Appendix) The proportion of its share is increasing due to the transformation of un-cultivated soil to tree crops, in order to strengthen the economic condition of the family.

(C) Cultivable Waste Land:

The cultivable wasteland in Lower Brahmaputra Valley is decreased from 33,880 hectare in 1970-71 to 21,249 in 1992-93, (1 65 & 1.06 percent respectively) It is observed that the cultivable wasteland has been decreasing in the past years The highest concentration of cultivable wasteland is found in Bongaigaon district with 1 70 percent, followed by Kamrup with 1 33 percent The remaining districts have a lesser concentration than the study region aveiage (1 05 percent) Goalpara with 0 81 percent, Kokrajhar with 0 80 percent, Nalbari with 0 68 percent and the lowest is in Barpeta district having only 0 51 percent in 1992-93 (Appendix) The over all decrease of cultivable wasteland is mainly due to the pressure of population on land

4.4.5 Fallow Land:

The fallow land other than current fallow includes all lands, which were taken up for cultivation but are temporarily out of utilisation for a period not less than five years The current fallow comprises of cropped areas that are kept fallow during the current year For instance, if seedling areas are not cropped again in the same year, it is treated as current fallow (Hussain-1979) The land under un-cultivable categories together recorded 1,34,044 hectares (2 12 percent) in 1992-93 in Lower Brahmaputra Valley region

(a) Fallow Land Other Than Current Fallow:

The fallow land other than current fallow in Lower Brahmaputra Valley is decreased in the past years from 34,960 hectares, that is, 1.73 percent during 1970-71 to 19,681 hectares accounting for 0 98 percent to the total area in the year 1992-93

Moreover in Assam, it also decreased from 2 10 percent to 0 89 to the total area, within a span of twenty-two years

The percentage coverage of fallow land other than current fallow in the Lower Brahmaputra Valley is not uniformly distributed in each and every district, varies from one district to another. The highest percentage is recorded in Dhuburi district with 2.00 percent, followed by Bongaigaon with 1 12 percent and Kamrup with 1 11 percent (Appendix) The remaining districts are far below than the study region average (0 98 percent) of the total area of respective districts according to 1992-93 and least is found in Nalbari with 0 55 percent

(b) Current Fallow:

The land under current fallow in the Lower Brahmaputra Valley as a whole is higher i.e 1 14 percent as compared to the state average which is 0.92 percent according to 1992-93 to the total area Moreover, the percentage of current fallow is not uniformly distributed and it is varies from one district to another

The district wise analysis provides a better result that the highest percentage of current fallow is found in Bongaigaon district with 2.23 percent, followed by Barpeta with 1.48 percent, Dhuburi with 1.42 percent, Nalbari with 1.29 percent and Kamrup with 0.99 percent. The remaining two districts particularly Goalpara with 0.87 percent and the lowest is in Kokrajhar with 0 47 percent in the year 1992-93 (Appendix).

4.4.6 Net Area Sown:

Net area sown represents the extent of cultivated area actually sown during the current agricultural year. This represents the differences between the total and the sum of total area under these classes. The total net sown area was recorded as 9,20,252 hectares, i.e. 45.77 percent to the total area against 35.41 percent in Assam, during 1992-93, is comparatively high.

The net sown area to the total area is also varies from one district to another in Lower Brahmaputra Valley. Nalbari recorded the highest i.e. 71.37 percent and the lowest is in Kokrajhar with 27.44 percent of the total area of the district (Appendix). The net sown area is comparatively high in Barpeta with 54.87 percent, Dhuburi with 53.71 percent, Goalpara with 42.49 percent, Kamrup with 39.89 percent and Bongaigaon with 39.11 percent in 1992-93. The high percentage of net sown area is mainly due to the alluvial nature of soil and moderate to high rainfall.

4.4.7 Area Sown More Than Once:

The area sown more than once or multiple cropped area in the Lower Brahmaputra Valley was 4,33,989 hectares i e 21 54 percent against 14 65 percent during 1992-93 in Assam This is due to the favourable agro-climatic condition and high population pressure

Table-4 03 **District Wise Distribution of Double Cropped Area in Lower Brahmaputra Valley, 1992-93**

(Area in hectare)

District	Operated Area (P)	P.C. to the total area
Barpeta	131735	40 60
Dhuburi	76709	27 03
Bongaigaon	55090	21 95
Nalbari	48364	21 43
Kokrajhar	56733	18 13
Goalpara	19906	10 91
Kamrup	45452	10 46
L B Valley	433989	21 54
Assam	1148796	14 65

Source: Directorate of Economic and Statistics, Government of Assam, Guwahati, 1997

P: Figures are Provisional

Barpeta district recorded the largest double/multiple cropped area with 40 60 percent and is followed by Dhuburi with 27 03 percent (Figure-4 02) The remaining districts, basically Bongaigaon with 21 95, Nalbari with 21 43, Kokrajhar with 18 13, Goalpara with 10 91 and the least is in Kamrup with 10 46 percent to the total area during 1992-93

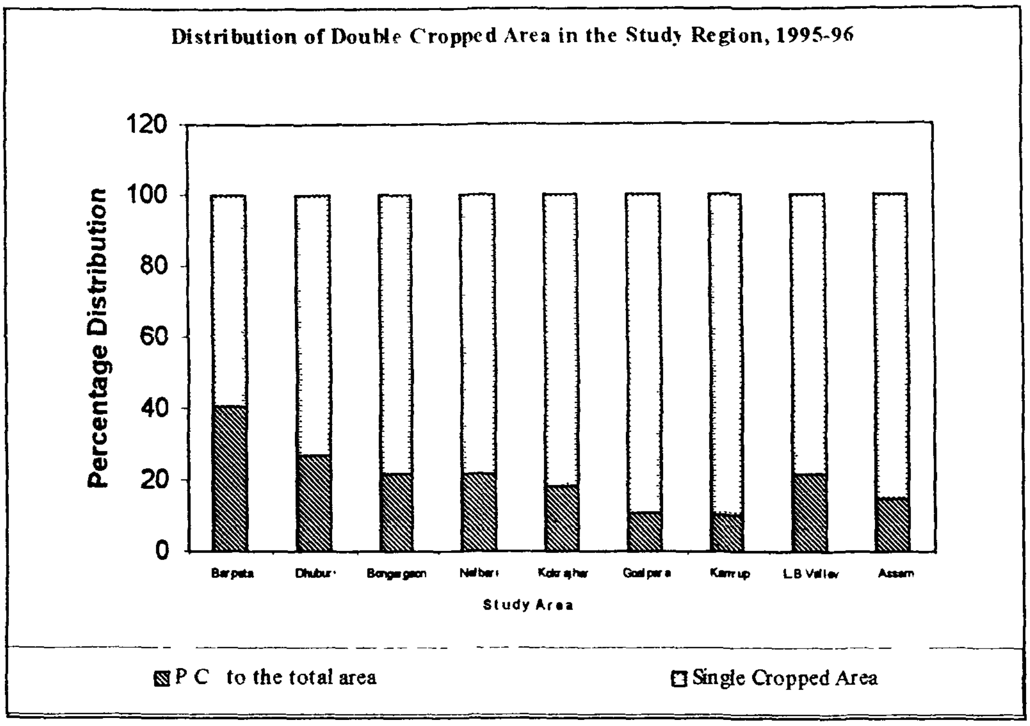


Figure-4 02

4.5 Changing Pattern of General Land Use in Lower Brahmaputra Valley:

Land use pattern in Lower Brahmaputra Valley region has been experienced a major change within a span of twenty-two years since 1970-71 to 1992-93. It is evident from the Table-4.02 that, the forest area has decreased from 29.19 percent to 26.50 percent by 2.69 percent within twenty-two years to the total area

Although, the area not available for cultivation is found to have decreased but it is at a slow pace from 20 64 percent to 18.84 percent with 1 18 percent The permanent pasture and grazing land also decreased from 5.49 percent to 3.29 percent (Figure-4.03). The land under miscellaneous tree crops has increased from 2.03

percent to 2 31 percent Further. the cultivable wasteland has decreased from 1 65 percent to 1 05 percent during the period of 1970-71 to 1992-93

It is also evident from the Table-4 02 that, other than current fallow has decreased from 1 73 percent to 0 98 percent The current fallow land too decreased from 1 17 percent to 1 14 percent within last twenty-two years

The net area sown, though increased but it is growing at a slower pace from 38 11 percent to 45 67 percent (i e 7 56 percent extra), which is slightly higher as compared to the state average of 6 93 percent since 1970-71 to 1992-93

It is also evident from the Table-4 02 that, there is a considerable increase in multiple cropped area The percentage of increase in case of multiple cropped area is about 7 6 percent, which is almost the same as the net sown area i e 7 56 percent in Lower Brahmaputra Valley region since 1970-71 to 1992-93

4.6 Agricultural Land Use in Assam:

An agricultural year traditionally has been subdivided into 'Rabi' and 'Kharif' crop seasons, corresponding to winter and summer season The third crop season is known as 'Zaid' crop grown between rabi and kharif sowing season, i e mid March to mid June, within these period some of the cultivators grow some short duration crops The standard agricultural calendar is almost applicable in the study region, characterised high temperature and moist climate prevails through out the year. The warm humid climatic conditions permit farmers to grow even rice during winter season.

The kharif crop season corresponds with the commencement of summer, i.e. June to October. The kharif crop requires high temperature and high moisture content in soil. The area occupied by each crop in every district is given in the Table-4.04.

Agricultural land use in Assam is characterised with low percentage of cultivable land and a very high proportion devoted to rice. Agricultural land use means the cultivation of soil for growing crops, leaving a small area for grass land, horticulture, pisciculture as well as dairy farming. It is observed that, there has been a very slow increase in area under different crops in Assam over four and half decades. The gross cropped area increased from 22.02 lakh hectares in 1951-51 to 39.26 lakh hectares in 1995-96. The principal characteristic of agricultural land use pattern in Assam is that, where a large proportion of cropped area is devoted to food crops, particularly 83.37 percent of the total cropped area. This proportion is due to the population pressure upon land in response to food requirements and it is the reflection of low commercialisation of agricultural sector in Assam.

Rice is the principal crop and also the staple food for the people of Assam. Rice is grown extensively in all the districts by traditional methods with varying proportions In Assam generally three varieties of rice are grown, those are winter rice (Sali and Bao), summer rice (Ahu) and spring rice (Boro). The winter rice follows transplantation, while summer rice is grown on broadcast method There is another variety of rice grown in Assam called as 'Bao' which is generally grown in the low-lying areas. Bao rice also is sown on broadcast method during the months of February-March and this variety is called as 'Autumn rice' and it is harvests during the months of September-October. The spring rice called as 'Boro Rice' is sown by transplantation during October-November and is harvests during February-March cultivates in marshy and water logged areas.

The winter rice grown in Assam occupies 17.60 lakh hectares, which is the largest in area, i.e. 69.29 percent of the total rice hectareage. The summer rice occupied an area of 62.50 lakh hectares representing 24.61 percent and remaining 6.10 percent is devoted to spring rice during 1995-96. The summer rice variety is highly concentrated in Lower Brahmaputra Valley region.

From the over all cropping pattern in Assam, it is evident that out of total net area sown, food crops occupied 83.23 percent and 17.36 percent, non-food crops. The food crop (Grains) includes rice, wheat, maize, small millets, pulses, whereas the non-food crops includes the rest of the crops like- oilseeds, fibre crops, miscellaneous crops etc

Table-4 04 **Agricultural Land Use in Assam, 1970-71 and 1995-96**

(Area in '000' hectare)

Crops	**1970-71**		**1995-96**	
	Area	Percentage	Area	Percentage
Winter Rice	1421 3	57 68	1760	54 76
Summer Rice	526 7	21 37	625	19 44
Spring Rice	26 3	1 07	155	4 83
Total Rice	1974 3	80 12	2540	79 03
Maize	12 4	0 50	19	0 59
Wheat	20 1	0 82	86	2 68
Other Pulses & Millets	4 3	0 17	11	0 34
Total Cereals	2011 1	81 61	2656	82 64
Gram	1 6	0 06	3	0 09
Tur (Arhar)	4 1	0 17	6	0 19
Rabi Pulses	79 1	3 21	10	0 31
Total Pulses	84 8	3 44	19	0 59
Total Food Grains	2095 9	85 05	2675	83 23
Sesamum	9 8	0 40	16	0 50
Rape & Mustard	137 5	5 58	279	8 68
Linseed	0 8	0 03	10	0 31
Castor	1 8	0 07	2	0 06
Total Oil Seeds	149 9	06 08	307	9 55
Cotton	4 1	0 18	2	0 06
Jute	128 0	5 19	89	2 77
Mesta	6 7	0 27	6	0 19
Total Fibre	138 8	5 63	97	3 02
Sugar Cane	32 0	1 30	36	1 12
Tobacco	8 4	0 34	2	0 06
Potato	24 2	0 98	74	2 30
Sweet Potato	6 9	0 28	9	0 28
Chilli	8 1	0 33	14	0 44
Misc Total	79 6	3 23	135	4 20
Grand Total	2464 2	100 00	3214	100 00

Source: Agricultural Census, 1971, Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997

P: Figures are Provisional

Apart from rice, wheat and maize are two important cereals grown in Assam Wheat is mainly cultivated in Lower Brahmaputra Valley region and maize is in the two hill districts of Karbi Anglong and North Cachar Wheat hectareage in Assam is very meagre, only 86 thousand hectares are under wheat i e 2 68 percent and maize is only 19 thousand hectares i e 0 59 percent of the total cropped area of the state in the year 1992-93

Pulses are also another important food crops in Assam Pulses occupied only 19 thousand hectares i e 0 59 percent of the total cropped area in the year 1995-96 Pulses include- gram, tur (arhar), rabi pulses i e lentil (masur), black gram (mati kalai), green gram (moong), pea (matar) etc

Oilseeds also an important crop cultivated in Assam, which includes rape and mustard, linseed and castor, among them rape and mustard received the prominent place The total oilseed occupied 3 07 lakh hectares, i e 9 55 percent of the total cropped area during 1995-96 in Assam

The fibre crops in Assam covers only 97 thousand hectares i e 3 02 percent Among fibre crops, jute attained the prominent place and hectareage is also high as compared to mesta and cotton in Assam The miscellaneous crops includes sugarcane, tapioca, potato, sweet potato, chillies etc which occupied an area of 1 35 lakh hectares i e 4 20 percent of the total cropped area in the year 1995-96 Generally, tobacco is also grown in those areas, where jute is cultivated mainly by Muslim immigrants

4.7 Changing Pattern of Agricultural Land Use in Assam:

It is evident from the Table-4 04 that within a span of twenty-five years the proportionate area coverage by rice is decreased from 80 12 percent to 79 03 percent since 1970-71 to 1995-96 According to variety, winter rice is decreased from 57 68 percent to 54 76 percent, summer rice from 21 37 percent to 19 44 percent during same period, whereas spring rice is increased the proportionate area from 1 07 percent in 1970-71 to 4 83 percent during 1995-96 (Figure-4 03)

The growth rates of other cereals like wheat increased from 0 82 percent to 2 68 percent, other pulses and small millet from 0 17 percent to 0 34 percent and maize from 0 50 percent to 0 59 percent since 1970-71 to 1995-96 Total cereals as a whole increased its proportionate area from 81 61 percent to 82 64 percent within a period of last twenty-five years in Assam

Apart from cereals, there is a tremendous negative growth experienced in pulses decreased from 3 44 percent to 0 59 percent Crops such as gram increased from 0 06 percent to 0.09 percent, tur from 0 17 percent to 0 19 percent and other rabi pulses from 3 21 percent to 0 31 percent to the total cropped area of Assam within a span of twenty-five years It is also evident from the Table-4 04 that food crops as a whole decreased its proportionate area over the years. decreased from 85 05 percent to 83 23 percent during last twenty-five years since 1970-71 to 1995-96

The oilseeds shows an increase its proportionate cropped area over the year's i e 6 08 percent in 1970-71 to 9 55 percent during 1995-96 Rape and mustard increased its area from 5 58 percent to 8 68 percent, sesamum from 0 40 percent to 0 50 percent, whereas castor decreased from 0 07 percent to 0 06 percent over the same period The fibre crops also decreased its proportionate area from 5 63 percent in 1970-71 to 3 02 percent during 1995-96 Accordingly crop wise also decreased, particularly jute from 0 18 percent to 0 06 percent, mesta from 0 27 percent to 0 19 percent and cotton from 0 18 percent to 0 06 percent since 1970-71 to 1995-95

The miscellaneous shows a medium rise of percent of cropped area to the total area increased from 3 23 percent in 1970-71 to 4 20 percent during 1995-96 Potato shown an increase of proportionate area from 0 98 percent to 2 30 percent and chillies from 0 33 percent to 0 44 percent to the total area over the same period Whereas, sugarcane decreased from 1 30 percent to 1 12 percent, tobacco from 0 34 percent to 0 06 percent and sweet potato shown remained constant i.e 0 28 percent in the same period This positive growth in cereals i e oilseeds and miscellaneous crops is because of the increasing population growth to meet the high food demands, which has forced the cultivators to incline towards food these crops

4.8 Agricultural Land Use in Lower Brahmaputra Valley:

Agricultural land use of an area is well conceived, when its area dominated with different crops, is identified with the help of standard statistical techniques. The simple delineation of an area into a crop region conceals the degree of their concentration, therefore the study of concentration of crops has great relevance to understand the agricultural land use for planning at macro or micro level. The main objective of such is to study or analyse the cropping pattern of an area at regional level. The introduction of HYV crops in the field of agriculture is perhaps relatively easier in the region where a traditional method of agriculture is dominated. The study of the spatial concentration of a particular crop is of immense help to the planners, agricultural statistics and administrators or policy makers for the implementation of new innovations for the agricultural development.

4.8.1 Principal Crops:

The land use under different crops can not be regarded as complete unless a study of geography of crops grown in the region is made. The diverse soils and other physical condition of the area, which results a number of crops grown in the entire region. The number of crops cultivates in the area is so large that all crops can not be taken into consideration in the present study. Therefore only few significant crops (nine) have been selected for this study are- rice, sugarcane, jute, rape and mustard, wheat, pulses, mati kalai, and gram. These crops account for 90 percent of the cropped area in the study region.

4.8.2 Rice:

Rice is most extensively cultivated and the staple food of the entire study region. Rice is grown under variety of conditions ranging from comparatively drier un-irrigated hilly slopes of shallow soils to the wet and water logged areas of deep alluvial soils. The roots of paddy are semi- aquatic and well adopted and can thrive even under water. The presence of water above the soil level hampers tilling and also retards plant growth. Rice thrives well in the heavy soils of acidic reaction in nature. The entire Lower Brahmaputra Valley is most suitable for the rice cultivation. The temperature, rainfall and alluvial soils are all very conducive for the growth of rice, though mostly depends on monsoon rain.

Primarily, two principal varieties of rice are grown in Lower Brahmaputra Valley region. During kharif season, the early maturing variety of rice is grown during mid-June to mid-July and is harvests in the end of October. This paddy cultivation is locally called as 'Ahu' or 'Autumn Rice'. The second rice variety is the late maturing and is grown during August and harvests in November-December and is locally called as 'Sali' or 'Winter Rice'. 'Boro' is a special variety, which is grown on broadcast method in deep-water areas, grown in the flooded and water logged areas.

Basically rice in the region is a puddle crop. Its cultivation is carried out in three different ways. In the first method, the seed is sown after being sprouted slightly.

The second method is broadcast and the third method, seedlings are separately raised in a nursery before being transplanted in to the puddle field

The late maturing varieties of rice usually transplanted during rainy season, i e , July and August, seedlings are raised in highly manure nurseries Before transplantation, the paddy field is ploughed and puddles four to six times depending upon the nature of soil and labour and cattle energy available at the disposal of the cultivators Afterwards seedlings are transplanted in bunches in a standing water in the paddy field 'Sali' crop flourishes well during the monsoon season and harvests during the month of November and December

'Boro' Rice is grown on broadcast method in the low lying as well as waterlogged areas during the month of December and January after being ploughed four to five times. Excessive weeding operation becomes essential for 'Boro' rice cultivation before the land gets flooded This variety of rice is harvests during the month of March and April

Table-4.05. **Agricultural Land Use of Cereals in Lower Brahmaputra Valley 1995-96**

(Area in Percent to the Total Cropped Area)

District	Autumn Rice	Winter Rice	Summer Rice	Total	Maize	Wheat	Or. Cr. and Sm. Millets	Total Cereals
Goalpara	23.73	41.67	4.88	70.28	0.23	4.74	0.76	76.01
Dhuburi	22.58	19.36	4.34	46.27	0.07	6.28	1.71	54.33
Kokrajhar	24.09	44.21	2.83	71.13	0.54	1.26	0.32	73.25
Bongaigaon	24.69	41.67	3.20	69.56	0.27	3.12	0.64	73.59
Kamrup	18.08	45.48	8.37	71.72	0.15	2.81	...	74.68
Nalbari	22.70	54.24	0.69	77.09	0.16	2.13	0.07	79.45
Barpeta	28.14	36.36	3.32	67.82	0.02	4.25	0.99	73.08
L.B. Valley	24.58	40.42	4.27	76.09	0.17	3.95	0.77	74.17

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997.

Winter rice is dominated with 76.09 percent of the total cropped area of Lower Brahmaputra Valley. In Dhuburi district only 19 percent of total cropped area is devoted to winter rice and in remaining districts are more than 35 percent. In Nalbari the highest percent of cropped area is devoted to rice i.e. 54.24 (Table-4.05). The autumn rice is the second rank in the study region occupies 24 percent of cultivated area. Barpeta occupies the highest area with 28.14 percent and Kamrup with 18.08 percent of total cropped area. Boro rice is considered as kharif rice occupies only 4.27 percent to the total cropped area. Kamrup district is ranked top with 8.37 percent and Nalbari is the least i.e. 0.69 percent only to the total cropped area during 1995-96.

Table-4.05 evident that rice is the dominant crop in all the districts. But its shares to the total cropped area varies from 46.27 percent (Dhuburi) to 77.09 percent

(Nalbari) respectively. Except Dhuburi district, in all districts more than 69 percent of the cropped area devoted to rice, as it shows a fairly high concentration

Cereals other than rabi pulses having very less proportionate area to the total, includes- maize, wheat and other cereals and small millets. Wheat occupied a prominent place with 3.95 percent of the total area in Lower Brahmaputra Valley. The maximum concentration is found in Dhuburi with 6.28 followed by Goalpara with 4.74 percent. The remaining districts are having less proportionate area in relation to the average in the study region during 1995-96.

In order to show the density pattern of rice cultivation in Lower Brahmaputra Valley, a season-wise break up of area under rice has been presented. The regional diversification of rice has been determined by comprising the sown area in proportion and relating the crop density in each of the component area units. For this purpose, the location quotient has been applied. The index of crop concentration or location quotient has been worked out with the help of the following formula.

$$\textbf{Index:}\ \frac{\text{Area of crop 'X' in a component Area unit}}{\text{Area of all crops in the component Area unit}} \div \frac{\text{Area of crops 'X' in the entire region}}{\text{Area of all crops in the entire region}}$$

The Table-4.06 shows the frequency distribution of the indices of three varieties of rice in Lower Brahmaputra Valley. It can be concluded that out of three seasons of rice cultivation, the situation of summer with winter rice shows an opposite trend. One interesting feature emerges from the indices that in Nalbari district, winter rice shows the best performance, but summer rice performance is poor i.e. index values are 1.30 and 0.15 respectively. In case of autumn rice, except Kamrup in all the districts the index values are nearer to one i.e nearing to the regional pattern and in Kamrup with 0.60 percent only. The summer rice has lot of variations and the significant ones is in Kamrup which is 1.75 three times of autumn rice. The result shows that concentration of rice on district level varies from one district to other within Lower Brahmaputra Valley.

Table-4.06: **Rice Concentration Index in Lower Brahmaputra Valley**

District	**Autumn Rice**	**Winter Rice**	**Summer Rice**
Goalpara	0.939447	1.003151	1.111212
Dhuburi	1.073337	0.55964	1.186379
Kokrajhar	0.848008	0.946233	0.572878
Bongaigaon	0.902709	0.926512	0.674181
Kamrup	0.656021	1.003537	1.746972
Nalbari	0.866269	1.288838	0.154455
Barpeta	1.046836	0.822378	0.711262
L.B. Valley	0.912403	0.912403	0.912403

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997.

4.8.3 Fibre Crop:

Fibre crop is also an important crop grown in the study region. Its includes jute, mesta and cotton. In Lower Brahmaputra Valley jute cultivation is considerably high as compared to other fibre crops i.e.3.84 percent, mesta with 0.31 percent and cotton with 0 01 percent in 1995-96 The fibre crop occupies 56 62 percent of the total fibre cropped area of Assam in the year 1995-96

Apart from rice, jute is another main kharif crop in Lower Brahmaputra Valley Fertile alluvial soils, high relative humidity, warm temperature and cheap manual labour are required for successful jute cultivation Its occupies second position in area as well as production In Lower Brahmaputra Valley, generally two varieties of jute are cultivated, for instance, capsularies and olitories The capsularies grows in high as well as low lands Before harvest, jute needs sufficient water, therefore after 'sali' rice, jute is broadcast during February-March in low land areas and harvested during June-July months

Table-4.07. **Agricultural Land Use of Fibre Crops in Lower Brahmaputra Valley 1995-96**

(Area in Percent to the Total Cropped Area)

District	Jute	Mesta	Cotton	Total
Goalpara	4.08	0 31	0.01	4.40
Dhuburi	7.04	0 43	3.21	7.48
Kokrajhar	3.60	0.89	4.28	4.49
Bongaigaon	3.56	0.58	7.31	4.15
Kamrup	2.39	0.12	0.03	2.54
Nalbari	1 39	0 08	Insig	1.48
Barpeta	2.81	0.05	Insig	2.86
L.B. Valley	3.84	0.31	0.01	4.16

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997.

The spatial distribution of jute and its areal proportion to the total cropped area is sown in the Table-4 07 The highest percentage of areal coverage is evident in Dhuburi with 7 04 and is followed by Goalpara with 4 08 percent of the total cropped area of the district The least percentage areal coverage of jute is visible in Nalbari with 1 39 percent The other districts like- Kokrajhar with 3 60 percent, Bongaigaon with 3 56 percent, Barpeta with 2 81 percent and Kamrup with 2 39 percent in the year 1995-96

4.8.4 Pulses:

Pulses are also another important food crops (rabi) in the Lower Brahmaputra Valley Pulses are sown during the month of October and November and harvested during the month of February and March

Table-4 08 **Agricultural Land Use of Pulses in Lower Brahmaputra Valley 1995-96**

(Area in Percent to the Total Cropped Area)

District	Tur	Gram	Black Gram	Green Gram	Lentil	Pea	Other Rabi Pulses	Total
Goalpara	0 39	0 18	3 17	0 15	0.95	0.57	0 74	6 15
Dhuburi	0 06	0 13	1 91	0 11	0 57	0 27	0 18	3 23
Kokrajhar	0 19	0 03	0 58	0 13	0 49	0 19	0 10	1 71
Bongaigaon	0 11	0 05	1 91	0 11	0.64	0 38	0 23	3 42
Kamrup	0 13	0 13	1 21	0 29	1 24	0 80	0 52	4 33
Nalbari	0 17	0 02	0 31	0 15	1 41	1 31	0 35	3 72
Barpeta	0 09	0 09	1 50	0 39	0 15	0 83	0 64	4 71
L B Valley	0.14	0 09	1 52	0 22	0.99	0.68	0 42	4 08

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997

In the Lower Brahmaputra Valley region, pulses occupied 9 96 percent in 1995-96 It includes gram, tur, arhar, lentil, black gram, green gram, pea etc Pulses occupied an area of 49 percent of the total area of Assam during 1995-96

It is evident from the Table-4 08 that pulses are one of the important rabi crops practised throughout the Lower Brahmaputra Valley Pulses cultivated in Goalpara district ranked top with 6.15 percent and followed by Barpeta with 4 71 percent and Kamrup with 4 33 percent In Nalbari with 3 72 percent, Bongaigaon with 3 42 percent, Dhuburi with 3.23 percent and in Kokrajhar with 1 71 percent only to the total cropped area in 1995-96

4.8.5 Oil Seeds:

Apart from food grains, different varieties of oilseeds are also grown in the study region The linseed, castor, sesamum, rape and mustard are cultivated as rabi crops Oilseeds occupied an area of 1,18,156 hectares (9.07 percent) to the total cropped area in the year 1995-96 The sesamum occupied only 0.57 percent, linseed with 0 55 and castor with 0.03 percent Rape and mustard is the principal source of oil and ranks top and is the third largest crop in the study region in terms of operated area, which is one of the principal sources of oil and fat. It occupied an area of 1,03,086 hectares (7.91 percent). It is revealed from the Table-4.09 that, the oil seeds other than rape and mustard occupied very small proportion of area

The rape and mustard is cultivated throughout the riverine belt of Assam and grows well in the flood prone low lying areas particularly in fertile alluvial soil, which are less acidic in nature. For the successful cultivation, artificial supply of water into the agricultural field is necessary. Rape and mustard are sown in the month of October and November and harvesting is done during February and March.

Table-4.09: **Agricultural Land Use of Oilseeds in Lower Brahmaputra Valley 1995-96**

(Area in Percent to the Total Cropped Area)

District	Linseed	Castor	Sesamum	Rape & Mustard	Total
Goalpara	0.56	0.06	0.59	3.68	4.88
Dhuburi	0.35	...	0.59	5.35	6.29
Kokrajhar	0.16	0.04	0.42	14.09	14.72
Bongaigaon	0.36	0.05	0.68	10.80	11.89
Kamrup	0.40	0.07	0.69	6.35	7.51
Nalbari	0.78	0.03	0.37	7.17	7.35
Barpeta	0.87	...	0.47	8.22	9.56
L.B. Valley	0.55	0.03	0.57	7.91	9.96

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997.

Though rape and mustard are cultivated throughout the Lower Brahmaputra Valley but its share varies. Kokrajhar is ranked top with more than 14.09 percent to the total cropped area of the district devoted to it, followed by Bongaigaon with 10.80 percent and Barpeta with 8.22 percent. In Kamrup with 6.35 percent, Nalbari with 6.17 percent, Dhuburi with 5.35 percent and in Goalpara district it was only 3.68 percent in the year 1995-96 (Table-4.09).

4.8.6 Miscellaneous Crops:

The miscellaneous crop cultivated in the study region but does not occupy a sizeable area and it includes potato, sweet potato, tapioca, and tobacco. The miscellaneous crops as a whole occupied an area of 57,494 hectares, accounting for 4 41 percent to the total cropped area in the year 1995-96. Among these, potatoes occupied a considerable area to the total

Table-4.10: **Agricultural Land Use of Miscellaneous Crops in Lower Brahmaputra Valley, 1995-96**

(Area in Percent to the Total Cropped Area)

District	Sugarcane	Tapioca	Potato	Sweet Potato	Tobacco	Total
Goalpara	0.15	0.15	0.95	0.42	0.17	1.83
Dhuburi	0.06	0.05	2 03	0.99	0.02	3.14
Kokrajhar	0.03	0.37	1.83	0.29	0.09	2.62
Bongaigaon	0.15	0.09	1.72	0.27	0.05	2.28
Kamrup	0.27	0.09	3.21	0.31	0.16	4.05
Nalbari	0.16	0.17	2.04	0.11	0.08	2.56
Barpeta	0.08	0.01	3.49	0.28	0.01	3.89
L.B. Valley	0.01	0.11	2.54	0.44	0.08	4.41

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997.

(1) Potato:

Potato is an important rabi crop cultivated in the study region. It is grown in all the districts, but on a small scale. The ahu and jute fields are not suitable for sali paddy cultivation, so devotes to potato. Potato is planted during the months of October and November and harvests in the months of February and March. In Lower Brahmaputra Valley, potato occupied an area of 33,105 hectares (44.70 percent) to the total operated area of Assam in 1995-96. It is evident from the Table-4.10 that, the highest operated area by potato is in Barpeta district with 3 49, followed by Kamrup with 3 21 percent The remaining districts occupied less than the study region average (i e 2 54 percent) and the lowest devotion is prominent in Goalpara with 0 95 percent of the total area in 1995-96

(2) Sweet Potato:

In Lower Brahmaputra Valley, sweet potato is an important rabi crop and it occupied only 0 44 percent (Table-4 10) The highest sweet potato occupied area is in Dhuburi with 0 99 percent, followed by Goalpara with 0 42 percent and least is in Nalbari district with 0 11percent to the total area of the district in the year 1995-95

(3) Tobacco:

Tobacco is a cash crop mainly cultivated by the migrants Though the area under tobacco is less, but the study region occupied an area of 60 95 percent to the total area of the state in 1995-96 It is evident from the Table-4 10 that, the average operated area in Lower Brahmaputra Valley is only 0 08 percent to the total area and the highest is found in Goalpara with 0 17 percent Kamrup follows with 0 16 percent and the lowest is in Barpeta district with only 0 01 percent in the year 1995-96

(4) Tapioca:

Tapioca cultivation is not common and the average cultivated area in Lower Brahmaputra Valley is about 0 11 percent The highest cultivated area is in Kokrajhar with 0 37 and the lowest is Barpeta district with only 0 01 percent in 1995-96

(5) Sugarcane:

Sugarcane is another important cash crop It's a ratoon crop and gives two to three cuttings from a single sowing However, the productivity decreases with successive ratooning It is sown during March-April when the temperature is high, but low rainfall in the early period of sugarcane growth, which makes irrigation essential and harvests during the month of December and January Before sowing of sugarcane, the land is repeatedly ploughed and the soil is properly manured Sugarcane requires hot and wet climate and well-drained fertile loamy soil In the study region it occupies a small proportion of area (4 82 percent only)

The spatial concentration of sugarcane is shown in the Table-4 10, which reveals that its concentration is highest in Kamrup district with 0 27 to the total cropped area, followed by Nalbari with 0 16 percent Goalpara and Bongaigaon with 0 15 percent respectively and the lowest found in Dhuburi with 0 06 percent only in the year 1995-96

4.8.7 Horticultural Crops:

The horticultural crops in Lower Brahmaputra Valley are mainly tropical fruits It includes banana, papaya, arecanut, pineapple, coconut, oranges etc This occupies an area of 53,586 hectares (4 52 percent) of the total cropped area of the valley Banana with 1 10, papaya with 0 15, orange with 0 06, pine apple with 0 27, arecanut with 1 99 and coconut with 0 53 percent in the year 1995-96

Table-4 11 **Agricultural Land Use of Horticultural Crops in Lower Brahmaputra Valley, 1995-96**

(Area in Percent to the Total Cropped Area)

District	Banana	Papaya	Orange	Pine Apple	Arecanut	Coconut	Total
Goalpara	1 55	0 16	0 33	0 25	2 88	0 59	5 76
Dhuburi	0 43	0 11		0 08	0 70	0 21	1 53
Kokrajhar	0 67	0 24	0 07	0 14	0 99	0 21	2 32
Bongaigaon	0 63	0 18	0 06	0 28	2 08	0 33	3 56
Kamrup	1 30	0 13	0 11	0 82	2 50	0 80	5 67
Nalbari	0 97	0 17		0 17	2 13	1 13	4 57
Barpeta	1 69	0 11		0 10	2 39	0 37	4 67
L B Valley	1 10	0 15	0 06	0 27	1 99	0 53	4 52

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997

The highest areas of horticultural crops are in Goalpara with 5 76 percent, followed by Kamrup with 5 67 percent, Barpeta with 4 67 percent, Nalbari with 4 57 percent in 1995-96 (Table-4 11) The remaining three districts Bongaigaon with 3 56 percent, Kokrajhar with 2 32 percent and Dhuburi district with 1 53 percent in the same period

4.8.8 Spices:

Spices also grown in Lower Brahmaputra Valley, but the proportion to the total operated area is comparatively less than other crops The three important spices are cultivated, are- chillies, turmeric and onion Among these, turmeric is cultivated during kharif crop season, whereas chillies and onion are in rabi crop season

Table-4 12 **Agricultural Land Use of Spices in Lower Brahmaputra Valley 1995-96**

(Area in Percent to the Total Cropped Area)

District	Chillies	Onion	Turmeric	Total
Goalpara	0 37	0 32	0 27	0 96
Dhuburi	0 69	0 32	0 15	1 15
Kokrajhar	0 44	0 20	0 25	0 89
Bongaigaon	0 53	0 21	0 37	1 11
Kamrup	0 41	0 19	0 39	1 01
Nalbari	0 38	0 16	0 32	0 86
Barpeta	0 60	0 37	0 25	1 22
L B Valley	0 54	0 28	0.29	1 11

Source: Calculated from the information collected from the Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997

The Table-4 12 shows 1 11 percent of area occupied by spices in the Lower Brahmaputra Valley to the total area The highest operated area is in Barpeta with 1 22 percent, followed by Dhuburi with 1 15 percent and the remaining districts occupied between 0 96 to 1 22 percent in the year 1995-96 The lowest area occupied by spices is in Goalpara with 0 96 percent only

In order to have a clear picture of relative agricultural land use between district with Lower Brahmaputra Valley is prepared and it is prominent from the Figure-4 05, that in Nalbari, Kamrup and Kokrajhar district having higher proportionate areal coverage of rice than Lower Brahmaputra Valley average On the other hand, in Dhuburi having lower proportionate area to the study region (Figure-4 05) In Barpeta, Goalpara and Bongaigaon occupy almost nearest proportionate area as like as the Lower Brahmaputra Valley region

4.9 Changing Pattern of Agricultural Land Use in Lower Brahmaputra Valley:

There is a major change in the agricultural land use pattern in Lower Brahmaputra Valley Though the total rice area was seen to have increased from 7,70,578 hectares in 1970-71 to 9,02,929 hectares during 1995-96, but the percentage decreased from 79 43 percent to 76 02 percent Wheat shows an increase of 14,604 hectares in 1970-71 to 51,501 hectares in 1995-96, (1.51 percent to 4 34 percent) The millets area was 6,354 hectares in 1970-71 and it increased to 9,990 hectares during 1995-96 (0 65 percent to 0.84 percent) within last twenty-five years

It is also seen that the total food grain percentage of operated area is more or less constant but the overall operated area has increased from 7,88,141 hectares in 1970-71 to 9,64,420 hectares during 1995-96

Table-4 13 **Agricultural Land Use of Principal Crops in Lower Brahmaputra Valley, 1970-71 and 1995-96**

(Area in Percent to the Total Cropped Area)

	1970-71		1995-96	
Crops	Area	Percentage	Area	Percentage
Rice	770578	79 43	902929	76 02
Wheat	14604	1 51	51501	4 34
Millets	6354	0 65	9990	0 84
Total	788141	81 24	944420	81 20
Pulses	45764	4 72	53212	4 48
Oilseeds	65766	6 78	118156	9 95
Total	111530	11 50	171368	14 43
Cotton	415	0 04	143	0 01
Jute	63249	6 52	50022	4 21
Sugarcane	6756	0 70	1730	0 15
Total	70420	7 26	51895	4 37
Grand Total	**970091**	**100.00**	**1187683**	**100.00**

Source: Agricultural Census of Assam, 1971 and Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997

It is prominent from the Table-4 13 that, pulses have increased its area from 45,764 hectares in 1970-71 to 53,212 hectares during 1995-96 but the percentage decreased from 4 72 percent to 4 48 percent (Figure-4 06) The oilseeds also shows an increase from 65,766 hectares during 1970-71 to 1,18,156 hectares, (6 78 percent to 9 95 percent) in 1995-96

The miscellaneous crops like Cotton which covered about 415 hectares by 1970-71, was found to have decreased to 143 hectares by 1995-96 and the percentage decreased from 0 04 to 0 01 percent within a span of last twenty-five years In case of jute is decreased in both i e area coverage as well as percentage The area operated for Jute during 1970-71 was 63,249 hectares and it decreased to 50,022 hectares in 1995-

96 (i e 6 52 to 4 21 percent) within a span of last twenty-five years On the other hand, in respect of sugarcane, it decreased the operated area from 6,756 hectares by 1970-71 to 1,730 hectares during 1995-96, accordingly the percentage decreased from 0 70 percent to 0 15 percent during same period It is also evident that, the total commercial crop hectareage decreased from 7 26 percent to 4 37 percent within a span of last twenty-five years, as it reflects that the farmers are inclining towards the production of pulses and oilseeds to satisfy the local demands

The crop-combination pattern in Lower Brahmaputra Valley is an important aspect, provides a base for the agricultural planning For this purpose, J C Weaver's method of crop-combination has been worked out with the help of the following formula

$$\mathbf{d = \Sigma d^2/n}$$

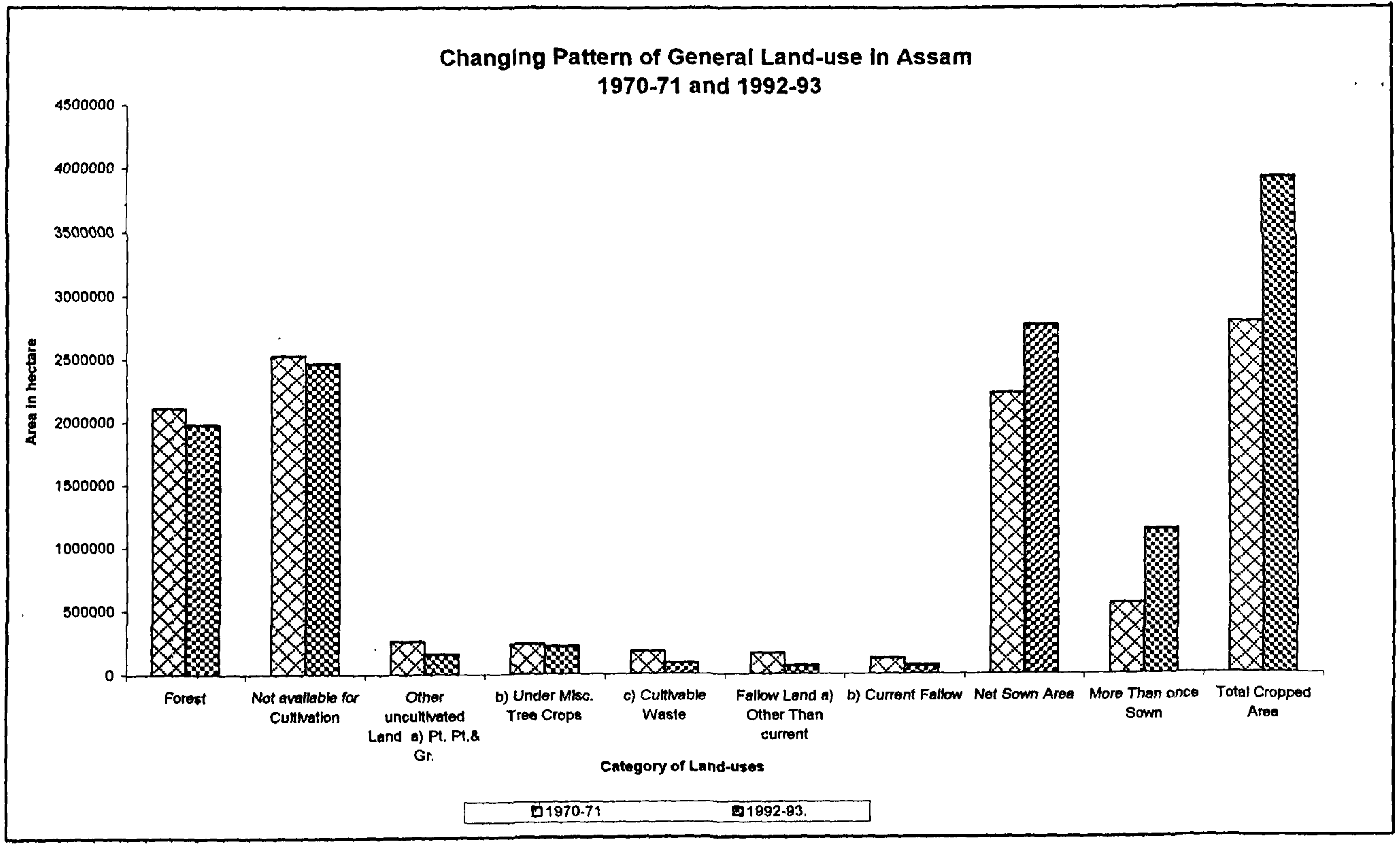
Table-4.14: **Crop Combinations of Lower Brahmaputra Valley**

District	**Crop Combinations**
Kamrup	Rice
Nalbari	Rice, Oilseeds, Pulses
Barpeta	Rice, Oilseeds, Pulses, Wheat, Fibre
Bongaigaon	Rice, Oilseeds, Pulses, Wheat, Other Cereals
Kokrajhar	Rice, Oilseeds, Fibre, Pulses, Wheat
Goalpara	Rice, Pulses, Oilseeds, Wheat, Fibre
Dhuburi	Rice, Fibre, Wheat, Oilseeds, Pulses

Source: The Directorate of Economics and Statistics, Government of Assam, Guwahati, 1997 (Data calculated by the author)

It is evident that from Table-4 14 that rice is the first ranking crop in all the districts Crop combination analysis shows Kamrup is the mono-cropped i.e rice Barpeta, Bongaigaon, Kokrajhar, Goalpara and Dhuburi shows five crop-combinations and Nalbari has three crop-combinations. In Nalbari Barpeta, Bongaigaon and Kokrajhar oil seeds, Goalpara pulses and in Dhuburi fibre crop ranks second In Nalbari, Barpeta, Bongaigaon by pulses, wheat in Dhuburi, oilseeds in Goalpara and fibre crop in Kokrajhar district ranks third. Wheat rank fourth in three districts of Barpeta, Bongaigaon and Goalpara Pulses rank fourth in Kokrajhar and oilseeds in Dhuburi. Fibre crop rank fifth in Barpeta and Goalpara, Wheat in Kokrajhar pulses in Dhuburi, other cereals in Bongaigaon district

The agricultural sector in Assam in general and Lower Brahmaputra Valley in particular approaching towards a demand based subsistence agriculture to feed the over growing population



Changing Pattern of General Land-use in Assam
1970-71 and 1992-93
Area in hectare
4500000
4000000
3500000
3000000
2500000
2000000
1500000
1000000
500000
0
Forest
Not available for Cultivation
Other uncultivated Land a) Pt. Pt.& Gr.
b) Under Misc. Tree Crops
c) Cultivable Waste
Fallow Land a) Other Than current
b) Current Fallow
Net Sown Area
More Than once Sown
Total Cropped Area
Category of Land-uses
1970-71
1992-93.

Figure-4.01

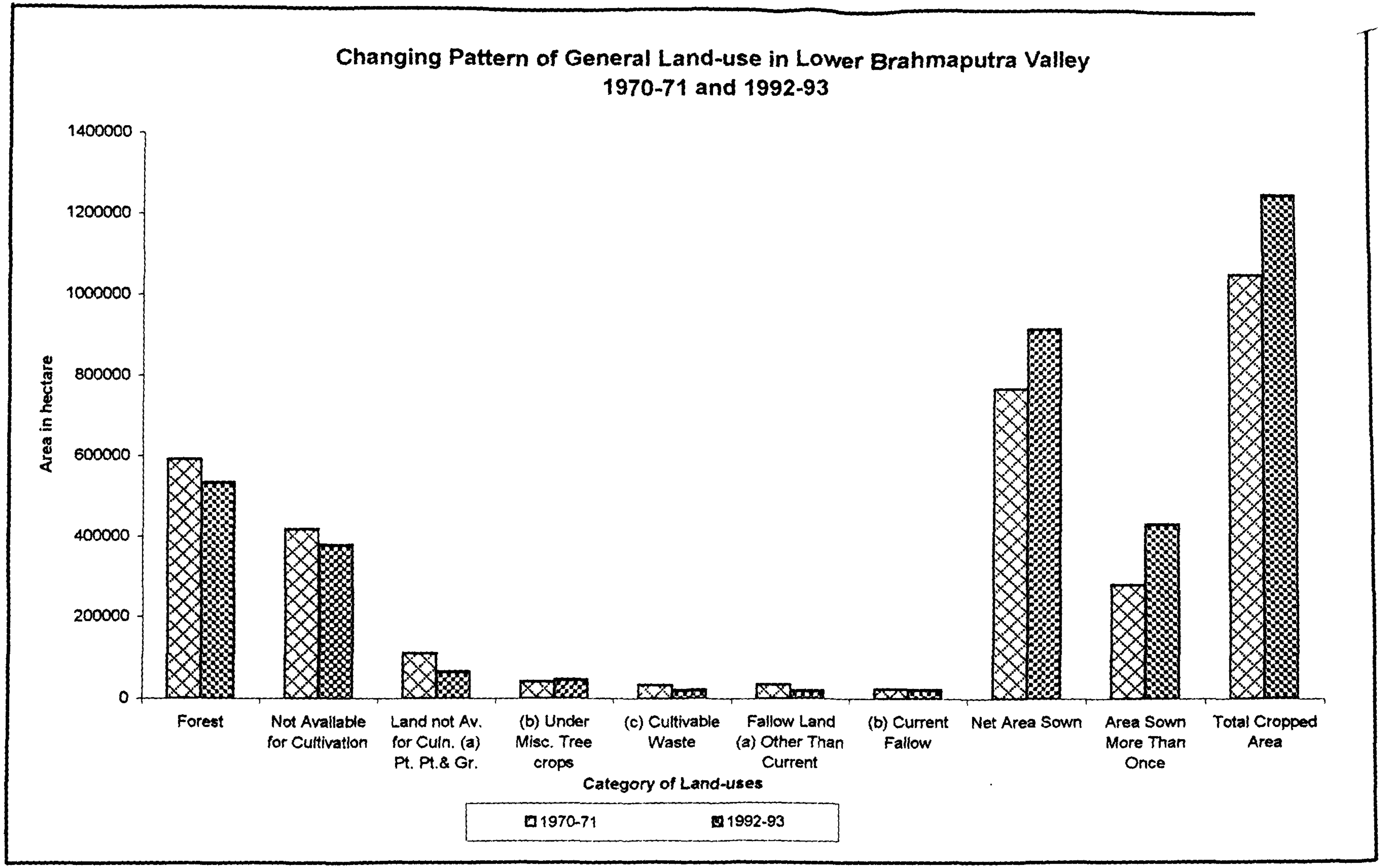
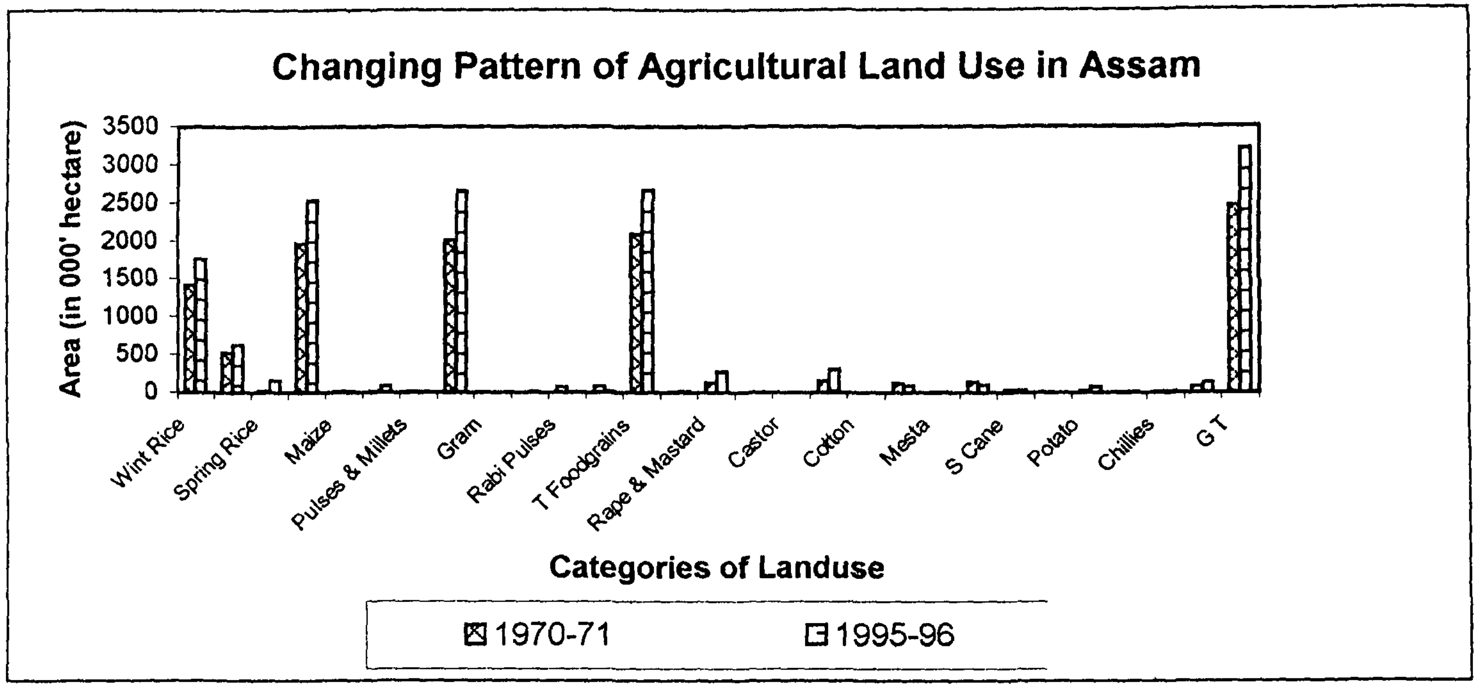

Changing Pattern of General Land-use in Lower Brahmaputra Valley
1970-71 and 1992-93
Area in hectare
1400000
1200000
1000000
800000
600000
400000
200000
0
Forest
Not Available for Cultivation
Land not Av. for Culn. (a) Pt. Pt.& Gr.
(b) Under Misc. Tree crops
(c) Cultivable Waste
Fallow Land (a) Other Than Current
(b) Current Fallow
Net Area Sown
Area Sown More Than Once
Total Cropped Area
Category of Land-uses
1970-71
1992-93

Figure-4.03



Changing Pattern of Agricultural Land Use in Assam
Area (in 000' hectare)
3500
3000
2500
2000
1500
1000
500
0
Wint Rice
Spring Rice
Maize
Pulses & Millets
Gram
Rabi Pulses
T Foodgrains
Rape & Mastard
Castor
Cotton
Mesta
S Cane
Potato
Chillies
G T
Categories of Landuse
1970-71
1995-96

Figure-4.04

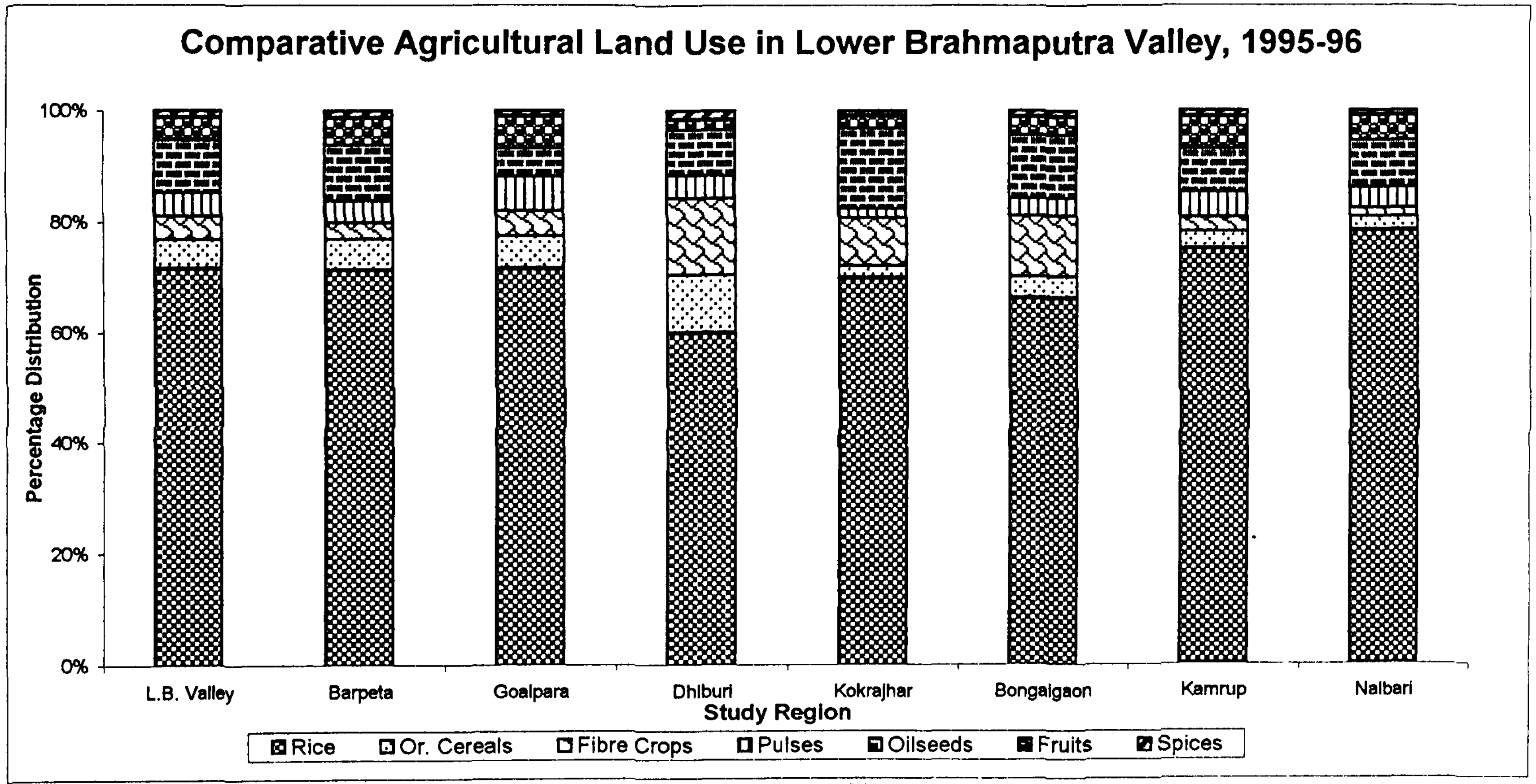
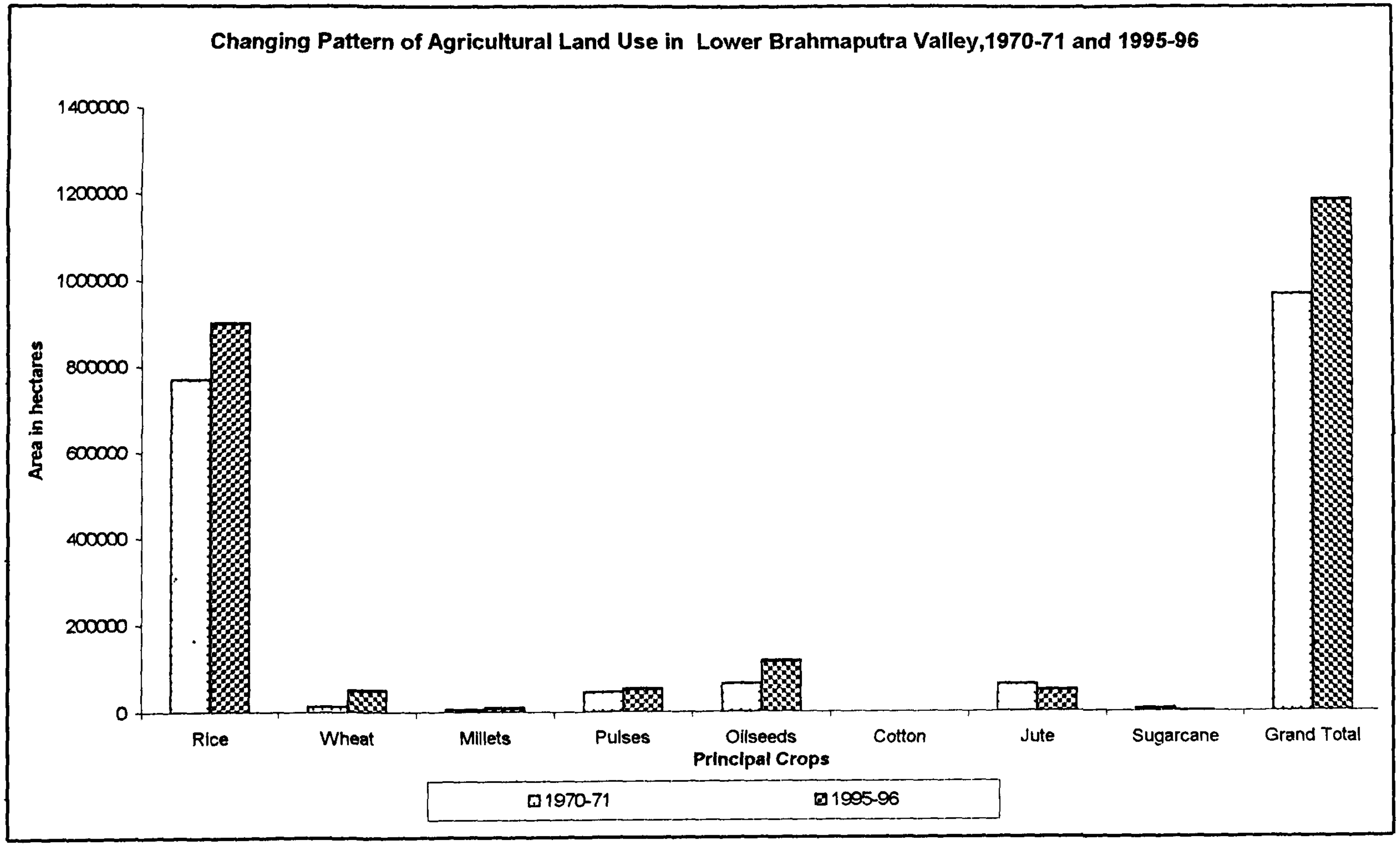

Comparative Agricultural Land Use in Lower Brahmaputra Valley, 1995-96
100%
80%
60%
40%
20%
0%
Percentage Distribution
L.B. Valley
Barpeta
Goalpara
Dhiburi
Kokrajhar
Bongaigaon
Kamrup
Nalbari
Study Region
Rice
Or. Cereals
Fibre Crops
Pulses
Oilseeds
Fruits
Spices

Figure-4.05



Changing Pattern of Agricultural Land Use in Lower Brahmaputra Valley,1970-71 and 1995-96
Area in hectares
1400000
1200000
1000000
800000
600000
400000
200000
0
Rice
Wheat
Millets
Pulses
Oilseeds
Cotton
Jute
Sugarcane
Grand Total
Principal Crops
1970-71
1995-96

Figure-4 06

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[1] The Location Quotient Method measures the degree of concentration of a specific unit region contains more less than its share of its share of crops hectareage, briefly indicating the ratio as follows -

Here Location Quotient = X/Y

X= Hectareage of Crop X in a District/ Hectareage of all crops in the district
Y= Hectareage of crop X in the Region/ Hectareage of all crops of the Region

CHAPTER V

EXISTING AGRICULTURAL PRODUCTION/PRODUCTIVITY AND ITS DETERMINANTS

5.1 Introduction:

Agricultural production and productivity are the principal component in agricultural complexes. The changing pattern of agricultural production/productivity is another important aspect to understand the optimal condition of the regional processes The agricultural production/productivity is the function of various combined factors, including physical, socio-economic and techno-organisational conditions. Therefore, the study of agricultural production/productivity occupies a prominent place in agricultural complexes, whether maximum returns per unit of area is achieved or not within the physico-cultural milieu as well as with the application of human efforts at the existing level of development (Bhatia-1967).

The agricultural sector of Assam is at subsistence level and the land is more or less below marginal. Although the study region, viz. Lower Brahmaputra Valley is one of the alluvial fertile soil regions of India, the average productivity of crops is much lower as compared to other regions. Assam is not self sufficient in food grain production, though more than 63 percent of working force is engaged in agriculture and allied activities and is the principal source of livelihood. But each year Assam imports food grains from other states to fulfil the requirements.

A large variety of crops are grown in Lower Brahmaputra Valley in varied land and meteorological conditions in different agricultural seasons. Food crops attain a prominent place in relation to its area and production Its total cropped area was 78 percent to the total operated area but returns were only 53 percent to the total production in Lower Brahmaputra Valley in the year 1995-96 The study region could produce 29 percent of food grain to the total food crop production of the state, though inhabiting 35 74 percent of population The average yield of food crop recorded 1,005 kg/ha against 1,288 kg/ha in Assam during 1995-96

5.2 Agricultural Production in Assam:

A large variety of crops are grown in Assam, essentially food crop is dominated the productivity pattern Table-5 01 shows that 46 percent of total production comes from food crops, where rice alone contributes 44 percent of the total production in the year 1995-96 (Figure-5 01)

Among others 27 percent of production comes from miscellaneous crops, 14 percent from fruits, 11 percent from fibre crops and oilseeds only 2 percent to the total production of Assam in the year 1995-96 (Table-5 01)

Table-5 01 **Agricultural Production in Assam, 1995-96**

(Production in tonnes)

Crop	Production	Percent
Winter Rice	2622667	33.68
Autumn Rice	516031	6.63
Summer Rice	251324	3.23
Total Rice	3390022	43.53
Wheat	95051	1.22
Maize	12966	0.17
Other Cereals & Millets	6002	0.08
Total Cereals	3504041	45.00
Tur (Arhar)	4381	0.06
Gram	1464	0.02
Other Rabi Pulses	51184	0.66
Total Pulses	57029	0.73
Total Food Grains	3561070	45.73
Rape & Mustard	143463	1.84
Sesamum	8409	0.11
Linseed	5107	0.07
Castor	695	0.01
Total Oil Seeds	157674	2.02
Jute	844221	10.84
Mesta	26623	0.34
Cotton	786	0.01
Total Fibre Crops	871630	11.19
Potato	504753	6.48
Sweet Potato	31238	0.40
Sugarcane	1490336	19.14
Tapioca	12141	0.16
Tobacco	797	0.01
Chillies	9355	0.12
Turmeric	6641	0.09
Onion	16247	0.21
Total Misc. Crops	2071508	26.60
Banana	564687	7.25
Arecanut	52390	0.67
Coconut	140263	1.80
Pine Apple	194915	2.50
Papaya	106610	1.37
Orange	66787	0.86
Total Fruits	1125652	14.45

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

5.3 Agricultural Production in Lower Brahmaputra Valley:

Food crops are the important crops in relation to its area as well as production in Lower Brahmaputra Valley In the year 1995-96, the total cropped area occupied 78 percent and production was 53 percent only, where the demographic force is very high Among the food crops rice is most important in Lower Brahmaputra Valley region

5.3.1 Rice:

Rice is the principal crop and ranked top in respect of operated area as well as production Rice occupies 69 percent of the total cropped area but the production was 48 percent only of the total study area's production Three varieties of rice are in practice, their sowing, transplanting and harvesting schedule for the crops varies accordingly Therefore, sowing, transplanting and harvesting season of different variety of rice are shown in the Table-5 02

Table-5.02: **Period for Rice Cultivation in Lower Brahmaputra Valley**

Rice Sowing Month	Transplanting Month	Harvesting Month
1.Winter Rice		
Normal		
April-May	June-July	October-December
Late		
June-August	August-September	November-January
2.Autumn Rice		
(a)Direct Broadcast		
Normal		
March-April	----	July-Mid September
Early		
February-March	----	Early June-July
(b) Transplanting		
Normal		
March-April	April-May	July-August
Early		
February-Early March	March-April	June-July
3.Summer Rice		
Normal		
November-December	December-January	April-May

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

The total production of three varieties of rice together in Lower Brahmaputra Valley in the year 1995-96 was 9,29,486 tonnes which is 27.42 percent of the total state's production. The total cereal crop occupied an area of 74 percent of the total cropped area in Lower Brahmaputra Valley and the total production was 51.45 percent in 1995-96. Autumn rice is predominant in the study region, which recorded a production of 38 percent, summer rice with 33 percent and winter rice with 23 percent of the total production of rice in relation to Assam's total production (Table-5.03).

Table-5.03: **Rice Production in Lower Brahmaputra Valley, 1995-96**

(Production in tonnes)

District	Winter Rice	Autumn Rice	Summer Rice	Total Rice	% to L.B.V.
Goalpara	60431	22325	6159	88915	9.57
Dhuburi	64826	36002	15729	116557	12.54
Kokrajhar	78497	21397	6137	106031	11.41
Bongaigaon	64057	18104	3078	85239	9.17
Kamrup	128803	37611	37978	204392	21.99
Nalbari	133475	31048	1513	166036	17.86
Barpeta	120553	29753	12010	162316	17.46
Total Percent	650542 (24.81)	196240 (38.03)	82604 (32.87)	929486	27.42
Assam	2622667	516031	251324	3390022	

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

Though Lower Brahmaputra Valley contains seven plain districts, but the productivity per hectare of land is not uniform. The highest amount of rice returns was recorded in Kamrup district i.e. 22 percent of the total output, followed by Nalbari with 18 percent, Barpeta with percent. The remaining districts i.e. Dhuburi with 13 percent, Kokrajhar with 11 percent, Goalpara with 10 percent and the lowest was evident in Bongaigaon district was 9 percent only in the year 1995-96 (Figure-5.02).

5.3.2 Wheat:

Wheat is another important cereal in Lower Brahmaputra Valley but the production of wheat was 60,227 tonnes against 95,051 tonnes of Assam. Wheat is not a staple food for the people of the region The production of wheat was about 63 36 percent as compared to the total production of Assam in 1995-96 (Table-5 04)

Table-5 04 **Production of Other Cereals & Small Millets in Lower Brahmaputra Valley, 1995-96**

(Production in tonnes)

District	Maize	Wheat	Percent	Sm. Millets	Total	Percent
Goalpara	134	5845	9 70	296	6275	9 39
Dhuburi	126	23714	39 37	2660	26500	39 65
Kokrajhar	377	1992	3 31	242	2611	3 46
Bongaigaon	221	3480	5 78	523	4224	6 32
Kamrup	219	8536	14 17		8755	13 10
Nalbari	226	5239	8 69	47	5512	8 25
Barpeta	31	11421	18 96	1500	12952	19 38
L B Valley	1334 (10 29)	60227 (63 36)	63 36 (87 77)	5268	66829	58 62
Assam	12966	95051		6002	114019	

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997

The district wise analysis is evident from the Table-5 04 that, Dhuburi recorded highest production of 23,714 tonnes with 39 37 percent as compared to the study region in 1995-96 The minimum production was in Kokrajhar district with 1,992 tonnes accounting 3 31 percent of Lower Brahmaputra Valley

5.3.3 Pulses:

Pulses are also grown but the proportion of operated area is very low (4 08 percent) to the study region, which includes tur, gram, black gram, green gram, lentil, pea and other rabi pulses The production of pulses was 28,878 tonnes being 50 64 percent of pulses produced as compared to the state's total production in the year 1995-96

Table- 5.05 **Production of Pulses in Lower Brahmaputra Valley, 1995-96**

(Production in tonnes)

District	Tur	Gram	Or. R. Pulses	Total Pulses	Percent
Goalpara	312	72	2159	2543	8.81
Dhuburi	114	238	4367	4717	16.33
Kokrajhar	164	17	978	1159	4.01
Bongaigaon	127	46	3144	3317	11.49
Kamrup	236	93	4258	4587	15 88
Nalbari	195	14	4234	4443	15 39
Barpeta	231	120	7963	8314	28.79
L.B. Valley	1379 (31 48)	600 (40.98)	26899 (52 55)	28878	50 64

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997

The district wise analysis is made in the Table-5.05 that highest production is prominent in respect of pulses in Barpeta with 8,314 tonnes accounting 28 79 percent to the total study region's pulses production The minimum proportion is evident in Kokrajhar about 1,159 tonnes with 4 01 percent to the study regions total

5.3.4 Oil Seeds:

The farmers in Lower Brahmaputra Valley cultivate oil seeds The total oil seeds production was about 56,080 tonnes against 1,57,674 tonnes i e. 35 57 percent of the total oil seeds production of Assam The important oil seeds grown in the area are-rape and mustard, sesamum, linseed and castor. The district wise analysis provides a better result of the production of oil seeds of Lower Brahmaputra Valley in the year 1995-96 (Table-5.06).

Table- 5.06: **Production of Oilseeds in Lower Brahmaputra Valley, 1995-96**

(Production in tonnes)

District	**Linseed**	**Castor**	**Sesamum**	**Rape & Mustard**	**T. Oil Seeds**
Goalpara	280	21	224	1208	1733
Dhuburi	538	7	835	4647	10027
Kokrajhar	108	25	325	18880	8558
Bongaigaon	429	25	528	6553	7635
Kamrup	425	51	642	6484	7602
Nalbari	812	25	361	5877	7075
Barpeta	1430	6	846	11168	13450
L.B. Valley	4022	160	3761	103086	56080

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

Rape and mustard attained the prominent place in production in comparison to the other oilseeds. The production of rape and mustard was 1,03,086 tonnes against 1,43,463 tonnes of all oil seeds in Lower Brahmaputra Valley. The highest production of rape and mustard recorded in Barpeta with 11,168 tonnes and the lowest production was in Goalpara with 1,208 tonnes in 1995-96. Table-5.06 evident that the remaining districts had the following production pattern i.e. Dhuburi with 10,027 tonnes, Kokrajhar with 8,558 tonnes, Bongaigaon with tonnes, Kamrup with 7,602 tonnes and Nalbari with 7,075 tonnes in the year 1995-96.

5.3.5 Fibre Crops:

The Fibre Crops are also cultivated in Lower Brahmaputra Valley for household requirements only, not for commercial purposes The fibre crops grown in the study region are- jute, mesta and cotton, whereas jute is the principal fibre crop mainly cultivated by the immigrants in the low-lying areas. The total production of all fibre crops was about 78,237 kg in the valley in 1995-96 i.e. 47.57 percent, whereas the total production of jute was 74,905 kg (Table-5.07). The highest production was in Dhuburi with 23,396 kg and the lowest was in Barpeta with 10,373 kg in the year 1995-96. It reveals that the production pattern varies from one district to another within lower Brahmaputra valley.

Table-5.07 **Production of Fibre Crops in Lower Brahmaputra Valley, 1995-96**

(Production in bales)

District	Jute	Mesta	Cotton	T. Fibre Crop
Goalpara	7437	270	.00850	7707.0085
Dhuburi	23396	1018	.00510	24414.005
Kokrajhar	9163	1160	.00850	10323.008
Bongaigaon	8558	773	.00680	9331.0068
Kamrup	10835	257	.06460	11092.064
Nalbari	5143	102	.0190	5245.19
Barpeta	10373	152	.00340	10525.003
L.B. Valley	74905	3732	.1159	78237.116

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

The total production of mesta was 3,732 kg and the least production was cotton with only 10,880 kg in the year 1995-96 in the Lower Brahmaputra Valley.

5.3.6 Miscellaneous Crops:

Miscellaneous crops grown in Lower Brahmaputra Valley are– Sugarcane, tapioca, potato, sweet potato, tobacco, chillies, onion and turmeric. Among the miscellaneous crops, sugarcane ranked top in production in the valley, which was 86,897 tonnes in the year 1995-96 (Table-5.08).

Table-5.08: **Production of Miscellaneous Crops in Lower Brahmaputra Valley, 1995-96**

(Production in tonnes)

District	S. Cane	Tapioca	Potato	S. Potato	Chillies	Onion	Turmeric
Goalpara	7590	698	4923	1254	266	622	140
Dhuburi	6774	410	44577	11680	1384	2309	309
Kokrajhar	1870	2393	29854	1652	421	756	256
Bongaigaon	8684	503	20648	1122	472	584	297
Kamrup	37447	810	65986	1794	472	1220	824
Nalbari	14476	2178	35203	1182	490	300	570
Barpeta	10056	185	84847	2125	1444	1650	600
L.B. Valley	86897	7177	286038	20809	4909	7441	2996

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

Table-5.08 reveals that Potato production was 2,86,038 tonnes, tapioca with 7,177 tonnes and sweet potato was 20,809 tonnes. The least production was tobacco with 434 tonnes in the year1995-96. The other crops like- chillies, onion and turmeric showing comparatively low production pattern.

5.3.7 Fruits:

The important fruits cultivated are- banana, papaya, orange, pineapple, arecanut and coconut. The total fruit production was 3,63,878 tonnes in Lower Brahmaputra Valley with 32.33 percent of Assam in 1995-96, with an average yield of 6,791 kg/ha against 7,140 kg/ha of Assam.

Table-5.09: **Production Pattern of Fruits in Lower Brahmaputra Valley, 1995-96**

(Production in tonnes)

District	Banana	Papaya	Orange	Pineapple	Arecanut	Coconut	Total
Goalpara	24024	2492	2974	2504	2029	2611	36630
Dhuburi	18410	4575	47	3032	701	1367	28132
Kokrajhar	14657	4765	805	2670	864	841	24602
Bongaigaon	10522	3834	600	6983	2926	2068	26933
Kamrup	38586	5691	27468	36836	4767	11336	124684
Nalbari	26370	5766	149	3976	3578	11882	51721
Barpeta	76455	6475	91	4834	6137	5384	99376
L.B. Valley	209024	33598	32130	32635	21002	35489	363878

Source: Directorate of Agriculture, Government. of Assam, Guwahati, 1997.

Table-5.09 shows that, the highest production is recorded in banana with 2,09,024 tonnes, orange with 32,130 tonnes, papaya with 33,598 tonnes and pineapple with 32,635 tonnes, coconut with 35,489 tonnes and arecanut with 21,002 tonnes in the year 1995-96 in Lower Brahmaputra Valley.

From the above points it is reflected that the over all production pattern is completely dominated by food crops, therefore the agricultural production system can be termed as at subsistence level, cultivating the soil by the farmers to fulfil their home requirements only It is also evident that the agricultural system is at a very low level of commercialisation, since the farmers are not inclined towards commercial crops

5.4 Changing Pattern of Agricultural production in Assam:

Though the region is fertile, the production is much lower in comparison to the other regions of India The agricultural production is increasing at a slower pace. Rice is the staple food for the people of Assam and the production has increased from 1,981 thousand tonnes in 1970-71 to 3,390 thousand tonnes in 1995-96 with a growth rate of +171 percent Table-5 10 evident that the other cereals and small millets also increased from 31 thousand tonnes to 114 thousand tonnes with a maximum growth rate of +369 percent and pulses increased from 36 to 57 thousand tonnes with a growth rate of +159 percent within a span of twenty-five years (Figure-5.03)

Table-5 10 **Production of Principal Crops in Assam, 1970-71 and 1995-96**

(Production in Thousand Tonnes, Growth Rate in Percent)

Crop	**1970-71**	**1995-96**	**Growth Rate**
Rice	1980 5	3390 02	+ 171
Other Cereals & Small Millets	30 9	114 02	+ 369
Pulses	35 8	57 03	+ 159
Total Food Grains	2047 2	3561 07	+ 174
Oil Seeds	62 2	157 67	+ 253
Fibre Crops	173 7	871 63	+ 502
Misc Crop	156 4	2071 51	+ 1324
Fruits	24343	1125 65	- 444

Source: Agricultural Census of Assam, 1971, Directorate of Agriculture, Government of Assam, Guwahati, 1997

It is also evident from the table that, the total food grain production was 2,047 thousand tonnes in 1970-71 and it increased to 3,561 thousand tonnes during 1995-96 with a growth rate of +174 percent Oil seeds also increased from 62 thousand tonnes to 158 thousand tonnes with +253 percent of growth over the same period The fibre crops also increased the production from 174 thousand tonnes to 872 thousand tonnes with +502 percent of growth rate The highest growth rate is in miscellaneous crops which increased from 156 thousand tonnes to 2,072 thousand tonnes with a growth of +1,324 percent since 1970-71 to 1995-96 But the negative growth rate is evident in fruits, which decreased from 24,343 thousand tonnes to 1,125 65 thousand tonnes with –444 percent growth rate within a span of twenty-five years

5.5 Changing Pattern of Agricultural Production in Lower Brahmaputra Valley:

Due to the lack of data on all crops in Lower Brahmaputra Valley, only few crops have been taken into consideration to measure the magnitude of agricultural growth since 1971-72 to 1995-96. Rice production has shown maximum growth i.e. +205 percent, increased from 4,53,201 tonnes in 1971-72 to 9,29,486 tonnes in 1995-96, followed by rape and mustard increased from 24,123 tonnes to 48,137 tonnes with +199 percent over last twenty-five years (Figure-5.04). Since, 1971-72 to 1995-96, wheat production also increased from 33,223 tonnes to 60,227 tonnes with +181 percent and pulses from 16,366 tonnes to 28,878 tonnes with +176 percent of growth (Table-5.11).

Table-5.11: **Production of Principal Crops in Lower Brahmaputra Valley 1971-72 and 1995-96**

(Production in tonnes)

Crop	Production 1971-72	Production 1995-96	Growth Rate
Rice	453201	929486	+205
Rape & Mustard	24123	48137	+199
Wheat	33223	60227	+181
Pulses	16366	28878	+176
Fibre Crop	533367	286038	-54
Sugar Cane	21638	7177	-33

Source: Agricultural Census, 1971, Directorate of Agriculture, Government of Assam, Guwahati, 1997

Sugarcane has shown a decline in production from 21,638 tonnes to 7,177 tonnes with negative growth of -33 percent. Table-5.11 shows that fibre crops also decreased from 5,33,367 tonnes to 2,86,038 tonnes with –54 percent during 1971-72 to 1995-96. The food crops shows better performances, production pattern became almost double in the last twenty-five years in Lower Brahmaputra Valley. It could be because of over growing population pressure on land, demands for more food; therefore farmers are compelled to produce at maximum level to satisfy its requirements. The production pattern never provides complete results until and unless compares the yield patterns in the field of agriculture.

5.6 Agricultural Productivity in Lower Brahmaputra Valley:

5.6.1 Rice:

Rice is an important crop and ranked first in respect of productivity per hectare of land among the food crops. The average yield of rice per hectare in the study region was 1,029 kg/ha, which is much lower than Assam's average yield of 1,354 kg/ha in the year 1995-96.

Table-5.12: **Yield Rate of Rice in Lower Brahmaputra Valley, 1995-96**

(Yield in Kg/ha)

District	Winter Rice	Autumn Rice	Summer Rice	Total Rice
Goalpara	1466	952	1257	1278
Dhuburi	1214	579	1295	912
Kokrajhar	1346	674	1619	1129
Bongaigaon	1124	536	702	909
Kamrup	1253	921	1977	1255
Nalbari	1341	764	1182	1174
Barpeta	1122	358	1204	809
Total	1234	613	1483	1029
Assam	1513	839	1619	1354

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

In Lower Brahmaputra Valley doesn't have uniform rice productivity pattern per hectare in each and every district The Table-5 12 shows that the highest average yield per hectare was recorded in Goalpara district with 1,278 kg/ha followed by Kamrup district with 1,255 kg/ha Then Nalbari with 1,174 kg/ha and Kokrajhar with 1,129 kg per hectare were above the average yield of study region (i.e 1,029 kg Per hectare) in 1995-96 The productivity is relatively lower in the districts of Dhuburi with 912 kg/ha, Bongaigaon with 909 kg/ha and the lowest is in Barpeta district with 809 kg per hectare only in the year 1995-96

It is also prominent from the Table-5 12 that in Lower Brahmaputra Valley, where the productivity is comparatively high in summer rice with 1,483 kg/ha against 1,619 kg/ha in Assam. It followed by winter rice with 1,234 kg/ha against 1,513 kg/ha and the lowest rate of yield is prominent in autumn rice with 613 kg/ha against 839 kg/ha in Assam

The highest rate of yield of summer rice is in Kamrup with 1,977 kg/ha and the lowest is only 702 kg/ha in Bongaigaon district (Table-5.12). In case of winter rice, where the highest yield is in Dhuburi district with 1,466 kg/ha and the least is in Barpeta with 1,122 kg/ha in 1995-96. The summer rice yield is very low as compared to other varieties of rice, but the highest yield is in Dhuburi with 952 kg/ha and the lowest is only 358 kg/ha in Barpeta district

5.6.2 Wheat:

The district wise analysis is evident from the Table-5 13 that. the productivity of wheat is 1,169 kg/ha in Lower Brahmaputra Valley against 1,107 kg per hectare in Assam in the year 1995-96. It is also revealed that the highest rate of yield was in Dhuburi district with 1,347 kg per hectare and the least is in Bongaigaon districts with 816 kg per hectare.

Table-5.13: **Yield Rate of Other Cereals in Lower Brahmaputra Valley, 1995-96**

(Yield in Kg/ha)

District	Maize	Wheat	S. Millets	Total
Goalpara	580	1227	390	1090
Dhuburi	600	1347	555	1172
Kokrajhar	520	1178	570	919
Bongaigaon	608	816	591	766
Kamrup	620	1325	....	1288
Nalbari	750	1318	370	1252
Barpeta	650	895	500	819
L. B. Valley	598	1169	527	1049
Assam	681	1107	523	982

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

The remaining districts are having lower productivity of wheat per hectare than the study region's average, i.e. Kamrup with 1,325 kg/ha, Nalbari with 1,318 kg/ha, Goalpara with 1,227 kg/ha, Kokrajhar with 1,178 kg/ha and Barpeta with 895 kg/ha in the year 1995-96.

5.6.3 Pulses:

The average yield rate of pulses in the study region was recorded 543 kg/ha, which is slightly higher as compared to the state's rate of yield, i.e. 533 kg/ha. From district level point it is prominent that the highest average yield is in Bongaigaon with 709 kg/ha and the minimum is about 411 kg/ha in Goalpara in the year 1995-96 (Table-5.14).

Table- 5.14: **Yield Rate of Pulses in Lower Brahmaputra Valley, 1995-96**

(Yield in Kg/ha)

District	Tur	Gram	Or. Rabi Pulses	T. Pulses
Goalpara	820	400	384	411
Dhuburi	728	655	512	522
Kokrajhar	648	506	488	506
Bongaigaon	840	709	705	709
Kamrup	800	310	455	461
Nalbari	600	450	643	640
Barpeta	820	400	587	588
L.B. Valley	749	472	537	543

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

It is evident from the Table-5.14 that, the average yield of pulses recorded in Barpeta with 640 kg/ha, Nalbari with 588 kg/ha, Dhuburi with 522 kg/ha, Kokrajhar with 506 kg/ha and Kamrup with 461 kg/ha in the year 1995-96.

5.6.4 Oil Seeds:

Though farmers in Lower Brahmaputra Valley cultivate oil seeds, but the average yield per hectare is low, that is, 475 kg/ha as compared to the state average yield of 515 kg/ha in 1995-96. Rape and mustard attained prominent place in productivity per hectare in comparison to the other oil seeds. The rape and mustard recorded the yield of 466 kg/ha in Lower Brahmaputra Valley, which is comparatively low with the state average yield of 514 kg/ha. The sesamum and linseed were having the average yield of 506 and 557 kg/ha respectively, which is above the average yield per hectare of oil seeds. Castor with 386 kg/ha only, the lowest yield rate in oilseeds in 1995-96 (Table-5.15).

Table- 5.15: **Yield Rate of Oilseeds in Lower Brahmaputra Valley, 1995-96**

(Yield in Kg/ha)

District	Linseed	Castor	Sesamum	Rape & Mustard	T. oilseeds
Goalpara	500	360	380	327	353
Dhuburi	550	600	500	677	568
Kokrajhar	503	454	576	8100	434
Bongaigaon	875	410	567	450	469
Kamrup	460	302	407	445	441
Nalbari	560	500	520	511	517
Barpeta	550	580	600	453	469
L.B. Valley	557	386	506	466	475

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

As per Table-5 15 the highest yield rate in rape and mustard was 810 kg/ha in Kokrajhar and the lowest in Goalpara with 327 kg/ha The remaining districts i e Dhuburi with 677 kg/ha, Nalbari with 511 kg/ha, Barpeta with 453 kg/ha. Bongaigaon with 450 kg/ha and Kamrup with 445 kg/ha in the year 1995-96

5.6.5 Fibre Crops:

The Fibre Crops are cultivated in Lower Brahmaputra Valley for household requirements only The fibre crops grown are- jute, mesta and cotton, whereas jute is the principal fibre crop The average productivity of fibre crops was 1,375 kg/ha against 1,715 kg/ha in Assam in the year 1995-96 and Jute with 1,497 kg/ha (Table-5.16) The productivity pattern varies from one district to another within Lower Brahmaputra Valley

Table-5.16. **Yield Rate of Fibre Crops in Lower Brahmaputra Valley, 1995-96**

(Yield in Kg/ha)

District	Jute	Mesta	Cotton	T. Fibre Crop
Goalpara	1814	865	65	1742
Dhuburi	1106	838	70	1165
Kokrajhar	1900	978	72	1714
Bongaigaon	1754	979	68	1644
Kamrup	1977	866	75	1894
Nalbari	1978	700	66	1899
Barpeta	1232	920	75	1225
L.B. Valley	1497	912	.01	1375

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

Mesta had shown the yield of 912 kg/ha and cotton with 76 kg/ha only in the year 1995-96. It is prominent from the Table-5.16. that the highest productivity of jute was in Nalbari with 1,978 kg/ha, followed by Kamrup with 1,977 kg/ha, Kokrajhar with 1,900 kg/ha, Goalpara with 1,814 kg/ha, Bongaigaon with 1,754 kg/ha. The remaining districts are below the average yield of Lower Brahmaputra Valley i.e. 1,497 kg/ha, particularly Barpeta with 1,232 kg/ha and the lowest is in Dhuburi with 1,106 kg/ha in the year 1995-96.

5.6.6 Miscellaneous Crops:

The important miscellaneous crops in Lower Brahmaputra Valley are– sugarcane, tapioca, potato, sweet potato, tobacco, chillies, onion and turmeric. Table-5.17 shows the highest productivity in respect of potato with 8,640 kg/ha, tapioca with 4,895 kg/ha and sugarcane ranked third highest in productivity per hectare of land in the study region with 4,149 kg/ha during 1995-96 (Table-5.17).

Table-5.17: **Yield Rate of Miscellaneous Crops in Lower Brahmaputra Valley 1995-96**

(Yield in Kg/ha)

District	S. Cane	Tapioca	Potato	S. Potato	Chillies	Onion	Turmeric
Goalpara	50600	4500	5182	3000	720	1920	520
Dhuburi	41553	3221	7844	4200	718	2600	750
Kokrajhar	41553	4785	8169	3772	714	2800	780
Bongaigaon	41553	4285	8786	3000	655	1999	587
Kamrup	60692	3600	8957	2488	453	2729	899
Nalbari	47620	7050	9264	5630	700	1000	950
Barpeta	41553	5000	8081	2500	800	1500	800
L.B. Valley	4149	4895	8640	3626	695	2055	791

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

Table-5.17 shows that sweet potato with 3,626 kg/ha, which are having higher productivity as compared to the state average yield The least yield was in tobacco with 443 kg/ha in the year 1995-96 The yield of other crops i e chillies, onion and turmeric are having very less productivity per hectare

5.6.7 Fruits:

The important fruits cultivated in Lower Brahmaputra Valley are- banana, papaya, orange, pineapple, arecanut and coconut The total fruits all together had shown the yield was 6,791 kg/ha against 7,140 kg/ha in Assam in 1995-96

Table-5.18: **Yield Rate of Fruits in Lower Brahmaputra Valley, 1995-96**

(Yield in Kg/ha)

District	Banana	Papaya	Orange	Pineapple	Arecanut	Coconut	Total
Goalpara	15400	15100	9000	10015	167	47	6327
Dhuburi	15303	15000	9315	13654	112	37	6562
Kokrajhar	16449	14985	8849	13821	187	43	7928
Bongaigaon	12136	15337	7689	18376	200	52	5530
Kamrup	12918	18600	10788	1500	141	48	9587
Nalbari	14650	18600	8750	12825	99	42	6076
Barpeta	15050	19500	9112	15850	124	47	7089
L.B. Valley	14527	16917	40826	17649	810	5098	6791

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997.

Table-5.18 shows that, the highest productivity was recorded in orange with 40,826 kg/ha, followed by pineapple with 17,649 kg/ha, Papaya with 16,917 kg/ha, banana with 14,527 kg/ha, coconut about 5,098 kg/ha The lowest yield was in arecanut with 810 kg/ha in 1995-96 in Lower Brahmaputra Valley

From the above points it is reflected that the overall productivity pattern is not very high as compared to other regions of India and is completely dominated by food crops. Therefore the production system is at subsistence agricultural, cultivating the soil by the farmers to fulfil their home requirements only

5.7 Changing Pattern of Agricultural productivity in Assam:

Though the productivity pattern is sowing a better result since 1970-71 to 1995-96, but at a slower pace. It is evident from the Table-5.19 that, all the varieties of rice together was the productivity per hectare was 1,245 kg/ha in 1970-71 and it raised to 1,354 kg/ha during 1995-96, with an increase of 109 kg/ha (Figure-5.05). Other cereals and small millets yield per hectare was 537 kg/ha during 1970-71 and it increased to 982 kg/ha in 1995-96. The productivity of pulses together increased from 380 to 533 kg/ha in twenty-five years time (Table-5.19).

Table-5 19 **Average Yield of Crops in Assam, 1970-71& 1995-96**

(In kg per hectare)

Crop	1970-71	1995-96
Rice	1245	1354
Other Cereals & Small Millets	537	982
Pulses	380	533
Total Food Grains	973	1289
Oil Seeds	417	515
Fibre Crops	1234	9095
Misc Crop	2753	1656
Fruits	3669	7140

Source: Agricultural Census of Assam, 1971, Directorate of Agriculture, Government of Assam, Guwahati, 1997

The total food grain productivity increased from 973 kg/ha during 1970-71 to 1,289 kg/ha in 1995-96 The average yield of oil seeds also increased from 417 to 515 kg/ha The productivity of fruits increased from 3,669 to 7,140 kg/ha The fibre crops too increased from 1,234 to 9,095 kg/ha with an extra of 7,861 kg/ha In contrary to it, the productivity of miscellaneous crops decreased from 2,757 kg/ha to 1,656 kg/ha over last twenty-five years in Assam

5.8 Changing Pattern of Agricultural Productivity in L. Brahmaputra Valley:

The agricultural productivity pattern is almost similar in Lower Brahmaputra Valley as like as in Assam It is evident from the Table-5 20 that the yield of rice has increased from 802 kg/ha during 1971-72 to 1,029 kg/ha in 1995-96 Pulses also increased from 444 kg/ha to 543 kg/ha within the same period Rape and mustard too increased the productivity from 416 kg/ha to 467 kg/ha (Figure-5 06)

Table-5.20 **Productivity of Principal Crops in Lower Brahmaputra Valley 1971-72 and 1995-96**

(Yield in Kg/ha)

Crop	1971-72	1995-96
Rice	802	1029
Wheat	1208	1169
Pulses	444	543
Rape & Mustard	416	467
Fibre Crop	7267	1376
Sugar Cane	3547	4149

Source: Agricultural Census, 1971, Directorate of Agriculture, Government of Assam, Guwahati, 1997

Sugarcane also increased the productivity from 3,547 kg/ha during 1971-72 to 4,147 kg/ha in 1995-96 In contrary to it, the yield decreased in wheat from 1,208 kg/ha in1971-72 to 1,169 kg/ha in 1995-96 (Table-5.20) Fibre crop also decreased from 7,267 kg/ha to 1,376 kg/ha over the same period The productivity of fibre crops is decreasing over the years is may be due to the market price, which has been gone down at a faster rate

5.9 Determinants of Agricultural productivity:

Agricultural productivity has been handicapped by several factors. The physical, biological and socio-economic-cultural and technological factors play a determinant role in agricultural productivity as well as land use pattern. Therefore, the determinants of agricultural productivity are being discussed in brief to highlight the adverse effect upon it.

5.9.1 Physical and Biological Factor:

Physical and Biological factors determine the agricultural productivity of a region. Man without science and technological has a very little control over the success or failure of agricultural production. In a calamity prone area like Lower Brahmaputra Valley, where cultivators are almost untouched by modern science and technology, therefore cultivators are unable to show better performance in the agricultural production system.

(A) Flood:

The Lower Brahmaputra Valley of Assam is chronically flood-affected zone. Every year, the entire valley is subjected to flood by the river Brahmaputra and its innumerable tributaries causing extensive damages to the standing crops. Kharif crop is affected very badly because of the floods than others (Figure-5.07).

(B) Soil Erosion:

The problem of fluvial erosion is very severe along the river Brahmaputra and its tributaries. The topsoil in the undulating areas washes away by surface run-off during summer rainy days. A large area of cultivable land as well as dwelling areas severely affects because of landslides caused every year along the river Brahmaputra and its tributaries. Palasbari is in the south bank of river Brahmaputra is worsely affected. A large-scale damages of good cultivable land causing misery to the poor cultivators.

(C) Draught:

For the successful cultivation of crops, timely and adequate supply of water is a must. The whole agricultural operation in the valley is dependent upon rainwater only. Unfortunately, rainfall in the valley is seasonal, uncertain and it is highly concentrated during summer, moreover rain is highly fluctuating. It is evident from the meteorological data that monsoon is highly erratic (discussed in Chapter-II). Summer draught affects agriculture in the valley more seriously, hampers the processes of seedlings as well as transplantation, consequently affects the proper growth and agricultural production.

(D) Animal, Pests and Diseases of Crops:

Agricultural production is handicapped not only due to flood, draught, soil erosion but also by insects, pests, diseases, weeds and other animals. The actual damages caused by these factors have not been calculated But it is estimated to be 10 percent of the total agricultural crops in India, which are destroyed by insects, pests and diseases Even in Lower Brahmaputra Valley, crops are destroyed and the total loss of crops is estimated to be 100-125 thousands tonnnes every year Insects like locusts, caterpillars, rice grasshoppers, army worms, paddy steamers, rice hipsters and rice bugs are responsible at varying degrees

The tropical climate with high percentage of relative humidity prevails over a long period provides an ideal condition for the growth and development of insects Moreover, rodents also cause severe damages to crops during pre and post harvest period It is estimated about 10-15 percent of crop damages by rats either in the fields or in the storage

Besides pests and rodents, the domestic as well as wild animals are also responsible for the destruction of crops in the paddy fields. The birds and wild elephants are the prominent destroyers of crops The extent of damage is very severe caused by elephants every year and most of the districts of Lower Brahmaputra Valley are suffering from this acute problem. This problem is probably caused due to the destruction of forest, the habitat of the elephants As a result, the wild elephant comes down to the paddy fields in groups in search of food and damages the standing crops to a large extent especially during the winter rice period. The domesticated animals like cattle and goats also cause damages to the standing crops. Most of the crop fields are open without having proper fencing in the fragmented plots It is due to the poor economic condition of the cultivators, as they are unable to erect permanent enclosures to protect the standing crops from the wrath of animals

Weeds are also another problem, which reduces the agricultural production/productivity The varied species of weeds hamper upon production in the study area are- rumex maridimus, oryza factua during winter paddy fields and cynadon dactylon, cyperus rotundus in the summer paddy fields The extent of damages done to 'Bao' and 'Sali' rice and jute in the low-lying areas is estimated that weeds in Lower Brahmaputra Valley damages 10 to 20 percent of summer rice and 08 to 10 percent of winter rice

(E) Poor Health of the Farmers:

The cultivators of the region are living in the rural areas Due to unhealthy conditions of living, climate and malnutrition, the farmers easily fall into prey of various diseases The food taken by the majority of the cultivators is not satisfactory Most of them hardly get required quantity as well as requisite quality Usually rice is the staple food with very little pulses and vegetables The poor farmers very rarely take fish, ghee, egg, meat etc Consequently the health of the farmers are very poor with low resistance to diseases Medical facilities in the rural areas are not adequate and health centres are located in the urban areas, consequently most of the people dies in the rural areas without detection of diseases even

(F) Poor Health of the Draught animals:

Drought animals are the main source of power among the traditional cultivators Ox and buffalo are the traditionally important animals used to plough and to carry agricultural products from the agricultural fields to the storage and from storage to the market Though the numbers of draught animals are not very low but the productivity efficiency is the lowest, as compared to it's number The existing grazing land in the region is very low, a very little portion of arable land is devoted to fodder crops (i e permanent pasture and grazing land)

Further, farmers usually take little care in feeding of their cattle Cows are allowed to graze in the grazing land During winter, dry rice straw is the only fodder for the animals During summer season roadsides, slope of the embankments and playgrounds are the grazing lands for cattle, hardly get proper food, consequently cattle's are under-fed and ill-fed, therefore resistance capacity used to be poor Most of them suffer and dies accordingly because of various diseases as well as epidemics

5.9.2 Socio-Economic-Cultural Complexes:

Agriculture is the backbone for the economic development of Lower Brahmaputra Valley The cultivators in the study region are suffering from various socio-economic-cultural constraints and these have a great impact upon the agricultural growth and development in the study region

(a) Population Pressure:

Population in the region is increasing at a geometric rate, due to the explosive growth of population giving an excess pressure upon the agricultural sector The tradition bound people have historically given old attitudes of apathy and neglect towards the peasant lives This stands as a big hurdle in the way of progressive agriculture The agricultural sector accounts for the largest economic sector, where the percentage of working population is much higher. This is because of the low industrial growth and more unemployed people engaged in agricultural sector, ultimately causing severe wastage of valuable man-power in the region

The total population of the Lower Brahmaputra Valley was 80 11 lakhs, which was 35 74 percent to the total population of Assam according to 1991 census The decadal growth rate of population in the region was +42.51 percent between 1961-71 period against +58.59 percent in 1971-91 period It is evident that the growth rate of population in the valley is much more than the state's average of +52.44 percent (Figure-5.07).

The Lower Brahmaputra Valley is thickly populated, where average density was recorded 397 persons against 284 persons per km² in Assam according to 1991 census. The density of population in Lower Brahmaputra Valley was 252 persons against 186 persons per km² in Assam during 1971, which is much higher as compared to the state average. But it increased to 397 persons, with an extra of 145 persons per km² *in relation to 1971 census over last twenty years.*

Table-5.21: **District Wise Distribution of Population in Lower Brahmaputra Valley, 1971 and 1991**

(Population in number)

District	Population by 1991	Density		Growth Rate	
	Persons	1971	1991	1971	1991
Dhuburi	1332475	300	470	+40.51	+56.67
Kokrajhar	800659	N.A	256	+54.53	+76.78
Bongaigaon	807523	N.A	322	+40.29	+64.64
Goalpara	668138	N.A	366	+45.88	+54.12
Barpeta	1385659	299	427	+35.81	+43.02
Nalbari	1016390	302	450	+42.02	+49.27
Kamrup	2000071	278	460	+38.80	+65.72
L.B.V. Total	8010915	252	397	+42.50	+58.59
Assam	22414322	186	286	+34.95	+53.26

Source: Calculated from Census of Assam, 1971 and 1991.

The population pressure on land is quite high, as it is evident from the Table-5.21 that, density of population is the highest recorded in Dhuburi with 470 persons per km² (Figure-5.08). It followed by Kamrup with 460, Nalbari with 450, Barpeta with 366, Bongaigaon with 322 and the lowest population density is recorded in Kokrajhar district with 256 persons per km² during 1991.

The population growth was recorded the highest in Kokrajhar with +76.78 percent, followed by Kamrup with second highest and the growth rate was +65.72 percent. The lowest population growth is evident in Barpeta with 43.02 percent within a span of twenty years.

(b) Peasant Society:

Agriculture is the way of living in the rural area like Lower Brahmaputra Valley is the outcome of various cultural, legal, economic and political factors The farming practice is carried out by the farmers in the valley is conceived as the way of life as compared to economic proposition. Most of the farm families living in the villages are completely dependent upon agriculture and a small percentage of people depend on secondary or tertiary activities. Specifically villages are surrounded by agricultural fields and in certain cases farmers are away from their villages Usually these farms are newly operated agricultural fields and dominated by other than rice

The social structure that constitutes the village community can be categorised into the following groups: -

(1) Farmers with own land who have the hereditary right of tenancy and who partly or fully cultivate their land;
(2) Share Croppers (Adhiars) with little own land;
(3) Land-less cultivators;
(4) Persons in professional services; and
(5) Others.

The farmers belonging to first two categories cultivate their land with the help of family labour and some with the help of hired labours. Rice (mainly sali) cultivation is performed for six months and the remaining six months lands are left fallow and people take rest for the remaining months, except for few farmers who practices summer rice. The agricultural practice is mainly subsistence with little or no surplus for the rest of the season They try their level best to produce grain for the family and for the domesticated animals

The third group comprises of mainly land less agricultural labourers, is the poorest section of the community. They work as wage labour and during the off season they engaged themselves in other activities The fourth group of the people is engaged in various professional services besides agricultural activities and is economically sound but their percentage is very low in the society. Besides the above groups, there are some which are engaged other than agricultural activities like shop-keeper, village artisans, money-lenders, business, contractors etc

Agricultural fields generally surround the villages and those are usually high and dry land, free from flood. Generally farmers keeps some amount of dry and high land around their houses for the cultivation of certain crops other than rice which is called as 'Bari'. The area is generally varies from 0.5 to 01 hectare according to the capacity of the farmers. Cultivators cultivate varieties of crops like- battle nuts, battle leaves, citrus fruits, vegetables etc.

The economic condition of the cultivators in the rural areas particularly in Lower Brahmaputra Valley region is very poor, they hardly have the cash savings Whenever they are in need of money for medical or education of their children, expenditure for various social, religious functions or for buying agricultural tools, draught animals or to build houses, they go to the middle-man and money lenders. At the time of return they have to dispose off their agricultural products to them without getting the reasonable price for the concerned crops.

(c) Law of Inheritance:

The joint families in the rural societies play an important role upon the law of inheritance and successions. In the Hindu as well as Muslim communities, the law of inheritance ensures equal distribution of ownership land is available is to be distributed among the sons. The distribution of land does not entail a collection or consolidated one, but the nature is fragmented. As a result, this trend creates independent and self respecting farmers but has got very little scope for capital accumulation as well as large-scale enterprises and high rate of investment. The most dangerous affect of the law of inheritance is not only for Hindu but also for Muslim communities in the region, results excessive fragmentation of land holdings. Even if a son of the family is engaged other than agricultural activities, is also entitled to get the proportionate share of parental land property at equal share with other agricultural based brothers. Thus the law of inheritance is directly responsible for the creation of

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(d) Religious Attitude:

The religious belief of cultivators is one of the important social factors that affect economic growth and agricultural development in the region. Faith, mystery, superstitions, taboos occupied the minds of the cultivators. The Hindu cultivators are greatly affected by the rituals, beliefs and thought. A large number of holidays prohibiting tilling and other agricultural operations, which reduced the total working days, even during the peak agricultural season. The money they received by selling some surplus crops is usually spent in various religious functions, which ultimately make their economic condition worse. Though there is a basic difference between Hinduism and Islamism, but the have one common idea effecting the working efficiency is that they teach to cultivate anti-materialistic and anti-productive out look and to be passive against exploitation as well as injustice (Das-1984).

5.9.3 Technology:

Technology is another important contributing factor for the growth and development of agriculture. Human and animal power with traditional method of cultivation cannot bring more production to the region. The traditional technology must be transformed or replaced by new technology in order to induce the dynamism in agriculture. On the other hand, mechanisation on agricultural operations creates labour displacements. Due to lack of technological application, agriculture in the valley is still in subsistence nature.

Technology is defined here is the utilisation of modern inputs in the field of agriculture to increase the agricultural productivity, such as: fertilizer, high yielding varieties seeds, insecticides and pesticides, irrigation facilities etc.

(a) Fertiliser:

Manure/fertiliser play an important role upon the agricultural production. Agriculture in the valley does not get proper manure. The soil fertility is being decreased due to continuous cultivation without supplementation of its. The cultivation in Lower Brahmaputra Valley is characterised by low consumption of manure/ fertiliser's particularly chemical fertilizers. The fertilizer consumption in Assam as a whole was 10.5 kg/ha in 1990-91, which is extremely low as compared to Punjab (i.e.171.2 kg/ha). Followed by Andhra Pradesh (i.e.133.2 kg/ha), Nagaland use only 4.5 kg/ha. Fertilizer use in Assam is increasing at a faster rate, which was 23.1 kg/ha in the year 1994-95. In the lower Brahmaputra valley its consumption is quite high with an average of 31.8 kg/ha as compared to the state in 1993-94.

Table-5.22: **District Wise Consumption of Fertiliser in Lower Brahmaputra Valley, 1993-94**

(Fertiliser in tonnes)

District	Nitrogen	Phosphorous	Potash	Total
Goalpara	1318	75	36	1429
Dhuburi	1389	240	68	1697
Kokrajhar	182	252	96	530
Barpeta	248	371	1266	1886
Nalbari	328	147	1129	1604
Kamrup	4370	1097	2048	7513
Bongaigaon	N.A	N.A	N.A	N.A
L.B.V.Total	7935	2254	4783	14971
Assam	29871	5257	8044	43172

Source: Directorate of Agriculture, Guwahati, Assam, 1997.

It is evident from the above Table-5.22 that the highest amount of fertiliser is used in lower Brahmaputra valley is in Kamrup with 7,513 tonnes, followed by Barpeta with 1,886 tonnes, Dhuburi with 1,697 tonnes, Nalbari with 1,604 tonnes and Goalpara with 1,429 tonnes in 1993-94. It is very low in Kokrajhar with 530 tonnes and the lowest is Bongaigaon district about 312 tonnes only in the year 1993-94 (Figure-5.09).

The low amount of fertilizer used by the farmers in Lower Brahmaputra Valley may be due to: -

(1) Large number of Small and Marginal farmers unable to purchase fertilizer at high price.

(2) Inadequate supply arrangement of fertilizer into the rural areas,

(3) Lack of irrigation facilities during rabi crop season, and

(4) Ignorance of the farmers

(b) High Yielding Varieties Seeds:

The high yielding dwarf varieties of food grain seeds introduced in 1963, which ushered a new era in the field of agriculture in India The farmers, who have sown high yielding dwarf variety seeds and adopted new technology in agriculture, could show prosperity and development The high yielding variety seeds brought miraculous result in agricultural operations with irrigation facilities This 'Green Revolution' could not bring any impact in Assam, basically big and capitalist farmers were benefited at maximum level as compared to the small and marginal cultivators Unfortunately, Assam was deprived of such advantages

The farmers in the valley region grow some high yielding varieties of food grain crops (Rice), TN-1, IR-8, IR-20, Pankaj, Pusa, Jaya and Monohar Sali are some of the important ones

Table-5 23 **Area Under HYV/ Improved Rice in the Lower Brahmaputra Valley 1993-94**

(Area in hectares)

District	Autumn Rice	Winter Rice	Summer Rice	Total Rice	% to Total Rice
Barpeta	40000	69515	5000	114515	56 26
Kamrup	25300	53120	8000	86420	52 34
Goalpara	6450	22920	3000	32370	45 86
Kokrajhar	20680	22325	400	43405	45 55
Nalbari	20000	42545	600	63145	43 96
Bongaigaon	16375	22020	250	38645	40 61
Dhuburi	17460	26860	8000	52320	40 37
L B Valley	146265	259305	25250	430820	47 71
Assam	289884	780275	66831	1136990	

Source: Directorate of Agriculture, Government of Assam, Guwahati, 1997

Table-5 23 reveals that the percentage of HYV rice practised in Lower Brahmaputra Valley was 47 71 percent to the total of Assam The Barpeta district recorded the highest percentage of HYV rice utilisation with 56 26 percent, followed by Kamrup with 52 34, Goalpara with 45 86, Kokrajhar with 45 55, Nalbari with 43 96, Bongaigaon with 40 61 and Dhuburi with 40 37 percent of area occupied (Figure-5 10)

(c) Mechanical Techniques:

Mechanical technique is generally labour saving, capital intensive and land augmenting Mechanisation of agriculture associated with displacement of human and animal labour The mechanisation of agriculture in the area like Lower Brahmaputra Valley is not prescribed and it will not be successful in achieving the manifold goals because the region is thickly populated with surplus agricultural workers A large percentage of worker engaged in agriculture can be taken away through mechanisation without adverse affect on its production. The labour displacement problem should not stand as a barrier in the way of production. This problem can be solved through proper manpower planning and at present it is very important task in the area like Lower Brahmaputra Valley. The detailed elaboration is being made in Chapter-VI and VII.

The large number of small land holdings and limited economic resources stand as an important barrier for the use of modern implements in the filed of agriculture in Lower Brahmaputra Valley.

5.10 Infra-Structural Needs:

The economic condition of Assam was not satisfactory till independence because of the policies 'British Colonial Rule'. During this period, British people were given more emphasis upon the exploitation of resources but not given any emphasis to develop the economic condition of the agricultural sector. The construction of roads and railways in the state was to cater to the needs of the tea, oil and for effective administration. Since independence the Government of Assam undertaken various development programmes upon the agricultural sector, though is developing but at a very slow pace.

Due to the lack of proper infra-structural facilities, the agricultural sector of Assam as a whole and Lower Brahmaputra Valley in particular is still at subsistence level, yet to develop on commercial level.

(i) Irrigation:

Artificial supply of water into the agricultural field is one of the most important infra-structural needs for the development of agriculture in order to increase the agricultural production/productivity as well as for intensive cultivation. Highly dependent on seasonal rainfall for growing crops, results high degree of instability.

High rainfall and high relative humidity characterised the Lower Brahmaputra Valley, during monsoon rainy season, concentrated more than 75 percent of rainfall, rest of the season is relatively dry and the rainfall is extremely low. Therefore, rabi crop cultivation becomes very difficult without irrigation facilities during winter months. The slow progress in adoption of multiple cropping systems by the cultivators in the valley is mainly due to the absence of reliable and controlled source of water supply.

Data in relation to the irrigated area in the region is shown in Table-5.24 that during 1994-95 the irrigated area to the state total cropped area occupied 17 percent only. Whereas, 11 percent from minor and 6 percent by medium and major irrigation facilities.

Table-5.24: **Source Wise Spatial Variation of Irrigated Area in Lower Brahmaputra Valley, 1994-95**

(Area in hectares)

District	Source of Irrigation		
	Minor	**Major/Medium**	**Total**
Goalpara	11203	---	11203
Kamrup	16918	15635	32553
Nalbari	17807	----	17807
Barpeta	17952	37453	55405
Bongaigaon	9609	---	9609
Kokrajhar	15696	5160	20856
Dhuburi	13917	---	13917
L.B. Valley	103102 (9.78)	58248 (5.52)	161350(15.30)
Assam	297890(10.66)	179273(6.42)	477163(17.08)

Source: Bracketed figures are the percentage to the total cropped area.

From the Table-5.24 is evident that Lower Brahmaputra Valley is mostly legging behind as far as irrigated area to the total cropped area is concerned in the year 1994-95 (i.e.15 percent only). Source wise 10 percent covered by minor and 5 percent by major and medium sources in the year 1994-95 and the principal source of irrigation is canal.

5.11 Agricultural Marketing:

Two types of market system is on operation in the region, i.e. free market and state controlled market. In the free market the village traders or agents of the whole sellers and millers operate in the village. The village market locally called as 'Hat' or 'Weekly Bazaar'. The whole sellers and millers operates terminal market, usually situated in the large urban areas where a part of produce is sold to the local customers and the rest is transported to other consuming centres Transaction takes place between the producers and the traders The free agricultural marketing system is predominant in Assam

Assam as a whole is highly deficient in cereals and also in pulses and oil seeds Even in Lower Brahmaputra Valley shows a highly deficient in cereals The region is also highly deficient in pulses, in earlier time, farmers extracted oil from the oil seeds with the help of simple device in a traditional way is called as 'Ghani' Presently this traditional practice is almost disappearing and oil seeds are generally sold to the mill owners at a very low price and purchased at higher rate

(a) Free Market:

In the free market system, the product of the farmers goes to the urban areas through the middleman This is common practice of the region, where farmers hardly get reasonable price for their crops At the time of harvest, the middleman collects crops from the farmers at a very low price and sells it at a high price in the urban market

Generally farmers take loan during off-season from the middleman, locally called as 'Bepari' when they require financial help. Repayment is made at the time of harvest; the middleman collects agricultural products from the farmers in lieu of money payable to them. This process of collecting agricultural products from farmers benefits a lot to the moneylenders, because the prices of the products are much less at the time of harvest In this way farmers are highly exploited by the moneylenders It is also prominent that most of the farmers go to nearby weekly market to purchase their essential commodities by selling of their agricultural products Most of the farmers dispose their marketable surplus through 'Beparis' is mainly due to fear of being *cheated in the market*

(b) State Controlled Market:

The marketing of agricultural products continued to be in the hands of middleman and traders The marketing of most important crop like- paddy came under state controlled market in 1960, when Government of Assam established the 'Assam Co-Operative Apex Marketing Society' This society played an important role for the procurement of paddy from 1960 to 1969. In 1969 the state trading in paddy was abandoned but it was re-introduced in the form of the whole sell trade in paddy during 1973. Moreover it was accompanied of Gaon Sabha Level Co-Operative Societies These societies were entrusted for the procurement of paddy as an agent of Food Corporation of India (FCI). The FCI and ACAMS took up the marketing of paddy in the state. There was wide spread coverage of paddy marketing by the Government agencies, but that time open market was playing an important role for the procurement and distribution of crops. Accordingly, the performances of these societies were not satisfactory because of the high price of crops in the open market as compared to the state-controlled market. Consequently, the procurement was not adequate for the distribution among the consumers, ultimately had to depend upon the free market where the price of crops was much higher as compared to the state controlled market Till now the market system in Assam is not satisfactory and the farmers are the prey of middle-man and traders, hardly gets the reasonable price of agricultural crops

Because of the price difference of crops, farmers compel to sell the agricultural products to the middleman instead of the state Government in order to repay their loans to the middleman and traders

5.12 Agricultural Credit:

The agricultural credit facilities to the farmers through various Government policies are not adequate and it is not encouraging in the study region Whatever money is available as credit from different sources, the farmers use to utilise the money in other necessities other than agricultural inputs. This is due to the poor economic condition of the farmers Their needs are mostly unproductive, particularly-foodstuffs, building and repairing of the house, repay the old debts, spent for the medical treatment and for the education of their children and other expenses in various social and religious festivals.

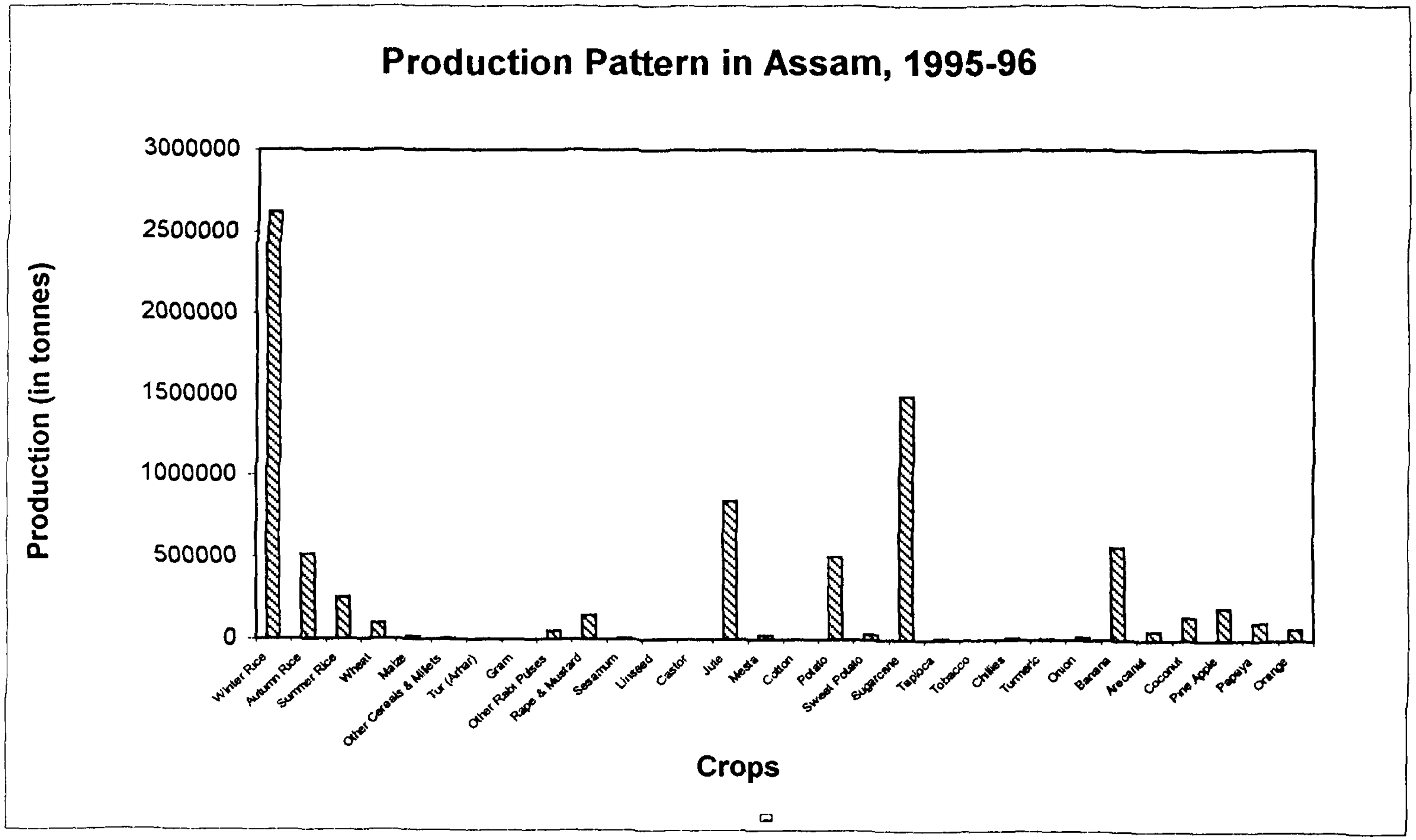

Production Pattern in Assam, 1995-96
Production (in tonnes)
3000000
2500000
2000000
1500000
1000000
500000
0
Winter Rice
Autumn Rice
Summer Rice
Wheat
Maize
Other Cereals & Millets
Tur (Arhar)
Gram
Other Rabi Pulses
Rape & Mustard
Sesamum
Linseed
Castor
Jute
Mesta
Cotton
Potato
Sweet Potato
Sugarcane
Tapioca
Tobacco
Chillies
Turmeric
Onion
Banana
Arecanut
Coconut
Pine Apple
Papeya
Orange
Crops

Figure-5.01

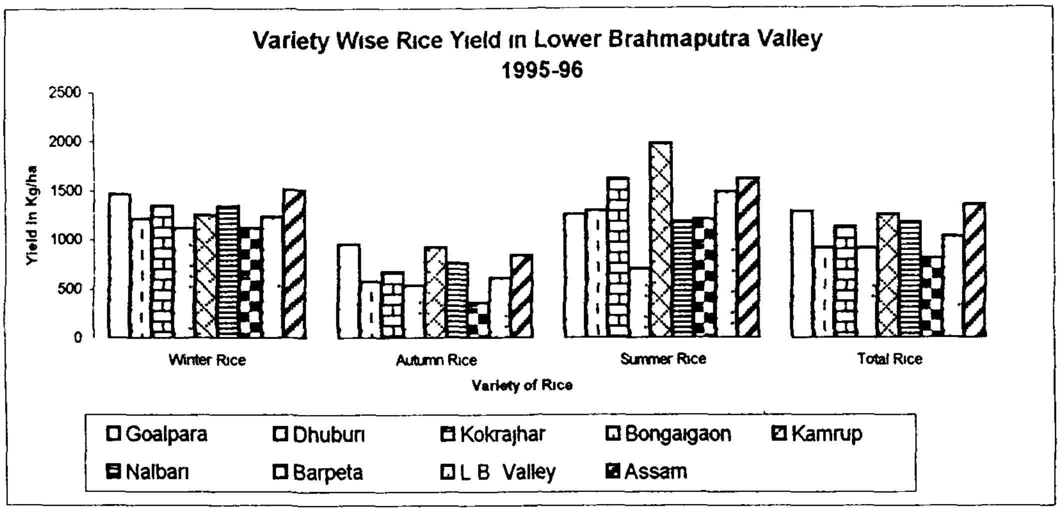


Figure-5 02

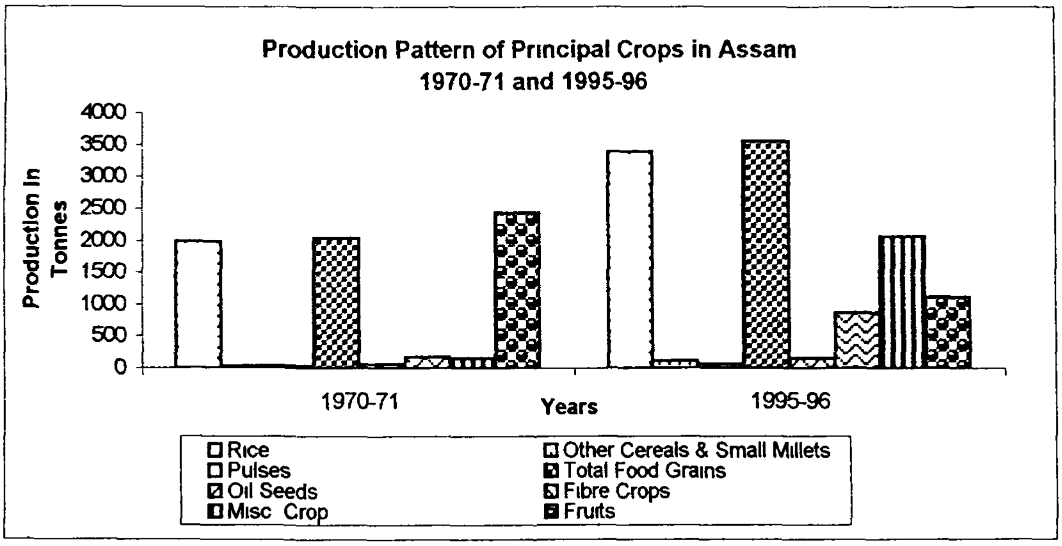


Figure-5.03

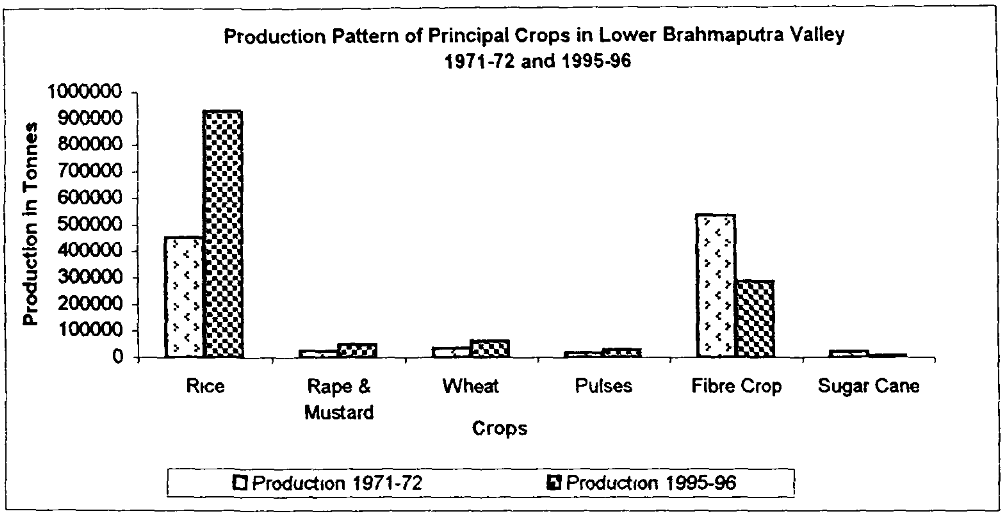


Figure-5.04

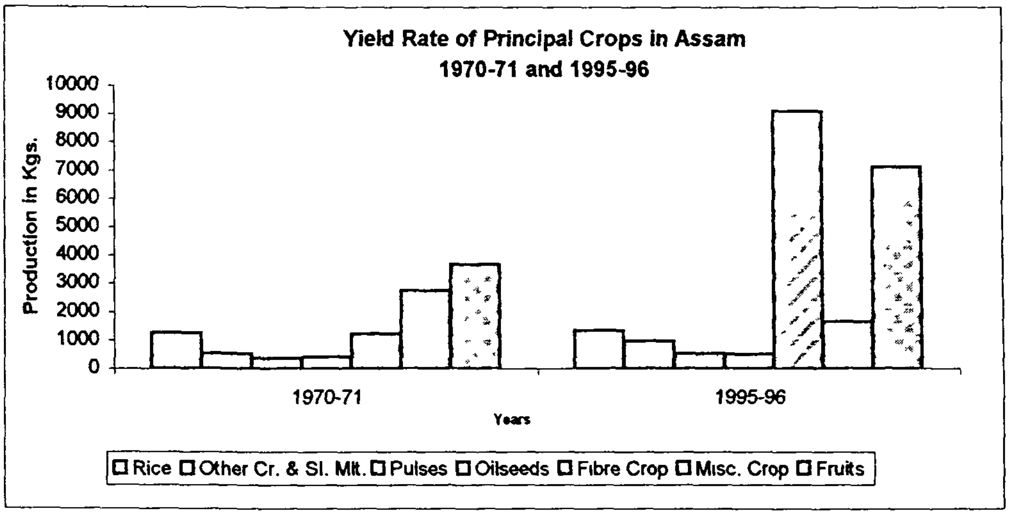


Figure-5.05

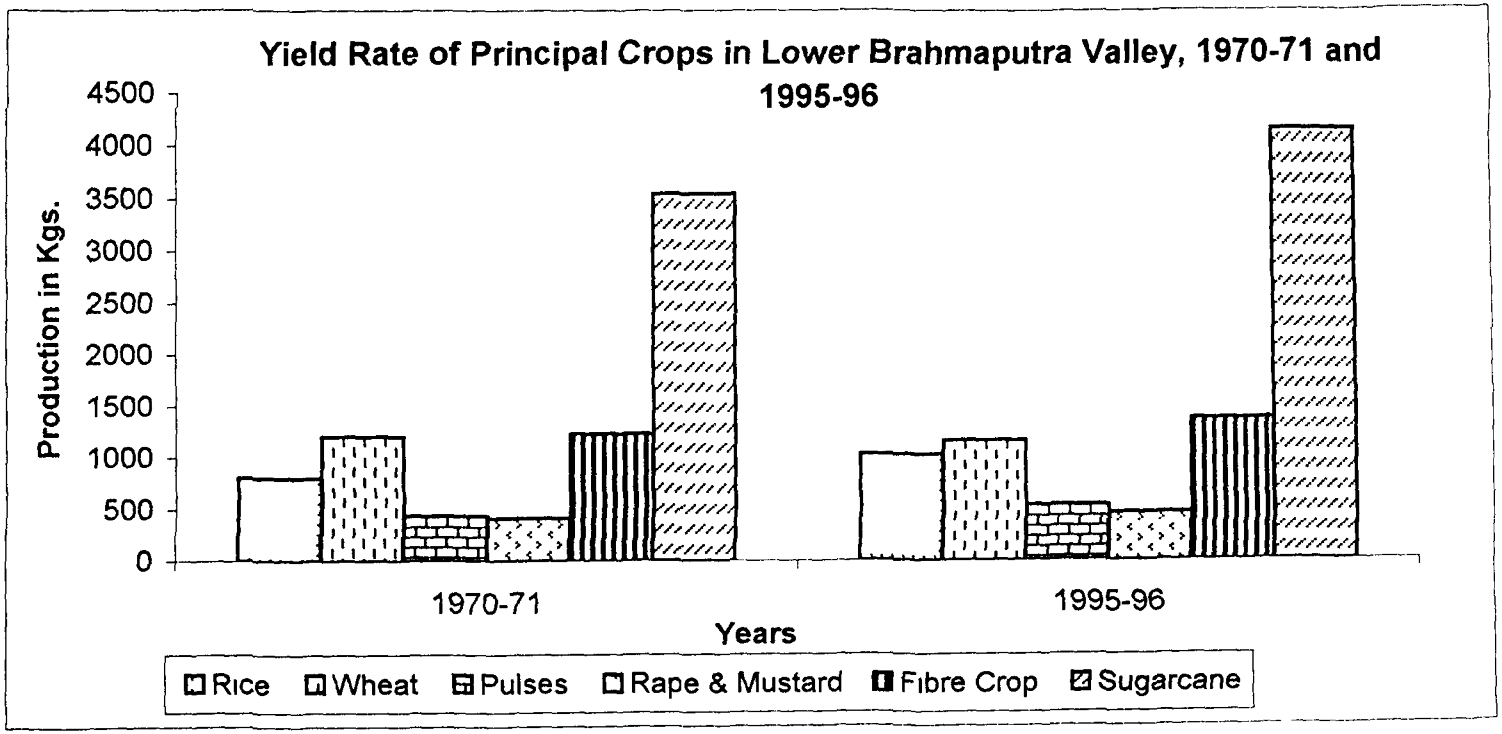

Yield Rate of Principal Crops in Lower Brahmaputra Valley, 1970-71 and 1995-96
Production in Kgs.
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1970-71
1995-96
Years
Rice
Wheat
Pulses
Rape & Mustard
Fibre Crop
Sugarcane

Figure-5.06

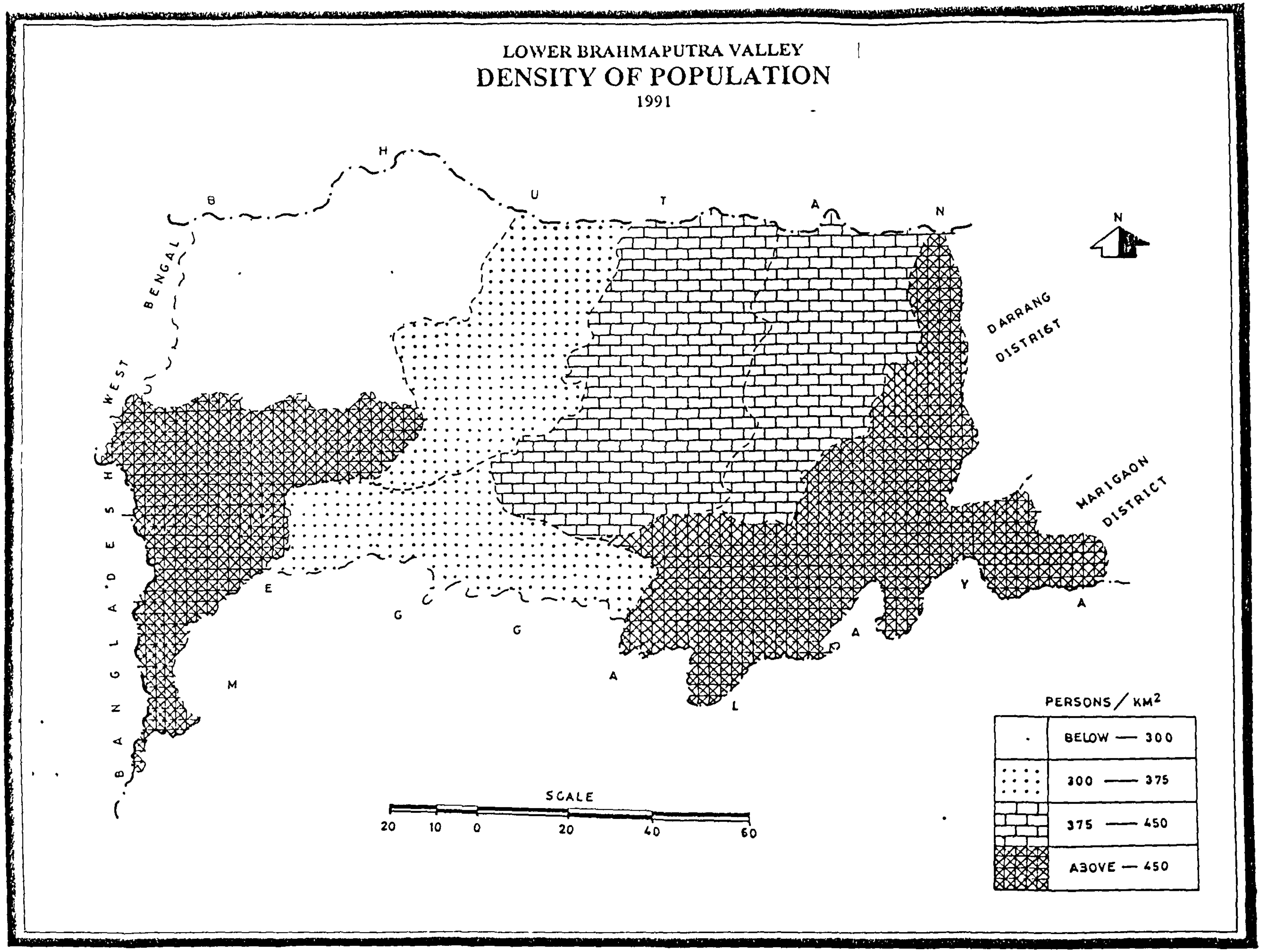
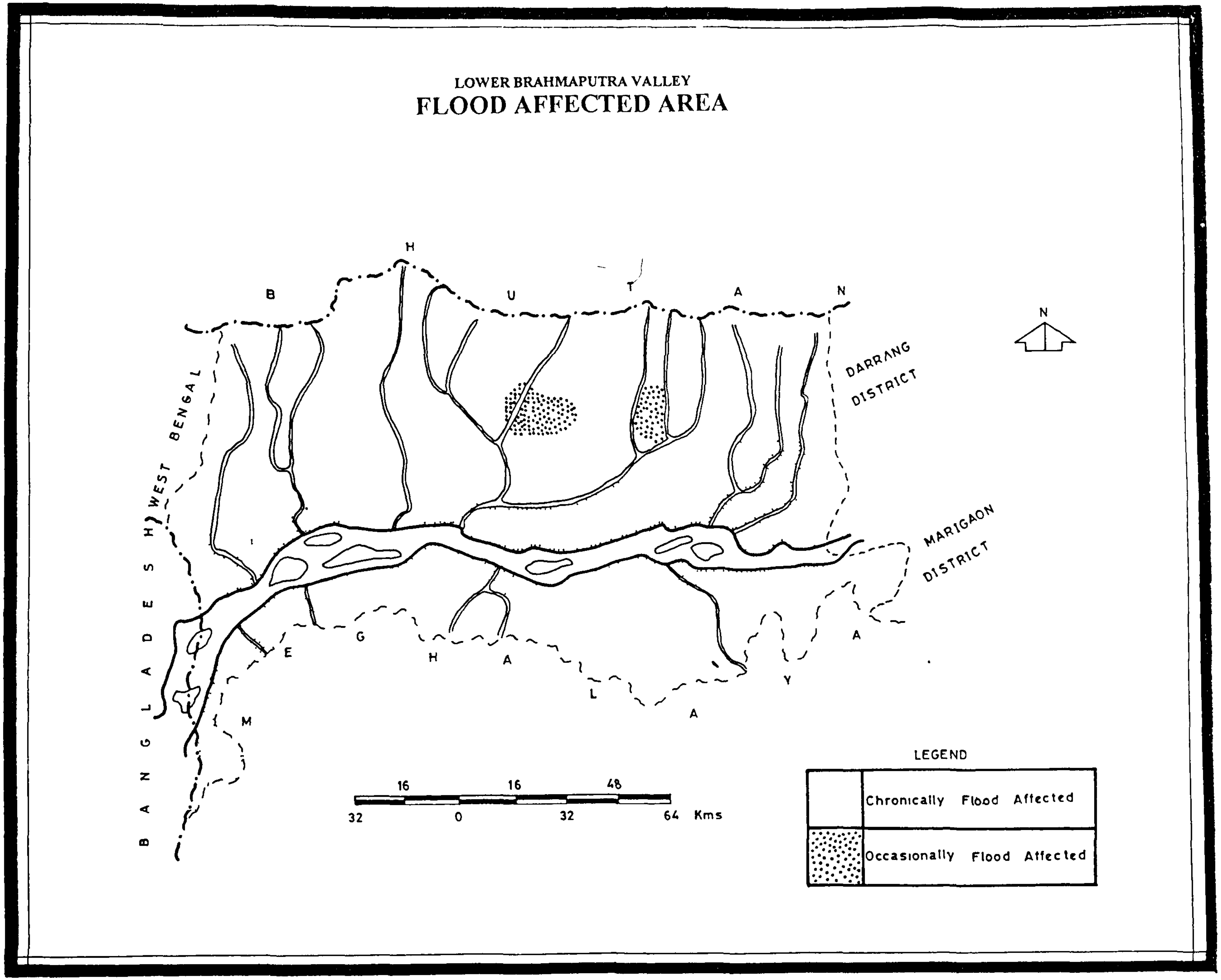

LOWER BRAHMAPUTRA VALLEY
DENSITY OF POPULATION
1991
BHUTAN
WEST BENGAL
BANGLADESH
MEGHALAYA
DARRANG DISTRICT
MARIGAON DISTRICT
N
PERSONS / KM²
BELOW — 300
300 — 375
375 — 450
ABOVE — 450
SCALE
20 10 0 20 40 60

Figure-5.07



LOWER BRAHMAPUTRA VALLEY
FLOOD AFFECTED AREA
BHUTAN
DARRANG DISTRICT
MARIGAON DISTRICT
MEGHALAYA
BANGLADESH
WEST BENGAL
N
16 16 48
32 0 32 64 Kms
LEGEND
Chronically Flood Affected
Occasionally Flood Affected

Figure-5.08

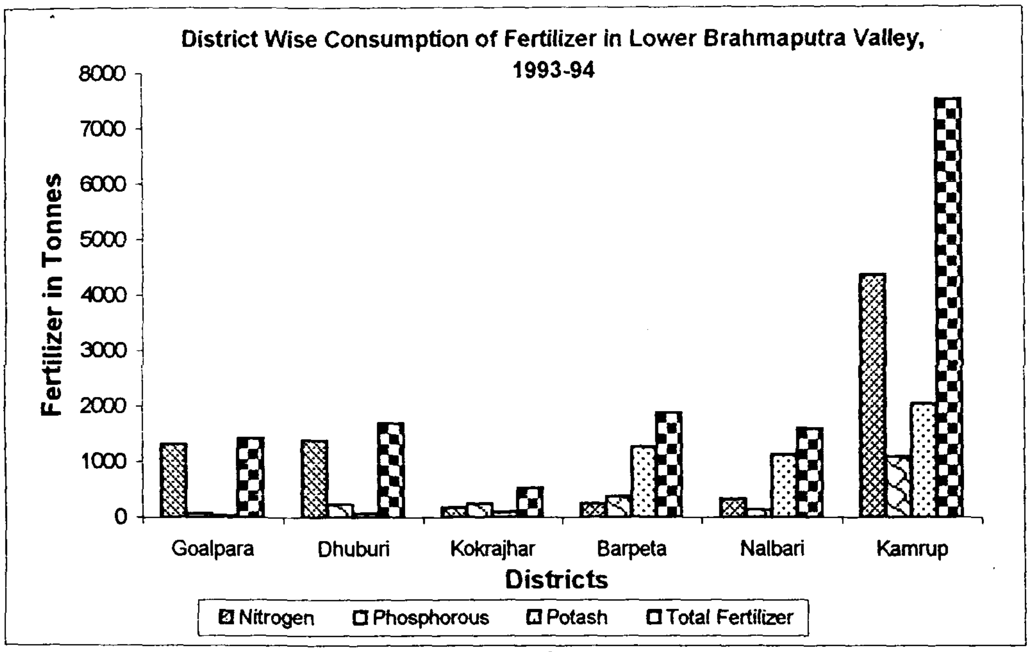


Figure-5.09

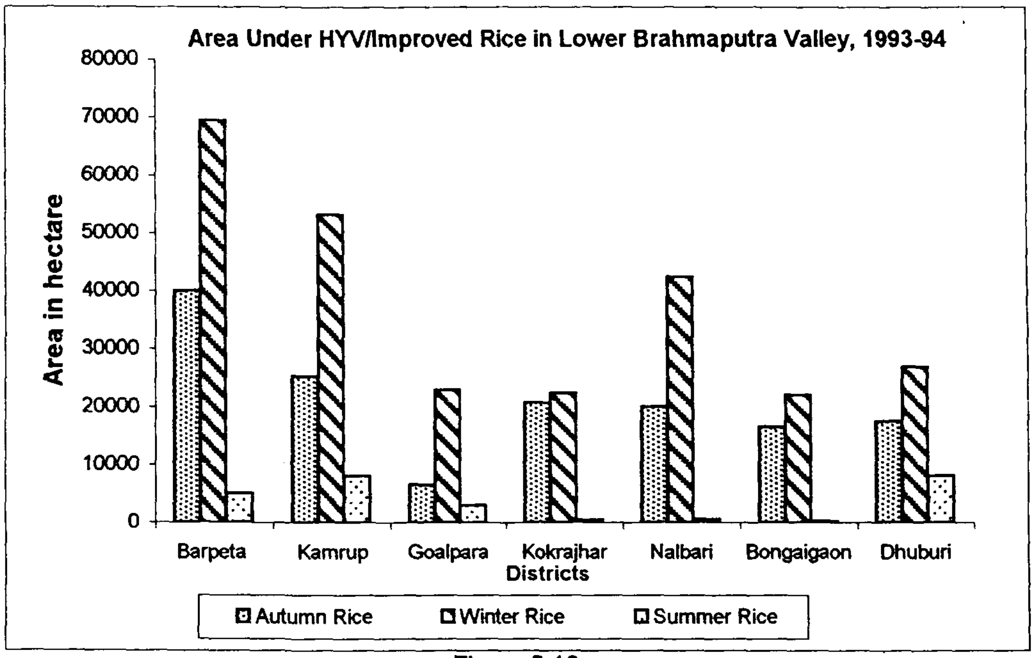


Figure-5.10

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CHAPTER VI

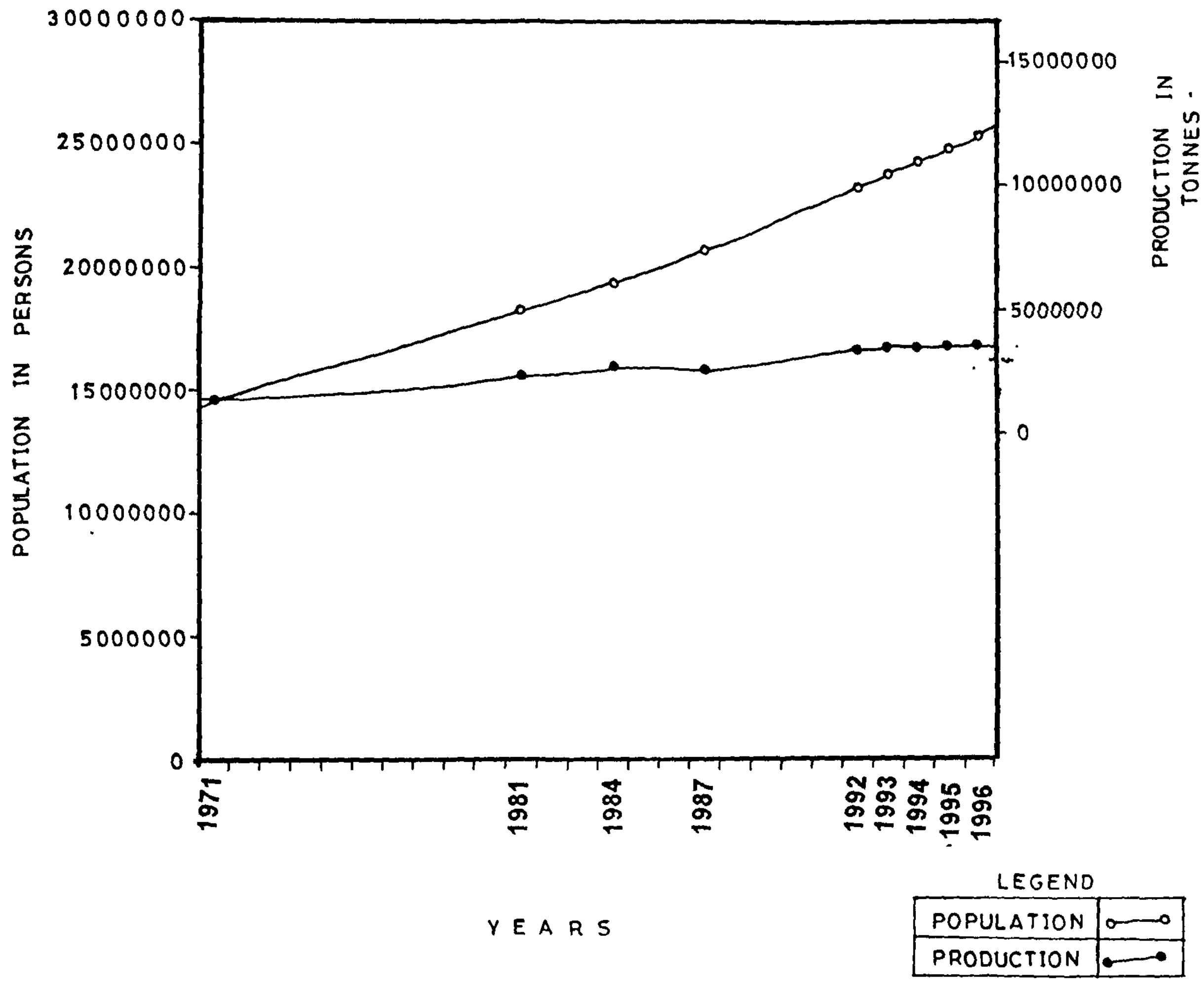
PRODUCTIVITY AND ITS FACTORS

6.1 Introduction:

The major components of agricultural production, that are related to the land use, crop intensity and the cropping patterns have already been interpreted and analysed in the preceding chapter The study reveals that the yields of various crops are very low and cropping pattern is characterised with mono-culture, i e paddy crop However, the area is agro-ecologically ideal for other crops too

Agricultural production in Lower Brahmaputra Valley, where the land use pattern is extensive in nature, the production pattern is characterised at subsistence level, without any surplus Therefore, the entire agricultural landscape is seen to be growing and the farming systems are in its initial stage, where agro-ecological conditions are more favourable rather than technological inducement in the production practices It means that the productivity in this condition may be low because of very low levels of technological inducement However, there is scope for the transformation of traditional agricultural technology to a modern one At the same time, the present production system is not sustainable and is unable to feed the over growing population

Trends of Population and Agricultural Production in Assam



Figure—601

6.2 Production – Population Relationship:

The relationship between agricultural production and population is indispensable The population in Assam as whole and in Lower Brahmaputra Valley in particular is growing at a geometric rate, whereas the growth tendency of food production is weak and moving upward in its initial stage with its slow arithmetic rate (Chandna-1992) It seems production processes are stagnant and not producing sufficient food to feed over growing population As a result, the gap between production and population curve is widening over time (Figure-6 01) It is evident from the figure that the gap between food supply with population is increasing at a faster rate, which emerge imbalances between food supply with population growth, which might turn towards human starvation or misery In order to feed the overgrowing population, certain positive steps are to be undertaken through multiplication of production functions and investment pattern to increase agricultural production by adopting recent technical know-how

There is a tremendous population pressure on arable land The growing demands for food and agricultural materials are the present day problems in the study area In order to eradicate the problems of food deficiency, under-nutrition and malnutrition, food production multiplication is the only solution Intensification of land use and diversification of crops through innovative measures can only raise the food production as well as productivity per hectare of land

In fact, the agricultural land use is transformed by the acceleration of two important processes of land use, they are- expansion and intensification An expansion process refers to the conversion of land from other category to the agricultural one, whenever population pressure increases on land This process of land use and the changes of cropping pattern, which has already been discussed in the previous chapter The only process for increasing production is the intensification of land use through modern technology It seems that intensification patterns are not being accelerated in the study area because of non-adaptability of modern technology

Keeping these aspects in mind, there is a need to study the production pattern in relation to the production factors It may give a good understanding and detailed background of the area for preparing the regional plan for sustainable agricultural development

6.3 Methods Used and Data Processed:

A general description for the collection of information, selection of samples and processing the materials has already been given in chapter one In order to analyse the production processes and farming practices in Lower Brahmaputra Valley, it is important to know the existing production pattern It is assumed here that agricultural production is the ultimate result of four major production factors, namely-

A The land, which has natural resource potential for crop growth, but is fixed Therefore, land potentiality to be utilised at maximum level,

B Labour is an equally important factor, as without involvement of the labour force, the production is impossible,

C Animal force is also an important production factor specially in the Lower Brahmaputra Valley, where it is considered as complementary to the technology as well as human power, because of the traditional farming system, and

D Technological factors like irrigation, HYV seeds, pesticides, insecticides, which are related to the investment considered non-land capital but they are weak in the study area

Land has the latent capacity to grow crop, where other factors of production are mobile but can be adjusted with other available agricultural resources on a piece of land Therefore, the collected information regarding the agricultural production and production factors are presented by preparing separate indexes of production factors Labour, non-land capital and animal power are engaged in agricultural production process Such sets of information are compiled on the basis of three agro-ecological conditions for showing the impact of physical factors of land and explanations of regional personalities of production functions in the study area

The compilation index of labour intensity is processed on the basis of incorporating three main components of labour force They are - (a) The persons employed in agricultural operations, family workers as well as hired labour separately, (b) The number of working days per year, basically employment opportunities of labour and, (c) The daily wage rate which is an economic factor for the mobilisation of labour force Multiplying these three components, a labour intensity index has been prepared for family labour, hired labour and for total labour engages in agricultural operations in its physical as well as money terms

The index of animal force is also prepared in its physical as well as monetary term by calculating it in number of drought animals as physical index and multiplying it by their prices in different agro-ecological conditions Similarly, non-land capital of the farmer is assessed in money term by calculating the total investments on irrigation, HYV seeds, fertilizers, pesticides, herbicides and insecticides

In order to establish the relationship between agricultural production with production factors, a simple Linear Multiple Model, which is called 'Multiple Linear Production Function', has been used The mathematical form of the model is given below -

$$Yc = a + B_1 L + B_2 K + B_3 A +$$

Where,

Y is the production per hectare (in Rs), L is labour input per hectare, K is non-land capital invested per hectare, A is animal input per hectare and a is constant and B_1,B_2,B_3 are the co-efficient of the functions.

Furthermore, the relationships of production with production factors have also been established by using 'Carl Pearsonean Correlation method' for each and every agro-ecological zone. Such correlation matrix would give us detailed picture of production characteristics in the area under study.

6.4 Analysis and Interpretation of Results:

The agricultural production/productivity is a relative term that indicates the agricultural output in respect to a piece of land where farming is being practised, labour engaged and capital invested (Singh-1994). Capital investment means the application of modern technology, i.e. irrigation, seeds, fertilizers, pesticides, insecticides and herbicides. The agricultural sector in Lower Brahmaputra Valley in particular and Assam as a whole in general is characterised as labour intensive and production is almost limited for local consumption with traditional methods of cultivation. Therefore, the level of production is below the subsistence level.

6.4.1 Agricultural Production Pattern according to Agro-Ecological Zones:

The productivity of agricultural land is measured in terms of output per hectare, which varies greatly Soil differs widely in their productivity owing to physical and climatic properties as well as inputs (Das-1984) Soils and climatic conditions have direct impact on productivity pattern in the area and productivity varies with the areal differentiation of soil and climate The output per hectare is called land productivity Land productivity is solely dependent on the physical characteristics of land, however the labour and technological factors also influence upon it Therefore, the land productivity pattern is described for different land conditions The characteristics of agricultural production are based on cropping pattern, which has been discussed earlier

Table-6 01 **Productivity Pattern in Agro-Ecological Conditions**

Agro-Ecological Zone	No. of Holding	Area in ha	Average Yield kg/ha
Flood Plain	66	128 8	1770 00
Alluvial Soil	80	152 47	1834 40
Foot Hills	14	59 75	1105 33
Total	160	324 70	1597 20

Source: Household Survey, 1998-99

In a sample survey, conducted during 1998-99, it was observed that the average yields of agricultural crops are recorded highest in the alluvial soil zone (1,834 kg/ha), whereas the average yield in the study area was 1,597 20 kg/ha The higher yield in this zone is due to good fertile soil and is flood free, so the damage caused to the standing crops are less The thickness of the soil ranges from 200 – 300 meters, which holds the fertility of the soil, therefore, the crop yield recorded higher The soil moisture condition is good, so higher yield can be achieved even without irrigation However, constraints in practising agriculture in such areas are due to the occasional floods, which diminishes the intensity of cropping accordingly effects the production Though, the soils of this area are good for agriculture, but land use intensity is relatively higher and paddy can be grown twice or thrice in an agricultural year The soil moisture content is characterised with low with a lower exchangeable capacity and very low ground water table Agricultural practices in such agro-ecological conditions require irrigation facilities especially during winter season, whenever rainfall is negligible

In spite of favourable agro-ecological condition and suitable soil in the old alluvial plains of Lower Brahmaputra Valley, the average yield of crops are recorded slightly lower (2,547 kg/ha) than the regional average It means the total production system is not only influenced by the agricultural practices but also soil and other agro-ecological conditions of the area, which wholly controls crop yield pattern Moreover, the area does not have proper irrigational facilities and is subjected to draught during winter, therefore the crop yield is relatively low

The foothill agro-ecological zone is narrow, along with the foothills where slope effect can be visualised, which influences the agricultural production and productivity of this area As a result of low fertility of soil and a low ground water table, the average yields of agricultural crops are very low (1,105 33 kg/ha) The foothill zone is characterised by a rugged topography and belongs to the eastern Himalaya (Bhutan Himalaya), which is comparatively high but narrow The soil is of the upper tertiary sandstone associated with clay alternation is found along the foothills The foothill soil is rich in organic matter and nitrogen but deficient in phosphate, potash and low in nutrients

The foothill soil suffers from an acute problem, i e soil erosion, because of the uneven nature of land, which minimises the soil fertility Taking into account the above considerations, the productivity pattern in the foothill area is not conducive, so the productivity is comparatively low An appropriate agricultural technology may help to increase the agricultural production/productivity of this area, which to be discussed in the next chapter

In addition to it, the production pattern is an equally important factor, which influences the productivity pattern in agricultural complexes, considering productivity in money term (yield multiplied by its price), it is obvious that the regional variations of the productivity pattern shows different picture (Table-6.02)

Table-6 02 **Agricultural Productivity Pattern in Money Term in Different Agro-Ecological Conditions**

Agro-Ecological Zone	Rice	Wheat	Jute	Mustard	Others	Total Rs/ha
Flood Plain	10596 40	11775 00	8950 00	9379 50	6927 60	9525 70
Alluvial Soil	11800 00	8328 85	6956 25	8331 70	9227 60	8928 88
Foot Hills	6348 40			8813 35	2753 10	5971 62
Total	10661 30	8941 15	8006 25	8813 35	6246 80	8533 77

Source: Household Survey, 1998-99

The productivity pattern in Lower Brahmaputra Valley between physical and money terms shows a different picture It is evident from the Table-6 02 that the Production is recorded highest in the flood plain (Rs 9,525 00/ha), moderate in alluvial soils (Rs 8,928 88/ha) and low in the foothills of the study area (Rs 5,971 62/ha) It means, the production does vary substantially over space because of market price of crops As a whole, the Lower Brahmaputra Valley shows productivity per hectare of land to be about Rs 8,533 77 On the other hand in physical terms, the productivity per hectare is recorded highest in the alluvial soil areas and is followed by flood plain This differential picture is the results of the market price of jute, which plays a vital role The flood plain agro-ecological zone is favourable for jute cultivation and produces more, accentuating higher productivity in money term, therefore, the physical along with money term showing a different picture Therefore, we can justify that, market price of an item can play a vital role in generating higher productivity per hectare of land

6.4.2 Production Factors:

The farm assets may be categorised into (i) Labour Input, (ii) Animal Input and (iii) Non-Land capital inputs In respect of crop production behaviour, bullock plays an important role, used as multi-purpose by the farmers The bullock is a drought animal, used extensively for ploughing, transport operations as well as harvesting and a source of manure i e cow-dung In respect of non-land, capital includes implements and machinery for farm operation, which embraces machinery and implements, seeds, manure or fertilizer, irrigation and pesticides Moreover, capital can be categories into two i e 'Fixed' and Mobile 'Fixed Capital' includes residences, wells, and farm building However, implements may be sub-divided in to 'Traditional' and 'Improved' categories Secondly the 'Mobile Capital' is required for the acceleration of the farming processes

6.4.2.1 Labour input:

Labour is the dominant factor of production in the traditional method of agriculture The skilled labour used in agriculture is more important as compared to the unskilled labour for raising productivity and agricultural growth As a resul6t of under-developed conditions with less technological application in agricultural production, the productivity is labour-dominated with unlimited unskilled labour supply in the region Therefore, the practices are being operated in such conditions where, families as well as hired labours are used in the agricultural activities Family labour plays an important role for the agricultural operations, which is basically unskilled because of very low education and poor economic condition Comparatively, the engagement of family labour in the agricultural sector is higher (i e 63 47 percent), where the entire farmer's family subjected to employ in their respective farms Therefore, peasant farming is important in the area and there is a case of disguised unemployment in agricultural production pattern, resulting a fall in the level of labour productivity

The regional variation of the employment of labour in agricultural operations shows that there is an employment of 2 06 persons per hectare as an average in Lower Brahmaputra Valley which is significantly higher than the whole of Assam It shows that there is more pressure and unlimited supply of unskilled labour in the area The areas of flood plain have consequently high labour intensity (2 97 persons/ha) than the other parts of the region Because of the effect of seasonal floods in agricultural practices, the rural labour of this flood-affected area migrate to the foothill sides and increases the intensity of labour in those areas too, where intensity is recorded 2 10 persons per hectare Another interesting feature of the distribution shows that the foot hill areas of Lower Brahmaputra Valley have relatively high intensity of hired labour i e 1 00 persons per hectare with high intensity of family labour (1 12 persons per hectare) It shows that the migrated rural labours in this area buy some land and start their own agricultural practices and a section of the migrated labours are land-less and are generally employed in the agricultural sector on a hired basis As a result there is a problem of seasonal unemployment and low wage rates in the area Since labours are the important production factor in the process of agricultural production, it is important to give some salient economic characteristics of labour and their variations in different agro-ecological zones In fact, two types of labours are involved in the agricultural production and farming practice i e family and hired labour The economic characteristics of both type of employment of labours are different

(a) Employment of family labour:

Household survey conducted for labour employment in agricultural production practices, shows that the highest intensity of family labour is recorded in the alluvial soil areas (1.29 persons per hectare) It is followed by flood plain areas (1 14 persons/ha), which is because of very high density of population, therefore the employment is more However the numbers of working days are moderate (117 and 120 days annually) in this agro-ecological zone with very high wage rate of Rs 28 00 and Rs. 35.00 per day. Inversely, foothill areas of Lower Brahmaputra Valley has a very low intensity of family labour with its low wage rate (Table-6.02) It means, there are no opportunities for non-agricultural activities in the alluvial soil and flood plain areas So, the entire family labour is engages on agricultural activities, which in turn increases the intensity.

Table-6.03: **Labour Inputs According to Different Agro-Ecological Conditions**

Agro-Ecological Zone	Family Labour person/ha	Working Days /ha	Wage Rate	Hired Labour Person/ha.	Working Days	Wage Rate
Alluvial Soil	1.29	117	28.00	0.96	79	28.00
Flood Plain	1.14	120	35.00	0.64	45	35.00
Foot Hills	0.94	129	22.00	0.86	102	22.00

Source: Household Survey, 1998-99.

(b) Employment of hired labour:

Not only in Assam, but also in the entire country, the agricultural production activities are operating with hired labour including family labour. Therefore, the agriculture is more labour dominated and land-less labour is equally important in such activities. More details regarding labour characteristics subject to the size of holding is an important aspect of labour and has been discussed separately in the next chapter. However, there is a need of showing the regional variations of hired labour with its working capacity and wage rates.

It is obvious from the collected data that in flood plain areas as well as the foot hill areas of Lower Brahmaputra Valley, where having the intensity of one person per hectare of hired labour. However, it was recorded comparatively lower, that is, 0.64 per hectare in the alluvial soil zone of the study region (Table-6.03). It shows that the labour intensity in respect of hired labour is lower in alluvial soil areas, where the family labour is comparatively high. As far as the efficiency of worker and the employment opportunity of the hired labour are concerned, it can be visualised by calculating the number of working days in an agricultural year along-with daily wage rate of hired labour Table-6 03 shows that, foothill areas of Lower Brahmaputra Valley provides more opportunity to employ hired labour with more than 100 working days per year Here the daily wage rate is recorded lowest, that is, Rs 22 00 per day On the other hand, in flood plains areas, where the intensity of hired labour is good, the employment to hired labour is for 45 days only annually, with high wage rates of Rs 35 00 per day It means that agro-ecological conditions influence the employment opportunities, wage rate and the efficiency of the work force It can be concluded here that wage rate affects the working days on hired labours but family labours do not have any limitations in working days

Hired labours recorded nearly 50 percent in alluvial soils and flood plain areas, but it is recorded as 90 percent in the foothill zone It shows that the agricultural operations in the alluvial soils and flood plain areas of Lower Brahmaputra Valley are mainly dependent on family labour, with one-third-ratio employment of hired labour force (Table-6.04) It reflects that there is a high percentage of land-less labour in the foothill areas, than any other parts of Lower Brahmaputra Valley and immigration of land-less labour in the foothill areas causing high hired labour ratio

The work force intensity, which is employed in the Lower Brahmaputra Valley, is recorded at 2 persons per hectare including family and hired labour This intensity is 3 persons per hectare in flood plain but low in alluvial soil areas, where wage rate is comparatively low i e. Rs. 28 00 per day. The labour intensity in terms of money value is recorded very high in flood plain areas with Rs 5,775 00/ha and low in foothill areas with Rs 5,082 00/ha, which could be because of low wage rate

Table-6 04 **Labour Inputs According to Different Agro-Ecological Conditions**

Agro-Ecological Zone	Family Labour person/ha	Hired-Family labour ratio (in %)	Hired Labour Person/ha	Total Labour Intensity	Wage Rate	Working Days	Labour Intensity in Money Value
Alluvial Soil	1 29	50%	0 64	1 93	28 00	196	5488
Flood Plain	1 14	52%	0 96	2 10	35 00	165	5775
Foot Hills	0 94	90%	0 86	1 80	22 00	231	5082

Source: Household Survey, 1998-99

(c) Labour Productivity:

As far as the labour productivity in the Lower Brahmaputra Valley is concerned, it is imperative to highlight that the high labour productivity is pronounced in the alluvial soil areas with a maximum of Rs 4,626 00 per worker The flood plain areas too shows an equivalent result, like as in alluvial soil areas with Rs 4,536 00 per worker The lowest labour productivity is evident in the foothill areas with a minimum of Rs 3,318 00 per worker in an agricultural year

Table-6 05 **Labour Productivity According to Different Agro-Ecological Conditions**

Agro-Ecological Zone	Production (in Rs/ha)	Labour (in number/ha)	Labour Productivity
Flood Plain Areas	9526 00	2 10	4536 00
Alluvial Soil Areas	8929 00	1 93	4626 00
Foothill Areas	5972 00	1 80	3318 00

Source: Household Survey, 1998-99

From the Table-6.05, it is evident that the higher labour productivity is pronounced in plain areas and the lower in foothill areas, as it reflects that the land potentiality plays the dominant role to accentuate agricultural productivity. This indicates that the agricultural operation is below the subsistence level and it is practised only to fulfil the local demands.

6.4.3.2 Non-Land Capital:

Non-Land capital occupies the central position in the agricultural production system. In order to increase the productivity per hectare per farmer, the non-land capital investment must be increased. The non-land capital includes the extension of known inputs such as irrigation, fertilisers as well as improved seeds, pesticides and technology, which are the associate packages of non-land capital inputs. The utilisation of non-land capital input in agricultural operations in Lower Brahmaputra Valley is comparatively low. The non-land capital investment related to the enhancement of technological factors such as irrigation, fertilizer, pesticides and HYV seeds, which are the main components of green revolution package. Through these packages, the production and productivity in agricultural activities can be raised. The applications of these packages are weak in the study area as well as in entire Assam. Therefore, the productivity levels are recorded low. In the present context, we should interpret the performance of agriculture with respect to the application of package technology in the Lower Brahmaputra Valley. The development of irrigation facility is very low, though the under-ground water condition is favourable for enhancing irrigation facilities This can be raised with investing more capital on them The supply of water into the agricultural field is the most important required input for successful cultivation The timely supply of water into the agricultural field is the decisive factor for the performance of the crop yield The associated inputs like, chemical fertiliser, insecticides and pesticides would also perform satisfactorily, if timely irrigation is provides to the crop In the sample villages, the artificial supply of water in the agricultural field is not satisfactory

The transfer of technology from traditional to a modern one is an important aspect for an increase of agricultural production In fact, in the study area, there is an insignificant application of technology and farmers still rely on traditional means of production In order to boost up agricultural production, modern agricultural technologies (that is, HYV seeds, fertilizers, irrigation, pesticides, insecticides and herbicides) are essential. Secondly, technology is the substitution of labour, as it increases the labour productivity Therefore, it plays a pivotal role in accelerating the production. In the present context, the application of technology is assessed in money term, that is non-land capital, after transferring the data of various technological factors like- seeds, fertilizer, irrigation, . and pesticides The details of their technological factors are given below:

Table-6 06 **Irrigational Investment According to Different Agro-Ecological Conditions**

(Area in hectare)

Agro-Ecological Zone	No. of Holdings	Total Area (ha)	Irrigational Investment per Farm (in Rs.)	Average Irrigational Investment (Rs/ha)
Alluvial Soil	80	152 48	97.25	51.02
Flood Plain	66	136 26	18.94	9 17
Foot Hills	14	51.14	0.00	0 00
Total	160	339.88	56.44	26 57

Source: Household Survey, 1998-99.

It is evident from the Table.6.06 that the average investment in respect of irrigation is only Rs 26.57 per hectare and in the foothill areas, its application is completely absent The irrigational investment in the alluvial soil area is relatively high with Rs. 51.02 per hectare and in the flood plain areas with Rs 9 17 per hectare, which reflects a very low level of inclination towards the utilisation of artificial water supply into the agricultural fields

In the sample villages the amount of fertilisers used in the farm is extremely low, most of the people use cow-dung as manure. The uses of HYV seeds are quite negligible. Paddy used by the farmers is locally developed. Wooden plough is the only tool; the use of tractors is absent, as was experienced in the sample villages. It is evident from the Table-6.07 that, the non-land capital input, which includes seeds and fertilizers spends only Rs. 77.72 per hectare in the sample villages This condition reflects that the farmers in the study region are still practising on traditional method of cultivation

Table-6 07 **Non-Land Capital Input Investment According to Different Agro-Ecological Conditions**

(Area in hectare)

Agro-Ecological Zone	No. of Holding	Total Area	Non-Land Capital (Rs.)	Non-Land Input/Hectare (Rs.)
Alluvial Soil	80	152 48	11600 00	76 08
Flood Plain	66	136 26	9525 00	69 90
Foot Hills	14	51 14	5290 00	103 44
Total	160	339 88	26415 00	77 72

Source: Household Survey, 1998-99

The agro-ecological analysis reveals that the highest non-land capital investment is recorded in the foothill areas with Rs 103 44 per hectare In contrast, in the alluvial soil areas it is Rs 76 08 and in the flood plain areas it was recorded the lowest with Rs 69 90 per hectare This reveals that the non-land investment in the agricultural operations is very low, in order to increase the agricultural productivity per hectare, the proportionate investment of non-land capital should get the top priority

6.4.3.3 Animal Input:

Animal power is an important infrastructure for the agricultural operations Animal supplements human labour for all agricultural operations Drought animal's like-· cattle or buffaloes are used for ploughing, transitment of agricultural products and the source of manure i e cow dung From the field investigations, especially in the sample villages, it was observed that the utilisation of modern implements is almost absent Bullocks are the only animal power used for the agricultural operations It is evident from the Table-6 08 the high level investment in respect of animal is prominent in flood plain areas with a maximum of 1 85 animals per hectare and is followed by alluvial soil areas with 1 66 per hectare The lowest level is evident in the foothill areas with a minimum of 1 27 animals per hectare

Table-6 08 **Animal Input According to Different Agro-Ecological Conditions**

(Area in hectare)

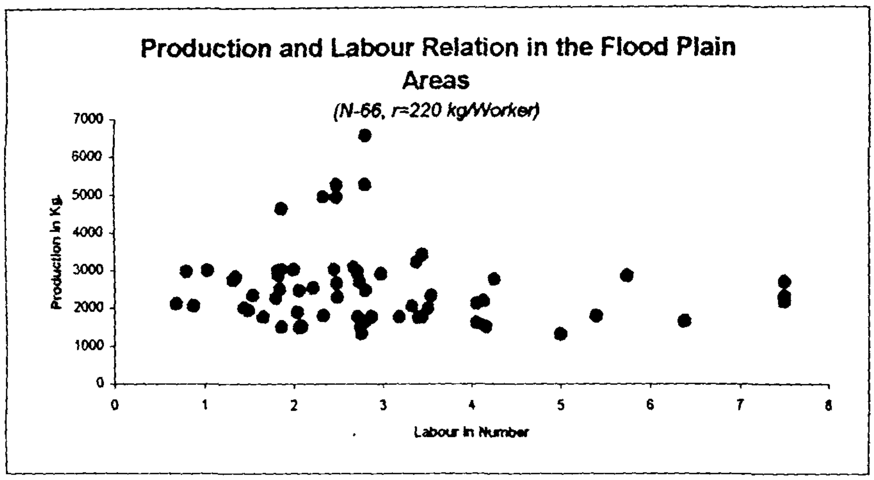
Agro-Ecological Zone	**No. of Holding**	**Total Area (hectare)**	**Animal Intensity (No./ha.)**	**Animal Input (Rs./ha.)**
Alluvial Soil	80	152 48	1 66	1175
Flood Plain	66	136 26	1 85	1310
Foot Hills	14	51 14	1.27	899
Total	160	339 88	1 68	1189

Source: Household Survey, 1998-99

The average investment of money value in animals is Rs 1,189 per hectare and the highest investment is experienced in the flood plain areas which is Rs 1,310 per hectare, followed by alluvial soil areas with Rs. 1,175 per hectare The lowest level of investment is prominent in the foothill areas i e Rs 899 per hectare

6.4.4 Production and its Factors Relationships:

After interpreting the general characteristics of agricultural production and its factors, which are considered as inputs for reproduction and growth of agriculture, it is important to establish their relationship between production and its factors for finding out the weak components of production processes. These components may strengthen in future for raising the level of production and productivity in Lower Brahmaputra Valley. These relationships are essential in various agro-ecological zones of the region, so that the regional characteristics of such relationships may be highlighted and their areal variations can be studied. The relationships are established between production with production factors in a linear relationship, which are based on the law of constant marginal return of factor intensification. The Recardian Model of economic growth based on the Law of Diminishing Returns still upholds in agricultural sector of Lower Brahmaputra Valley in particular and in Assam in general. There is no reason to be pessimistic, as the people would be able to make technological improvement to counter-act with its affect of the law of diminishing return, by increasing farm yields and making international movements on agricultural production (Nag-1970). However, many agricultural economists follow the law of diminishing marginal return in agricultural production (Rao-1968). Preparing scattered diagrams of production distribution with respect to their production factors are shown separately and average yield and the correlation between them are being calculated for



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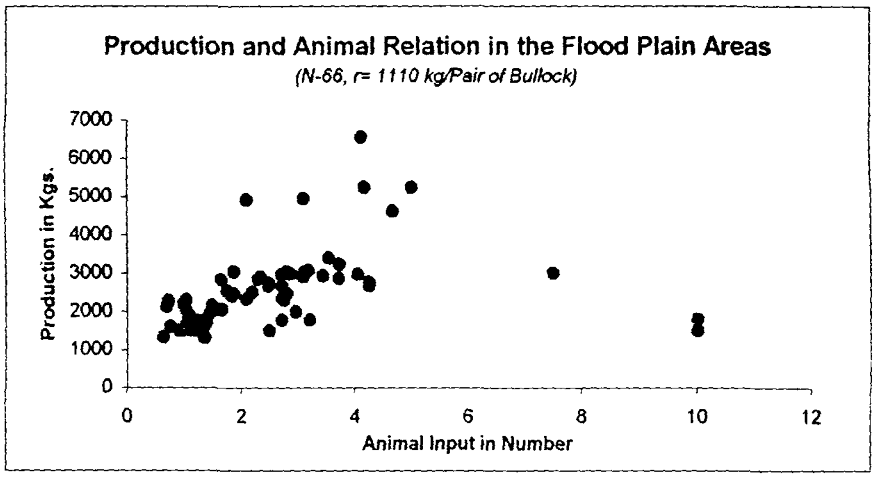

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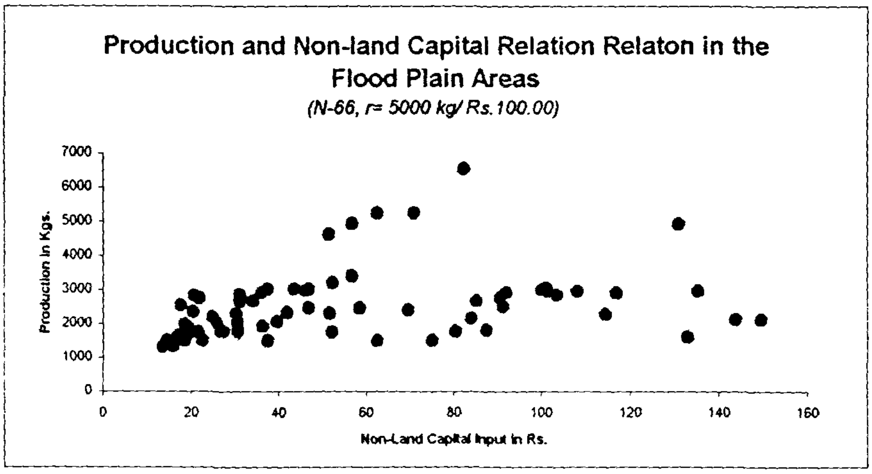


Figure-6.04

each agro-ecological zone of Lower Brahmaputra Valley. The main results and its detailed description are given below.

6.5 Production function Flood Plain Agro-Ecological Areas:

The flood plain region is considered as highly productive and one of the important zone for agriculture. Agricultural production is the function of various inputs used in agricultural operations. In order to understand the inter-relationship between production with its factor relationship and rate of production factors, where Correlation Matrix and Regression analysis are used. It is imperative to emphasise based on regression analysis and correlation, where production is being considered as a dependent variable and the related inputs such as labour, non-land capital and animals are independent variables.

The Figure-6.02, Figure-6.03 and Figure-6.04 shows the relationship between the production with animal power input that, it might help to increase the productivity pattern in the flood plain areas. It reveals the slow positive correlation between the production and non-land capital investment and the least with labour.

The Table-6.09 shows the correlation between the production with all the inputs used in agricultural operations shown independently to understand their inter-relationships.

Table-6 09 **Correlation Matrix for Flood Plain Areas**

	Production	Labour	Non-Land Capital	Animal
Production	1 0000	0 088387	0 297425	0.321932
Labour		1 0000	0 143685	0 702838
Non-Land Capital			1.0000	0.187014
Animal				1.0000

Source: Calculated from the Information Collected during Household Survey

From the scattered diagram and correlation matrix of a dimension of 4 X 4 of flood plain area, the correlation's are very weak in each case and in some cases the correlation between production and labour is found insignificant (r = 0.088387) The relationships of production with non-land capital as well as animal inputs are also positive but insignificant, because of high degree of scatteredness in the distribution (Figure-6 03 & Figure-6 04) It reflects the following features of the production processes in the flood plain areas, are. -

(1) An increase in production is recorded when per unit of labour input is increased (i.e. 220 kg/ worker) This slow positive change shows labour productivity is not significant and labour does not yield much As a result of slow positive response of labour on production because of seasonal floods causes migration from this area to other areas

(2) Capital plays a significant role in changing the production pattern. A small amount of investment of Rs. 100.00 in agricultural production practices in flood plain areas gives an extra ordinarily 5,000 kg of production per hectare, inspite of its investment relationship with production (r = 0.2974) Non-land

capital investment brings a significant impact on the changes of productivity in the flood plain areas.

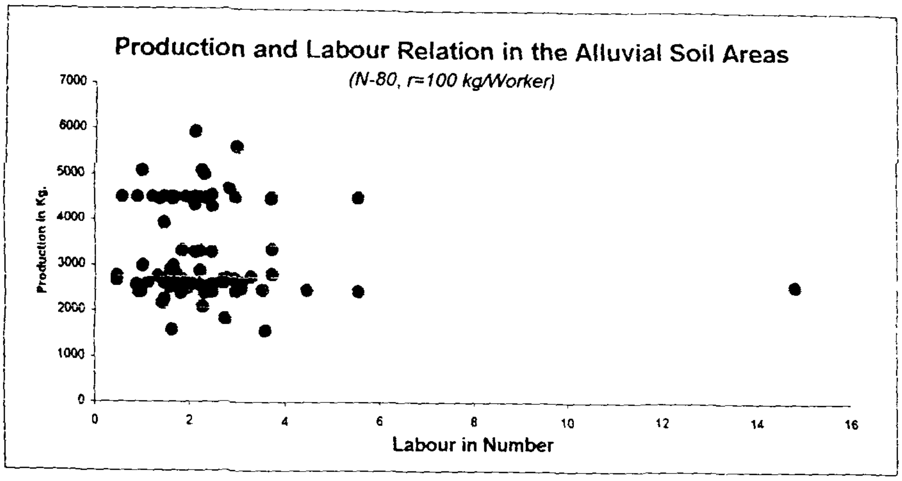
(3) The animal force is moderate and there is a significant change in agricultural production, is mainly due to the increase of animal force in agricultural practices i.e. 1,110 kg/pair of bullocks (Figure-6.04).

(4) In order to increase the productivity pattern in the flood plain areas, animal along with non-land capital investment is a must.

6.6 Production function in Agro-Ecological Areas of Alluvial Soil:

Alluvial soil area is important from the agricultural point of view but is of comparatively more important than the flood plain areas as far as the productivity pattern is concerned in physical term. Production in alluvial soil dominated areas interplay various factors like- land, labour, non-land capital and animal input per unit of land. To examine the inter-relationships between productions with functions, three scattered diagrams have been prepared to measure the magnitude and the relationship pattern per unit of land.

We can see a strong positive co-relation between production with animal input along with non-land capital input. It reflects that there is a possibility to increase productivity behaviour by increasing the input investment of non-land capital along with animal power in the alluvial soil areas of Lower Brahmaputra Valley (Figure-



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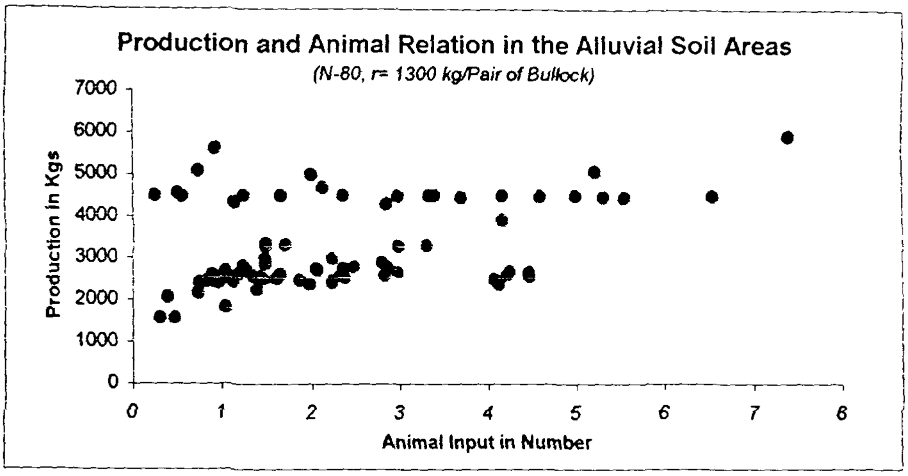

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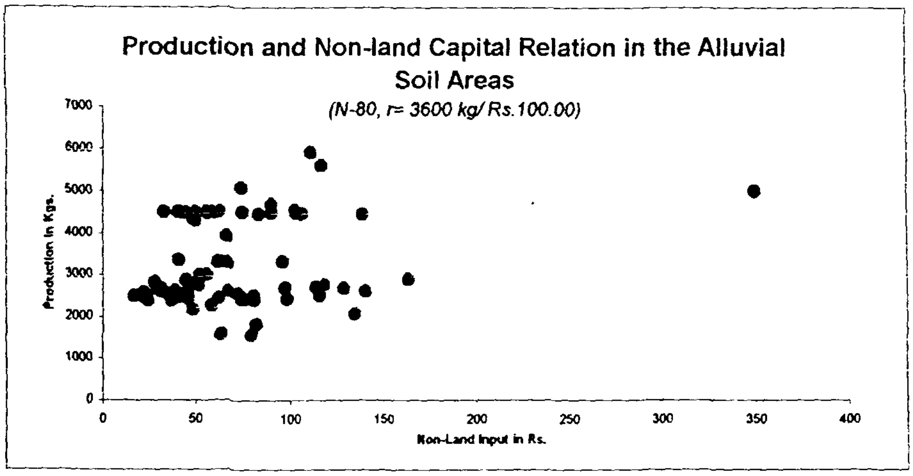


Figure-6.07

6 05, Figure-6 06 and Figure-6 07) On the other hand, there is a high stationery tendency maintained in production with labour input, which reflects the possibility of increase productivity pattern at low level

In this agro-ecological zone agricultural production practices, results to the change of production subject to its factors are slightly different from the flood plain areas The physical relationship and distribution map of such relationship gives the following results

Table-6 10 **Correlation Matrix for Alluvial Soil Areas**

	Production	**Labour**	**Non-Land Capital**	**Animal**
Production	1 0000	0 197252	0 262566	0 419637
Labour		1 0000	0 703517	-0 01089
Non-Land Capital			1 0000	-0 07927
Animal				1 0000

Source: Calculated from the Information Collected during Household Survey

(1) Increase of labour force in production system has a weak but positive relationship though it is insignificant An amount of 100 kg is increased with an increase of one worker in agricultural operations in the alluvial soil area Engagement of labour is only an organisational factor for non-land capital and animal There is a case of disguised un-employment Therefore, there is no effect of labour on production By increasing labour force in agriculture is unable to increase much productivity in agricultural practice inspite of favourable soil moisture conditions and physiographic features of the area

There is no damage due to flood in crop production, where topography is gentle with fertile old alluvial soil, where without fertiliser even a good crop yield can be achieved

(2) Capital has a positive and significant effect in the increase of production It raises 3,600 kg of production when Rs 100.00 is invested on the items of modern technology, namely, irrigation, HYV seeds, pesticides, fertilizers as well as insecticides in agricultural practices.

(3) The input of animal force is also recorded positive with a significant co-efficient correlation ($r = 0.419$) in the area of alluvial soil, that is, about 1,300 kg of production is raised by employing a pair of bullocks.

(4) The relationship shows that to increase the agricultural production, non-land capital as well as animal force is essential. By investing only Rs. 100.00 only one may raise the production to nearly three times higher than animal engagement pattern.

From the above facts, we can come to a conclusion that a rational input investment is a must in order to increase the productivity pattern in the alluvial soil areas of Lower Brahmaputra Valley region.

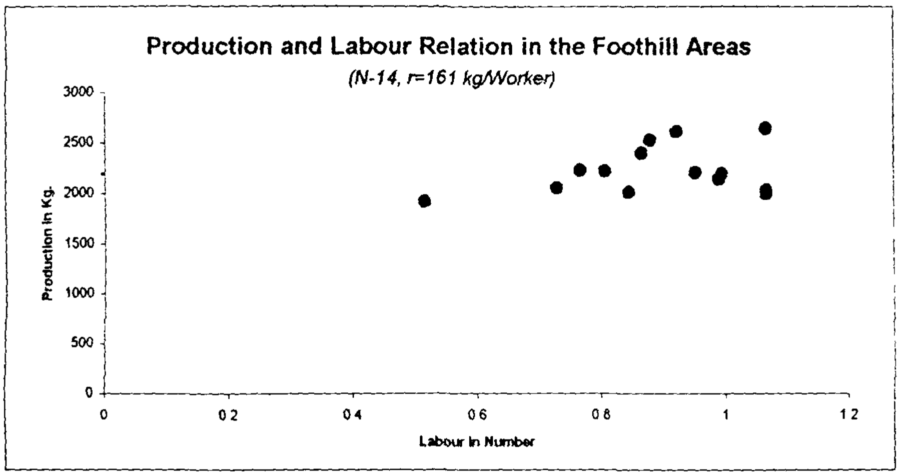
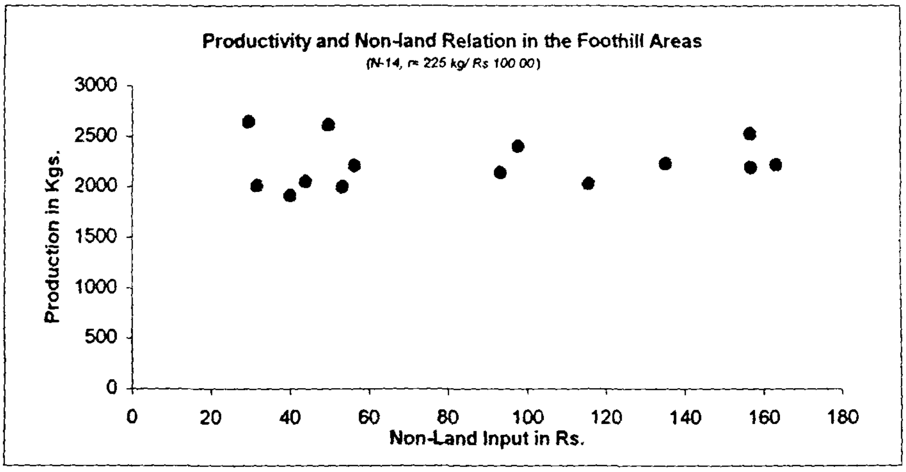


Figure-6.08



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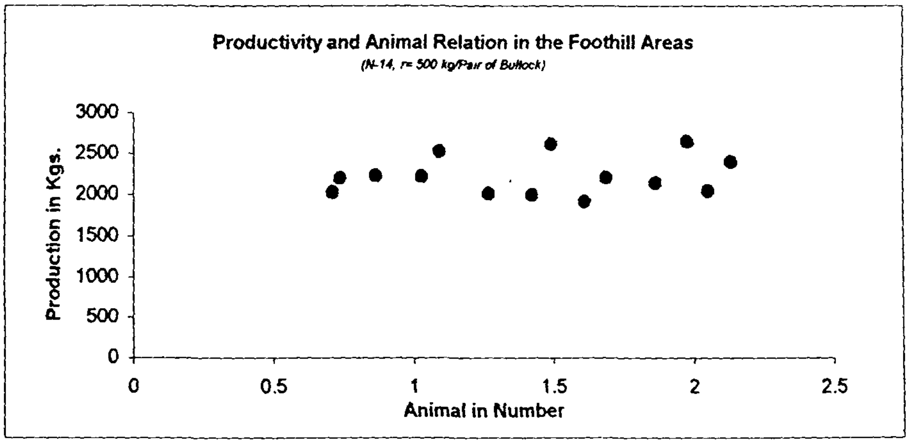

Figure-6.10

6.7 Production function in the Agro-Ecological Areas of Foot Hills:

The foothill area is relatively less important from the agricultural point of view. By taking the physical characteristics of soil into account, one understands that the foothill areas are not conducive as far as the productivity behaviour is concerned. The general picture of production function in this area is different from other areas, which has already been discussed earlier. To specify the relative relationship between production and its functions, three (Figure-6.08, Figure-6.09 and Figure-6.10) scattered diagrams are prepared, based on primary information collected during field survey.

The above statement reveals that there seems a comparatively higher co-efficient of co-relation between the production with labour, as well as animal power per hectare of land. On the contrary, there is a positive relationship indicated between production with non-land capital investment in the foothill areas. It reflects the possibility to increase the productivity pattern by increasing proportionate involvement of labour along with non-land capital. There have a very slow possibility to increase the productivity by increasing the animal power and technological expertise. The rate of change in production is recorded per unit of labour, which is even lower than the capital and animal force. The important observations relating to the production with its factors operating in this area provides the following results (Table-6.11).

Table-6 11 **Correlation Matrix for the Foothill Areas**

	Production	**Labour**	**Non-Land Capital**	**Animal**
Production	1 0000	0 437329	0 11634	0 177204
Labour		1 0000	-0 43773	0 608648
Non-Land Capital			1 0000	-0 65331
Animal				1 0000

Source: Calculated from the Information Collected during Household Survey

(1) There is a significant positive impact of labour in the change of production in the foothill area A record improvement in production is evident with one additional worker can give an extra 161 kg/ha of production (Table-6 11) However, the intensity of work force is low in the existing agricultural operation in the area Therefore, there is a need for labour employment to boost up production levels in the area

(2) Marginal productivity of non-land capital investment is very low (i e 225 kg per Rs 100 00) This is because of the use of primitive tools It is observed that farmers of the foothill areas use only wooden plough, small hoes and traditional husking and threshing implements in agricultural operations with family labour

(3) It is seen that production of 500 kg by a pair of bullocks, which is comparatively higher than non-land capital investment Therefore, the employment of animal force may produce more than the non-land capital investment In this area more labour can be substituted by more animal power use

It is reflected from the above analysis that the rational investment of non-land capital and animal input can show a better result in respect of agricultural production/productivity pattern in the foothill agro-ecological areas. We can summarise here, that there is a possibility of increase in productivity behaviour through investments, such as non-land capital and animal power resources. It might increase the productivity pattern in the traditional method of agriculture in Lower Brahmaputra Valley region.

6.8. Conclusion:

From an interpretation of the results and observations, which have been drawn here for the production functions and production relationships in various agro-ecological conditions, the following main conclusion can be drawn:

(1) The marginal product of capital investment is recorded as very high in the flood plain and in the alluvial soil areas. It means that there is a need to change the agricultural operation system from labour intensive to capital intensive. Using advance technological know-how (Green Revolution Package) can only raise the productivity or average yield of the crops, which would be helpful to raise labour productivity. However, the marginal productivity of non-land capital is very low in foothill areas i.e. 225 kg/ha. To maximise the agricultural production, the investment of non-land capital is a must in Lower Brahmaputra Valley.

Table-6 12 **Effects of Production Factors on Agricultural Production**

	Production Changes With Respect to		
Agro-Ecological Conditions	Labour (kg/worker)	Non-land Capital (kg/Rs 100 00)	Animal (kg/pair of bullock)
Flood Plain	222	5000	1110
Alluvial Soil Area	100	3600	1300
Foothill Area	161	225	500

Source: Calculated from the Information Collected during Household Survey

(2) Comparatively animal investment characterised with low marginal productivity in all agro-ecological conditions and relatively higher productivity is evident in alluvial and flood plain, but low in foothill areas (Table-6 12) As far as the investment pattern in money term is concerned, it's having relatively higher investment in relation to other corporal units

(3) The marginal productivity of labour in the foothill areas is higher than the marginal production of capital and animal force, more labour can be employed to increase production/productivity pattern (Table-6 12)

(4) A big share of family labour is employed in the agricultural practices in the study area Of flood plain areas have the highest intensity of family labour with a very high number of working days The area experiences seasonal flood, low productivity level, less investment of non-land capital and very low employment of animal force, still cultivators does not like to move away from the area, because they do not want to sell off their land Therefore, they are forced to engage their entire family member in the farming system to generate either production-surplus or self-sufficiency As a result, farming system in the study area is at subsistence level to fulfil cultivators family needs only.

(5) In contrast, the foothill zone can employ high wage labours because of high marginal productivity of labour, characterised with low wage rate. Here, the ratio of hired labour with family labour was recorded highest (i.e. 90 percent) in foothill area. The farming practice in this area can accommodate more work forces, by constantly raising the production to 161 kg per worker.

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CHAPTER VII

FARM SIZE AND PRODUCTIVITY PATTERN

7.1 Introduction:

Indian agriculture is characterised by a very close relationship between land holding size and the productivity pattern. Some economists have argued against it that, there is an 'Inverse' relationship between the size of the operational land holding and the productivity pattern. On contrary to it, some of them stand against, considering it as 'Statistical traps', forwarding the conclusion that there exists no relationship between land holding size and productivity pattern. As the relationship between the operational holding size and productivity has a very close bearing for the further agricultural planning, in order to adopt certain policies at state or regional level. It would be more convenient to make correct use of the latest information for testing the specific hypothesis.

Even, if such an inverse relationship holds, which does not provide significant base to judge the relative potentialities of different sizes of land holding to predict the pattern of farm size distribution. Besides, the inverse relationship required some significance as it could provide rationale argument that the small farms are superior as compared to large ones on economic point of view (Bharadwaj-1974). The explanation came into being in favour of the superiority of small farms which falls into three following categories: -

1. The differences in techniques, specifically small landholders used technically advanced method of production.
2. More intensive application of other productive inputs, such as- labour, animal power or artificial supply of water in the agricultural fields.
3. The Qualitative differences in factor endowment, either land or labour on small farms is intrinsically of better quality.

Keeping in view the above-mentioned generalisations, it may be worthwhile to understand the distribution of farms as a pre-condition for the relationship with productivity. 'Green Revolution', has brought miraculous transformation in Indian agriculture, though it is highly concentrated in certain areas/states. Basically land is in the hands of various groups of people, therefore cropping pattern changes. Perhaps the problem is the result of fundamental differences upon the agricultural ecology, which allows variable relationship between the operational land holding size and productivity. An attempt is being made for further understanding of the controversial relationship between farm size and productivity pattern in Lower Brahmaputra Valley.

In the previous chapter, the existing agricultural productivity in relation to agro-ecological conditions with its production factors has been elaborated. Agricultural productivity is the ultimate function of required imputs. It is important to consider the genuinity of production approach in Lower Brahmaputra Valley to understand the production behaviour according to farm size, which helps to explain the degree of production and growth in respect to size of land holding.

The land holding size influences agricultural operations with its production pattern. If farmer does not have a significant size of land holding for operation, he may not be able to manage infrastructure for agricultural production.

There are various studies, which shows the diminishing rate of production increases subject to the increase of the size of land holdings (Rao-1966). Further, it is evident that, the marginal and very small farm sizes does not embodied infrastructure facilities for the development of farming activities

The farmers of large size holdings have enough land to manage modern technology to increase the intensity of land use, accordingly effects the agricultural productivity, while the case is reverse for smaller size of land holdings.

7.2 Fragmentation of Land Holding:

Size of land holding is also an overall part of the fragmentation and the variation of agricultural production components, which is studied in detail here for various land holding sizes. According to the agricultural census of India (1991), the entire land holding systems have been classified into nine categories and the farms of different categories are defined below (Table-7.01). In the present study the same criterion is followed to study the agricultural production and productivity characteristics of various land holdings.

Table-7.01: **The Nomenclature of the Farm Sizes**

Nomenclature	**Farm Size**
Low-Marginal	0.00 – 0.20
Semi-Marginal	0.20 – 0.50
Marginal	0.50 – 1.00
Small	1.00 – 2.00
Small-Medium	2.00 – 3.00
Semi-Medium	3.00 – 4.00
Medium	4.00 – 5.00
Medium-High	5.00 – 7.50
Very-High	Above 7.50

Secondly the impact of fragmentation of land holding can also be seen by studying the parcels of land, under each land holding size and the average parcels size. More parcels of land reduce the operational efficiency as well as production efficiency of farm. When the number of parcels of land increases, then the land become un-manageable, which were studied by Bhagavati and Chakravorty (1964). Due to non-availability of reliable data regarding this fact, the study in this chapter is restricted to the size of land holdings.

7.3 Method Used:

(1) The primary survey was conducted by collecting information of 160 numbers of farms of various sizes of land holdings in the study area. The general characteristic of the sample survey has already been given in Chapter-I.

(2) The percentage share of land holdings varies according to the land holding sizes, because the sample farms have been taken on the basis of strength of total farm distributed. According to the Agricultural Census of India, there are four major categories of land holdings - marginal, small, medium-large and very large, but in Lower Brahmaputra Valley this is not applicable. The results are drawn on the basis of sample size, rather than the total area. The results based on sample farms are compared according to different agro-ecological zones to find out the causes and to show the results of different agro-ecological conditions according to farm size groups.

(3) The statistics related to the general land use, production intensity, yield pattern and various farm assets have been generated from duly filled questionnaires according to various sizes of land holdings.

7.4 Agricultural Production Pattern:

7.4.1General land-use:

On the basis of data collected, the overall land uses has been divided into four major categories namely, land under settlement & forest, wasteland, tree crops and cultivated land. According to the different sizes of land holdings of different agro-ecological zones of Lower Brahmaputra Valley, the following observations are being made.

Table-7.02: **General land-use in Different Agro-Ecological Zones**

(A) Flood plain: (Figures in hectare)

Characteristic	Farm Size	Settlement & Forest	Waste Land	Tree Crops	Cultivated Land
Low-Marginal	0.00 – 0.20	---	---	---	---
Semi-Marginal	0.20 – 0.50	1.65 (32.80)	1.26 (25.09)	0.04 (0.70)	2.07 (41.23)
Marginal	0.50 – 1.00	1.05 (13.37)	0.27 (3.47)	0.68 (8.60)	5.85 (74.52)
Small	1.00 – 2.00	4.74 (7.35)	3.90 (6.04)	2.28 (3.53)	53.55 (83.06)
Small-Medium	2.00 – 3.00	2.04 (8.04)	1.33 (5.24)	1.09 (4.29)	20.89 (82.40)
Semi-Medium	3.00 – 4.00	1.92 (9.11)	---	0.53 (2.50)	18.62 (88.37)
Medium	4.00 – 5.00	0.20 (4.46)	---	0.13 (2.90)	4.15 (92.63)
Medium-High	5.00 – 7.50	0.74 (8.70)	---	0.25 (2.95)	7.47 (88.29)
Very-High	Above 7.50	0.58 (2.08)	1.67 (6.00)	0.25 (0.08)	25.30 (99.00)
Average		**12.92 (7.84)**	**8.43 (5.11)**	**5.61 (3.40)**	**137.90 (83.65)**
(B) Alluvial Soil:					
Low-Marginal	0.00 – 0.20	0.09 (64.28)	---	0.04 (28.57)	0.01 (7.14)
Semi-Marginal	0.20 – 0.50	0.25 (43.80)	---	0.05 (8.70)	0.27 (57.00)
Marginal	0.50 – 1.00	1.66(15.38)	---	0.73 (6.76)	8.4 (77.84)
Small	1.00 – 2.00	5.86 (8.92)	0.07 (0.01)	3.66 (5.57)	56.08 (85.39)
Small-Medium	2.00 – 3.00	2.14 (5.11)	0.51 (1.21)	2.52 (6.01)	36.7 (87.65)
Semi-Medium	3.00 – 4.00	0.92 (3.97)	0.07 (0.03)	0.90 (3.88)	21.28 (91.84)
Medium	4.00 – 5.00	0.13 (2.46)	---	0.40 (7.57)	4.75 (89.96)
Medium-High	5.00 – 7.50	1.47 (5.11)	---	0.30 (1.05)	26.67 (93.77)
Very-High	Above 7.50	---	---	---	---
Average		**12.52 (7.12)**	**0.65 (0.37)**	**8.60 (4.89)**	**154.16 (87.63)**
(C) Foot Hill:					
Low-Marginal	0.00 – 0.20	---	---	---	---
Semi-Marginal	0.20 – 0.50	---	---	---	---
Marginal	0.50 – 1.00	---	---	---	---
Small	1.00 – 2.00	0.27 (13)	0.67 (33)	0.07 (3)	1.01 (50)
Small-Medium	2.00 – 3.00	4.62 (23)	0.54 (3)	1.82 (9)	12.72 (65)
Semi-Medium	3.00 – 4.00	2.88 (19)	1.07 (7)	1.34 (9)	10.11 (66)
Medium	4.00 – 5.00	0.60 (11)	---	0.60 (7)	4.62 (82)
Medium-High	5.00 – 7.50	4.15 (14)	---	2.42 (8)	22.35 (77)
Very-High	Above 7.50	---	---	---	---
Average		**12.52 (17.42)**	**2.28 (3.17)**	**6.25 (8.69)**	**50.81 (70.71)**
(D) Total general land-use in lower Brahmaputra valley:					
Low-Marginal	0.00 – 0.20	0.03 (37.50)	---	0.04 (50.00)	0.01 (12.50)
Semi-Marginal	0.20 – 0.50	1.74 (32.04)	1.26 (23.20)	0.09 (1.66)	2.34 (43.09)
Marginal	0.50 – 1.00	1.30 (7.54)	0.27 (1.57)	1.41 (8.13)	14.25 (82.70)
Small	1.00 – 2.00	6.67 (5.21)	4.64 (3.63)	6.01 (4.69)	111.64 (86.46)
Small-Medium	2.00 – 3.00	12.52 (13.81)	2.38 (2.63)	5.43 (5.99)	70.31 (77.57)
Semi-Medium	3.00 – 4.00	6.94 (11.40)	1.14 (1.87)	2.77 (4.55)	50.01 (82.17)
Medium	4.00 – 5.00	1.72 (10.50)	---	1.13 (6.90)	13.52 (82.59)
Medium-High	5.00 – 7.50	5.02 (7.78)	---	2.97 (4.60)	56.49 (87.60)
Very-High	Above 7.50	2.05 (7.00)	1.67 (5.71)	0.25 (0.85)	25.30 (86.44)
Average		**37.99 (9.19)**	**11.36 (2.75)**	**20.10 (4.86)**	**343.87 (83.19)**

Source: Household Survey, 1998-99.

N.B. Figures in parentheses indicate percentage share to the total area.

(1) The general land use shows that there is a gradual decrease of percentage of share under settlement and forest, as the farm size increases. This fact can be observed in all agro-ecological zones except in foothills, where the farms of small and medium sizes of land holdings have a comparatively higher percentage and it goes up to 23 percent of their total land (Table-7.02). It is also observed that a farm has a minimum requirement for settlement, which shows more proportionate area in the smaller size of land holdings and lesser in larger size, which shows a valid reason for the hypothesis imposed here In the flood plain areas the semi-marginal farmers have one-third of its area under settlement and forest.

(2) The distribution of wasteland is nearly one-fourth of the total land, but this size is in semi-marginal land holdings and decreases, when farm size increases in the study area. It is less in the larger sizes even goes up to 1.87 percent in Lower Brahmaputra Valley, because of the conversion of wasteland into the cultivated area with the help of technological factors at the disposal of farmer's hand and good management It is not expected that wasteland should be more in the marginal and small farm sizes, however it was recorded high in the present primary survey

(3) The pattern of tree crops shows that small and medium size of farmers have nearly 4 to 8 percent of their land under tree crops in the flood plain areas as well as in the alluvial soil areas. The tree crops and forest cover has a positive

relationship and simultaneous decrease with the increase of farm size in all agro-ecological conditions of Lower Brahmaputra Valley.

(4) Most of the shares of the land holdings are under cultivated land, it varies from 42 to 85 percent. The variations of cultivated land clearly shows that there is a constant increase of the percentage shares of cultivated land, as the farm size increases from low marginal to large. This variation can be seen from 41.3 to 99 percent in the flood plain and 7.14 to 93.77 percent in the alluvial soil areas and 50 to 77 percent in the foothill areas of Lower Brahmaputra Valley. It is shows that the farmers having smaller size of land holdings have a bigger proportion of land under cultivation.

7.4.2 Cropping Intensity:

The qualitative as well as quantitative difference of inputs reflects upon the cropping pattern and the utilisation of agricultural land. The differences of value productivity thus finally boil down to the differences in intensity of land use and cropping pattern (Usha Rani-1971). Besides, intensive land use contributes to the relative higher value productivity specifically in smaller farms, whereas the intensive use of land involves the application of other relative inputs too.

Table-7.03: **Cropping Intensity in Different Agro-Ecological Zones**

(A) Flood Plain: (Figures in hectare)

Characteristic	Farm Size	N.C.A.	D.C.A.	G.C.A.	Cropping Intensity in P.C.
Low-Marginal	0.00 – 0.20(0)	---	---	---	---
Semi-Marginal	0.20 – 0.50(5)	2.07	1.34	3.41	165
Marginal	0.50 – 1.00(7)	5.85	3.54	9.39	161
Small	1.00 – 2.00(35)	53.3	30.02	83.57	156
Small-Medium	2.00 – 3.00(9)	20.97	11.38	32.27	154
Semi-Medium	3.00 – 4.00(5)	18.86	7.16	25.78	138
Medium	4.00 – 5.00(1)	4.14	1.14	5.29	127
Medium-High	5.00 – 7.50(1)	5.82	0.80	8.27	111
Very-High	Above 7.50(3)	25.25	1.96	27.26	108
Average		**136.26**	**57.34**	**195.24**	**143**
(B) Alluvial Soil:					
Low-Marginal	0.00 – 0.20(1)	0.01	0.01	0.02	200
Semi-Marginal	0.20 – 0.50(1)	0.26	0.20	0.47	174
Marginal	0.50 – 1.00(11)	8.38	5.34	13.74	164
Small	1.00 – 2.00(39)	55.49	32.42	88.50	158
Small-Medium	2.00 – 3.00(16)	36.00	14.58	53.28	145
Semi-Medium	3.00 – 4.00(7)	20.93	8.57	29.85	140
Medium	4.00 – 5.00(1)	4.74	1.43	6.18	130
Medium-High	5.00 – 7.50(4)	26.67	7.90	34.57	130
Very-High	Above 7.50(0)	---	---	---	---
Average		**152.48**	**70.45**	**226.61**	**149**
(C) Foot Hill:					
Low-Marginal	0.00 – 0.20(0)	---	---	---	---
Semi-Marginal	0.20 – 0.50(0)	---	---	---	---
Marginal	0.50 – 1.00(0)	---	---	---	---
Small	1.00 – 2.00(1)	1.01	0.47	1.48	147
Small-Medium	2.00 – 3.00(5)	12.85	2.61	15.40	122
Semi-Medium	3.00 – 4.00(3)	10.17	2.14	12.25	121
Medium	4.00 – 5.00(1)	4.62	0.80	5.42	117
Medium-High	5.00 – 7.50(4)	22.49	3.75	26.10	117
Very-High	Above 7.50(0)	---	---	---	---
Average		**51.14**	**9.77**	**60.65**	**119**
(D) Average Cropping Intensity in Lower Brahmaputra Valley:					
Low-Marginal	0.00 – 0.20(1)	0.01	0.01	0.02	200
Semi-Marginal	0.20 – 0.50(6)	2.33	1.54	3.88	167
Marginal	0.50 – 1.00(18)	14.23	8.88	23.13	163
Small	1.00 – 2.00(75)	109.8	62.91	173.55	158
Small-Medium	2.00 – 3.00(30)	69.82	28.57	100.95	145
Semi-Medium	3.00 – 4.00(15)	49.96	17.87	67.88	136
Medium	4.00 – 5.00(3)	13.5	3.37	16.89	125
Medium-High	5.00 – 7.50(9)	54.98	12.45	68.94	125
Very-High	Above 7.50(3)	25.25	1.96	27.26	108
Average		**339.88**	**137.56**	**482.50**	**142**

Source: Household Survey, 1998-99.

Crop intensity is an indicator of intensification of agricultural production Therefore, it may have positive co-relation with agricultural productivity. The measurement of crop intensity is directly related to the double-cropped area on net cultivated area. Therefore the gross cropped area is equal to the net cultivated area and double cropped area, crop intensity is defined as the ratio of gross cropped area with net cultivated area. Therefore, net cultivated area and double-cropped areas vary in different agro-ecological conditions. As a result crop intensity also varies accordingly. The characteristics of the distribution of crop intensity in Lower Brahmaputra Valley is given in the following manner.

(a) There is a gradual decline in crop intensity from 200 percent in small-marginal size of land holding to 108 percent of very high size of land holding in Lower Brahmaputra Valley. It means the marginal farmers are utilising their land intensively by cultivating nearly 63 percent of its agricultural area twice or more than twice in an agricultural year. Such high degree of crop intensity is recorded in all agro-ecological zones of Lower Brahmaputra Valley.

(b) However, the small and medium sizes of land holdings have a medium degree of crop intensity varying from 125 to 160 percent. This range is recorded lower in the foothill areas and higher in the flood plain areas. It shows that foothill areas of Lower Brahmaputra Valley have comparatively low crop intensity (Table-7.03)

(c) The data shows that a very low degree of crop intensity, even lower than the national average, is observed in the case of the medium- high to very high sizes of land holdings.

7.4.3 Cropping Pattern:

The cropping pattern in Assam is characterised as mono-crop dominated with a very high percentage of rice hectareage to the total cultivated area. This chief characteristic prevails with respect to the cropping pattern in the agricultural sector, not only in Lower Brahmaputra Valley but also in Assam and occupies a very high percentage by food crops, which is an overwhelming proportion to the total cropped area. The predominance of food grain crops in agricultural operation reflects low level of commercialisation of the agricultural sector.

Food grain domination is not only in the plains of Lower Brahmaputra Valley and Assam but also in the entire country and this is because of the food demand of the people. However, the characteristic feature of cropping pattern in Lower Brahmaputra Valley is the dominance of a single crop. Therefore, there is a mono-crop culture pattern, where a very high percentage of area is under paddy crop. The statistics, which were collected and compiled, which shows that there is not much significant variation in the percentage of paddy crop among different sizes of land holdings The characteristic features of cropping pattern are given below:

Table-7.04 **Cropping Pattern in Different Agro-Ecological Zones**

(A) Flood Plain: (Figures in hectare)

Characteristic	Land Holding Size	Rice	Wheat	Jute	Rape & Mustard	Others
Low-Marginal	0.00 – 0.20	---	---	---	---	---
Semi-Marginal	0.20 – 0.50	1.94 (93.17)	---	---	---	0 13 (6.28)
Marginal	0.50 – 1.00	5.49 (93.84)	---	---	---	0.36 (6.15)
Small	1.00 – 2.00	45.9 (86.11)	0.10 (0.01)	1.44 (2.70)	0.81 (1.51)	5.05 (9.47)
Small-Medium	2.00 – 3.00	17.84 (85.07)	0.20 (0.09)	1.12 (5.34)	0.58 (2.76)	1.23 (5.86)
Semi-Medium	3.00 – 4.00	14.05 (74.49)	---	0.65 (3.44)	1.34 (7.00)	2.82 (14.95)
Medium	4.00 – 5.00	3.35 (80.91)	---	0.25 (6.03)	---	0.54 (13.04)
Medium-High	5.00 – 7.50	3.75 (64.43)	---	0.80 (13.74)	0.67 (11.50)	0.60 (10.30)
Very-High	Above 7.50	16.85 (66.73)	---	0.25 (0.99)	---	8.15 (32.22)
Average		**109.17 (80.12)**	**0.30 (0.22)**	**4.51 (3.31)**	**3.40 (2.49)**	**18.88 (13.86)**

(B) Alluvial Soil:

Characteristic	Land Holding Size	Rice	Wheat	Jute	Rape & Mustard	Others
Low-Marginal	0.00 – 0.20	---	---	---	---	0.01 (100)
Semi-Marginal	0.20 – 0.50	0.13 (50.00)	---	---	---	0.13 (50.00
Marginal	0.50 – 1.00	8.13 (97.00)	---	---	---	0.25 (2.98)
Small	1.00 – 2.00	47.84(86.21)	0.61 (1.09)	1.8 (3.24)	0.79 (1.42)	4.45 (8.01)
Small-Medium	2.00 – 3.00	30.84 (85.66)	0.39 (1.08)	1.27 (3.52)	1.79 (4.97)	1.71 (4.75)
Semi-Medium	3.00 – 4.00	18.34 (87.60)	0.26 (1.24)	0.46 (2.19)	0.93 (4.44)	0.94 (4.49)
Medium	4.00 – 5.00	3.88 (81.80)	0.13 (2.74)	0.13 (2.74)	0.40 (8.43)	0.20 (4.20)
Medium-High	5.00 – 7.50	25.84(96.88)	---	0.40 (1.49)	---	0.43 (1.61)
Very-High	Above 7.50	---	---	---	---	---
Average		**135.00 (8.54)**	**1.39 (0.91)**	**4.06 (2.66)**	**3.91 (2.56)**	**8.12 (5.33)**

(C) Foot Hill:

Characteristic	Land Holding Size	Rice	Wheat	Jute	Rape & Mustard	Others
Low-Marginal	0.00 – 0.20	---	---	---	---	---
Semi-Marginal	0.20 – 0.50	---	---	---	---	---
Marginal	0.50 – 1.00	---	---	---	---	---
Small	1.00 – 2.00	0.94 (93)	---	---	---	0.07 (7)
Small-Medium	2.00 – 3.00	8.16 (64)	---	---	1.94 (15)	2.75 (21)
Semi-Medium	3.00 – 4.00	6.15 (60)	---	---	1.27 (12)	2.75 (27)
Medium	4.00 – 5.00	3.21 (69)	---	---	0.54 (12)	0.87 (19)
Medium-High	5.00 – 7.50	15.40 (68)	---	---	2.94 (13)	4.15 (18)
Very-High	Above 7.50	---	---	---	---	---
Average		**33.86 (66.21)**	**---**	**---**	**6.69 (13.08)**	**10.59 (20.71)**

(D) Average Cropping Pattern in Lower Brahmaputra Valley:

Characteristic	Land Holding Size	Rice	Wheat	Jute	Rape & Mustard	Others
Low-Marginal	0.00 – 0.20	---	---	---	---	0.01 (100)
Semi-Marginal	0.20 – 0.50	2.07 (88.84)	---	---	---	0.26 (11.16)
Marginal	0.50 – 1.00	13.62 (95.71)	---	---	---	0.61 (4.29)
Small	1.00 – 2.00	94.68 (86.23)	0.71 (0.65)	3.24 (2.95)	1.6 (1.46)	9.57 (8.72)
Small-Medium	2.00 – 3.00	56.84 (81.41)	0.59 (0.85)	2.39 (3.42)	4.31 (6.17)	5.69 (8.15)
Semi-Medium	3.00 – 4.00	38.54 (77.14)	0.26 (0.52)	1.11 (2.22)	3.54 (7.09)	6.51 (13.03)
Medium	4.00 – 5.00	10.44 (77.33)	0.13 (0.96)	0.38 (2.81)	0.94 (6.96)	1.61 (11.93)
Medium-High	5.00 – 7.50	44.99 (81.83)	---	1.2 (2.18)	3.61 (6.57)	5.18 (9.42)
Very-High	Above 7.50	16.85 (66.73)	---	0.25 (0.99)	---	8.15 (32.28)
Average		**278.03 (81.80)**	**1.69 (0.49)**	**8.57 (2.52)**	**14.0 (4.12)**	**37.59 (11.06)**

Source: Household Survey, 1998-99.

N.B. Figures in parentheses indicate percentage share.

(a) There are four important crops in the region that covered about 90 percent of the cultivated land (Table-7 04) These are- rice, wheat, jute and mustard Rice is the staple food and wheat is also an important food grains for the consumption of local people Jute is a commercial crop and rape and mustard is the source of edible oil and is consumed locally There is another category, which includes potatoes and vegetables In such cropping pattern even rape and mustard is more important than jute, it occupied nearly 6 5 percent to the total cultivated land, which is far greater than the area under jute crop (2 80 percent) Out of these two crops, rape and mustard is important because of the dry winter prevails in the study area On the other hand, jute is grown during rainy season, where rice is dominant crop for food, therefore jute occupies a very small area

(b) Among the two food grains wheat occupies an insignificant area (less than one percent), while rice has its ample dominance in the cropping pattern Rice and jute are the principal kharif crops, whereas wheat and mustard are rabi crops in Lower Brahmaputra Valley

(c) The cropping pattern according to the size of land holdings shows that there is an insignificant variation in the percentage of rice among the various sizes of land holdings It varies from 93 percent (marginal farms) to 81 percent (large size) in the flood plain areas as well as in the alluvial soil areas On the other hand, the foothill areas have a higher range of variation from 93 to 60 percent from medium to high size of land holdings

(d) The four principal crops can be visualised in different agro-ecological conditions of Lower Brahmaputra Valley except foothill zone, where cropping pattern is characterised only towards rice and rape and mustard Jute is negligible here, because of the relief characteristics and less moisture content into the soil. On the other hand, wheat is not grown in foothill areas, because it is not preferred as food crop

7.4.4 Yield Pattern:

Agricultural yield is the function of a variety of factors including agro-climatic conditions (topography, soil and climate), socio-economic (size of land holding, land ownership) and input structure (labour, non-land capital and animal power) The combined effect of these factors manifests itself in yield and the measurement of agricultural yield is therefore required to understand whether maximum return per unit area has been achieved or not within physico-cultural milieu and with the application of man-power effect (Bhatia, S.S.-1967)

Table-7.05: **Crop Yield in Different Agro-Ecological Zones**

(A) Flood Plain: (Figures in kg/ha)

Characteristic	Farm Size	Rice	Wheat	Jute	Rape & Mustard	Others	Average Yield/ha
Low-Marginal	0.00 – 0.20	---	---	---	---	---	---
Semi-Marginal	0.20 – 0.50	1845	---	---	---	1769	1807.00
Marginal	0.50 – 1.00	2536	---	---	---	4333	3434.50
Small	1.00 – 2.00	2005	1500	1722	1099	4238	2112.80
Small-Medium	2.00 – 3.00	1890	1500	1402	1164	4325	2056.20
Semi-Medium	3.00 – 4.00	1698	---	1431	1119	3830	2019.50
Medium	4.00 – 5.00	1493	---	1920	---	2722	2045.00
Medium-High	5.00 – 7.50	1200	---	1125	1858	2167	1587.50
Very-High	Above 7.50	1154	---	1000	---	1813	1322.33
Average		**1796**	**1500**	**1432**	**1110**	**3012**	**1770.00**
(B) Alluvial Soil:							
Low-Marginal	0.00 – 0.20	---	---	---	---	10000	10000.00
Semi-Marginal	0.20 – 0.50	3077	---	---	---	7692	5384.50
Marginal	0.50 – 1.00	2935	---	---	---	5600	4267.50
Small	1.00 – 2.00	2500	1107	1150	1114	4231	2020.40
Small-Medium	2.00 – 3.00	2001	1154	1118	1117	3851	1848.20
Semi-Medium	3.00 – 4.00	1450	962	1130	1141	3468	1630.20
Medium	4.00 – 5.00	1302	769	962	1125	2500	1331.60
Medium-High	5.00 – 7.50	1270	---	963	---	2093	1442.00
Very-High	Above 7.50	---	---	---	---	---	---
Average		**2000**	**1061**	**1113**	**986**	**4012**	**1834.40**
(C) Foot Hill:							
Low-Marginal	0.00 – 0.20	---	---	---	---	---	---
Semi-Marginal	0.20 – 0.50	---	---	---	---	---	---
Marginal	0.50 – 1.00	---	---	---	---	---	---
Small	1.00 – 2.00	1436	---	---	---	2143	1789.50
Small-Medium	2.00 – 3.00	1205	---	---	1121	1255	1193.67
Semi-Medium	3.00 – 4.00	1198	---	---	945	1227	1123.33
Medium	4.00 – 5.00	1012	---	---	1111	1207	1110.00
Medium-High	5.00 – 7.50	950	---	---	1020	1120	1030.00
Very-High	Above 7.50	---	---	---	---	---	---
Average		**1076**	**---**	**---**	**1043**	**1197**	**1105.33**
(D) Total Crop Yield Pattern in Lower Brahmaputra Valley:							
Low-Marginal	0.00 – 0.20	---	---	---	---	10000	10000.00
Semi-Marginal	0.20 – 0.50	1923	---	---	---	4731	3327.00
Marginal	0.50 – 1.00	2688	---	---	---	4852	3770.00
Small	1.00 – 2.00	2774	1162	1404	1084	4219	2128.60
Small-Medium	2.00 – 3.00	2249	1271	1251	1065	2699	1707.00
Semi-Medium	3.00 – 4.00	1852	962	1306	934	2678	1546.40
Medium	4.00 – 5.00	1500	769	1197	1033	1876	1275.00
Medium-High	5.00 – 7.50	1155	---	1071	1060	1322	1152.00
Very-High	Above 7.50	1154	---	1000	---	1813	1322.33
Average		**1807**	**1139**	**1281**	**1043**	**2716**	**1597.20**

Source: Household Survey, 1998-99.

The crop yield pattern Table-7 05 gives a different picture than the cropping pattern in the area It may give a different picture for productivity also The average yield of crops is the real indicator of production In case of Lower Brahmaputra Valley, the yield pattern is significantly different from the predictions The various studies conducted on crop yield pattern in India, shows that there is a positive relationship between crop yield and farm size Crop yield increases as the farm size increases because of the application of modern technology in the larger sizes of land holdings (Singh-1994) But the observations in the present study are different from the general observations, as mentioned above The salient features of yield patterns in different agro-ecological conditions of Lower Brahmaputra Valley are summarised below.

(a) As far as the yield patterns in different agro-ecological zones are concerned, rice is the predominant crop The average yield of rice is 1,807 kg/ha in Lower Brahmaputra Valley, which is higher than the Assam average The highest average yield of rice is recorded in alluvial soil areas with 2,000 kg/ha and the yield pattern is recorded with a maximum of 3,077 kg/ha to a minimum of 1,270 kg/ha and it decreases as the farm size increases (Table-7.05) The flood plain areas are also having an average yield of 1,796 kg/ha and here too is maintained a gradual decrease of yield pattern from the smaller to the larger with an exception of semi-marginal farm size ranging from 2,536 kg/ha to 1,154 kg/ha The foothill areas shows comparatively lower yield pattern ranging from 1,436 kg/ha to 950 kg/ha and it reveals that there is a slow gradual decline of yield pattern as the farm size increases. It is also evident that the overall yield pattern in respect of rice decreases as the size of the land holding increases.

(b) Wheat is not widely cultivated in the study region and it is completely absent in the foothill region. In the flood plain areas also, practices only in the small and medium sizes of farms, where maximum yield is 1,500 kg/ha On the other hand, in the alluvial soil areas too not very common, but practices in the medium size of land holdings, showing a decline yield from small to large. The average yield of wheat is 1,139 kg/ha and maintained the tendency of decreasing yield as the farm size increases.

(c) Jute is a fibre crop, practised only in the alluvial soil and in the flood plain areas. Its maximum yield in the flood plain recorded highest i.e. 1,432 kg/ha, while in the alluvial soil areas it is 1,113 kg/ha and the average is 1,281 kg/ha. The Table-7.05 shows that there is a gradual decline of yield pattern from small to the larger one.

(d) Mustard is another crop cultivated generally by the medium sizes of land holdings and it shows the highest average yield of 1,110 kg/ha in the flood plain areas, 1,043 kg/ha in the foothill areas and the lowest with 986 kg/ha in the alluvial soil areas. The yield pattern of rape and mustard is ranges from 1,858 kg/ha to a minimum of 1,020 kg/ha of land.

Table-7.06: **Agricultural Productivity in Money Term in Different Agro-Ecological Zones**

(A) Flood Plain: (Figures in Rs/ha)

Characteristic	Farm Size	Rice	Wheat	Jute	Mustard	Others	In Rs./ha
Low-Marginal	0.00 – 0.20	---	---	---	---	---	---
Semi-Marginal	0.20 – 0.50	10885.50	---	---	---	4068.70	7477.10
Marginal	0.50 – 1.00	14962.40	---	---	---	9965.90	12464.15
Small	1.00 – 2.00	11829.50	11775.00	10762.50	9286.55	9747.40	10680.19
Small-Medium	2.00 – 3.00	11151.00	11775.00	8762.50	9835.80	9947.50	10294.36
Semi-Medium	3.00 – 4.00	10018.20	---	8943.75	9455.55	8809.00	9306.63
Medium	4.00 – 5.00	8808.70	---	12000.00	---	6260.60	9023.10
Medium-High	5.00 – 7.50	7080.00	---	7031.25	15700.10	4984.10	8698.86
Very-High	Above 7.50	6808.60	---	6250.00	---	4169.90	5742.83
Average		**10596.40**	**11775.00**	**8950.00**	**9379.50**	**6927.60**	**9525.70**

(B) Alluvial Soil:

Characteristic	Farm Size	Rice	Wheat	Jute	Mustard	Others	In Rs./ha
Low-Marginal	0.00 – 0.20	---	---	---	---	23000.00	23000.00
Semi-Marginal	0.20 – 0.50	18154.30	---	---	---	17691.60	17922.95
Marginal	0.50 – 1.00	17316.50	---	---	---	12880.00	15098.25
Small	1.00 – 2.00	14750.00	8689.95	7187.50	9413.30	9731.30	9954.41
Small-Medium	2.00 – 3.00	11805.90	9058.90	6987.50	9438.65	8857.30	9818.47
Semi-Medium	3.00 – 4.00	8555.00	7551.70	7062.50	9641.45	7976.40	8157.41
Medium	4.00 – 5.00	7681.80	6036.65	6012.50	9506.25	5750.00	6997.44
Medium-High	5.00 – 7.50	7493.00	---	6018.75	---	4813.90	6108.55
Very-High	Above 7.50	---	---	---	---	---	---
Average		**11800.00**	**8328.85**	**6956.25**	**8331.70**	**9227.60**	**8928.88**

(D) Foot Hill:

Characteristic	Farm Size	Rice	Wheat	Jute	Mustard	Others	In Rs./ha
Low-Marginal	0.00 – 0.20	---	---	---	---	---	---
Semi-Marginal	0.20 – 0.50	---	---	---	---	---	---
Marginal	0.50 – 1.00	---	---	---	---	---	---
Small	1.00 – 2.00	8472.40	---	---	---	4928.90	6700.65
Small-Medium	2.00 – 3.00	7109.50	---	---	9472.45	2886.50	6489.48
Semi-Medium	3.00 – 4.00	7068.20	---	---	7985.25	2822.10	5958.52
Medium	4.00 – 5.00	5970.80	---	---	9387.95	2776.10	6094.95
Medium-High	5.00 – 7.50	5605.00	---	---	8619	2576.00	5600.00
Very-High	Above 7.50	---	---	---	---	---	---
Average		**6348.40**	---	---	**8813.35**	**2753.10**	**5971.62**

(D) Average Crop Yield Pattern in Lower Brahmaputra Valley:

Characteristic	Farm Size	Rice	Wheat	Jute	Mustard	Others	In Rs./ha
Low-Marginal	0.00 – 0.20	---	---	---	---	23000.00	23000.00
Semi-Marginal	0.20 – 0.50	11345.70	---	---	---	10881.30	11113.50
Marginal	0.50 – 1.00	15859.20	---	---	---	11159.60	13509.40
Small	1.00 – 2.00	16366.60	---	8775.00	9159.80	9703.70	11001.28
Small-Medium	2.00 – 3.00	13269.10	9977.35	7818.75	8999.25	6207.70	9254.43
Semi-Medium	3.00 – 4.00	10926.80	7551.70	8162.50	7892.30	6159.40	8138.55
Medium	4.00 – 5.00	8850.00	6036.65	7481.25	8728.85	4314.80	7082.31
Medium-High	5.00 – 7.50	6814.50	---	6693.75	8957.00	3040.60	6376.46
Very-High	Above 7.50	6808.60	---	6250.00	---	4169.90	5742.83
Average		**10661.30**	**8941.15**	**8006.25**	**8813.35**	**6246.80**	**8533.77**

Source: Household Survey, 1998-99.

(e) As far as the other crops are concerned, which includes all the crops grown in the study region, other than rice, wheat, jute and mustard, these are more or less cultivated by all sizes of land holdings with a few exceptions The average yield pattern is evident in the alluvial soil areas with 4,012 kg/ha, followed by 3,012 kg/ha in the flood plain areas and the lowest is in the foothill areas with an average of 1,197 kg/ha It's also evident that there is a gradual decline of yield as the farm size increases from a smaller to the larger one

(f) The general decrease of crop yield with the increase of farm sizes in all types of agro-ecological zones depicts the reverse picture It may be because modern technology is not applied even in the larger size of land holdings and the use of fertilisers and pesticides are negligible in the larger size of land holdings Therefore, yield diminishes at the larger farm sizes

As far as the agricultural productivity in money term is concerned, it is revealed from the Table-7 06 that the average agricultural productivity is recorded at about Rs 8534 00 per hectare in the Lower Brahmaputra Valley The highest agricultural productivity is recorded in flood plain areas (Rs 9,526 00/ha), whereas in physical term it is evident in the alluvial soil areas The alluvial soil areas recorded the productivity of about Rs 8,929 00/ha and in the foothill zone with Rs 5,929 00/ha The differential agricultural productivity is mainly due to the market price of jute, as dominated in the flood plain areas, which boost up the agricultural productivity in money term From jute cultivation point of view, it may be mentioned that the flood plain areas are favourable for its cultivation and jute flourishes well, as it is resistant to flood. From the above Table-7.06, we can come to a conclusion that the market price of crop can affect the agricultural productivity in an area.

7.5 Pattern of Production Factors by Size of Land Holdings:

It has already been discussed in the previous chapter that labour, non-land capital and animal are the three major factors of production in Lower Brahmaputra Valley. The patterns of these production factors have been analysed here according to the size of land holdings, because it varies significantly in different agro-ecological conditions and even has direct bearings on intensification of agricultural production in the region. It is already pointed out that, labour input is very important in the agricultural production processes, while the genesis of agricultural production and the causes of low-level of labour productivity can be found out by interpreting the results, not only the labour inputs but also the other inputs, according to various sizes of land holdings in the different agro-ecological zones. On compiling of data, on the basis of these inputs and considering the same size of land holdings, which have been considered for the study of production patterns, various interesting results have been drawn from the analysis. These results are put under following three categories for different production inputs and then the tendencies of variation of such inputs are compared with the size of land holdings.

7.5.1 Labour Input:

The employment of labour plays a vital role in the production processes and is considered as one of the important production function The principal features are mentioned below

(a) There is a declining tendency of labour in agricultural activities by increasing the farm size of land holdings in Lower Brahmaputra Valley as a whole The intensity of total labour is recorded very high, that is, 10 persons/ha in low marginal land sizes and 7 7 persons/ha in semi-marginal farms It decreases up to 0.8 persons/ha in very high size of land holdings

(b) There is a variation of these figures in various agro-ecological zones For example, 6 6 person/ha intensity of labour is recorded in semi-marginal farm size in flood plain areas and 14 8 persons/ha in the alluvial soil areas Therefore, alluvial soil zone has a very high intensity of employment of labour input in agricultural production system, especially in the marginal and semi-marginal land holdings On high and very size of land holdings have the employment of less than 1persons/ha in the areas of alluvial and flood plain of Lower Brahmaputra Valley

Table-7 07 **Labour Input in Different Agro-Ecological Zones**

(A) Flood Plain: (Figure in Number)

Characteristic	Farm Size	Family Labour/ha	Hired Labour/ha	Total Labour/ha
Low-Marginal	0 00 - 0 20	---	---	---
Semi-Marginal	0 20 - 0 50	2 42	4 34	6 76
Marginal	0,50 - 1 00	2 57	1 71	4 28
Small	1 00 - 2 00	1 46	1 20	2 58
Small-Medium	2 00 - 3 00	1 23	0 91	2 04
Semi-Medium	3 00 - 4 00	0 98	0 91	1 89
Medium	4 00 - 5 00	0 72	0 72	1 45
Medium-High	5 00 - 7 50	0 27	0 54	0 80
Very-High	Above 7 50	0 40	0 39	0 79
Average		**1.14**	**0.96**	**2.09**

(B) Alluvial Soil:

Low-Marginal	0 00 - 0 20	10 00	0 00	10 00
Semi-Marginal	0 20 - 0 50	3 70	11 11	14 81
Marginal	0,50 - 1 00	2 38	0 71	3 09
Small	1 00 - 2 00	1 72	0 75	2 47
Small-Medium	2 00 - 3 00	1 14	0 63	1 77
Semi-Medium	3 00 - 4 00	0 86	0 57	1 43
Medium	4 00 - 5 00	0 84	0 84	1 68
Medium-High	5 00 - 7 50	0 41	0 22	0 63
Very-High	Above 7 50	---	---	---
Average		**1.29**	**0.64**	**1.93**

(C) Foot Hill:

Low-Marginal	0 00 - 0 20	---	---	---
Semi-Marginal	0 20 - 0 50	---	---	---
Marginal	0,50 - 1 00	---	---	---
Small	1 00 - 2 00	1 98	0 99	2 97
Small-Medium	2 00 - 3 00	1 09	0 94	2 03
Semi-Medium	3 00 - 4 00	1 19	0 89	2 08
Medium	4 00 - 5 00	0 65	0 87	1 52
Medium-High	5 00 - 7 50	0 76	0 81	1 57
Very-High	Above 7 50	0 94	0 87	1 81
Average		**0.94**	**0.86**	**1.80**

(D) Total Labour Input in Lower Brahmaputra Valley:

Low-Marginal	0 00 - 0 20	10 00	---	10 00
Semi-Marginal	0 20 - 0 50	2 58	5 15	7 72
Marginal	0,50 - 1 00	2 46	1 12	3 58
Small	1 00 - 2 00	1 60	0 97	2 54
Small-Medium	2 00 - 3 00	1 20	0 80	1 98
Semi-Medium	3 00 - 4 00	0 96	0 74	1 70
Medium	4 00 - 5 00	0 74	0 81	1 56
Medium-High	5 00 - 7 50	0 55	0 51	1 05
Very-High	Above 7 50	0 40	0 40	0 79
Average		**1.18**	**0.81**	**1.94**

Source: Household Survey, 1998-99

(c) There is another interesting feature of the distribution features of labour input in agricultural practices. In all agro-ecological conditions of Lower Brahmaputra Valley, family labours as well as hired labour are being engaged simultaneously. The average figure of different agro-ecological zones shows that 1.14 person/ha of the family labour are employed in flood plains, while these figures goes up to 1.29 person/ha of family labour in alluvial soils. On the other hand, hired labour is recorded slightly lesser with 0.96 person/ha in flood plain and 0.64 person/ha in the alluvial soil areas.

(d) So far as the distributional characteristics of family as well as hired labour is concerned, it is surprising to note that there is a gradual decline in family labour per hectare and this also decreases in the hired labour intensity in all agro-ecological conditions of Lower Brahmaputra Valley. This unusual feature should be different as more hired labour intensity is required to operate at high and very high size of land holdings. Hired labour intensity decreases from 4.34 persons/ha in the marginal sizes to 0.39 person/ha in very high sizes in the flood plain areas. Such declining features are observed in alluvial soil as well as in the foothill areas.

(e) Declining trend of hired labour as well as family labour shows that the overall intensity decreases in large and very large sizes of land holdings. Since, agricultural production process is a labour intensive in this area but intensity of labour tends to decline by the increase of land holding sizes. This is not emphasised for the maximum production by increasing the labour inputs, as the farm size increases

7.5.2 Non-land Capital:

The distributional pattern of non-land capital is equally important to examine the use of assets and implements in various sizes of land holdings However, the non-land capital input intensity is recorded as very low in Lower Brahmaputra Valley The general features are as follows

(a) In general the aggregated investment is recorded only Rs 165 00 per farm in Lower Brahmaputra Valley, which varies from Rs 5 00 in small marginal to Rs 1,200 00 per farm in very high sizes of land holdings

(b) The variation according to the sizes shows a different picture of distribution In flood plain as well as in alluvial soil areas of Lower Brahmaputra Valley has a similar distributional pattern For example- in the marginal size of land holding the farms are investing only Rs 34 00 per farm, while this figure is recorded as much as Rs 1, 000 00 in high and very high farm sizes It is obvious that, when farm size increases the capital investment also increases but the intensity of non-land capital investment shows a different picture

Table-7 08 **Non-Land Capital Investment in Different Agro-Ecological Zones**

(A) Flood Plain:

Characteristic	Farm Size	Non-Land Capital/Farm	Non-Land Capital/ha
Low-Marginal	0 00 - 0 20	---	---
Semi-Marginal	0 20 - 0 50	34 00	82 13
Marginal	0 50 - 1 00	86 43	103 59
Small	1 00 - 2 00	50 71	33 15
Small-Medium	2 00 - 3 00	150 00	58 62
Semi-Medium	3 00 - 4 00	190 00	61 77
Medium	4 00 - 5 00	475 00	114 46
Medium-High	5 00 - 7 50	600 00	80 32
Very-High	Above 7 50	1200 00	142 29
Average		**144.32**	**69.90**
(E) Alluvial Soil:			
Low-Marginal	0 00 - 0 20	5 00	500 00
Semi-Marginal	0 20 - 0 50	30 00	111 11
Marginal	0,50 - 1 00	58 64	76 79
Small	1 00 - 2 00	65 51	45 78
Small-Medium	2 00 - 3 00	192 19	83 79
Semi-Medium	3 00 - 4 00	327 14	93 39
Medium	4 00 - 5 00	550 00	115 79
Medium-High	5 00 - 7 50	612 50	91 86
Very-High	Above 7 50	---	---
Average		**145.00**	**76.08**
(C) Foot Hill:			
Low-Marginal	0 00 - 0 20	---	---
Semi-Marginal	0 20 – 0 50	---	---
Marginal	0,50 - 1 00	---	---
Small	1 00 - 2 00	30 00	29 70
Small-Medium	2 00 - 3 00	175 00	70 06
Semi-Medium	3 00 - 4 00	150 00	44 51
Medium	4 00 - 5 00	625 00	135 28
Medium-High	5 00 - 7 50	827 50	148 09
Very-High	Above 7 50	---	103 97
Average		**377.86**	**103.44**
(D) Total Non-Land Capital Input in Lower Brahmaputra Valley			
Low-Marginal	0 00 - 0 20	5 00	500 00
Semi-Marginal	0 20 - 0 50	50 00	85 84
Marginal	0,50 - 1 00	69 44	87 84
Small	1 00 - 2 00	58 13	39 71
Small-Medium	2 00 - 3 00	176 67	75 71
Semi-Medium	3 00 - 4 00	246 00	73 84
Medium	4 00 - 5 00	550 00	122 22
Medium-High	5 00 - 7 50	706 67	115 68
Very-High	Above 7 50	1200 00	142 57
Average		**165.09**	**77.72**

Source: Household Survey, 1998-99

(c) The non-land capital input per hectare is recorded at Rs 80 00 to 100 00/ha in marginal farm size in flood plain areas, while these figures is raised up to Rs 500 00/ha in the alluvial soil areas

(d) The high and medium sizes of land holdings also shows that Rs 80 00 to 100 00/ha in the flood plains as well as in the alluvial soil zone and Rs 150 00/ha in high and very high sizes in foothill areas An overall picture of distribution shows that there is a gradual increase of the investment of non-land capital of Rs 85 00/ha in marginal sizes to Rs 142 00/ha in the high and very high sizes of land holdings

7.5.3 Animal Input:

The distributional pattern of animal input also plays an equivalent role like non-land capital The cultivators of the Lower Brahmaputra Valley are solely dependent on drought animals for various operational works The intensity of animal input is relatively high The distributional patterns along with animal intensity according to farm sizes are mentioned below -

(a) From the Table-7 09, it is revealed that the aggregate animal engagement is 3 56 animals per farm, whereas it is ranging from 8 (medium-high) to 1 (low-marginal) per farm It is also recorded that the average animal engagement is higher in the foothill areas with 4 64 animals/farm to 3 16 animals/farm in the alluvial soil areas and 3 82 animals/farm in the flood plain areas

Table-7 09 **Animal Input in Different Agro-Ecological Zones**

Characteristic	Farm Size	Animal Input/Farm	Animal Input/ha
(A) Flood Plain			
Low-Marginal	0 00 - 0 20	---	---
Semi-Marginal	0 20 - 0 50	2 80	6 76
Marginal	0,50 - 1 00	2 71	3 25
Small	1 00 - 2 00	3 71	2 43
Small-Medium	2 00 - 3 00	4 22	1 65
Semi-Medium	3 00 - 4 00	4 40	1 43
Medium	4 00 - 5 00	3 00	0 72
Medium-High	5 00 - 7 50	8 00	1 07
Very-High	Above 7 50	6 00	0 71
Average		**3.82**	**1.85**
(B) Alluvial Soil:			
Low-Marginal	0 00 - 0 20	1 00	100 00
Semi-Marginal	0 20 - 0 50	2 00	7 41
Marginal	0,50 - 1 00	3 00	3 93
Small	1 00 - 2 00	2 56	1 79
Small-Medium	2 00 - 3 00	4 25	1 85
Semi-Medium	3 00 - 4 00	3 00	0 86
Medium	4 00 - 5 00	7 00	1 47
Medium-High	5 00 - 7 50	5 00	0 75
Very-High	Above 7 50	---	---
Average		**3.16**	**1.66**
(C) Foot Hill:			
Low-Marginal	0 00 - 0 20	---	---
Semi-Marginal	0 20 - 0 50	---	---
Marginal	0,50 - 1 00	---	---
Small	1 00 - 2 00	2 00	1 98
Small-Medium	2 00 - 3 00	4 40	1 72
Semi-Medium	3 00 - 4 00	5 67	1 68
Medium	4 00 - 5 00	4 00	0 87
Medium-High	5 00 - 7 50	5 00	0 89
Very-High	Above 7 50	---	---
Average		**4.64**	**1.27**
(D) Total Animal Input in Lower Brahmaputra Valley:			
Low-Marginal	0 00 - 0 20	1 00	100 00
Semi-Marginal	0 20 - 0 50	2 67	6 87
Marginal	0,50 - 1 00	2 89	3 65
Small	1 00 - 2 00	3 09	2 11
Small-Medium	2 00 - 3 00	4 27	1 83
Semi-Medium	3 00 - 4 00	4 00	1 20
Medium	4 00 - 5 00	4 67	1 04
Medium-High	5 00 - 7 50	5 33	0 87
Very-High	Above 7 50	6 00	0 71
Average		**3.56**	**1.68**

Source: Household Survey, 1998-99

(b) On the contrary, the average animal intensity varies from 100 00/ha (low-marginal) in the alluvial soil areas to 0 71/ha (very-high size) in the flood plain areas This reflects that the animal intensity shows a tendency of gradual decline as the farm size increases

(c) The overall tendency is that not only in different agro-ecological conditions, but also an average it is observed that there is a tendency of gradual decline of animal input, as the farm size increases It is indicated that the farmers of Lower Brahmaputra Valley are not engaging the animal power on proportionate way, according to the farm size (Table-7 09) It is evident that there is higher animal intensity in the smaller farm sizes and lower intensity in the higher sizes of farms As it reflects that the farmers of the region are solely dependent on drought animal for the production processes, not inclined towards other ways of investment to increase the productivity in the region The excessive engagement of animal power in agricultural operations reflects traditional method of farming, cultivating for their own consumption, not for commercial purposes

7.6 Agricultural Productivity Pattern by Size of Land Holding:

In the proceeding section of the discussion, various attributes of agricultural production and production factors have been analysed Since, productivity is a relative term, which can be measured for various input factors It is imperative to show the patterns of productivity with respect to land, labour, non-land capital as well as animal inputs Measuring values of production in money term (i e in Rs) and dividing it by labour, non-land capital and animal input intensities. The productivity for various factors are calculated and the patterns of different agro-ecological conditions are featured below:

7.6.1 Land Productivity:

Land productivity is assessed in Lower Brahmaputra Valley by the conversing the average yield into monetary term by multiplying with market price, where the average productivity was recorded at Rs. 8,534.00/ha, which varies from Rs. 23,000.00/ha in the small marginal size to Rs. 5,743.00/ha in very large sizes. It reveals that there is a gradual decrease in productivity per hectare of land from marginal to large size of land holdings (Figure-7.01).

There is a record variation in average productivity in different agro-ecological conditions. Productivity recorded very high with Rs. 9,526.00/ha in the flood plains, followed by Rs. 8,929.00/ha in the alluvial soil areas (Table-7.10). But in the foothill areas of Lower Brahmaputra Valley recorded the lowest productivity. There is another peculiar characteristic of distribution that there is a decrease of land productivity by increase of land holding sizes in all different agro-ecological conditions, however decrease tendency records faster in flood plain areas.

Table-7 10: **Agricultural Productivity in Different Agro-Ecological Zones**

(A) Flood Plain:

Nomenclature	Farm Size	Land Productivity in Rs /ha	Labour Prdn in Rs /labour	Capital Prdn in Rs /Rs 100	Animal Prdn in Rs /animal
Low-Marginal	0 00 - 0 20	---	---	---	---
Semi-Marginal	0 20 - 0 50	7477 10	1106 08	9104	1106 08
Marginal	0,50 - 1 00	12464 15	2912 19	12032	3835 12
Small	1 00 - 2 00	10680 19	4139 61	32218	4395 14
Small-Medium	2 00 - 3 00	10294 36	5046 26	17561	6239 01
Semi-Medium	3 00 - 4 00	9306 63	4924 14	15067	6508 13
Medium	4 00 - 5 00	9023 10	6222 83	7883	12532 08
Medium-High	5 00 - 7 50	8698 86	10873 58	10830	8129 78
Very-High	Above 7 50	5742 83	7269 41	4036	8088 49
Average		**9525.70**	**4557.75**	**13628**	**5149.02**

(B) Alluvial Soil:

Nomenclature	Farm Size	Land Productivity in Rs /ha	Labour Prdn in Rs /labour	Capital Prdn in Rs /Rs 100	Animal Prdn in Rs /animal
Low-Marginal	0 00 - 0 20	23000 00	2300 00	4600	115 00
Semi-Marginal	0 20 - 0 50	17922 95	1210 19	16131	2418 75
Marginal	0,50 - 1 00	15098 25	4886 17	19662	3841 79
Small	1 00 - 2 00	9954 41	4030 13	21744	5561 12
Small-Medium	2 00 - 3 00	9818 47	5547 16	11718	5307 28
Semi-Medium	3 00 - 4 00	8157 41	5704 48	8735	9485 36
Medium	4 00 - 5 00	6997 44	4165 14	6043	4760 16
Medium-High	5 00 - 7 50	6108 55	9696 11	6649	8144 73
Very-High	Above 7 50	---	---	---	---
Total		**8928.88**	**4626.36**	**11736**	**5378.84**

(C) Foot Hills:

Nomenclature	Farm Size	Land Productivity in Rs /ha	Labour Prdn in Rs /labour	Capital Prdn in Rs /Rs 100	Animal Prdn in Rs /animal
Low-Marginal	0 00 - 0 20	---	---	---	---
Semi-Marginal	0 20 - 0 50	---	---	---	---
Marginal	0,50 - 1 00	---	---	---	---
Small	1 00 - 2 00	6700 65	2256 11	22561	3384 17
Small-Medium	2 00 - 3 00	6489 48	3196 79	9263	3772 95
Semi-Medium	3 00 - 4 00	5958 52	2864 67	13387	3546 74
Medium	4 00 - 5 00	6094 95	4009 84	4505	7005 69
Medium-High	5 00 - 7 50	5600 00	3566 88	3781	6292 14
Very-High	Above 7 50	---	---	---	---
Total		**5971.62**	**3317.57**	**5773**	**4702.06**

(D) Agricultural Productivity in the Lower Brahmaputra Valley:

Nomenclature	Farm Size	Land Productivity in Rs /ha	Labour Prdn in Rs /labour	Capital Prdn in Rs /Rs 100	Animal Prdn in Rs /animal
Low-Marginal	0 00 - 0 20	23000 00	2300 00	4600	115 00
Semi-Marginal	0 20 - 0 50	11113 50	1439 57	12947	1617 69
Marginal	0,50 - 1 00	13509 40	3773 58	15379	3701 21
Small	1.00 - 2 00	11001 28	4331 21	27704	5213 88
Small-Medium	2 00 - 3 00	9254 43	4673 96	12224	5057 07
Semi-Medium	3 00 - 4 00	8138 55	4787 38	11022	6782 13
Medium	4 00 - 5 00	7082 31	4539 94	5795	6809 91
Medium-High	5 00 - 7 50	6376 46	6072 82	5512	7329 26
Very-High	Above 7 50	5742 83	7269 41	4028	8088 49
Total		**8533.77**	**4398.85**	**10980**	**5079.63**

Source: Household Survey, 1998-99

7.6.1 Labour Productivity:

Labour productivity is the most important measurement for agricultural activities in the area, because labour is the diminishing production factor here (Figure-7.02). The labour productivity is recorded Rs. 4,399.00/worker in Lower Brahmaputra Valley. On account of the employment less labour force per hectare in the high and very high sizes of land holdings (which is already been interpreted in previous section), labour productivity figures are recorded very high i.e. more than Rs. 6,000.00/worker. As opposed to this, intensive labour employment is in marginal sizes, though land productivity is high here, labour productivity is recorded very low even less than Rs. 2,000.00/worker in semi-marginal sizes of land holdings (Table-7.10).

The highest level of labour productivity in all small sizes are Rs. 4,626.00/worker, while the trend tends to increase productivity is more or less similar by size of land holdings. In the foothill areas the average productivity is Rs. 3,317.00/worker, while it decreases in high and very high size of land holdings.

7.6.2 Non-land Capital Productivity:

In connection with the decrease of capital productivity in Rs., the investment of Rs. 100.00/ha is recorded very high with Rs. 10,980.00/ha productivity for the investment of Rs. 100.00 in the Lower Brahmaputra Valley. Surprisingly, it tends to decrease, as the holding size of land increases (Figure-7.03). This result does not tally with the general results, as it is conceived that the capital productivity increases, as the sizes of land holding increases, but here it diminishes in high and very high sizes of land holdings in each and every agro-ecological zone. It may be because of falling of land productivity in these high and very high sizes of land holdings, not because of less investment of capital in the region The capital productivity is recorded slightly higher in the flood plain i.e. Rs 13,628.00/Rs.100.00 and very low in the foot hill areas i.e. Rs. 5,773.00/Rs100.00 (Table-7.10).

7.6.3 Animal Productivity:

It is already discussed that animal input is equally important factor for the agricultural production, because its productivity is recorded essentially higher which is Rs. 5,080.00 per pair draught animal in Lower Brahmaputra Valley and it trends to increase as the land holding sizes increases. In high and very high land sizes animal productivity is recorded more than Rs. 7,000.00 per pair of draught animal, where in marginal size only Rs. 115.00/ pair of draught animal. The average figure of animal productivity shows that the productivity of animal is higher in the alluvial soil areas and gradually increases by increasing land-holding sizes (Figure-7.04).

In general if the productivity of all these four factors are compared, then it can be said that the physical factor of land still having more influence on agricultural operation, where land productivity is recorded comparatively higher than the other inputs. There is a sufficient scope for the investment of non-land capital in agricultural

Agricultural Productivity in Different Agro-Ecological Conditions

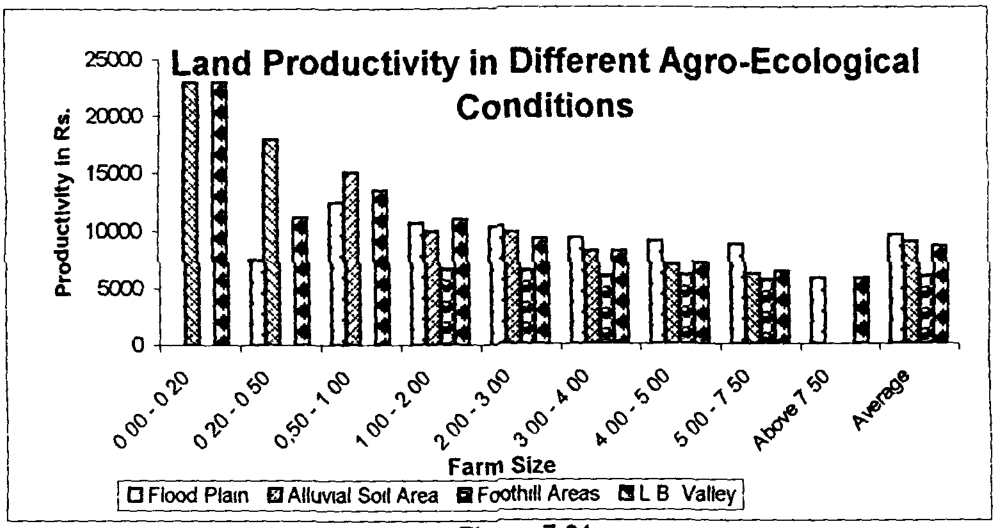

Figure-7.01

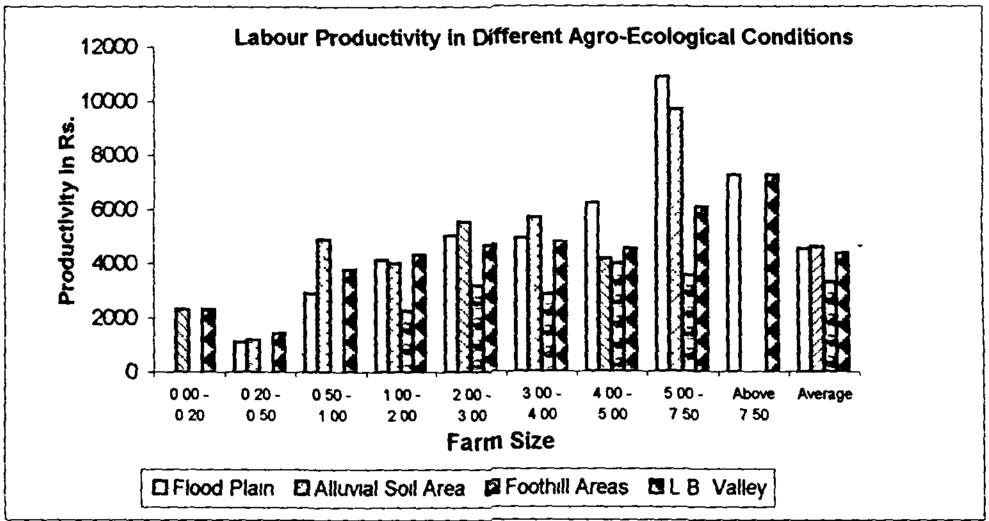

Figure-7.02

Agricultural Productivity in Different Agro-Ecological Conditions

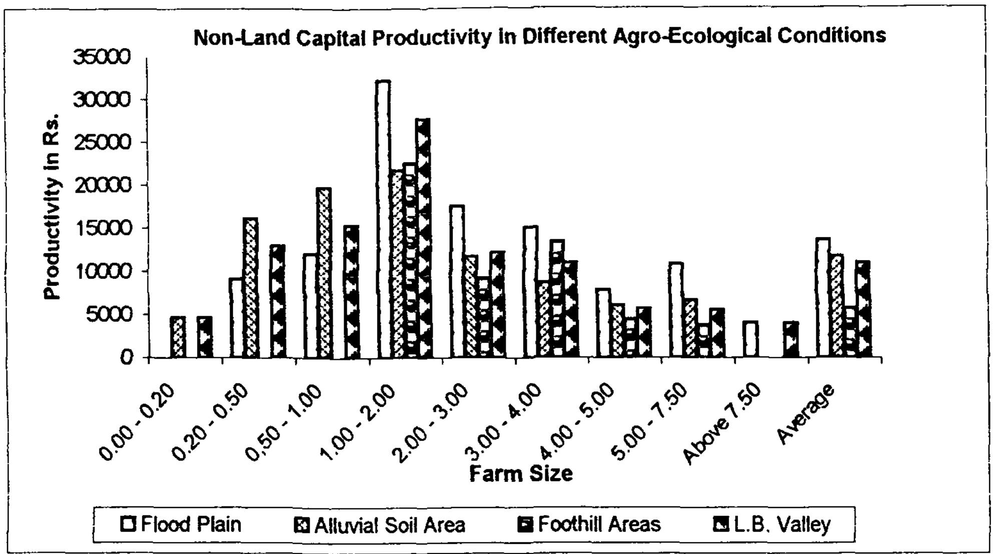

Figure-7.03

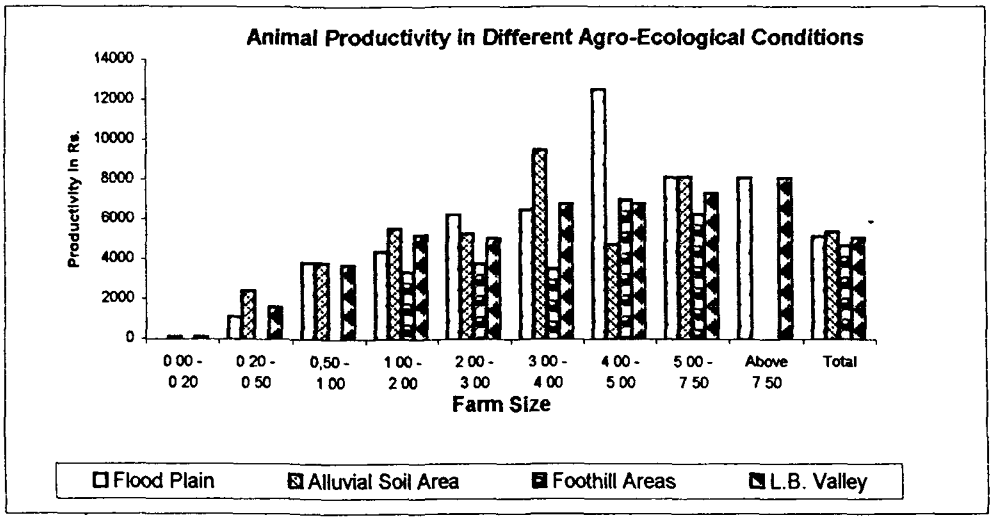

Figure-7.04

production practices because the non-land capital productivity is comparatively high. Being the problem of disguised unemployment and unlimited supply of labour in the agricultural production processes, labour productivity is comparatively lower, higher productivity can be achieved by substituting modern technology and investing more non-land capital in Lower Brahmaputra Valley.

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CHAPTER - VIII

SUMMARY AND RECOMMENDATION

Summary:

The agricultural system of Assam in general and the Lower Brahmaputra Valley in particular, suffers from various problems, these are seems to be highly sympathetic in nature Farmers are considering it as the way of life instead of livelihood Therefore, the present work is being undertaken in order to understand structural problems along with the agricultural production/productivity system in Assam

The study region is endowed with more or less diversified physiography, which provides possibilities and embodied with potentiality for agricultural development Since the region is prone to natural calamities or hazards, such as floods as well as drought, the farmer is at the mercy of the monsoons, which follows an uncertain pattern Therefore, there is a need for initiative, skill and wisdom at highest order, without proper planning, agricultural development would be a difficult task

The study region is very fortunate to have a very high proportion of area dominated by alluvial soil and flood plain, which provides potentiality for agricultural development Whereas, a small proportion of area occupied by either the foothill, residual hills scattered here and there and dotted with beels and swamps Moreover, the region has a very low concentration of laterite soil, which are basically found in the foothills in the north bank and the adjoining areas of Meghalaya plateau

Climatically the region is very suitable for the cultivation of various crops such as up-land rice, wet-land rice, jute and a variety of rabi crops, i.e. wheat, pulses, potatoes and a host of tropical fruits. The region characterised with humid during summer and relatively dry in winter and rainfall is fairly high during the kharif crop season.

The existing land tenure system is the result of the past, where expanding population pressure on limited arable land, results excessive fragmentation of land holding. These small land holdings are highly uneconomic in nature and stands as a barrier for the implementation of modern as well as advanced technology in the field of agriculture.

Various land reform measures have been undertaken since the country's independence in order to diversify the land ownership. By following these measures, the surplus lands were distributed to the farmers to help them in order to achieve maximum benefits of it.

The rural settlements in the study region are surrounded by innumerable operational holdings of varying shapes and sizes. The average farm size is decreasing over the years not only in Assam but also in Lower Brahmaputra Valley. This result shows high population pressure on arable land that leads to further fragmentation.

Assam is essentially an agricultural based state and fortunate to have about 35.41 percent of net sown area during 1992-93 against 28.48 percent in 1970-71. The double-cropped areas also increased from 7.10 percent to 14.65 percent during same period. This is the result of high population pressure, compelling the farmers to utilise the soil intensively. The double-cropped area is increasing at a faster rate with a positive growth rate of +51.49 percent. In the Lower Brahmaputra Valley, the net sown area occupied 45.67 percent of the total area during 1992-93, which indicates an increase from 38.11 in 1970-71, which shows a positive growth rate of +16.10. The double-cropped area also increased from 13.94 percent to 21.54 percent with a growth rate of +34.93 percent within the last twenty-two years. At the same time, forest cover is depleting over the years because of high population growth, required for settlement as well as other requirements.

The total land available for cultivation was only 35.39 percent in Assam and 45.77 percent in the Lower Brahmaputra Valley during 1992-93. It may be possible to bring this figure up, but this would be at the cost of forest cover, which is 26.50 percent, or barren land of 7.10 percent, to the total area.

The land use pattern in the region is characterised by a high percentage devoted to cereals, specifically high rice hectareage with low average yield and also characterised with low intensity of cropping. More than 82 percent of the total cropped area was occupied by food grains, where rice alone accounting for about 79.03 percent to the total cropped area in Assam, during 1995-96 In Lower Brahmaputra Valley, cereals occupied 74.17 percent, whereas 69 27 percent with rice Oilseeds occupy the second position in respect of area, which is 9 96 percent, whereas rape and mustard alone with 7.91 of the total area

The small farmers in the study region are almost untouched by the modern and advanced methods of agriculture. Consequently, farmers are worsely affected by various natural calamities The entire region is chronically flood affected, which results heavy loss of life and property as well as cause extensive damages to the standing crops in each year. Drought is also another significant calamity, Where farmers are highly dependent upon the monsoon rains, as the irrigation facilities in the valley region is very insignificant Summer drought affects agriculture very seriously, as more than 75 percent of rain is concentrated during the kharif crop season.

Insects, weeds, domestic and wild animals as well as diseases also affect agriculture. The humid tropical climate with a high relative humidity provides an ideal growing ground for various insects, weeds and diseases. Domestic as well as wild animals also affect the standing crops, since agricultural fields are not fenced. It is a difficult task to raise the fencing in the small, fragmented and scattered agricultural fields, which is mainly because of the poor economic condition of the farmers, who cannot erect permanent enclosures to protect their standing crops. Besides these, birds and wild elephants too cause severe damages, results lower production/productivity.

The tremendous pressure of population on arable land stands as an important determinant for the agricultural development in the study region. The region is enriched with a variety of natural resources but is industrially backward, causing low-level development in the secondary and tertiary sectors. As a result, the increasing population is compelled to be absorbed into the agricultural sector, thus attributing to an excessive wastage of man-power.

The unhealthy living conditions of the farmers as well as the food intake by them are inadequate and inferior, so they easily fall prey to various diseases. The medical facilities provided by the Government are not sufficient and most of them are localised in the city areas. Moreover, the poor health of the drought animal is another important character in the agricultural sector of Assam, where farmers are dependent for overall agricultural operation. The grazing land in the study region is less in comparison to the number of the drought animals and farmers take little care in feeding them. During winter season the drought animals hardly get sufficient food, as the grazing land grows dry. As a result, the ill-fed animals lose their resistance and become vulnerable to epidemics, diseases, and finally dies, making the farmer economically poor.

Farmers in the study region generally live in the rural areas and fully rely on agriculture. Basically they are poor and have hardly cash savings. Thus, whenever they are in need of money for various purposes such as agricultural inputs, children's education, social and religious functions and repair of houses, they generally go to the traders or moneylenders. Consequently, at the time of harvest, farmers are compelled to dispose off their agricultural products to moneylenders, without even reasonable price for it.

The law of inheritance ensures equal distribution of land among the sons, which leads to further fragmentation of land-holdings. Besides, the farmers are greatly affected by the rituals and ceremonies prohibiting ploughing and other agricultural operations, minimising the total working days even during peak season.

Due to the absence use of modern and advanced technology, the ultimate utilisation of the potentiality of soil cannot be achieved, as the farmers practice the agricultural operations with animal power and traditional methods. The use of fertilisers is also very low. The artificial supply of water into the agricultural field is highly limited and rainfall is also low during the winter season. Therefore, rabi crop as well as multiple cropping system is almost absent, due to lack of controlled sources of water. The use of HYV seeds is also negligible in the agricultural sector in Assam in general and Lower Brahmaputra Valley in particular.

The market system is primarily free market; the marketable surplus is sold through middlemen, who offer un-reasonable prices for the produce. The agricultural credit system in Lower Brahmaputra Valley is not adequate and is dis-encouraging, though various Government agencies are on operation. Whenever farmers receive any financial assistance from any source, they generally spend it on other form of necessities, rather than investing on agricultural requirements.

The agricultural production system is based on infrastructure and the factors of production, that is, land, labour, non-land capital and animal. The agricultural production system can be modernised, as soon as all these factors of production are inter-linked at proportionate way. The radical transformation of this system is possible only when a farmer is free from the obligation of employing family labour.

A major share of family labour is employed in agricultural practices in the study area, where flood plain areas have the highest intensity among the agro-ecological zones. The farmer wants to engage their entire family members in the farming system, since they are operating their lands at a subsistence level, in order to fulfil their family needs only. The existing mode of production with high share of family labour stands as constraint upon the economic development of the farmers and it is an important characteristic of agriculture in Assam.

The marginal productivity of labour in the food plain area is relatively higher; therefore more labour can be employed in order to accelerate the agricultural production. Contrary to this, in the foothill zone, the labourers are employed with low wage rate than other agro-ecological conditions. Hence, the ratio of hired labour with family labour was recorded as highest, i.e., 90 percent. The farming practices of this area can accommodate more work force since the production is high, that is 161 kg per worker.

The marginal product of non-land capital investment is recorded as very high in flood plains and in the alluvial soil areas. This means that changing of agricultural operation system from labour intensive to capital extensive is essential. Following the guidelines/framework of the green revolution technology can only increase the productivity or average yield of crops. This would be helpful to raise labour productivity and also increase the marginal productivity of labour.

The agricultural yield pattern in Lower Brahmaputra Valley was recorded at 1,597 kg per hectare and the highest yield was prominent in the alluvial soil areas with 1,834 kg per hectare. It followed by flood plain with 1,770 kg per hectare and the lowest yield pattern was prominent in the foothill areas with 1,105 kg per hectare. Whereas, it shows a different picture based on productivity in money term.

In Lower Brahmaputra Valley, multiplying the yield rate with market price of item assesses the agricultural productivity. In Lower Brahmaputra Valley as a whole the land productivity recorded at Rs.8534.00/ha that varies from Rs.23, 000.00 per hectare in the small-marginal size to Rs. 5,743.00 per hectare in very high sizes of land holding. It reveals that there is a gradual decrease in production from marginal to large.

There is a variation recorded in the average productivity in different agro-ecological zones. Productivity is relatively high in the flood plain with Rs. 9,526.00 per hectare, followed by Rs. 8,929.00 per hectare in the alluvial soil areas. But in the foothill areas of lower Brahmaputra valley, productivity is the lowest. There is another peculiar characteristic of distribution that there is a decrease of land productivity by size in all the different agro-ecological conditions, however, this decrease tendency is faster in flood plain areas.

Labour productivity is the most important measurement for agricultural activities in the area, because labour is the diminishing production factor in the study area. Labour productivity is recorded at Rs. 4,399.00 per worker in Lower Brahmaputra Valley. The employed labour forces per hectare in the high and very high sizes of land holdings are comparatively low. Labour productivity figures are recorded as very high in these large and very large sizes of land holdings, i.e. more than Rs. 6,000.00 per worker. On contrary to it, intensive employment of labour in the marginal size holdings, even though land productivity is high, the labour productivity is recorded as very low, even less than Rs. 2,000.00 per worker in semi-marginal sizes of land holdings.

The highest level of labour productivity in all small sizes of holdings, is Rs. 4,626.00 per worker in Lower Brahmaputra Valley as a whole, while the trend tends to increase productivity is more or less similar, as the sizes of land holding increases. In the foothill areas the average productivity is Rs. 3,317.00 per worker, while it decreases in large and very large sizes of land holdings.

The increase of capital productivity in Rupees, the investment of per Rs. 100.00 is recorded very high with Rs. 10,980.00/ha for the investment of Rs. 100.00 in the Lower Brahmaputra Valley. Surprisingly, it tends to decrease as the holding size of land increases. This result does not tally with the general results, as it is conceived that the capital productivity increases, as the sizes of land holding increases, but here it diminishes in high and very high sizes of land holdings in each and every agro-ecological zone. It may be because of declining land productivity in high and very high sizes land holdings, not because of less investment of non-land capital in the region. The capital productivity is recorded slightly higher in the flood plain i.e. Rs. 13,628.00 per Rs.100.00 and very low in the foot hill areas i.e. Rs. 5,773.00 per Rs100.00.

It has already been discussed that animal input is an equally important factor for the agricultural production, because its productivity is recorded as essentially high with Rs. 5,080.00 per pair drought animal in the Lower Brahmaputra Valley. Its trend is recording an increase as the land holding sizes increases. In the high and very high land sizes animal productivity is recorded at more than Rs. 7,000.00 per pair of draught animal, where in *marginal size it is only Rs. 115.00 per pair of drought* animal. The average figure of animal productivity shows that the productivity of animals is higher in the alluvial soil areas and this gradually increases by increasing land-holding sizes.

The marginal productivity is significantly high in respect of animal input in flood plain and alluvial soil areas, however the animal input pattern is low in this area. The marginal productivity of animal is comparatively lower than even labour in the foothill areas.

In general, if the productivity of all these four factors is compared, then it can be said that the physical factors of land still exert more influence on agricultural operations, where land productivity is recorded as comparatively higher than the other inputs. There is a sufficient scope for the investment of non-land capital in agricultural production practices since the capital productivity is comparatively high. The agricultural sector is characterised with unlimited supply of labour into the agricultural production processes; therefore labour productivity is comparatively lower. The higher *productivity can only be achieved by substituting modern technology. It is also to be* emphasised by the investing more on non-land capital at a proportionate way between labour with non-land capital in Lower Brahmaputra Valley.

Recommendation:

The detailed study of the agricultural land use and productivity pattern in Assam in general and in the Lower Brahmaputra Valley in particular, leads to conclude the present work with the following recommendations: -

The scope for further expansion of arable land is highly limited, as it has reached to the ultimate frontier. Therefore emphasis must be made on the intensive use of land resources at the maximum level in order to achieve the goal of higher agricultural productivity, to strengthen the economic conditions of the poor farmers.

The agricultural landscape is characterised with scattered, innumerable small agricultural holdings of varying shapes and sizes, surrounded by rural settlements. The small-scattered agricultural holdings are not economically viable; therefore the consolidations of fragmented small innumerable holdings are a must by creating a village co-operative land management society. Taking certain steps in different stages, such as- by restricting further fragmentation of land holdings and to consider the agricultural land is a village common property.

The agricultural land-use is characterised by extra-ordinarily high proportionate area devoted to cereals, specifically paddy to feed the over growing population, showing low-level of commercialisation in agricultural sector. The commercialisation of agricultural sector is a must in order to raise the living standard of agricultural based people and to make agriculture economically viable.

The cropping intensity over the last twenty-five years shows an increase but it is due to high population pressure. The cropping intensity is therefore to be increased through the application of modern package technology (i.e. Green Revolution Technology). Hence, in order to facilitate the application of modern technology, the transformation of traditional farming technology should be supported by required infra-structural facilities. The cropping intensity should be a result of well-equipped scientific methods of agriculture.

Since 1970-71 to 1994-95, there has been a slow growth in the agricultural productivity and yield in Assam in general and Lower Brahmaputra Valley in particular. Therefore, there is a need for an emphasis to be laid on both yield and agricultural productivity through inter-crop-culture, crop-rotation, crop-diversification and also by the application of advanced technology with a suitable crop rotation.

Agricultural productivity can also be raised through intensification of cropping, increased use of manure/fertilisers, improved seeds/HYV seeds, proper control of pests and diseases. The identification of more profitable crops based on market price/economy in particular to be adopted to maximise the agricultural productivity as well as yield.

Essentially the study region is a flood-prone area and causes inundation every year. Therefore, flood control measure is a must and should be undertaken by the Government. Moreover, in the flood prone areas during the pre-flood season, the early-matured crop should be sown in order to harvest before the onset of floods. On the other hand, during the post-flood period too suitable crops can be grown depending upon the soil characteristics as well as the climatic conditions. Therefore, the Agricultural Department, Government of Assam should take initiatives to distribute good quality seeds to the farmers of the flood-prone area at subsidised rate with respect to appropriate time.

Besides floods, drought is another determinant in agricultural production system. In the study region, irrigational facilities are close to negligible. Therefore, the government should take steps to regulate water management programme (Water Supply Scheme) into the agricultural field, by considering drought as constraint to agricultural production/productivity during the growth period and to safeguard the interest of the farmers during such uncertain periods. Government should undertake certain plans to insure the standing crops from the uncertainty of its return.

The crop protection is also another aspect of agricultural system, but it is beyond the capacity of the farmers in the study region. Therefore, Government should take positive scheme for the adequate and regular supply of herbicides, pesticides and insecticides at a subsidised rate, by which the poor farmers would be able to procure these required crop protection chemicals. Moreover, a proper agricultural credit system should be designed to the farmers by the Government, in order to induce and enable them to invest more and get back higher returns.

In the Lower Brahmaputra Valley, there is very little development of the tertiary sector and the level of industrialisation is also insignificant. Thus, the agricultural sector is characterised with over population. Therefore, the extra-man-power resources needs to be engaged in tertiary sector, by opening new small scale and cottage industries in the rural areas. Moreover, the agricultural sector is considered as a way of life. Therefore, there is an urgent necessity to transform this sector into an economically viable industrial sector, which would be able to engage the surplus manpower resource in productive ways to strengthen the overall economy of the state in general and Lower Brahmaputra Valley in particular.

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APPENDICES

DEPARTMENT OF GEOGRAPHY
School of Human and Environmental Sciences
NORTH EASTERN HILL UNIVERSITY
Shillong Meghalaya

Schedule for the Village Survey on Agricultural Programme

1 Name of the Village
2 Name of the District
3 Name of the Block
4 Name of the Head of the Family
5 Age
6 Sex
7 Religion
8 Literacy Status
9 Caste
10 Occupational Status
11 Name of the Respondent
12 His/her Literacy Status
13 His/her Occupational Status
14 Total Number of the Family
i) Male (ii) Female
15 Total Area of the Land Holding
16 Mode of Cultivation
i) Share Cropping ii) Own Land iii) Lease Land
17 Agricultural Land Use

Crop	Area	Production	Sowing Season	Harvesting Season
Rice i) HYV ii) Local				
Maize				
Wheat				
Gram				
Jute				
Sugarcane				
Potato				
Others				

18. Land Use Pattern:

a) Total Area
b) Total Cropped Area
c) Area Sown More Than Once
d) Land Not Available for Cultivation
e) Land Put to Non-Agricultural Uses
f) Barren and Un-Cultivable Land
g) Permanent Pasture and Grazing Land
h) Use Under Miscellaneous Crops
i) Cultivable Waste
j) Home Stead Orchards
k) Forest
l) Tree Crops
m) Any Other

19. Do you receive any assistance from the Agricultural department : if yes, Year

20. Are you the recipient of any Loan/Dept : No/Yes. Year

Department	Amount Received	Duration of Loan	Purpose	Perform ance
Individual				
Village Council				
Village Co-Op Bank				
National Bank				

21. Irrigational Facilities

Modes of Irrigation	Area Covered	Estimated Cost	Production	Yield/ha
Tube Well				
Well				
Tank				
River				
Stream				
Others				

22. Labour Use

Kind of Labour	Number	Wage Rate	Total
Family Labour			
Wage Labour			
Contract Labour			
Others			

23 Production Patter

Crop	Area	Production	Yield/ha
Rice iii) HYV iv) Local			
Maize			
Wheat			
Gram			
Jute			
Sugarcane			
Potato			
Others			

24 Dis-satisfaction if any

a)

b)

c)

d)

e)

25 Nearest Market and Distance

26 Any Problem Faced by the Farmers

a)

b)

c)

d)

e)

DISTRICT WISE DISTRIBUTION OF FOREST IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Forest Area	P.C. to the total area
Kokrajhar	180084	57.55
Barpeta	86649	36.95
Kamrup	117035	26.94
Bongaigaon	53898	21.47
Goalpara	38126	20.9
Dhuburi	40607	14.3
Nalbari	17616	7.81
L.B.Valley	534015	26.5
Assam	1984548	25.3

Source: Directorate of Economics and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are provisional.

DISTRICT WISE DISTRIBUTION OF NON AGRICULTURAL LAND USES IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Area in Hectare.	Percentage to the Total Area
Dhuburi	55049	19.4
Kamrup	67401	15.51
Bongaigaon	38784	15.45
Goalpara	21776	11.94
Barpeta	21015	6.48
Nalbari	14268	6.32
Kokrajhar	18185	5.81
L.B.Valley	236478	11.74
Assam	1012649	12.91

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are provisional.

DISTRICT WISE DISTRIBUTION OF BARREN LAND IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93.

(Area in Hectare)

District	Barren Land Area	P.C. to total
Goalpara	33086	18.14
Bongaigaon	37207	14.82
Dhuburi	14281	5.03
Kamrup	21566	4.96
Barpeta	16045	4.94
Kokrajhar	15146	4.84
Nalbari	5760	2.55
L.B.Valley	143091	7.1
Assam	1460455	18.62

Source: Directorate of Economic & Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures area Provisional.

DISTRICT WISE DISTRIBUTION OF PERMANENT PASTURE AND GRAZING LAND IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Area under Pt. pasture & Grazing	P.C. to total Area
Nalbari	15050	6.67
Kamrup	21296	4.9
Barpeta	12939	3.99
Bongaigaon	6528	2.6
Goalpara	3576	1.96
Kokrajhar	3962	1.27
Dhuburi	2960	1.04
L.B.Valley	66311	3.29
Assam	163062	2.08

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are Provisional

DISTRICT WISE DISTRIBUTION OF LAND UNDER MISC.TREES AND GRASSES IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Area under Misc. trees & Grasses	P.C. to the total Area
Kamrup	25709	5.92
Goalpara	5527	3.03
Barpeta	4530	1.39
Kokrajhar	3982	1.27
Bongaigaon	2504	0.99
Dhuburi	2646	0.93
Nalbari	1586	0.7
L.B.Valley	46484	2.31
Assam	219926	2.8

Source: Directorate of Economic and Statistics, Govt. of Assam, Jawahar Nagar, Guwahati, 1997.

P: Figures are Provisional

DISTRICT WISE DISTRIBUTION OF WASTE LANDIN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Waste Land Area	P.C. to the total
Bongaigaon	4239	1.69
Dhuburi	3981	1.4
Kamrup	5943	1.37
Goalpara	1502	0.82
Kokrajhar	2494	0.78
Nalbari	1405	0.62
Barpeta	1685	0.52
L.B.Valley	21249	1.05
Assam	88780	1.13

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.

P: Figures are Provisional

DISTRICT WISE DISTRIBUTION OF OTHER THAN CURRENT FALLOW LAND IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Area other than current fallow	P.C. to the total area
Dhuburi	5572	1.96
Kamrup	4948	1 14
Bongaigaon	2793	1.11
Barpeta	2331	0.72
Goalpara	1110	0.61
Kokrajhar	1720	0.55
Nalbari	1207	0.53
L.B.Valley	19681	0.98
Assam	69938	0.89

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are Provisional

DISTRICT WISE DISTRIBUTION OF CURRENT FALLOW LAND IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Current Fallow Area	P.C. to the total Area
Bongaigaon	5582	2.22
Dhuburi	3960	1.4
Nalbari	2675	1.19
Barpeta	3788	1.17
Kamrup	4422	1.02
Goalpara	1063	0.58
Kokrajhar	1455	0.47
L.B.Valley	22945	1.14
Assam	71789	0.92

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are Provisional

DISTRICT WISE DISTRIBUTION OF NET AREA SOWNIN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Net Area Sown	P.C. to the Total Area
Nalbari	148519	65.8
Barpeta	181230	55.85
Dhuburi	149841	52.79
Goalpara	78555	43.07
Kamrup	178082	40.98
Bongaigaon	98153	39.1
Kokrajhar	85872	27.44
L.B.Valley	920252	45.67
Assam	2777347	35.4

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are Provisional

DISTRICT WISE DISTRIBUTION OF DOUBLE CROPPEDAREA IN THE LOWER BRAHMAPUTRA VALLEY, 1992-93

(Area in Hectare)

District	Double Cropped Area	P.C. to the total area
Barpeta	131735	40.6
Dhuburi	76709	27.03
Bongaigaon	55090	21.95
Nalbari	48364	21.43
Kokrajhar	56733	18.13
Goalpara	19906	10.91
Kamrup	45452	10.46
L.B.Valley	433989	21.54
Assam	1148796	14.65

Source: Directorate of Economic and Statistics, Govt. of Assam, Guwahati, 1997.
P: Figures are Provisional

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