AGRICULTURAL LAND USE RESPONSES TO LAND SCARCE AND LAND ABUNDANT CONDITIONS: A COMPARISON BETWEEN TRIBAL AND MIXED COMMUNITIES IN ASSAM

Dissertation submitted to Jawaharlal Nehru University
In partial fulfillment of the requirement for the award of the degree of

Master of Philosophy

ATUR KIRI INGTI

Centre for the Study of Regional Development
School of Social Sciences
JAWAHARLAL NEHRU UNIVERSITY
NEW DELHI - 110067
2009

जवाहरलाल नेहरू विश्वविद्यालय
JAWAHARLAL NEHRU UNIVERSITY
Centre for the Study of Regional Development
School of Social Sciences
New Delhi-110067

Date-29-07-2009

DECLARATION

I do hereby declare that the dissertation titled **"AGRICULTURAL LAND USE RESPONSES IN LAND SCARCE AND LAND ABUNDANT CONDITIONS: A COMPARISON BETWEEN TRIBAL AND MIXED COMMUNITIES IN ASSAM"** submitted by me for the award of the degree of Master of Philosophy is a bonafide work and it has not been submitted to any other university for the award of any other degree.

akkiti

(Atur Kiri Ingti)

CERTIFICATE

We hereby recommend that this dissertation may be placed before the examiners for evaluation.

RKSharma

Prof. Ramesh Kumar Sharma

Chairperson

Chairperson
Centre for the Study of Regional Development
School of Social Science
Jawaharlal Nehru University
New Delhi-110 067

Sucharita Sen

DR. Sucharita Sen

Supervisor
Centre for the Study of Regional Development
Jawaharlal Nehru University,
New Delhi-110067

Tel.: 26704463, Gram : JAYENU Fax : 91-11-26742586, 26741504

ACKNOWLEDGEMENTS

In the very beginning, I express my profound gratefulness to my supervisor, Dr. Sucharita Sen, Associate Professor, Centre for the Study of Regional Development, Jawaharlal Nehru University, New Delhi, for her valuable guidance and support. I am deeply thankful to her for her time and attention, and for offering me her valuable suggestions and comments.

I am also extremely thankful to Dr. B.C. Barah, Principal Scientist, NCAP, New Delhi, who in the initial stages of this dissertation has greatly encouraged me.

My heartfelt gratitude to Dr. J.K. Dey, Principal Scientist, Regional Agriculture Research Station, Assam Agriculture University, Diphu, who has shared with me his valuable insights on agriculture in the study area.

Deepest appreciation to my friends - Somsubhra Moulick, Anshuman Barua, Soumyadeep Banerjee, Albert Lalnunzama, Longbir Teron, Long Terang, Mandeep Boro, Chingboi Vualnam and Yin Min Thann, who have always been there with me.

Lastly, I am greatly indebted to my parents – my late father, my mother, my sisters - Utpala and Momi, and all my family members without whose love and support this work would not have been complete and possible.

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

CONTENTS

I. INTRODUCTION

"Land is an essential natural resource, both for the survival and prosperity of humanity, and for the maintenance of all terrestrial ecosystems. Over the millennia, people have become more experts in exploiting land resources for their own ends. The limits on these resources are finite while human demands on them are not. Increased demand, or pressure on land resources, shows up as declining crop production, degradation of land quality and quantity, and competition for land," (FAO and UNEP 1999: 7). Land surface occupies only 29 percent (around 148, 940, 000 km^2) of the total earth's surface, out of which only around 11 percent of the land is arable. However, it has been misused, mismanaged, modified, degraded and destroyed by humankind since ages.

To humans, land provides physical space for settlements, industries, and recreation. It provides food, fibre, fuel, and other biotic materials. It is a storehouse of minerals and other raw materials for human use. It is a co-determinant in the global energy balance and the global hydrological cycle, which provides both a source and a sink for greenhouse gases: a buffer, filter or modifier for chemical pollutants. It also regulates the storage and the flow of surface water and groundwater. To other living beings: plants, animals or micro organism, it provides biological habitats. Recognizing its immense importance, the United Nations Conference on Environment and Development held in Rio de Janerio, Brazil in June, 1992 in its Agenda 21 included a chapter entitled, "Integrated approach to the planning and management of land resources," under the section, "Conservation and management of resources for development." It was realized that land is a finite resource and that "expanding human requirements and economic activities are placing ever increasing pressures on land resources, creating competition and conflicts and resulting in suboptimal use of land and land resources." Therefore, to meet the demands of the future, "human requirements are to be met in a sustainable manner," by resolving the conflicts and moving towards effective and efficient use of land and its natural resources in an integrated manner.

1.1. Land as a resource. According to FAO and UNEP (1999), "land and land resource refers to a delineable area of the earth's terrestrial surface, encompassing all attributes of the biosphere immediately above or below the surface, including those of the near-surface climate, the soil and terrain forms, the surface hydrology (including shallow lakes, rivers, marshes and swamps), the near-surface sedimentary layers and associated groundwater and geohydrological reserve, the plant and animal populations, the human settlement pattern and physical results of past and present human activity (terracing, water storage or drainage structures, roads, buildings, etc.)." Like any other resources, land is limited and scarce in supply; "and despite the role that technology can play in increasing the number of people that can be supported by it, the supply of land resources is actually limited due to the limitations imposed by either the topography of the land or its soil conditions; hence, not all land is available for agricultural production." (Alexandratos, 1995 as cited by FAO and UNEP 1999: 9)

Thus, land differs a lot from other resources in economics like labour and capital. Although it cannot be increased in physical extent, within agriculture its use is flexible and dynamic. It is flexible because a land user can decide whether s/he will use the land for productive purposes or otherwise, and it is dynamic because land can be used differently in different points of time. Another aspect of land is that it does not fit easily into the conventional categories of renewable and non-renewable resources. In general, they are slowly renewable; however, their rate of degradation far exceeds their natural rate of regeneration. This means that the land that is lost to degradation is not naturally replaced within a human time frame, resulting in the loss of opportunities for the future generation (FAO and UNEP 1999: 8).

1.2. Land resource and population. The relationship between human activity and the natural environment (of which natural resources are a part) is exceedingly complex and imperfectly understood. It is seen that land or agriculture as such cannot be taken in isolation; one finds that an intrinsic relationship exists between land, agriculture, population, and technology, which cannot be ignored. Population and technology are instrumental in bringing about widespread agricultural changes.

The role of population on agricultural change had been realised as early as in 1798, when Thomas Malthus argued for an intrinsic imbalance between rates of population increase and food production, concluding that it was the fate of human numbers to be checked by 'misery and vice', in the form of starvation and war. Although intended mainly as an essay on poverty, population, and enlightenment doctrines, 'An Essay on the Principle of Population' by Malthus infused popular and scientific thought with a particular model of agricultural change, where an inelastic agricultural sector operated at the highest level with the available technology.

In 1965, Danish agricultural economist Ester Boserup objected to Malthus's model by arguing that, particularly in 'primitive' agricultural systems, farmers tended to produce well below the maximum because this allowed greater efficiency (output-input ratio). She maintained that production was intensified and additional technologies were adopted mainly when forced by population growth. Her book 'The Conditions of Agricultural Growth' (1965) provided an altogether new perspective on agricultural change. Since Malthus's time, there had been much comparative agricultural research, especially on peasant systems, which Boserup used in developing a 'dynamic analysis embracing all types of primitive agriculture'. Rather than technological change determining population (via food supply), in this model population determined technological change (via the optimization of energetics). This countered Malthus's assumption that agricultural systems tended to produce at the highest efficient level with the available technology. Instead, land was used irregularly, with heavy reliance on fire to clear fields and fallowing to restore fertility in the widespread practice of 'slash and burn' farming. Therefore, comparisons of agricultural productivity had to be in terms of output per unit of land per unit time, also called 'production concentration'. Boserup held that extensive agriculture with low overall production concentration is commonly practiced when rural population density is low enough to allow it, because it tends to be favourable in total workload and efficiency (output-input). Rising population density, thus, require production concentration to rise and fallow period to shorten. With less fertile plots, covered with grass or bushes, the farmers have to put more efforts on fertilizing, field preparation, weed control, and irrigation. These changes often induce agricultural

innovation but increase marginal labour cost to the farmer as well. The higher the rural population density, the more hours the farmer must work for the same amount of produce. In other words, as the benefits of fire and fallowing are sacrificed, workloads tend to rise while efficiency drops. It is because of this decreased labour efficiency that farmers rarely intensify agriculture without strong inducements, the most common inducement being population growth. Changing agricultural methods to raise production concentration at the cost of more work at lower efficiency is what Boserup describes as agricultural intensification.

The critiques of Boserup's model find that the model does not talk anything about technology generation, although it talks about technology transmission. The 'induced technological innovation' model given by Ruttan and Hayami, on the other hand basically talks about the process by which the public sector investment in agricultural research, in the adaptation and diffusion of agricultural technology and in the institutional infrastructure that is supportive of agricultural development actually takes place. It talks about why technological innovation and transmission needs to endogenous and how this can be achieved. The model assumes the functioning of a perfect market where technological transfer is not easy. Therefore, the solution lies in more and more investments in research and development done locally. This would mean that the government and its institutions like the research institutions and the universities will have to respond to the needs of the farmers. This model was based mainly on the agricultural conditions in the US and in Japan where both the countries have made tremendous progress in agriculture. In the case of the US, large amount of agricultural land is available, what it lacks is the labour force. This has compelled it to adopt labour saving technology. Thus, one sees large scale mechanisation of agriculture in the US which is labour saving. In the case of Japan, land is scarce, since most of it is covered by hills and mountains; plus, whatever plain area is available has been mostly covered with settlements. It meant that Japan had to go for land saving technology, i.e. adopting bio-chemical processes. Thus, it provided the impetus for technological change to occur.

Both the models, Boserup as well as Ruttan and Hayamis address the issue of agriculture in relation to land, technology, and population. It is seen that both the models are still relevant in any agricultural country, as it explains many aspects of agricultural practices as well as the problems of scarcity of resources, technology and so on.

1.3. Objectives. Land use study is an important step towards understanding land resources. It varies with difference in regions, physical features, people and culture. The broad objective of this study is to study the nature of land utilization of agricultural land in different physiographical condition across different communities. They can be summarised as follows.

i. To position Assam in the larger context of North East India with respect to agricultural land use practices.
ii. To study the micro level responses of agricultural land utilization to land scarce and land abundant conditions.
iii. To compare the differences in agricultural land use in homogenous tribal communities and mixed communities.

1.4. Research questions.

A. Is there any significant difference in cropping pattern among the tribal and mixed communities in both land scarce and land abundant conditions? How are they different from each other?
B. What are their responses in both the cases? What are the inputs they use? How do they vary in different conditions?
C. How are the market connections? How do they differ in different conditions?

1.5. Area of primary survey. Karbi Anglong district of Assam which is located in the central part of the state was identified as the study area, mainly because it comprises plain as well as hill area and tribal as well as mixed communities. In the process, four villages namely, Serlonjon (Diphu sub-division), Deramukh Dera Gaon (Hamren sub-division),

Deramukh Kachari Gaon (Hamren sub-division) and Jirikindeng (Hamren sub-division) were selected for the primary survey. Serlongjon and Deramukh Dera Gaon are tribal villages located in the hills and the plains, respectively. Similarly, Jirikindeng and Deramukh Kachari Gaon are villages with mixed communities located in the hills and the plains, respectively.

As has already been mentioned, Karbi Anglong has been selected as the study area, primarily because it has both hill and plain topography. However, it has also been selected as the study area because it is one of the least developed districts in Assam, economically as well as agriculturally despite being well endowed with natural resources. According to the Assam Human Development Report 2003, it has the highest Human Poverty Index (HPI) in the state (33.52). The district ranks 19th out of the 23 districts in Education Index and 6th out of 23 districts in Health Index. Besides, it is inhabited by tribal communities who still retain their traditional culture, customs and traditions.

1.6. Database. The study is based on both secondary as well as primary data sources. The secondary data source includes the various issues of government publications like the Statistical Abstract India, Statistical Handbooks of Arunachal Pradesh, Assam, Meghalaya, Mizoram and Tripura, and the Basic Statistics of NER. These publications contain land use statistics in the 9-fold classification format as given by the Directorate of Economics and Statistics, Ministry of Agriculture, Govt. of India. The primary data, on the other hand, is mainly from the primary survey that was conducted in November – December, 2008 comprising of farming households in the district comprising both land scarce (hills) and land abundant (plains) conditions as well as tribal and mixed communities.

1.7. Methodology. As already mentioned, the study is primarily based on both secondary and primary data sources. The primary data was extracted from the primary survey that was conducted earlier in November – December, 2008. The survey was based on the questionnaire that was prepared for the occasion which dealt with land, crops grown, inputs used, market linkages and problems being faced.

Sampling of the observations was aimed to cover farming households from hill region as well as plain region, and tribal and mixed communities. Thus, four major groups were identified - tribal community and mixed community in the hill region and tribal community and mixed community in the plain region.

So that each of these groups is equally distributed, it was decided to have a sample size of 50 each, adding to a total of 100 for all the four groups. "Snowball sampling" method was applied when surveying. Snowball sampling is a technique for developing a research sample where existing study subjects recruit future subjects from among their acquaintances. Thus, as the sample builds up, enough data is gathered to be useful for research. It is also known as chain sampling, chain-referral sampling or referral sampling. Since sample members are not selected from a sampling frame, snowball samples are subject to numerous biases. However, with careful selection and avoiding personal bias, snowball sampling can still be a useful method. The study also depends much on qualitative research tools specially government documents and publications, case studies, field notes and interviews.

1.8. Organization of the study. The study consists of four sections. The first is an introductory section. It focuses on land as a resource and its relationship with population with regard to agriculture. It then deals with the objectives, area of primary survey, database for the study and the methodology. A section also deals with the personality of the study area.

The second chapter primarily deals with Assam with respect to agricultural land use practices. It discuses the agricultural condition of the state in general and then focuses on the status of agricultural land use in the state at the district-level.

The third chapter focuses on mainly at the micro-level agricultural land use responses by the farmers of the study area. It deals with agricultural land use, cropping pattern, yield of major crops and then the labour use.

The fourth and the concluding chapter finally summarizes the results obtained and tries to link them up with the present condition of agriculture as it is in the study area and also attempts to examine the prospects and problems faced by the farmers there.

PERSONALITY OF THE STUDY AREA

Assam is one of the seven north-eastern states of India. A major part of it is composed of the Brahmaputra and the Barak plain; beside, the hilly region in the central part of the state. Most of its population is concentrated in the plains which makes it one of the most highly populated regions in the country. The hills on the other hand are thinly populated.

The Assamese society is primarily an agrarian society wherein the traditional life revolves around agriculture. More than three-fourth of the population of the state directly depend on agriculture for their livelihood. Yet, agriculture in the state is in a bad shape. "Agricultural productivity is the lowest in the country and the growth is stunted. It exhibits the characteristics of underdevelopment, namely, high dependence on agriculture for livelihood, widespread subsistence and traditional farming, low usage of modern inputs, poor and inadequate agricultural infrastructure, and so on. As per the 2001 census, about 87 percent of the population in Assam lives in rural areas and about 69 percent of the workforce is engaged in agricultural activities. Despite the sluggish economic growth, the contribution of agriculture to the state's income has declined from nearly 50 percent in 1980s to 35 percent at the end of 1990s. Thus, it raises the issues of economic insecurity and sustainability." (Barah 2006: 4)

Before agricultural land use in Assam is further discussed with, it will be useful to look into the other aspects of the state for a better appreciation of the socio-economic

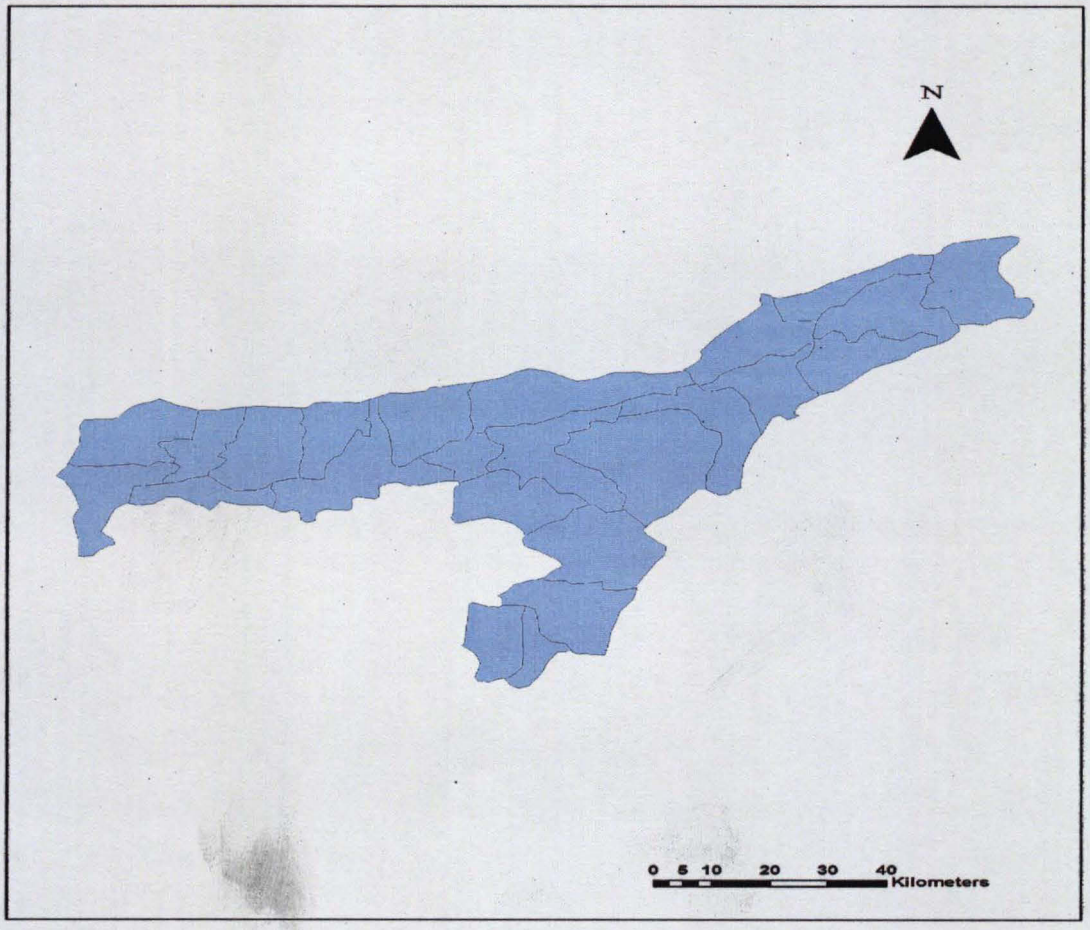
condition of its people which affects the pattern of agriculture and agricultural land use practices.

1.9. Assam

1.9.1. Physiography. Assam is situated between 24 ^{0} 8' N to 28 ^{0} 10' N latitude and 84 ^{0} 42' E to 95 ^{0} 15' E longitude. It has a total area of 78,523 km^2 (about 2.4 per cent of the total geographical area of the country) and a population of 22.2 million. It is made up of 23 districts, 21 in the plains and 2 in the hills. The state can be divided into two major physiographic divisions, viz., the plains and the hills. The plains consist of the Brahmaputra and the Barak valley which are separated by the hills consisting of the two hill districts of Karbi Anglong and North Cachar Hills.

The Brahmaputra valley (54,315 km^2) is the major physiographical division of the state which occupies about 70 per cent of the state's total area. It is surrounded by the Arunachal Himalayas in the north, the Patkai Hills in the east, and the Naga Hills and the Karbi-Meghalaya plateau in the south. To the west it joins the Gangetic plains and forms the eastern-most part of the Indo-Gangetic-Brahmaputra plains. From the north-east to the west, it is about 720 km long and from the north to the south, it is on an average 90 km wide. The plain is relatively wide in the north-east reaching a width of about 90 km between the Himalayas and the Patkai Hills and the Naga Hills. However, in the central part of the plain, the width is restricted by the Karbi Plateau to about 45 km near Burhapahar. It again widens towards the west of the Karbi Plateau covering Nagaon and Morigaon districts. With the Meghalaya plateau skirting along the river Brahmaputra near Guwahati, the width of the plain again narrows down; gradually widening again till the Indo-Bangladesh border and beyond as the Meghalaya plateau recedes southwards. The plain is characterised by the presence of isolated hillocks on either bank of the Brahmaputra. It may be noted these are all outliers of the Karbi-Meghalaya plateau and are made of hard Pre-Cambrian granite and granitic-gneiss. These stand evidence to the fact that the Gondawana platform (Indian Plate) extends underground further north and north-east and these hillocks crop up amidst alluvial cover.

Map 1.1. Assam (Political)



The gradient of the plain is very low. In the north-east where the plain begins around Sadiya, it lies at an elevation of 130 m while 700 km downstream in the west near Dhubri where the plain reaches the Indo-Bangladesh border, the elevation is 28 m. Thus, the average gradient of the plain is 14 cm per km rendering it to frequent flood hazards. The Brahmaputra has a large number of tributaries. Of these Subansiri, Jia Bharali, Jia Dhansiri, Manas, and Sonkosh in the north bank and Noa Dihing, Burhi Dihing, Disang, Dikhou, Jhanji, Bhogdoi, Dhansiri, Kapili, Dudhnoi, and Krishnai in the south bank are the main tributaries. The north-bank tributaries originate in the Himalayas and so they not only braid but also frequently change its course. The south-bank tributaries on the other hand originate from the lower hills and eroded plateau and meander over the plains. These tributaries, both north bank as well as south bank, give rise to ox-bow lakes in their

abandoned courses and meet the Brahmaputra sub-parallely due to the presence of incipient levee on either bank of the master river. The Brahmaputra is an extensively braided river and has numerous riverine islands locally called 'chars' and 'chaporis', among which Majuli (550 km^2) claims to be the largest riverine island in the world. Occurrence of 'bils', oxbow lakes and huge marshy tracts containing tall grasses are, thus, common in the Brahmaputra valley.

The Barak valley covering an area of 6962 km^2 is an undulating plain region with small isolated hillocks and swamps. It is situated in southern part of Assam and consists of three districts, viz. Cachar, Hailakandi, and Karimganj. It derives its name from the river Barak which originates from the Naga Hills near Mao in the Nagaland-Manipur border. The Barak plain is encircled on the north by the Barail range in North Cachar Hills, on the east by the Manipur Hills and on the south by the Mizo Hills. To the west, the plain merges with the Sylhet plains of Bangladesh. The east-west extension of the plain is about 85 km while north-south extension is about 70 km. The average elevation of the plain is 75 m.

As the Barail range in the north and the Mizo Hills in the south are aligned in north-south direction, some detached hillock in the same alignment as the above can be seen lying scattered in the plains, known locally known as 'tilas'. The middle-part of the plain along which the Barak flows sluggishly, is very low-lying, that the plain assumes the shape of a bowl. A large number of tributaries from the Barail range and the Mizo Hills join the river Barak in the plains, like the Jiri and Jatinga in the north bank and the Sonai, Dhaleswari, Singla, and Longai in the south bank. This makes the middle-part of the plain susceptible to frequent floods. In addition, the valley is characterised by numerous ox-bow lakes and swamps on the either banks of the river Barak.

Apart from the two major plain regions in the state is the hill area which is made up of two geologically distinct entities - the Karbi Plateau in the Karbi Anglong district and the Barail range in the North Cachar Hills district. The Karbi Plateau is the eastern-most extension of the Deccan Plateau and is part of the Meghalaya-Karbi Anglong

Plateau group which has been detached from the main Deccan plateau by the Malda-Rangpur gap. Its core is made up of hard crystalline massif which dates back to Pre-Cambrian times. The Karbi Plateau is almost isolated from the Meghalaya plateau by the age old erosion of the headstreams of the Kapili and the Dhansiri rivers. It is pear shaped and has an area of about 7000 km^2. To its south lie the young folded ranges of the Barail in North Cachar Hills district and to the north, the river Brahmaputra. The Karbi Plateau consists of the Rengma Hills in the centre and the Mikir Hills in the north. The central part of the plateau is much elevated than the surrounding area; as a result, radial pattern of drainage has developed over there. The highest peak in this region is the Dambukso (1363 m). The important rivers are Jamuna, Dikharu, Kaliyani, and Nambar. The western part of the Karbi Anglong district consisting of Hamren sub-division forms part of the Meghalaya plateau.

The Barail range is located in the North Cachar Hills district. It was formed in the late Himalayan orogeny and is made up of Tertiary sandstone, mudstone, shale and occasional limestone. It is generally above 1600 m high and has many peaks above 2,000 m. It reaches its maximum height at Japvo (3016 m), which is in Nagaland. Haflong (1713 m) situated in the Barail range is the only hill station in Assam; besides being the district headquater of North Cachar Hills. The major rivers are the Kapili and Dayang which are north-ward flowing rivers, while the Jatinga is a south-ward flowing river (Taher et al. 2001: 17-31).

1.9.2. Population characteristics. Assam since ages has been attracting numerous waves of migration to its lush and fertile lands. Chronologically, it has been settled by people belonging to Mon Khmer speaking Austro-Asiatic people, followed by the Tibeto-Burman and the Indo-Aryan speaking people, the Tai/Thai speaking people, the Bengalis, Rajasthanis and the Nepalese, the tribal people from Chhotanagpur, the Kuki-Chin, Naga and Kachin tribes from Burma, Muslim peasants from East Bengal prior to Independence, and finally, by the Hindu refugees from East Pakistan in 1947.

According to 2001 census, the state has a population of 26,638,407 with a density of 340 persons per km^2 having a decadal growth rate of 18.85%. The density is the

highest in Nagaon district with 604 persons per km^2 and the lowest in NC Hills with 38 persons per km^2. Nalbari (97.63%) has the highest percentage of rural population, while NC Hills (68.82%) has the lowest percentage. It can be clearly seen from the data that the districts in the plain region have high density of population; while, the districts in the hills have low density, indicating that physical factors greatly determine human habitation.

Table 1.1. District-wise Population, Assam, 2001

Districts	Area (Km^2)	Population (in '000)	Density	Rural Population (% of the total)
Dhubri	2,838	1,635	584	88.38
Kokrajhar	3,129	930	294	93.23
Bongaigaon	2,510	906	361	87.86
Goalpara	1,824	822	451	91.85
Barpeta	3,245	1,642	506	92.39
Nalbari	2,257	1,138	504	97.63
Kamrup	4,345	2,515	579	64.21
Darrang	3,481	1,504	432	95.08
Sonitpur	5,324	1,678	315	91.18
Lakhimpur	2,277	889	391	92.69
Dhemaji	3,237	569	176	93.15
Morigaon	1,704	776	455	95.10
Nagaon	3,831	2,315	604	87.99
Golaghat	3,502	946	270	91.65
Jorhat	2,851	1,009	354	83.05
Sibsagar	2,668	1,053	395	90.79
Dibrugarh	3,381	1,172	347	81.23
Tinsukia	3,790	1,150	303	80.52
Cachar	3,786	1,442	381	86.06
Karimganj	1,809	1,004	555	92.73
Hailakandi	1,327	543	409	91.71
Karbi Anglong	10,434	812	78	88.55
NC Hills	4,888	186	38	68.82
ASSAM	**78,438**	**26,638**	**340**	**87.28**

Source: Assam Human Development Report 2003, p. 5.

Scheduled Caste and Scheduled Tribe community are one of the most socially deprived communities in India. In Assam, the Scheduled Caste community makes up 6.85% and the Scheduled Tribe community makes up 12.41% of the state's total population. The percentage of SC population is the highest in Cachar (14.41%) followed

by Karimganj (12.99%), while it is the lowest in NC Hills district (1.79%). For the ST population, NC Hills (68.28%) followed by Karbi Anglong (55.69%) has the highest percentage of ST population in the state. The district with the lowest ST population is Hailakandi with 0.15%. The districts in the hills particularly, have high percentage of ST population. On the other hand, districts in the Barak valley have high percentage of SC population.

Assam has improved a lot in the field of literacy, with a literacy rate of 64.28 percent in 2001, from 52.89 percent in 1991; which is however, marginally below the national literacy rate. A large gender gap can be seen in terms of literacy in the state, the literacy rate for men being 71.93 percent, while for women it is 56.03 percent – a difference of more than 15 percent. The same pattern gets exhibited in the districts too, where male literacy rates are much higher than the female literacy rates, even in the districts with very high literacy rate.

Coming on to the status of main and marginal workers in the state, a look into the 2001 Census data shows that fewer women were employed as main workers than men. In 2001, only 9.68 percent of women were classified as main workers, while 42.35 percent of men were classified as main workers. In terms of marginal workers too, only 7.58 percent of men worked as marginal workers (both rural and urban), while 11.12 percent women worked as marginal workers. This suggests that women would have lesser say in the income shares and the control over the resources within the family.

In 2001 about 12.72 percent of the population in Assam lived in urban areas, a marginal increase from 11.10 percent in 1991. However, this is much below the all India figure of 27.78 percent in 2001. Large inter-district variation can also be seen in the state. Kamrup has 260 km^2 of urban areas whereas Dhemaji has only 4 km^2 classified as urban areas.

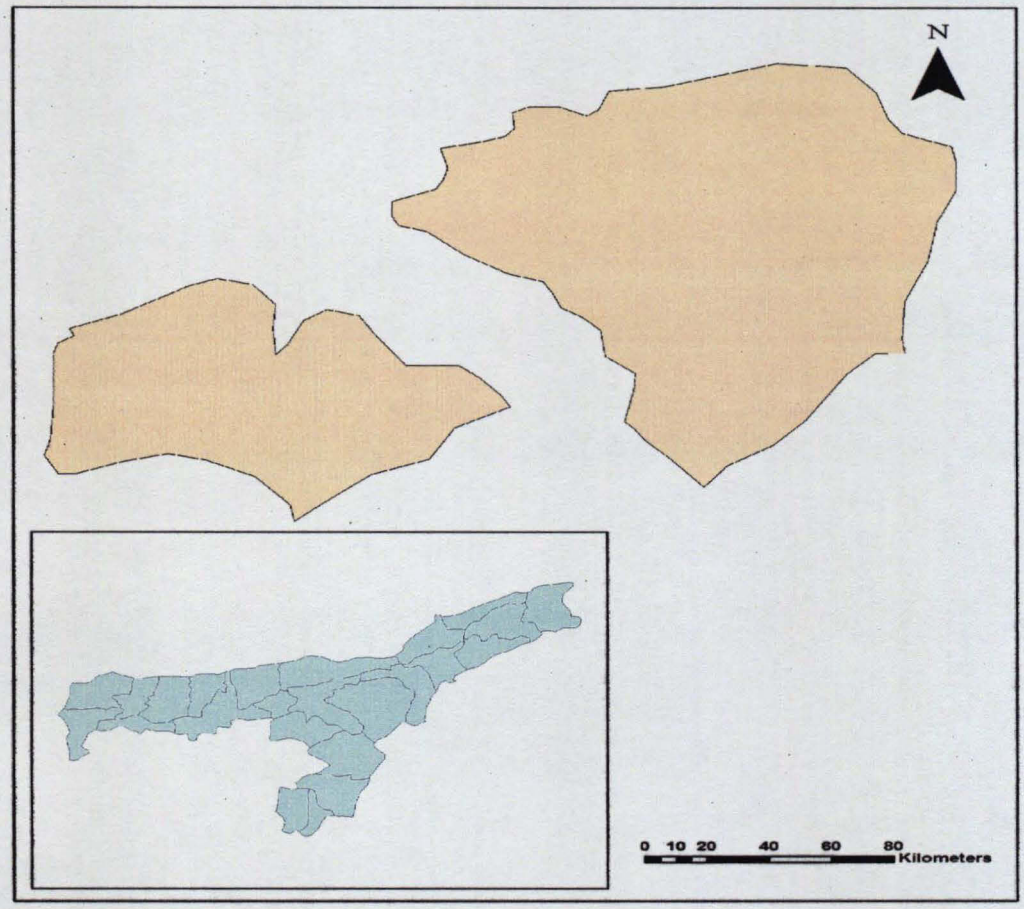
1.10. Karbi Anglong

1.10.1. Introduction. Karbi Anglong district is one of the two hill districts of Assam, the other being the North Cachar Hills district. The district is located in the central part of Assam, occupying the central hilly region that divides the Brahmaputra valley from the Barak valley. It is a part of the eastern-most extension of the Deccan plateau, forming a part of the Meghalaya-Karbi Anglong plateau region. It is bounded by the hills of Nagaland and Manipur on the east and by the plateau of Jaintia Hills on the west. On the north lies the Brahmaputra valley and on the south the hills of North Cachar Hills district.

The origin of the district can be traced back to the days of the Ahom kings, when the eastern part of the present district was granted special status by them. It was then known as the 'Mikirpar Mahal', a hill tract comprising area predominantly inhabited by the Mikirs (Karbis). The region was rechristened as 'Mikir Hills Tract' by the British administrators and was kept within the administrative boundary of the Nowgong (Nagaon) district constituting under a notification of the Assam Frontier Tracts Regulation. In 1893, a portion of the area was transferred to Sibsagar (Sivasagar) district. Both the parts were 'Partially Excluded Areas'[1] and were administered partially by Nowgong and partially by Sibsagar district. The Rongkhang area, another Karbi dominated area was earlier administered by the United Khasi and Jaintia Hills district and was an Excluded Area. These two areas, Mikir Hills Tract and Rongkhang now constitute the entire area of the present day Karbi Anglong district. After Independence, the United Mikir and North Cachar Hills district was constituted under the provision of the Sixth Schedule of the Indian Constitution on 17 November, 1951. The new district comprised of two sub-divisions, Mikir Hills and North Cachar Hills. On 2 February, 1970, North Cachar Hills sub-division was formed into a separate district. The Mikir Hills district was renamed as Karbi Anglong district in 1976.

[1] An 'Excluded Area' is an area directly administered by the Governor, and the elected Ministry has no jurisdiction over them, as per the Indian Constitution Act of 1935. A feature of the Excluded Areas of Assam which differentiates them from Excluded Areas elsewhere in India is that they form a compact block on the borders of or within Assam itself unlike those in rest of India. The 'Partially Excluded Area' is an area which has elected representatives in the Legislature and the Ministry is primarily responsible for the administration, with the Governor having special powers to maintain peace and good governance over there (Reid 1944: 18).

Map 1.2. Karbi Anglong (Political)



The district occupies an area of 10,434 km^2 making it the largest in Assam. According to the 2001 census, the population of the district is 812,000 with 55.69% of its population belonging to the Scheduled Tribes category. The population density of the district is 78 persons per km^2, a sex ratio of 922 females per 1000 males and a literacy rate of 47 per cent. Almost 89 per cent of the district lives in rural areas.

The district head quarter is located in Diphu (pop: 52,310) and has three sub-divisions (Diphu, Bokajan and Hamren). The district is constituted into 11 Development Blocks; namely, Lumbajong, Howraghat, Samelangso, Langsomepi, Bokajan, Nilip, Rongmongve, Rongkhang, Socheng, Chinthong and Amri; four revenue circles and 24 mauzas.

1.10.2. Physiography. The Karbi plateau is the eastern-most extension of the Deccan plateau and is part of the Meghalaya-Karbi plateau group which has been detached from the main Deccan plateau by the Malda-Rangpur gap. Its core is made up of hard crystalline massif which dates back to Pre-Cambrian times. The Karbi plateau is almost isolated from the Meghalaya plateau by the age old erosion of the headstreams of the Kapili and the Dhansiri rivers. It is pear shaped and has an area of about 7000 km^2. To its south lie the young folded ranges of the Barail in North Cachar Hills district and to the north, the river Brahmaputra. The Karbi plateau consists of the Rengma Hills in the centre and the Mikir Hills in the north. The central part of the plateau is much elevated than the surrounding area; as a result, radial pattern of drainage has developed over there. The highest peak in this region is the Dambukso (1363 m). The western part of the Karbi Anglong district consists of Hamren sub-division which forms part of the Meghalaya plateau. "The marginal plains of Rongkhang, Howraghat and Bokajan have been created by as a result of erosion and alluvial deposits of Kapili, Jamuna and Dhansiri rivers. These plains comprise about 21% of the district. Most of the human settlements and their activities are concentrated in these three plains" (Phangcho 2001: 10-18).

There are two major drainage systems in the district – Kapili and Dhansiri. The river Kapili is one of the largest tributary of the Brahmaputra. It originates in the eastern part of the Jaintia Hills in Meghalaya. Its major tributaries are the Umiam, Jamuna and Diyung. The Dhansiri is another prominent tributary of the Brahmaputra. It originates from the Assam-Nagaland border at Thingtubum peak (1,868.30 m). Its important tributaries are the Kaliyani, Deopani and Nambar Nadi.

1.10.3. Climate. The most important climatic phenomenon of the district that is different from rest of the state is its orography. The Cherra-Dawki escarpment of Meghalaya, Barail range and the hills of Manipur obstruct the easy access of the south-west monsoon winds into this region. The result is the rain-shadow effect over some parts of the district especially in areas around Lanka and Lumding of Nagaon districts. In addition, due to the unique location of the district and the alignment of the hills, the common weather and climatic phenomena of the Brahmaputra valley are rarely experienced. The average rainfall decreases towards the central and western portion of the district from, above 1300

mm to below 1100 mm. During summers many places lying at low altitudes record temperatures as high as 36^0 C, while the winters are dry and comfortable.

1.10.4. Population. The population density of Karbi Anglong in 1971 was 30 persons per km^2 which has now increased to 78 persons per km^2. Population density is particularly high in the police station areas of Baithalangso, Howraghat and Bokajan, mainly because these regions lie in the plains with its agricultural lands and large settlements. There are 6 urban centres in the districts and an urban area of 33.99 km^2. According to the 2001 census, 88.55% of the total population lives in the rural areas; while, 55.69% belongs to the ST category. The literacy rate for the district was 58.83%.

Table 1.2. Demographic information of Karbi Anglong, 2001

Blocks	Population	Workers		SC	ST	General
		Agriculture	Non-Agriculture			
Lumbajong	180,459	32,788	14,672	4,033	82,082	94,344
Hamren	149,669	33,354	12,971	15,540	72,968	61,161
Samelangso	64,070	16,289	7,271	613	43,379	20,078
Langsomepi	26,684	7,490	3,630	504	18,840	7,340
Bokajan	127,261	28,440	10,800	1,106	46,745	79,410
Nilip	74,954	20,446	7,314	241	50,163	24,550
Rongmongve	18,290	5,934	1,386	67	15,906	2,317
Amri	43,031	12,126	4,244	2,026	22,883	18,122
Chinthong	40,603	11,052	4,088	288	31,157	9,158
Rongkhang	152,165	39,816	12,310	7,546	80,654	63,965
Socheng	28,055	7,981	2,599	99	23,999	3,957
Total	905,241	215,716	81,285	32,063	488,776	384,402

Source: Office of the Deputy Commissioner, Karbi Anglong, Diphu.

The Karbis. The Karbis are the major tribe of the district. Although the majority of the Karbis live in the Karbi Anglong district, Karbi habitations are also found in NC Hills, Karimganj, Golaghat, Nagaon, Morigaon, Kamrup, Sonitpur and Lakhimpur districts of Assam, in Ri-Bhoi district of Meghalaya, in the Papum-Pare district of Arunachal Pradesh and in the vicinity of Dimapur in Nagaland. The Karbis are recoginized as a Scheduled Tribe in Assam, Meghalaya, Nagaland and Mizoram. The Karbis are

ethnically Mongoloid and linguistically belongs to the Kuki-Chin sub-group of the Tibeto-Burman language family.

The Karbis in different localities practise agriculture differently. "Those Karbis living in the hills invariably go for 'rit' i.e. jhum cultivation and those in the plains such as in Dongkamukam, Howraghat, Bakalia, etc. go for 'pani kheti' i.e. wet paddy cultivation. During the wet monsoon season such areas if affected by drought-like situation, use irrigation water in the paddy fields. Those settlements which are in the foothill areas practise both types of cultivation. In the hilly areas again the people often utilize narrow valley strips called 'dong-akhok' for raising wet paddy crops. Those who live in the plains part and have sufficient stagnant water raise jute as an important cash crop. In the plains, modern technology such as tractor is also used by some progressive Karbi cultivators in addition to the bull-drawn ploughs. In the true hill slopes, hoes still play the most vital part of tilling the lands." (Phangcho 2001: 33-34)

"Hill rice, pumpkin, taro, cotton, turmeric, sesame, gourd, musk-melon, cucumber, mesta, chili, kidney beans, castor, etc. are the common crops grown in the jhum fields of the Karbis. Presently, good number of Karbi families raises horticultural crops such as pineapple, egg-plant, orange, etc. on the hill slopes. Progressive youth cultivators have also taken up raising of rubber and coffee since a decade or so. During the Rabi season many have also taken up growing mustard, pulses, arhar and so on. These produces are mostly sold in the local weekly markets." (Phangcho 2001: 35)

1.10.5. Agriculture in the district. Cultivation of crops "varies from place to place according to the variation of relief, rainfall, soils, etc. Both sedentary as well as shifting cultivation is found in the district. Yield of crops, paddy for instance, greatly varies between the hills and the plains. Greater part of the district receives annual rainfall ranging from 1100 mm to above 1,300 mm. The scanty and erratic nature of rainfall in the rain shadow area, however, affects the proper growth and harvest of the crops. The temperature ranges between 21^0 and 25^0 C on an average is sufficient for most of the crops." (Phangcho 2001: 61)

Fig.1.1. A Karbi family working in a 'jhum' field.

"In the hilly portion which nearly covers 80% of the region's geographical area, the land tenure and private land-ownership are not prevalent among the tribal communities who still practice jhumming. Land belongs to the jhumming communities; as a result most individual jhumming families have less interest in land. Moreover, due to shifting nature of their villages, small population, low purchasing power, traditional habits and beliefs, the amenities and infrastructural facilities, education, marketing of agricultural produces, seeds, pesticides, chemical fertilizers, etc. cannot be easily provided." (Phangcho 2001:62) Shifting cultivation in the district occupied 4.15 lakh ha and it involved 45,600 tribal families in Karbi Anglong.

Land tenure and private land ownership are only limited to plain areas that roughly cover 20% of the district. In such areas the average size of land holding per man engaged in cultivation has been found to be 3 acres approximately.

The district is divided into four agro-ecological situations (AES). 20.11% area of the district comes under medium hills medium rainfall (AES 1), 21.85% area under medium hills low rainfall (AES 2), 30.54% under low hills medium rainfall (AES 3) and 27.50% area under foothills and plains medium to low rainfall (AES 4).

Table 1.3. Block-wise classification of Area, Karbi Anglong, 2001

Name of Blocks	Forest (% to total geog. area)	Area under Non-Agricultural Use (% to total geog. area)	Barren and Unculturable Wastelands (% to total geog. area)	Pasture (% to total geog. area)
Lumbajong	12.03	1.24	0.39	0.52
Langsomepi	6.52	0.58	0.42	0.84
Samelangso	7.97	1.00	0.75	1.39
Howraghat	0.00	0.80	0.65	0.71
Bokajan	0.99	0.88	0.29	0.73
Nilip	6.15	0.59	0.29	0.46
Rongmongve	5.80	0.55	0.47	0.58
Chinthong	2.31	0.26	0.60	0.54
Rongkhang	1.15	0.67	0.16	0.21
Socheng	2.60	0.27	0.72	0.52
Amri	2.51	0.44	0.42	0.50
Total	**48.03**	**7.26**	**5.17**	**7.00**

Name of Blocks	Area under misc.trees (% to total geog. area)	Culturable Wasteland (% to total geog. area)	Cultivated Area (% to total geog. area)	Cultivable Area (% to total geog. area)
Lumbajong	0.63	0.52	1.46	2.50
Langsomepi	1.13	0.31	1.35	1.87
Samelangso	0.50	0.35	1.47	2.31
Howraghat	0.74	0.12	2.32	2.97
Bokajan	0.52	0.16	2.26	2.79
Nilip	1.12	0.36	0.93	1.05
Rongmongve	0.88	0.47	0.41	0.57
Chinthong	0.44	0.84	0.82	1.09
Rongkhang	0.41	0.20	2.90	3.13
Socheng	0.27	0.82	0.81	1.10
Amri	0.48	0.69	0.83	1.20
Total	**7.13**	**4.83**	**15.57**	**20.58**

Source: Calculated from data provided by District Agril. Office and Statistics Deptt., Diphu.

The total geographical area of the district is 1,043,396 ha with only 214,705 ha (20.58%) available as cultivable land and 162,410 ha (15.57%) presently under cultivation. 4.83% area is under culturable wasteland, 5.01% area is under current fallow, 48.03% area is under forest, 7% under pasture, 7.26% area under non-agricultural use, 7.13% under miscellaneous plantation and 5.17% area is under barren and unculturable wasteland.

It can be seen that the blocks which are predominantly in the plain region have larger percentage of cultivated area; for example, Rongkhang, Howraghat and Bokajan blocks with Rongkhang having the highest percentage of cultivated area. The least cultivated area is in Rongmongve block which is located in the hilly region of central Karbi Anglong (Table 1.3)

The total number of operational land holding in the district is 109,404 with 1.48 ha as the average size of land holding. The very large land holding (more than 4 ha) are 0.99% of the total land holdings and occupy 2.33% of the total cultivable area. Similarly, large holdings (3-4 ha) are 12.93% of the total land holdings and possess 26.99% of the total cultivable area; medium holdings (2-3 ha) are 22.48% of the total land holdings and occupy 34.38% of the total cultivable area; small holdings (1-2 ha) are 24.83% of the total land holdings and occupy 22.93% of the total cultivable area; marginal holdings (0.4-1 ha) are 23.69% of the total land holding and occupy 9.57% of the total cultivable area and landless farm families are 15.51% of the total land holding and occupy 2.91% of total cultivable area. The largest numbers of land holdings were of small holdings category, whereas the highest percentage of cultivable area belonged to medium holdings category.

Rice is the main staple food crop of the district which is cultivated twice a year (winter and autumn). Winter paddy occupies about 88% and autumn paddy occupies about 12% of the total gross paddy area. The area under winter paddy has increased more than 30% over the last 35 years mainly because of the introduction of high yielding variety seeds, proper extension drive and rise in population. However, productivity has

not increased due to negative attitudes of the farmers towards the use of chemical fertilizers and pesticides.

Fig. 1.2. A Paddy field near a Karbi village in the plains.

Among the oil seeds, toria and sesamum are the two major oil seeds that are cultivated in the district. They occupy 95% of the total area under oilseeds. Variety of pulses is also grown in the district like green gram, black gram, pea and arahar. However, the production of pulse crop in the district is far below the requirements. Steps are now being taken to promote the cultivation of rajma and cow pea.

Fig. 1.3. Sesame pods being dried in a Karbi village near the jhum fields.

Sugarcane is another important crop in that is cultivated in the district. The area and the production of sugarcane have increased tremendously during the last few years with the effective implementation of various schemes such as IJDP, IWDP, etc. by the agriculture department.

Horticultural crops are also grown in the district in a big way. The main fruit crops that are grown in the district are banana, pineapple, orange, papaya, lime and lemon, coconut and areca nut. Moreover, litchi, guava, pears, mango, jackfruits and mousambi are also grown profitably. Tissue cultured banana and cashew nut cultivation ahs also been introduced in the district under Rastriya Samooh Vikas Yojana and Technology Mission Schemes.

Fig. 1.4. Mustard in full bloom.

Spices are another important agricultural produce of the district. The major spices that are grown in the district are ginger, turmeric, black pepper, chilies, garlic and onion. The district is in fact the highest producer of ginger among all the districts in Assam. In addition, the farmers in the district also go in for the cultivation of tubers, like potato, sweet potato and tapioca. Vegetables like tomato, egg-plant, cabbage, chilies, and leafy vegetables are also grown.

II. AGRICULTURAL LAND USE SCENARIO IN ASSAM

2.1. Introduction. Agriculture is an important sector for any economy as it not only provides raw materials to the secondary sector but also a market for the finished products. In Assam over the years, the contribution of the primary sector[2] to the Net State Domestic Product (NSDP) has declined from about 47.5 per cent in 1980-81 to around 40 per cent in recent years. However, it still continues to be the largest contributing sector. An analysis of the contribution of the sectoral contribution to the Gross District Domestic Product (DDP) by districts in 1994-95, shows the overwhelmingly high dependence on the primary sector. "In all districts, except Kamrup, the primary sector contributes more than one-third of the total Gross DDP. In Kokrajhar, Morigaon, Sivasagar, Lakhimpur and Dhemaji, the contribution of the primary sector was more than 50 per cent" (Government of Assam 2003: 28).

As has already been discussed, Assam has a high rural population and more than half of its work-force is engaged directly in agricultural activities. Its actual share in NSDP was 34.79 percent at constant prices in 2000-2001[3]. Of the total geographical area, only around 34 per cent is utilized for agriculture. The net area sown was 27.69 lakh hectares with a cropping intensity of 144 percent. The land man ratio of the state was 0.13 hectares as per the 2001 census. Most farmers work on small and marginal farms, and the average size of holdings has been falling. The small size of farms, traditional farming methods combined with low levels of mechanisation are the significant factors accounting for the relatively low productivity. Rice happens to be the major staple food in the entire state, which is almost grown entirely on rainfed condition. The availability of irrigation is less than 10% of the total cropped area (Bhowmick et. al. 2005: V).

Irrigation has remained under-developed in Assam despite having favourable conditions for improvements. "This may be because until very late the pressure of

[2] The primary sector includes agriculture, livestock forestry, hunting, plantations and other allied activities.
[3] Economic Survey of Assam, 2002 as cited by Government of Assam, 2003.

population was low and subsistence economy prevailed in the state. The peasants consequently, hardly felt the need for irrigation. Secondly, neither the government nor the poor peasants could pull enough capital to develop irrigational facilities rapidly." (Taher, et. al. 2001: 88). The state Irrigation Department by 1991-92 created an irrigation potential of 12,618 hectares, besides covering an area of 26,145 hectares under the Command Area Development Scheme through minor irrigation schemes. An increase in irrigated land and the number of tube wells has been seen under ARIASP (World Bank) and SKY (Samriddha Krishak Yojana).

Table 2.1. Sectoral Contribution (%) to Gross DDP, 1994-95, at 1980-81 prices

Districts	Primary Sector	Secondary Sector	Tertiary Sector
Dhubri	43.02	14.89	42.09
Kokrajhar	54.28	10.72	35.00
Bongaigaon	38.80	13.49	47.71
Goalpara	37.37	16.97	45.66
Barpeta	48.67	13.40	37.93
Nalbari	36.53	18.43	45.04
Kamrup	13.89	19.87	66.24
Darrang	48.30	12.43	39.27
Sonitpur	46.38	10.80	42.82
Lakhimpur	55.56	8.70	35.74
Dhemaji	59.72	8.79	31.49
Morigaon	53.95	10.85	35.20
Nagaon	40.95	14.45	44.60
Golaghat	49.01	12.26	38.73
Jorhat	30.60	15.90	53.50
Sibsagar	58.60	8.86	32.54
Dibrugarh	36.56	14.44	49.00
Tinsukia	47.27	12.99	39.74
KarbiAnglong	42.36	13.99	43.65
NCHills	40.34	11.60	48.06
Karimganj	32.93	18.82	48.25
Hailakandi	41.98	13.55	44.47
Cachar	36.20	14.58	49.22
ASSAM	**40.34**	**14.20**	**45.46**

Source: Assam Human Development Report 2003, p. 29.

Table 2.2. District-wise Irrigation Potential Created in Assam, 2004

Districts	Minor (Area in ha.)	Major & Medium (Area in ha.)	Total (Area in ha.)
Dhubri	14,593	---	14,593
Kokrajhar	21,249	6,060	27,309
Bongaigaon	6,161	---	6,161
Goalpara	12,017	---	12,017
Barpeta	18,559	41,453	60,012
Nalbari	18,360	300	18,660
Kamrup	17,600	15,635	33,235
Darrang	31,830	24,599	56,429
Sonitpur	26,267	31,655	57,922
Lakhimpur	10,594	---	10,594
Dhemaji	6,208	---	6,208
Morigaon	17,044	---	17,044
Nagaon	15,716	80,889	96,605
Golaghat	16,273	---	16,273
Jorhat	12,459	---	12,459
Sibsagar	15,970	---	15,970
Dibrugarh	10,754	2,040	12,794
Tinsukia	5,982	---	5,982
KarbiAnglong	20,652	7,661	28,313
NCHills	5,595	---	5,595
Karimganj	2,892	---	2,892
Hailakandi	3,875	---	3,875
Cachar	5,780	---	5,780
ASSAM	**316,430**	**210,292**	**526,722**

Source: Statistical Handbook, Assam, 2005, Government of Assam.

Fertilizer consumption (NPK) in the state has also increased in the past few years. It was 2.4 kg per ha. in 1971-72, which increased to 29.3 kg per ha. in 1999-2000. Fertilizer consumption in Assam during 2003-04 was 94,164 tonnes during the Kharif season and 95,280 tonnes during the Rabi season, the total being 189,444 tonnes. Wide contrast can be observed in terms of fertilizer consumption at the district level. The highest consumption during this period was recorded at 26,154 tonnes for Nagaon district, while NC Hills had the lowest fertilizer consumption with 43 tonnes.

Table 2.3. District-wise Fertilizer Consumption, Assam, 2004

Districts	Fertilizer Consumption (in tonnes)	Districts	Fertilizer Consumption (in tonnes)
Dhubri	25,459	Nagaon	26,154
Kokrajhar	6,070	Golaghat	3,096
Bongaigaon	9,683	Jorhat	8,546
Goalpara	8,658	Sibsagar	1,447
Barpeta	17,938	Dibrugarh	7,666
Nalbari	12,795	Tinsukia	6,187
Kamrup	11,306	KarbiAnglong	854
Darrang	19,263	NCHills	43
Sonitpur	4,863	Karimganj	4,248
Lakhimpur	1,639	Hailakandi	1,657
Dhemaji	236	Cachar	4,967
Morigaon	6,669	**ASSAM**	**189,444**

Source: Statistical Handbook, Assam, 2005, Government of Assam.

In terms of seeds, Assam, suffers from the perennial problem of non-availability of seeds, particularly for paddy and mustard. In order to mitigate this condition, the state government has leased at least 40 seed farms to private entrepreneurs for producing certified seeds in the state.

Mechanisation of agriculture has been recently attracting the attention of the government. The growth of mechanisation in the state has been rather slow. However, the situation has improved a bit after the large scale introduction of shallow tube-well irrigation resulting in an increased demand for farm power. The current power availability to the farmers in the state is barely 0.3 HP per hectare. It is one of the major constraints towards increasing area under double or multiple cropping.

2.2. Agricultural regions of the state. The state can be delineated into six agro-ecological zones, namely, Upper Brahmaputra Valley Zone (UBVZ), North Bank Plains Zone (NBPZ), Lower Brahmaputra Valley Zone (LBVZ), Central Brahmaputra Valley Zone (CBVZ), Hill Zone (HZ) and Barak Valley Zone (BVZ). The salient features of these zones are given in Table 2.2.3. From the table it can be seen that these agro-

ecological zones are highly diverse and, thus, lays the foundation for difference in agricultural systems across the state.

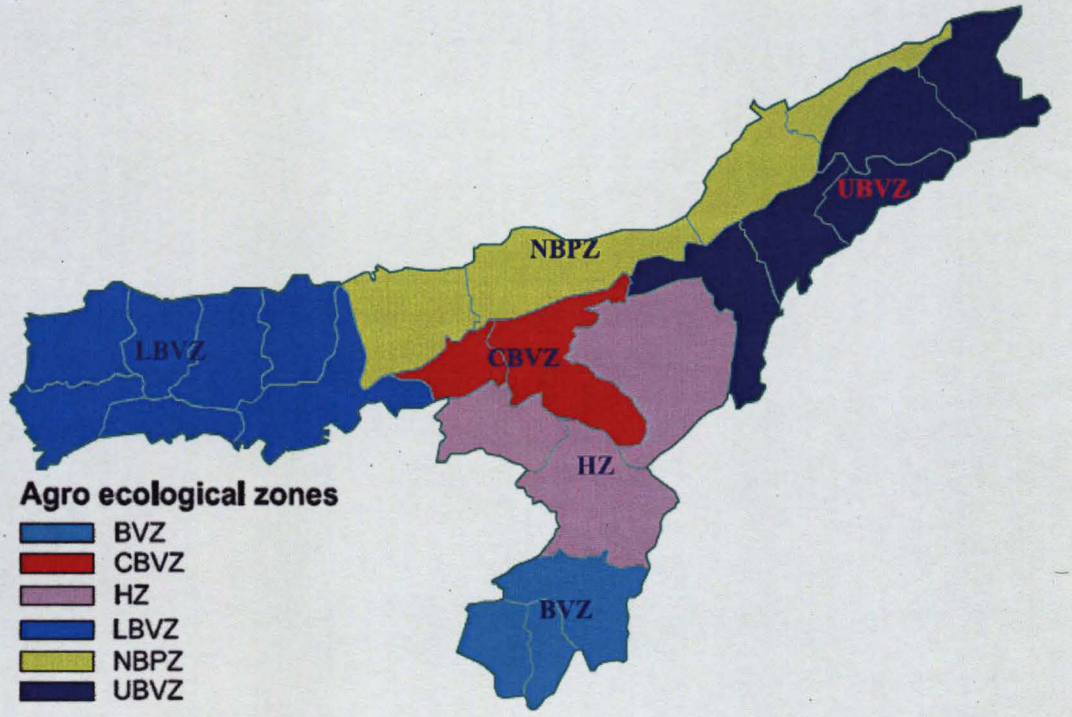


Fig. 2.1. Agro-ecological Zones in Assam. (Source: Bhowmick, B.C., et. al., 2005: 6)

Table 2.4. Salient features of the agro-ecological zones.

Zone	Soils	Rainfall (mm)	Density of pop.
LBVZ	Utisol	1778-2347	225
CBVZ	Entisol	2000	302
UBVZ	Alluvial	2650	241
NBPZ	New Alluvial	1700	388
BVZ	Alluvial	2000	245
HZ	Hill soil	2000	37

Source: (Bhowmick, B.C., et. al., 2005: 7)

2.3. Land-man ratio. The land man ratio reflects the availability of land per person. A favourable land man ratio would mean that more land can be utilized for agriculture. The all Assam land man ratio is only 0.13 ha. per person which is quite less. The analysis for the districts, according to the 2001 census, shows that almost half of the districts in Assam have less man land ratio in relation to state as a whole. Karimganj in the Barak valley and Kamrup in Lower Assam have the lowest land man ratio (0.09 ha. per person). Probable reasons for such low land man ratio in these districts can be high rate of urbanization as in the case of Kamrup and large population concentration as in the case of Barak valley. Dhemaji, on the other hand, has the highest land man ratio.

Table 2.5. District-wise Land-man ratio, Assam, 2001

Districts	Land man ratio (in ha. per person)	Districts	Land man ratio (in ha. per person)
Dhubri	0.10	Nagaon	0.11
Kokrajhar	0.12	Golaghat	0.16
Bongaigaon	0.13	Jorhat	0.15
Goalpara	0.11	Sibsagar	0.17
Barpeta	0.13	Dibrugarh	0.15
Nalbari	0.14	Tinsukia	0.12
Kamrup	0.09	KarbiAnglong	0.15
Darrang	0.17	NCHills	0.15
Sonitpur	0.11	Karimganj	0.09
Lakhimpur	0.13	Hailakandi	0.10
Dhemaji	0.22	Cachar	0.10
Morigaon	0.15	Assam	0.13

Source: Calculated from Statistical Handbook, Assam, 2005, Government of Assam.

2.4. Agricultural land use trends. A major part of the land in the state is devoted to agriculture - around 34 per cent of the total geographical area. The net sown area increased by around 0.37 per cent in the period 1981-2000. However, decline can be seen in the case of areas under fallow other than current fallow, culturable wasteland, land under tree crops, pastures and grazing land. Along with them, areas under barren and unculturable wastelands have also declined, as have the area under forests. The decline in

barren and unculturable wastelands which was the highest can most probably be attributed to the rise in areas under non-agricultural use. In fact, area under non-agricultural use has registered the highest increase (1.99%) in the time period. A decline in forest areas have also been registered during this time period. However, it is difficult to ascertain whether these forest areas or for that matter, the other categories of land which have declined; have actually been used for agricultural uses or for non-agricultural purposes.

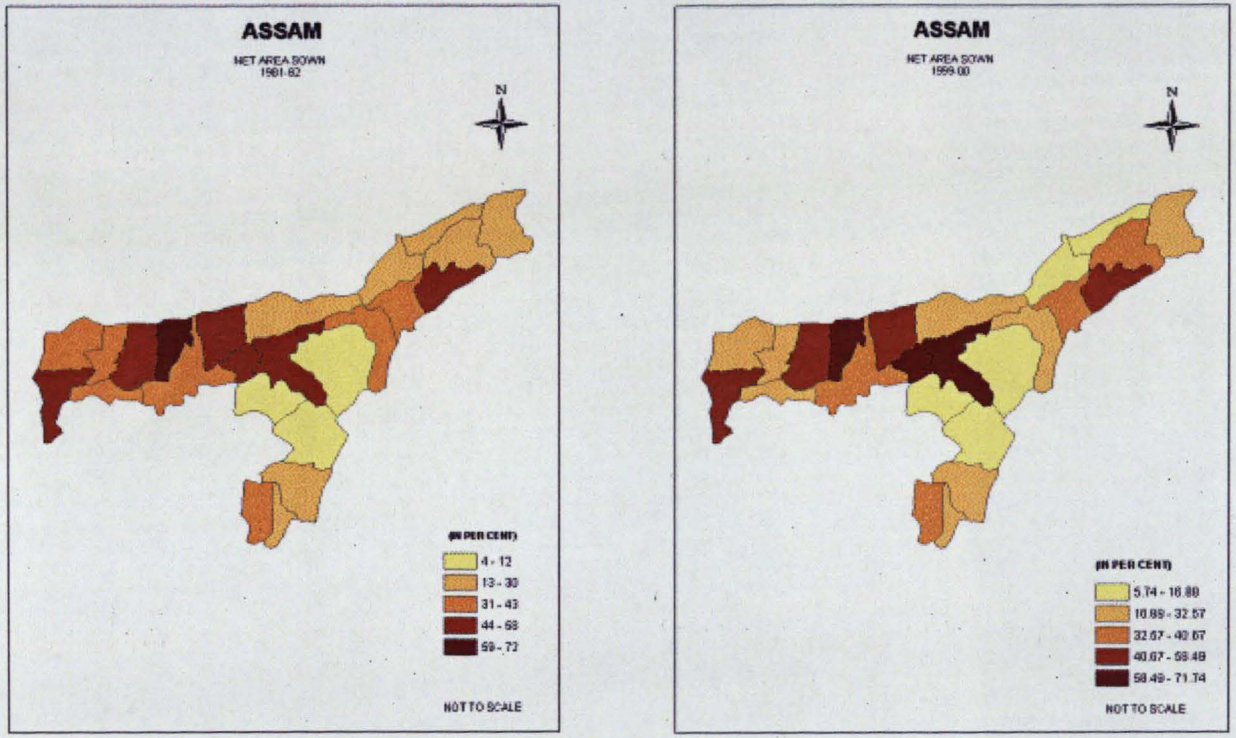
Table 2.6. Classification of Area in Assam, 1981-2000

Land Use Category	Area in ha.		% to reporting area		Change during 1981-2000
	1981	2000	1981	2000	
Reporting Area	7,852,000	7,850,005	---	---	---
Forest	1,984,000	1,931,631	25.27	24.61	-0.66
Land put to non-agricultural uses	914,000	1,069,891	11.64	13.63	1.99
Barren and unculturable land	1,541,000	1,461,034	19.63	18.61	-1.02
Permanent pastures and other grazing lands	184,000	162,968	2.34	2.08	-0.26
Land under Misc. tree crops	247,000	234,206	3.15	2.98	-0.17
Culturable wasteland	104,000	80,194	1.32	1.02	-0.30
Fallow other than current fallow	84,000	65,219	1.07	0.83	-0.24
Current fallow	88,000	110,401	1.12	1.41	0.29
Net area sown	2,706,000	2,734,461	34.46	34.83	0.37
Gross Cropped Area	3,460,000	4,087,341	---	---	---

Source: Calculated from Statistical Handbook, Assam, various issues.

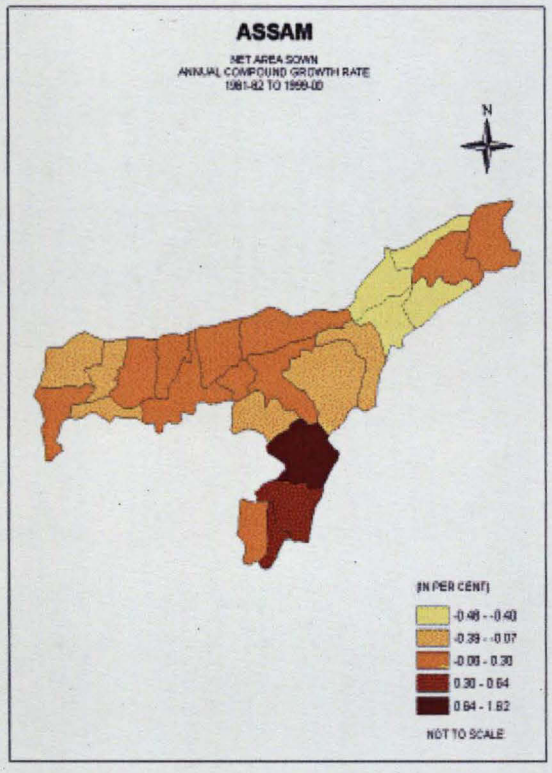
Net Sown Area. At the district-level, Nalbari, Morigaon and Nagaon had more than around 60 per cent of its geographical area as net sown area in the period 1999-2000. During 1981-82, Nalbari was the only district in the state where the percentage of net sown area was very high, and Dhubri, Barpeta, Darrang, Morigaon, Nagaon and Sivasagar districts were in the next rung with more than 50 per cent. Leaving aside the districts in Brahmaputra and Barak valley, the hill districts in both points of time, 1981-82 and 1999-2000, had low net sown areas (less than 12 per cent) as compared to the others.

Fig. 2.2. Net Sown Area, Assam, 1981 - 2000



Source: Data calculated from Statistical Handbook, Assam, various issues.

Fig. 2.3. Annual Growth Rate, Net Sown Area, Assam, 1981 - 2000



Source: Data calculated from Statistical Handbook, Assam, various issues.

The high percentage of the net sown area in the plain region of the state was as expected. In addition to the plain topography and the fertile soil, this region also has high density of population and low land man ratio. Another probable reason for high net sown area in these parts of the state (particularly Lower Assam and the districts of Morigaon and Nagaon) can be attributed to the historical fact that these places were settled by farmers of East Bengal origin who were technologically superior in wet rice cultivation under the British initiative.

The annual compound growth rate for net sown area shows that for the period 1981-2000, North Cachar Hills showed the highest annual growth rate of 1.62%, followed by Cachar and Hailakandi. It is seen that NC Hills had one of the lowest

percentage of net sown area. It is also to be recalled that NC Hills has the lowest population density in the state and a moderately high land man ratio.

Culturable wasteland. Land available for cultivation, whether taken up or not taken up for cultivation once, but not cultivated during the last five years or more in succession including the current year for some reason or the other are included in culturable wasteland. Such land may be either fallow or covered with shrubs and jungles which are not put to any use. They may be accessible or inaccessible and may lie in isolated blocks or within cultivated holdings.

Culturable wasteland in general has registered a decline in the state with almost all the districts displaying the same trend, except Kokrajhar, Bongaigaon, Goalpara, and Sivasagar. At the district-level, in 1999-00, Lakhimpur and Dhemaji had the highest percentage of land in this category, whereas Sonitpur had the least percentage of land in this category.

Fallow other than current fallow. This includes all land which was taken up for cultivation but is temporarily out of cultivation for a period of not less than one year and not more than five years.

This category also showed a decline in area (-0.19 per cent) for the entire state. At the district level for 1999-00, Karimganj in the Barak valley registered the highest percentage of land under this category, while Nagaon and Morigaon (0.33 per cent) had the least percentage.

Current fallow. Current fallow represents cropped area which is kept fallow during the current year. Area under current fallow had been growing very fast in the state. It grew at 3.6 per cent, highest among all the land use classes in the state. At the district-level, it is seen that for 1999-00, Nagaon and Morigaon had the highest percentage of area under current fallow. Cachar and Hailakandi on the other hand had the lowest percentage.

Total Cultivable Area. Culturable wasteland, area under fallow other than current fallow, area under current fallow and net area sown are all categorized together as total cultivable area. The districts showing the highest percentage of total cultivable area are Nagaon, Morigaon, Nalbari and Darrang; with Dhubri, Barpeta, Jorhat and Sivasagar districts in the following rung.

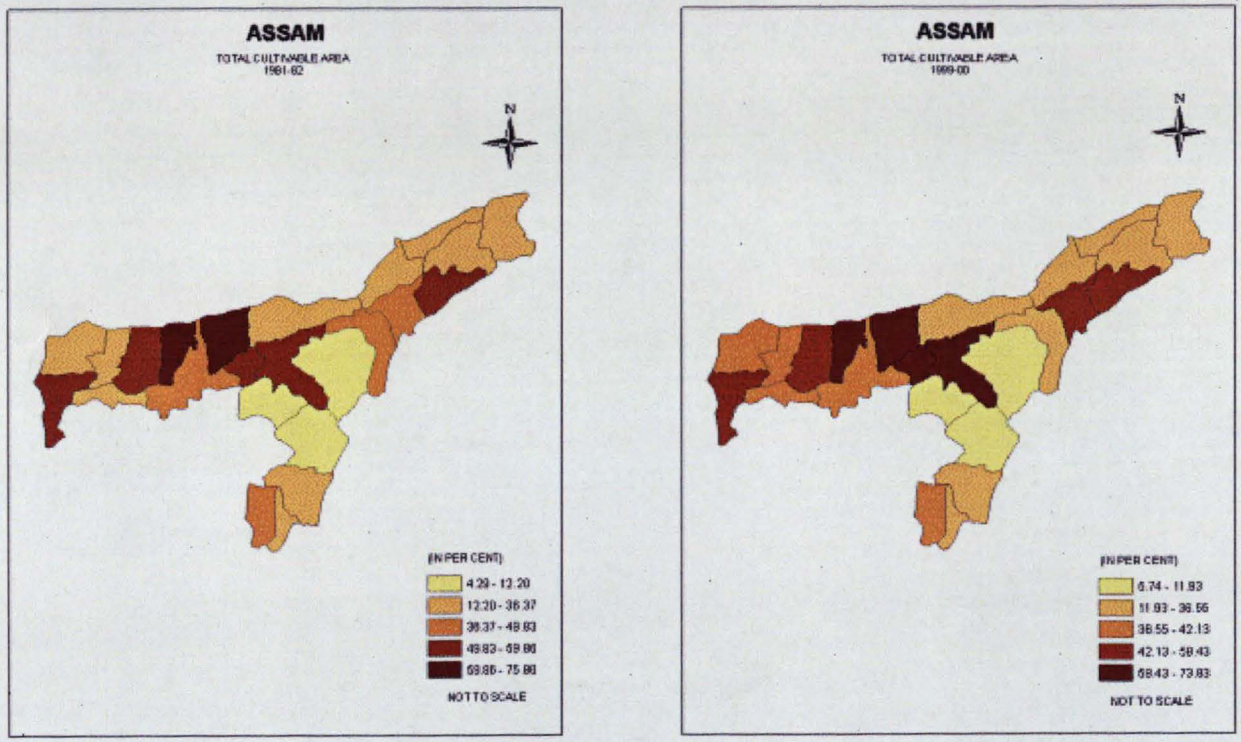
Observing both the net sown area and total cultivable land, it can be seen that these districts get frequently repeated in both the categories. One probable commonality among these districts is that - they have better market linkages and infrastructures than those in the neighbouring districts, thereby encouraging the expansion of cultivable lands. For instance, Nagaon and Morigaon have been known for rice, jute and vegetable cultivation. Local markets like those in Nagaon and Hojai not only cater to the market within the district (Nagaon district) especially the Jamuna plains but also the districts of Karbi Anglong, NC Hills, Sonitpur, Golaghat and even some parts of Nagaland. Both these market towns have excellent road and rail transport. In fact, Hojai, a small town in Nagaon district is an international supplier of 'Agaru' (Aquillaria agallocha Roxb.) oil and wood used for making perfumes and incense particularly in the Middle East.[4]

---

[4] It was during the 1940s that some enterprising families hailing from the erstwhile Sylhet district of Assam, now in Bangladesh, had the expertise to identify agar-wood and agar-attar from these trees for commercial ends. With partition, and a truncated India, the Agar entrepreneurs were relocated at Hojai, who then ventured to build agar business as a cottage industry. The North East in particular at that time hosted many *agar mahals*, a system of leased forest plantation exclusively for agar.

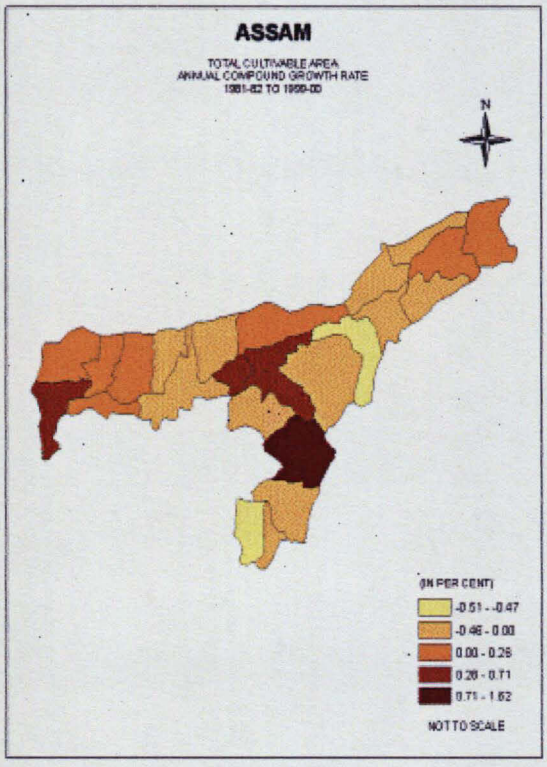
Today, numerous families particularly in Hojai are engaged in the extraction of Agar oil from the agar wood. These families are in the business of wholesaling of agar as well as the wood and the oil. The positive spin-offs on the economy are there for everyone to see.

Fig. 2.4. Total Cultivable Area, Assam, 1981 - 2000



Source: Data calculated from Statistical Handbook, Assam, various issues.

Fig. 2.5. Annual Growth Rate, Total Cultivable Area, Assam, 1981 - 2000



Source: Data calculated from Statistical Handbook, Assam, various issues.

Similar to the growth trend of net sown area, the growth trend for total cultivable area also shows that NC Hills has the highest growth rate, followed by Nagaon, Morigaon and Dhubri.

So far, it has been seen that physiography has played a major role in the expansion of cultivable areas in the state. The predominance of districts in Lower and Central Assam - all from the fertile and well irrigated plains of Brahmaputra valley and its tributaries, proves that. Secondly, population has also played an influential role in expanding agriculture in these districts. These were districts with high density of population and a large migrant population from erstwhile East Bengal. Thirdly, traditional market linkages have been further bolstered and better infrastructure has also

encouraged more land to be brought under cultivation. Lastly, these belts with vibrant agricultural activities have played a demonstrative effect on the neighbouring districts too, where agriculture is now taken up with a new zeal.

2.5. Agricultural land utilization. One of the common indicators to determine the utilization of land is the cropping intensity. Cropping intensity is defined as the ratio between gross cropped area and net sown area. It thus indicates the additional share of land sown more than once to the net sown area. It shows the number of crops raised from the same field during one single year.

Table 2.7. Cropping Intensity, Assam, 2000

Districts	Cropping Intensity	Districts	Cropping Intensity
Dhubri	167.75	Nagaon	157.33
Kokrajhar	167.32	Golaghat	134.51
Bongaigaon	165.68	Jorhat	154.77
Goalpara	136.55	Sibsagar	114.18
Barpeta	171.65	Dibrugarh	129.85
Nalbari	135.94	Tinsukia	138.50
Kamrup	141.78	Karbi Anglong	147.01
Darrang	145.11	NC Hills	129.06
Sonitpur	162.02	Karimganj	151.10
Lakhimpur	183.47	Hailakandi	133.79
Dhemaji	198.10	Cachar	116.08
Morigaon	154.63	**ASSAM**	**149.48**

Source: Data calculated from Statistical Handbook, Assam, various issues.

Cropping intensity in the state was particularly high in the districts of the northern bank (Sonitpur, Lakhimpur, Dhemaji), central Assam (Nagaon, Morigaon) and some of the lower Assam districts (Dhubri, Kokrajhar, Bongaigaon, Barpeta), surpassing the all Assam level of cropping intensity. Districts like Cachar, Karimganj, Sibsagar, Dibrugarh, Tinsukia, Golaghat, Karbi Anglong, NC Hills, Goalpara, Nalbari, Kamrup and Darrang had a cropping intensity below the state average. The highest was in Dhemaji district, which is better known for its flood and erosion. The lowest was in Sivasagar district in Upper Assam with 114.18.

A significant positive relation (0.831, significant at 1% level of significance) appears to exist between the net sown area and the irrigation infrastructure in the state. As already discussed, the irrigational situation in the state has been improving after the introduction of shallow tube-wells under the aegis of ARIASP and Samriddha Krishak Yojana programmes. Districts like Nagaon, Barpeta and Darrang, which had shown increase in both net sown area as well as total cultivable area are also the top ranking districts in the state as far as irrigational facilities are concerned. For example, Nagaon had 96,605 hectares of agricultural land under irrigation which is the highest in the state (see Table 2.2.2). Thus, as expected availability of irrigation facilities has increased the net sown area.

It was also found that the amount of fertilizer consumed and the net sown area have a high positive relation (0.751, significant at 0.01 levels). Again, it can be seen that Nagaon, Darrang, Dhubri and Barpeta have high consumption of fertilizers (see Table 2.2.3.). Nagaon had the highest fertilizer consumption in the state with 26,154 tonnes of fertilizer consumption. Interestingly, these were the districts which had a high net sown area as well as total cultivable area suggesting the relationship between fertilizer consumption and net sown area.

2.6. Conclusion. As in most cases, it seen that net sown area is very closely related to factors like irrigation and fertilizer consumption. In fact, these inputs encourages multiple as well as intensive cropping, thereby not only increasing the area under agriculture but also increasing its efficient use. It is seen that the districts doing well in agricultural land use in the state like Nagaon, Morigaon, Darrang, Barpeta, Dhubri and Nalbari have many commonalities. Despite the state being unable to support the farmers in a substantial way, these few regions have done better and the reasons are not far to look. Many factors have contributed to this phenomenon.

Most importantly, physiography has played a major role in the development of agricultural land use and agriculture as a whole in these districts. All of these districts are in the Brahmaputra valley which is rich and fertile. The soil is enriched every year by the annual flooding. Besides this, it is also crisscrossed by many rivers which are perennial.

Irrigation is better in these districts than the others. The irrigation potential being created by the government is the highest in these districts. In addition, the usage of fertilizer is again high in these districts (see Table 2.2.2. and Table 2.2.3.). The market linkages are better and strong than that of the other districts. This being so despite the fact that the state government has not been able to provide adequate market facilities, like cold storage, warehouses, etc. It is to be noted again that transportation infrastructure are better in these districts. Thus, it can be assumed that it has in some way reduced the problem of storage. However, the need for infrastructures such as cold storage, warehouses, etc. remains and cannot be given up.

It is to be remembered that population affects agricultural land use and agriculture in a big way. In fact, the aforesaid mentioned districts are some of the most densely populated in the state. For example, Nagaon is the most densely populated district of Assam with a density of 604 persons per km^2 (see Table 2.2.1). Here it can be recalled that in most of these districts in the 19th and the 20th century the British government had settled farmers of East Bengal origin, especially from Mymensingh, Rangpur, Pabna and Bogra districts in present day Bangladesh (Kar 1980: 67-75). Indeed, these farmers were instrumental in converting the marshy flood plains of the Brahmaputra valley into rice fields.

III. AGRICULTURAL LAND USE AT MICRO LEVEL IN ASSAM

One of the objectives of this study is to study agricultural land use practices and responses at a micro level in case of land scarce and land abundant conditions across different communities. A primary survey was conducted in response to it in selected villages of Karbi Anglong district in Assam.

The study was carried across hilly and plain region, and across homogenous tribal and mixed community. Four villages were, thus, selected; each representing the hills and the plains as well as the tribal and the mixed community. It is seen that much differences exist between agriculture and agricultural land use as practiced in the hills and in the plains.

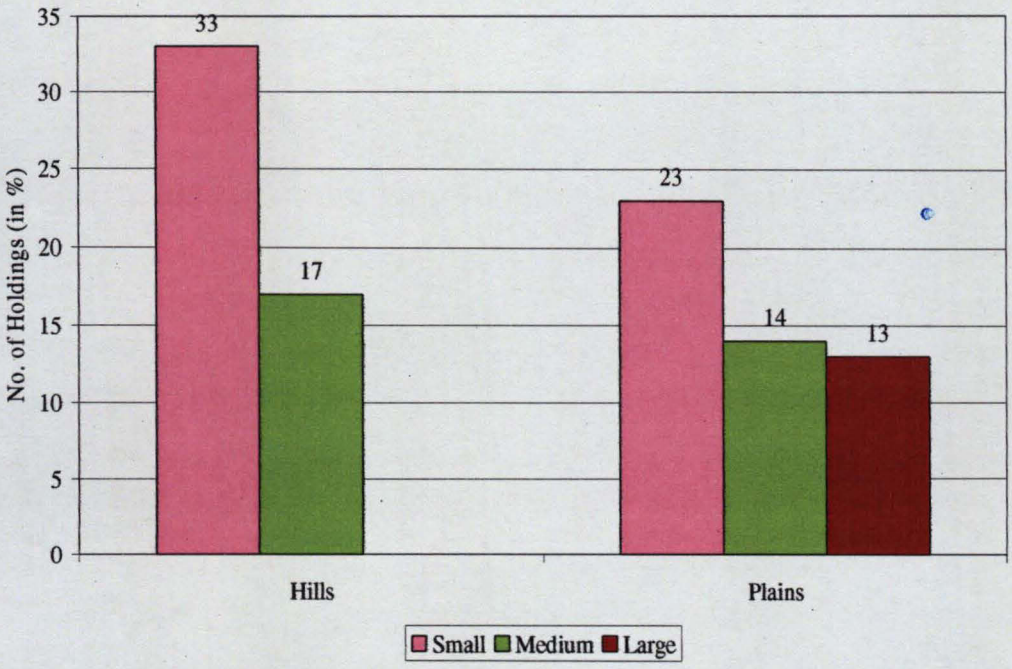
3.1. Land Holdings. Three land holding sizes have been observed in the study area - small land holdings (<5 bighas), medium land holdings (5-10 bighas) and large land holdings (>10 bighas). Most of the households in these villages, irrespective of the region or community, have small land holdings, followed by medium and large land holdings.

Across the region, keeping in tune with the general trend, most of the households in the hills and the plains have small land holdings, followed by medium and large land holdings. Small land holdings are more in the hills as compared to the plains (Fig. 3.1). However, at the community level, it is different. Most of the farmers belonging to the tribal community have small land holdings, followed by large and medium land holdings. Whereas in the mixed community, most of the land holdings are medium land holdings, followed by small land holdings and large land holdings (Fig. 3.2).

Variation in the size of land holdings in the hills is less compared to that in the plains. The coefficient of variation for hills is 59.54 as compared to the coefficient of variation for plains which is 143.14. It is probably due to the fact that societies in the hills are more egalitarian as compared to the plains. Far more variation is seen among the large

land holdings in the plains, probably suggesting the concentration of large amount of lands in the hands of a few individuals (Table A.3).

Fig. 3.1. No. of Operational Holdings across Locations.

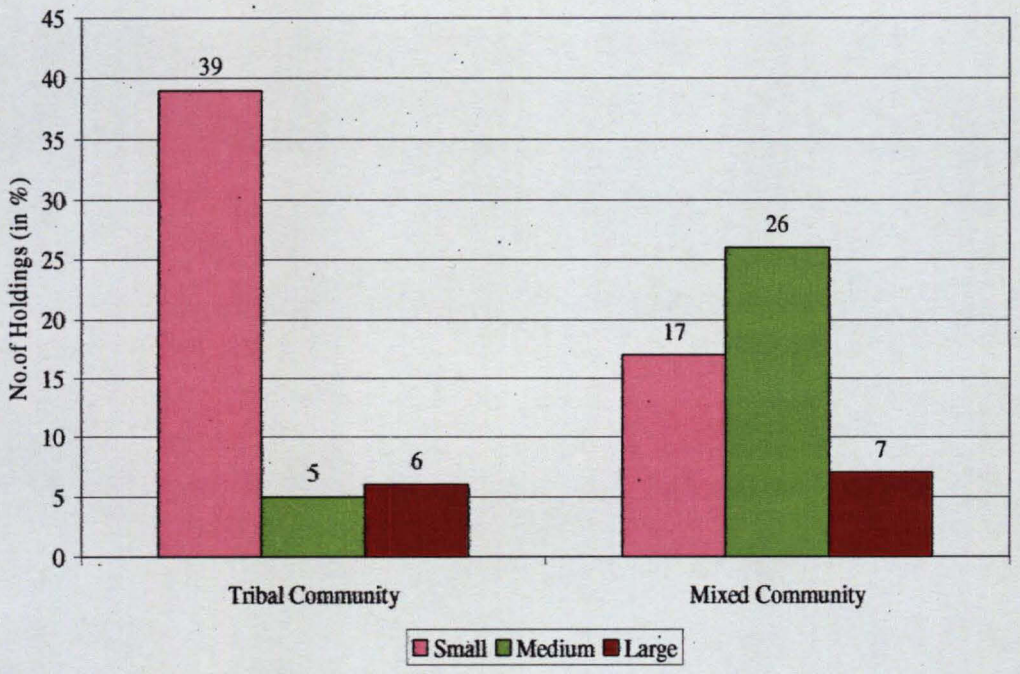


Across the communities, more variation is observed in the area of land holdings for the tribal community than that for the mixed community. On the other hand, variation is not much for areas of small and medium land holdings among the tribal community; but is the highest for large land holding, the standard deviation being 31.43. In fact, it is the highest for both the tribal as well as the mixed community. The area of land holdings among the mixed community is more evenly distributed when compared to those in the tribal community (Table A.3).

Considering the percentage of land holdings under the various communities, small land holdings is the highest among tribal community residing in the hills (24%), followed by tribal communities residing in the plains (15%), mixed communities residing in the hills (9%) and mixed communities residing in the plains (8%). For medium land holdings, mixed community residing in the hills have the highest percentage (16%), followed by mixed community residing in the plains (10%), tribal community residing in

the plains (4%) and lastly, by tribal community residing in the hills (1%). For large land holdings, both tribal community residing in the hills and the plains have almost the same percentage, 6 and 7 %, respectively (Table A.3).

Fig. 3.2. No. of Operational Holdings across Communities.

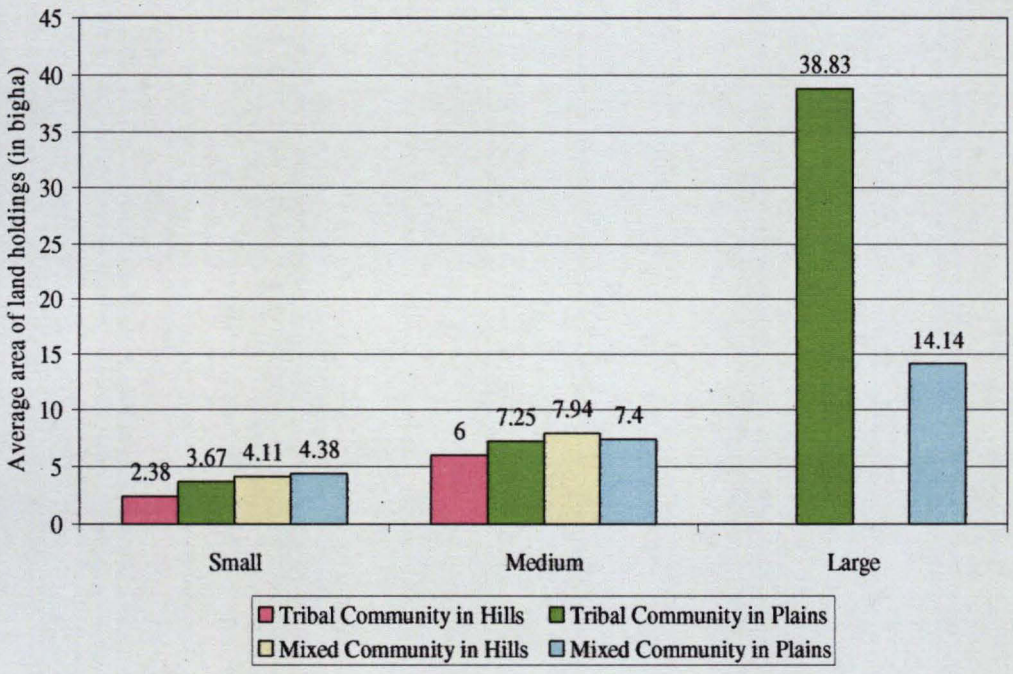


As regard the average area of operational holdings, the mixed community residing in the plain area have the highest average area for small land holdings; mixed community residing in the hills for medium land holdings and the tribal community residing in the plains for large land holdings (Fig. 3.3). Tribal community and the mixed community residing in the hills do not possess large land holdings, i.e. land holdings of more than 10 bigha.

A further analysis shows that the agricultural area owned and the operational holdings in the plains are significantly larger that in the hills. The average area owned in the hills is about 4 bighas; while, it is about 9 bighas in the plains - the mean difference being significant at 1% level of significance. In case of the operational holding, it is seen that average operational holding is about 4 bighas in the hills and about 10 bighas in the

plains – the difference again being significant, but at 5% level of significance (Table A.5).

Fig. 3.3. Average area of Operational Holdings



Community-wise, it is seen that no significant difference exists between the area owned and the operational holding. The average area owned by tribal community and by mixed community in the hills is about 5 and 6 bighas, respectively. While, the average operational holding of the tribal community and the mixed community is about 7 and 6 bighas, respectively. The mean difference for both the area owned and the operational holding is also insignificant (Table A.5).

The average area of operational holdings across region and community taken together is 2.520 bighas for tribal community residing in the hills, 12.680 bighas for tribal community residing in the plains, 6.560 bighas for mixed community in the hills and 8.320 bighas for mixed community in the plains.

Keeping the communities constant and comparing across the regions, the tribal community in the hills and the tribal community in the plains have huge difference with

regard to area owned and operational holding. The mean difference for area owned is significant at 1% level of significance. For the mixed community in the hills and in the plains, however, not much difference is seen for both area owned and operational holding; though the mean difference is significant at 1% level of significance for area owned. Mean difference of operational holding for both tribal as well as mixed community, irrespective of hills and plains is insignificant (Table A.5).

Similarly, keeping the regions constant and comparing across the communities, it is seen that the mean difference for area owned and operational holdings for tribal and mixed communities in the hills is significant at 1% level of significance. However, for the same in the plains, the mean difference for area owned and operational holding is insignificant (Table A.5).

It is seen that land holding size varies more between the hills and the plains than between the communities – tribal or mixed. It clearly suggests that physical conditions have greater influence on the land holding size; whereas belonging to a particular community does not make much difference. From the analysis it can be seen that, the difference between tribal community and mixed community in the hills is more pronounced than that between the tribal community and the mixed community in the plains. The difference between the tribal community in the hills and the plains and the difference between the mixed community in the hills and the plains are also significant. This suggests the overall importance of the physical aspect rather than the community aspect, in relation to land holding and agricultural land use in general.

In addition, it is also observed that the farmers in the hills have utilized almost all of their cultivable lands for agriculture, leaving no fallow land despite the constraints imposed by the physical conditions and cultivating wherever they can. Moreover, it is seen that among all the communities in the study, it is the tribal community residing in the hills that are in the worst-off condition.

3.2. Cropping pattern. Many varieties of crops are grown in the study area, as many as thirteen varieties, which include food crops, tubers, horticultural crops, oil seeds and

spices. Most of them are grown in the hill areas, followed by the plains. Again, it is seen that the tribal community in the hills grow far more diverse types of crops as compared to the crops grown by mixed community either in the hills or the plains.

Ginger occupies the largest area in the hills; while, rice occupies the largest area in the plains. Rice in the hills occupies only 6.12% of the GCA. In the plains, apart from rice; groundnut, coriander and mustard are also widely grown. It is interesting to observe that most of the crops grown in the hills and the plains are mutually exclusive, with rice being the exception. Crops like sesame, ginger, maize, pumpkin, turmeric, taro and tapioca are grown extensively only in the hills.

Table 3.1. Area under various crops across Locations (as % to the GCA)

	Hills	Plains
Rice	20.49	61.86
Sesame	4.45	---
Ginger	62.47	---
Maize	0.89	---
Pumpkin	5.12	---
Turmeric	0.11	---
Taro	0.89	---
Tapioca	0.22	---
Mustard	---	9.87
Coriander	---	10.44
Black Cumin	---	5.69
Groundnut	---	12.14
Sugarcane	5.35	---

In the hills, the summer rice is grown while winter rice is grown in the plains. The summer rice is also known as Aus or Ahu rice. It is broadcasted in the months of March and April in dry fields and harvested in summer. It is grown either in very low-lying areas where winter rice cannot be grown due to the presence of standing water in the summer or on the comparatively high lands where enough water does not accumulate even in summer for winter rice.

Rice occupies 26.48% and 23.02 % of the GCA amongst the tribal and the mixed communities, respectively. In the hills, it is followed by groundnut, mustard,

coriander, black cumin and sesame. While in the plains, rice is followed by ginger, coriander and sugarcane (Table 3.2.)

Other than rice, ginger is grown in large parts of the hills by the tribal as well as the mixed communities of the district. To promote the cultivation and the marketing of ginger, the district administration has set up an agency called GINFED (Ginger Growers Cooperative Marketing Federation Limited, Karbi Anglong, Diphu).

Table 3.2. Area under various crops across Communities (as % to the GCA)

	Tribal Community	Mixed Community
Rice	52.03	46.88
Sesame	2.61	---
Ginger	0.33	37.67
Maize	0.52	---
Pumpkin	0.92	2.17
Turmeric	0.07	---
Taro	0.52	---
Tapioca	0.13	---
Mustard	10.98	2.71
Coriander	10.20	4.34
Black Cumin	5.49	2.44
Groundnut	16.21	0.54
Sugarcane	---	3.25

Table 3.3. Area under various crops across Locations and Communities (as % to the GCA)

	Tribal Community in Hills	Tribal Community in Plains	Mixed Community in Hills	Mixed Community in Plains
Rice	69.29	48.59	1.24	82.21
Sesame	15.75	---	---	---
Ginger	1.97	---	86.34	---
Maize	3.15	---	---	---
Pumpkin	5.51	---	4.97	---
Turmeric	0.39	---	---	---
Taro	3.15	---	---	---
Tapioca	0.79	---	---	---
Mustard	---	13.17	---	4.81
Coriander	---	12.23	---	7.69
Black Cumin	---	6.58	---	4.33
Groundnut	---	19.44	---	0.96
Sugarcane	---	---	7.45	---

Many non-traditional crops like coriander, black cumin and groundnut are also grown in a large way by the farmers especially in the plains irrespective of tribal or mixed community. These have been mainly market-driven and the farmers have adapted well to their cultivation.

The cropping intensity in the study area is insignificant suggesting single crop farming, which is primarily due to the lack of irrigation and the consequent lack of use of fertilizer and HYV seeds.

3.3. Yield of various crops. Rice is the most wide grown crop in the study area. It is grown across all the regions and all the communities. The yield of rice in the hills is 232 kg per bigha as compared to 580 kg per bigha in the plains. For the tribal community, the yield of rice is 407 kg per bigha and 572 kg per bigha for mixed community.

Other than rice, ginger is also widely grown in the study area. It is particularly grown in the hill region by both the tribal as well as the mixed community. The yield of ginger in the hills is 1398 kg per bigha. Community-wise, it is 1200 kg per bigha among the tribal community and 1596 kg per bigha among the mixed community.

Table 3.4. Yield of crops across Locations (kg per bigha)

	Hills	Plains
Rice	232	580
Sesame	12	---
Ginger	1398	---
Maize	43	---
Pumpkin	89	---
Turmeric	50	---
Taro	100	---
Tapioca	50	---
Mustard	---	42
Coriander	---	134
Black Cumin	---	221
Groundnut	---	175
Sugarcane	700	---

Sugarcane, black cumin, groundnut and coriander are the other important crops grown in the study area. Sugarcane is mostly grown in the hills by the farmers of mixed

community, particularly those belonging to the Nepali community. Along with it they also grow maize and mustard, and occasionally potato. Farming is secondary to their main occupation, which in the hills of the district is cattle rearing and dairying.

In the case of black cumin and groundnut, it is seen that the yield is higher among the tribal community than the mixed community; whereas the yield of coriander is higher among the mixed community.

Table 3.5. Yield of crops across Community (kg per bigha)

	Tribal Community	Mixed Community
Rice	407	572
Sesame	12	---
Ginger	1200	1596
Maize	31	55
Pumpkin	89	---
Turmeric	50	---
Taro	100	---
Tapioca	50	---
Mustard	43	40
Coriander	130	138
Black Cumin	267	175
Groundnut	200	150
Sugarcane	---	700

Table 3.6. Yield of crops across regions and communities (kg per bigha)

	Tribal Community in Hills	Tribal Community in Plains	Mixed Community in Hills	Mixed Community in Plains
Rice	231	576	240	585
Sesame	12	---	---	---
Ginger	1200	---	1596	---
Maize	31	---	55	---
Pumpkin	89	---	---	---
Turmeric	50	---	---	---
Taro	100	---	---	---
Tapioca	50	---	---	---
Mustard	---	43	---	40
Coriander	---	130	---	138
Black Cumin	---	267	---	175
Groundnut	---	200	---	150
Sugarcane	---	---	700	---

Paddy. Being the most extensively grown crop in the study area, a detailed analysis for paddy was carried out. Looking into the share of area under paddy in the hills, it is seen that it is much lower than that in the plains with a significant mean difference at 1% level of significance (Table 3.7). At the community-level, the share of area under paddy is more for the tribal community as compared to the mixed community with the mean difference being significant at 1% level of significance (Table 3.8).

Table 3.7. Share of Area under Paddy in Hills and Plains (in %)

	Location	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of area under Paddy	Hills	50	36.31	0.000*	5.52
	Plains	50	85.99		3.05

Table 3.8. Share of Area under Paddy across Tribal and Mixed community (in %)

	Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of area under Paddy	Tribal community	50	76.74	0.000*	3.44
	Mixed community	50	45.56		6.57

* Mean difference significant at 1% level of significance.

Among the tribal community whether in hills or plains, the mean difference of the share of area under paddy is insignificant. However, significant mean difference at 1% level of significance was obtained for the mixed community. On analyzing the tribal and mixed community in the hills, considerable difference in the share of area under paddy was found. The mean difference is also significant at 1% level of significance. On the other hand, no difference is seen in the share of area under paddy for both the tribal and the mixed community residing in the plains.

Coming on to the yield of paddy, it is seen that significant difference exists between the yield in hills and in plains. Significant difference can also be seen across the communities – tribal and mixed (Tables 3.9. and 3.10).

The yield of paddy among the tribal community in both the hills and the plains shows significant difference at 1% level of significance. The yield of paddy among the mixed community in both the hills and the plains also shows significant difference at 1% level of significance as well (Table A.8).

Table 3.9. Yield of paddy across location (in kg/bigha)

	Location	N	Mean	Sig. (2-tailed)	Std. Error Mean
Yield of Paddy	Hills	25	232.00	0.000*	5.66
	Plains	50	580.80		5.74

Table 3.10. Yield of paddy across community (in kg/bigha)

	Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Yield of Paddy	Tribal community	49	407.35	0.000*	25.47
	Mixed community	26	572.31		14.68

* Mean difference significant at 1% level of significance

It is seen that the share of area under rice is significant in the plain regions, while it is significant for the tribal community when community aspect is considered. Within the tribal community across the location, no significant difference is seen with respect to the share of area. For mixed community across the location, however, significant difference can be seen. No difference exists between the shares of area under paddy between the tribal community and the mixed community in the plains; however, significant difference between the tribal community and the mixed community exists in the hills. Looking into the yield of paddy, significant difference can be seen between the hills and the plains, between tribal and the mixed community, and among the tribal community as well as the mixed community itself across the location.

The results suggest that paddy is grown significantly in the plain region across the communities. The tribal community in the plains have also adapted well to conventional way of cultivation as practiced in the plains; whereas, the tribal community in the hills have still adhered to their traditional way of agriculture. It can be clearly seen

that physical factors greatly influence the choices that a farmer makes in a given set of condition. Thus, physical factors greatly affect the cropping pattern regardless of the community the farmers belong to.

3.4. Inputs. The only input used by the farmers in the study area is seed for paddy. However, farmers in the hills do not purchase seeds for paddy; instead they use the paddy seeds of the last harvest, which they have stored.

Table 3.11. Seed use and its value

			Paddy Seed (in kg/bigha)	Paddy Seed Value (in Rs.)
Hills	Tribal community in Hills	N	24	---
		Mean	2.375	---
	Mixed community in Hills	N	1	---
		Mean	4	---
	Total	N	25	---
		Mean	2.44	---
Plains	Tribal community in Plains	N	25	25.00
		Mean	2.4	7.36
	Mixed community in Plains	N	25	25.00
		Mean	2.28	10.92
	Total	N	50	50.00
		Mean	2.34	9.14
Tribal community	Tribal community in Hills	N	24	---
		Mean	2.375	---
	Tribal community in Plains	N	25	25.00
		Mean	2.4	7.36
	Total	N	49	25.00
		Mean	2.388	7.36
Mixed community	Mixed community in Hills	N	1	---
		Mean	4	---
	Mixed community in Plains	N	25	25.00
		Mean	2.28	10.92
	Total	N	26	25
		Mean	2.346	10.92
Total		N	75	50
		Mean	2.373	9.14

Very little difference can be seen as to the amount of seeds used, both across the locations and across the communities. The average seed use for paddy per bigha is almost 3 kg. Exception is seen only in the case of mixed community in the hills, which has used 4kg of seeds for a bigha. The cost for the seeds that the farmers have paid ranges from about Rs.7 to about Rs.11.

3.5. Labour use. It is seen that the total labour used in the hills is more than that in the plains with the mean difference being significant at 1% level of significance. The mean difference of total family labour between the hills and the plains is also significant at 1% level of significance; while, the mean difference of total hired labour between the hills and the plains is significant at 5% level of significance. Significant difference of labour hours exist between the family labour (both male and female) and the hired labour (both male and female) in the hills and the plains, with the family labour working for more hours as compared to the hired labour.

Table 3.12. Labour use per bigha across Location (in hrs.)

	Location	N	Mean (in hrs)	Sig. (2-tailed)	Std. Error Mean
Male family labour	Hills	50	44.93	0.000*	1.20
	Plains	50	17.52		0.44
Female family labour	Hills	50	39.79	0.000*	2.31
	Plains	50	9.90		0.84
Total family labour	Hills	50	84.72	0.000*	3.28
	Plains	50	27.42		1.14
Male hired labour	Hills	50	11.02	0.002**	2.22
	Plains	50	3.62		0.68
Female hired labour	Hills	50	0.94	0.243	0.63
	Plains	50	0.18		0.10
Total hired labour	Hills	50	11.96	0.002**	2.41
	Plains	50	3.80		0.73
Total labour	Hills	50	96.68	0.000*	2.84
	Plains	50	31.22		1.13

* Mean difference significant at 1% level of significance

** Mean difference significant at 5% level of significance

Across the community, it is seen that no significant difference exists between labour use among the tribal and the mixed community as far as family labour is

concerned. However, difference does exist between the tribal and the mixed community as far as hired labour is concerned, which is significant at 1% level of significance. It is seen that male hired labour works for longer time in the tribal community than in the mixed community.

Table 3.13. Labour use per bigha across Communities (in hrs.)

	Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Male family labour	Tribal community	50	29.91	0.389	1.98
	Mixed community	50	32.54		2.30
Female family labour	Tribal community	50	20.87	0.040	2.50
	Mixed community	50	28.82		2.87
Total family labour	Tribal community	50	50.78	0.116	4.22
	Mixed community	50	61.36		5.15
Male hired labour	Tribal community	50	12.14	0.000*	2.14
	Mixed community	50	2.50		0.64
Female hired labour	Tribal community	50	0.94	0.243	0.63
	Mixed community	50	0.18		0.10
Total hired labour	Tribal community	50	13.08	0.000*	2.33
	Mixed community	50	2.68		0.70
Total labour	Tribal community	50	63.86	0.980	5.48
	Mixed community	50	64.04		4.80

* Mean difference significant at 1% level of significance.

Within the tribal community, significant difference can be seen between the labour use in the hills and the plains; the differences being significant at 1% level of significance. Similarly, for all the categories of labour - male and female, family and hired, significant difference can be seen between tribal community in the hills and the plains.

In the case of the mixed community as well, irrespective of hills and plains, family and hired; significant difference exists at 1% level of significance. Even in the case of labour use between the tribal community and the mixed community in the hills, significant difference can be seen at 1% level of significance. But no significant difference exists between the tribal community and the mixed community in the plains (Table A.9).

Considering the share of labours, it is found out that that the difference in share of male family labour and share of female family labour in the hills and the plains, is highly significant at 1% level of significance. This is not so for the hired labour, whether male or female. Similarly, the difference in share of male and female family labour and the share of male and female hired labour across the community – tribal and mixed, is not significant (Table 3.14. and 3.15.).

Table 3.14. Share of labour across Location (in %)

	Location	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of Male family labour	Hills	50	56.25	0.000*	2.08
	Plains	50	67.93		2.42
Share of Female family labour	Hills	50	43.74	0.000*	2.08
	Plains	50	32.06		2.42
Share of Male hired labour	Hills	20	90.09	0.172	5.81
	Plains	25	97.61		1.36
Share of Female hired labour	Hills	20	9.90	0.172	5.81
	Plains	25	2.38		1.36

Table 3.15. Share of labour across Communities (in %)

	Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of Male family labour	Tribal community	50	64.87	0.101	2.44
	Mixed community	50	59.31		2.30
Share of Female family labour	Tribal community	50	35.12	0.101	2.44
	Mixed community	50	40.68		2.30
Share of Male hired labour	Tribal community	28	92.92	0.531	4.21
	Mixed community	17	96.48		1.97
Share of Female hired labour	Tribal community	28	7.07	0.531	4.21
	Mixed community	17	3.51		1.97

* Mean difference significant at 1% level of significance.

For the tribal community in the hills and the plains, no significant difference is seen for share of labour; whereas, significant difference is seen for mixed community in the hills and the plains in the case of male and female family labour. The male and female family labour in a mixed community worked for longer duration in the hills than in the plains (Table A.10).

The mean difference of the share of family labour and hired labour between the hills and the plains is insignificant; so is the mean difference of family labour and hired labour between tribal and mixed communities. However, the mean difference of family and hired labour is significant among the tribal communities in the hills and the plains (significant at 1% level of significance), so is it for mixed communities in the hills and the plains (Table A.10).

Conclusion. It is seen that agriculture and agricultural land use is different across locations and communities. Nonetheless, differences have been more prominent when locations have been considered. The results for land holding, cropping pattern, yield of various crops and labour use suggest the overarching impact of physical aspect. On the other hand, little or no difference was observed due to the community aspect.

For instance, it is seen that tribal community in the hills still adhere to traditional methods of land husbandry and agriculture which is shifting cultivation. The returns from it being far more less than that of the mixed community who are also practising agriculture in hills. However, when in the plains, the tribal community do not practice shifting cultivation but adapt to the agricultural practices of the plains. It suggests that neither tradition nor customs nor community feelings influence the choices of a farmer; rather it is the physical constraints or the physical conditions, which affects his/her decisions regarding land use and agriculture.

Thus, it is seen that in the hills, the area owned and operational holding are of smaller area compared to those in the plains. Similarly, due to the uncertainties of agriculture in the absence of irrigation or other amenities in the hills; farmers tend to diversify in the crops they grow. While, in the plains, crop specialization is more or less practiced with farmers concentrating on a few crops. With regard to the labour use too, it is seen that use of labour is more in the hills than the plains due to the physical conditions. This is completely different in the case of the plains where lesser amount of labour is used, now more so with the increasing use of tractors and mechanization in the study area.

IV. CONCLUSION

Agricultural land use is invariably related to the agricultural practices. Agricultural practices vary from one another depending upon many factors. In this, physical aspects occupy a very prominent place in terms of agriculture and agricultural land use practices.

Assam is composed of both hills and valley plains. The physical characteristics of the state have also shaped its agriculture. Most of the agricultural activities are concentrated in the plains, primarily wet rice cultivation besides other crops. The hills on the other hand are characterised by low agricultural production and yield.

During the period 1981-2000, the state has witnessed a miniscule increase in net sown area, besides the current fallow. At the district-level, Nalbari, Nagaon, Morigaon, Darrang, Dhubri, and Barpeta had high percentage of net sown area; whereas, NC Hills and Karbi Anglong district had the least percentage of net sown area. The growth rate for net sown area in the entire state was the highest (1.62%) for NC Hills. In case of the total cultivable land too, Nalbari, Darrang, Nagaon and Morigaon had a high percentage of net sown area. The percentage of total cultivable area was the lowest for NC Hills and Karbi Anglong. Again, the growth rate for total cultivable area in the entire state was the highest (1.52%) for NC Hills.

By virtue of being in the hills, NC Hills and Karbi Anglong have not been able to increase land for agricultural purpose. On the other hand, the districts that have high percentage of agricultural land are located in the Brahmaputra valley. It is seen that physiography has played a major role in the expansion of cultivable land and the development of agriculture in general.

This has also affected the cropping intensity, with districts in the plains showing higher cropping intensity than those in the hills. The districts in the plains are well equipped with irrigational facilities and have easy access to seeds and fertilizers, which is

not the case with the districts in the hills. Again, the districts in the hills are among those who have the lowest cropping intensity in the entire state. The correlation results also show a significant positive relation between net sown area and irrigation facilities available, and net sown area and fertilizer consumption.

At the micro level too, the impact of physiography over agriculture and agricultural land use is clearly seen. In the study area, in the selected villages of Karbi Anglong district, it is seen that wide difference exists between those in the hills and in the plains. These differences are not so prominent when two villages of different communities of the same physical location are considered. For example, in the case of agricultural practices, a tribal community in the plains share more resemblance with a mixed community in the plains than with a tribal community in the hills and a tribal community in the plains. Thus, it is seen that physiography of the location binds all the communities together and influences the farming practices far more than other factors.

Taking a cue from this, it is seen that area owned and operational holdings in the hills are small in comparison to those in the plains. Most of the operational holdings in the hills are in fact, small land holdings.

In the case of varieties of crops grown too, the hills differ immensely from those in the plains. In the study area, the farmers in the hills grow as much as nine different types of crops as compared to only five in the plains. Since the hills lack irrigation facilities and also lack accessibility to pesticides, fertilizers and modern technology; agriculture in the hills is vulnerable to the uncertainties of nature. The farmers, thus, face this uncertainty by going in for multiple cropping. In a way it not only acts as a safe guard against crop failure, but also assures supply of essential nutrients to the impoverished villagers. In the plains, however, as such uncertainties are minimal, it is generally seen that farmers go in for single crops.

All these affect the productivity and the yield of the crops that are grown. It is seen that there is huge difference between the yields of the same crop in the hills to that

in the plains. For instance, the yield of paddy in the hills and the plains is very high. This gets also reflected in the share of area under paddy, with the share of area being high in the plains and low in the hills.

It is also seen that labour use in the hills is more than that in the plains. The inability to use draught animal or any form of mechanization in the slopes of a hill requires more labour use. However, such is not the case in the plains. Nonetheless, it is seen that the returns are high in the plains as compared to the hills.

This study was also to study agricultural land use responses between communities. It is seen that community aspects plays a very insignificant or no role in agricultural land use by a farmer. Instead they are mainly guided by the limits imposed by nature.

To ameliorate this situation and improve agricultural condition in the hills the government, both central and the state, have taken many steps. Initiatives like Horticulture Technology Mission, Samriddha Krishak Yojana, Rashtriya Sama Vikash Yojana have been launched in the study area. Besides, Kishan Melas and public demonstration are also regularly organised. There are also proposals to build five cold storage facilities in the district, two ginger dehydration plant and the propagation of tissue cultured banana and cashew nuts under the Horticulture Technology Mission. The district administration has also initiated credit and loans facilities in collaboration with the nationalized banks, rural banks and cooperative banks to Self Help Groups, Farmer's Clubs and Field Management Committees. As a result, the formation of these groups has been encouraged.

Despite the many steps taken by the government, the agricultural condition has not improved much. One of the major common problems is the overlapping of the programmes and the functions of the implementing agency. Along with this is also the problem of lack of coordination among them. Problems also exist at the planning formulation level, where many a times the problems are generalized.

Leaving aside the bureaucratic and planning aspect for a while, it is also observed that agriculture specific infrastructure is very much lacking in the study area. In course of the study, it is seen that on many occasion the farmers had to sell their produce at a very low price for the fear of getting it damaged, particularly in the case of horticultural crops. The absence of cold storage and processing plants is badly felt.

Lack of market linkages and a proper market facility also remains a major hurdle. The author in course of an interview with an official from the agriculture department was told that although the production of rice was sufficient to feed the entire population of the district; yet, the district had to bring in rice from states like Punjab and Haryana. He said that this was due to the lack of proper marketing facility within the district, whereby the rice from the district are sold in markets outside, creating shortage and then resulting in buying rice again from other states.

It was also observed that many farmers in the hills faced the shortage of land. They were also ignorant about the different government schemes for them. Some enthusiastic farmers, who wanted to cultivate horticultural crops in a big way, either faced the shortage of capital or land.

The problem of wild elephants intruding into the agricultural fields frequently and damaging crops and property was a common complaint encountered in the plain region. The complexity and inaccessibility of banking and loan facilities were also voiced by the farmers there. Better infrastructure in the form of roads, market sheds, storage facilities and supply of quality seeds were some of their common concerns.

It is seen that farmers from both the tribal as well as the mixed community in the hills and the plains are not averse to change as often thought. It is actually the lack of support and guidance that has impeded the development of agriculture in these parts of the country. The study also shows that it is the physical factors which are affecting the agricultural practices in the district. Overcoming the physical factors and harnessing it for the benefit of all the inhabitants of the region will be a way to improve the condition of

agriculture in the district. New and innovative techniques, modification of an existing traditional method, agro-forestry, horticulture, cultivation of high value products along with development of infrastructure and agricultural facilities can be a starting point towards the development of agriculture in Assam, and Karbi Anglong in particular.

With great potentialities in agriculture, the district can do well in horticulture, and in adopting crop diversification in a big way. Focussing on some particular high value crops in the initial stage which grow well in the district will help ameliorate the present state of agriculture in the district. Special emphasis needs to be placed on the possibilities and shortcomings with regard to infrastructure and marketing linkages of the district. A study into the market linkages will, thus, be beneficial. Farmer organizations like Self Help Groups, Field Management Committees, etc. have been vital in the dissemination of information, education and training, providing facilities and technology as well as for financial assistance. Strengthening them and sorting out the weak points will go a long way in the development of the region. In the future these fields of study can be taken up for a better understanding and a better future of agriculture in the district in particular as well as the people living there in general.

BIBLIOGRAPHY

Barah, B C (2006): Institutional Innovation: A Driver for Rural Prosperity – A study of Field Management Committees (FMC) in Assam, Research Report No. 1/2006, National Centre for Agricultural Economics and Policy Research, Indian Council of Agricultural Research, New Delhi.

Barah, B C ed. (2001): Prioritization of Strategies for Agricultural Development in Northeastern India, Proceedings 9, National Centre for Agricultural Economics and Policy Research, Indian Council of Agricultural Research, New Delhi.

Baruah, S (2001): "Clash of resource use regimes in Colonial Assam: A nineteenth-century puzzle revisited", *Journal of Peasant Studies*, 28:3, pp 109-124. Downloaded from http://www.informaworld.com on 5 August 2008.

Bell, S and S More (1999): Sustainability Indicators: Measuring The Immeasurable, Earthscan.

Bhalla, G S (2007): Indian Agriculture Since Independence, National Book Trust, New Delhi.

Bhowmick, B C, B C Barah, S Pandey and N Barthakur (2005): Changing Pattern of Rice Production Systems and Technology in Assam: A Spatio-temporal Temporal Analysis of Performance and Prospects, Policy Paper 22, National Centre for Agricultural Economics and Policy Research, Indian Council of Agricultural Research, New Delhi.

Birthal, P S, A K Jha, P K Joshi and D K Singh (2006): "Agricultural Diversification in North Eastern Region of India: Implication for growth and equity", Indian Journal of Agricultural Economics, Vol.62, No.1, January – March, pp 13-31.

Burmon, A K (1977): "Tribal Agriculture in the North-Eastern Hill Region", *Social Scientist*, Vol. 6, No. 3, October, pp 61-68. Downloaded from http://www.jstor.org on 28 July 2008.

Chaddha, G K, S Sen and H R Sharma (2004): Land Resources: State of Indian Farmer, Academic Foundation, New Delhi.

Choudhury, D (2005): "Jhum Stabilization and Transitions in Agricultural Systems" in Mark Poffenberger (ed.) Community Forestry in North East India, Community Forestry International.

Das, M M (1984): Peasant Agriculture of Assam, Inter-India Publications, New Delhi.

Deininger, K (2003): Land Policies for Growth and Poverty Reduction, World Bank.

Dhar, P K (2005): *The Economy of Assam including Economy of Northeast India*, Kalyani Publishers, New Delhi.

Dutta, B B and M N Karna ed. (1987): Land Relations in North East India, People's Publishing House, New Delhi.

FAO and UNEP (1996): Our Land Our Future, Rome.

FAO and UNEP (1997): Negotiating a Sustainable Future for Land: Structural and Institutional Gudelines for Land Resources Management in the 21st Century, Rome.

FAO and UNEP (1999): The Future of Our Land: Facing the Challenge, Rome.

Ghosh, B N (1987): Fundamentals of Population Geography, Sterling Publishing Pvt. Ltd., New Delhi.

Gohain, H (2006): "Land Question in Assam – A Short Note", Economic and Political Weekly, August 12, pp 3459-3460.

Goswami, C (2002): "Agricultural Land Use in the Plains of Assam", *Economic and Political Weekly*, December 7, pp 4891-4893.

Government of Assam (2003): Assam Human Development Report 2003, Planning and Development Department, Dispur, Guwahati.

Government of Assam: Statistical Handbook - Assam, Directorate of Economics and Statistics, various issues.

Government of India (2008): North eastern Region – Vision 2020, Vol. I, II and III, North Eastern Council and Ministry for Development of North Eastern Region.

Goyari, P (2005): "Flood Damages and Sustainability of Agriculture in Assam", Economic and Political Weekly, June 25, pp 2723-2729.

Grimble, R (1996): Carrying Capacity: Sustainable Use and Demographic Determinants of Natural Habitats and Ecosystem Management, Environment Department Papers, Paper No. 35, Natural Habitats and Ecosystem Management Series No.3, Land, Water and Natural Habitat Division, The World Bank, Washington, DC.

Kerkhoff, E and E Sharma, ed. (2006): Debating Shifting Cultivation in the Eastern Himalayas – Farmers' Innovation as Lessons for Policy, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.

Lyall, C (1997): The Karbis, Spectrum Publication, Guwahati.

Mearns, R (1999): Access to Land in Rural India: Policy Issues and Options, World Bank.

Mellor, J W (1962): "The Process of Agricultural Development in Low-income Countries", *Journal of Farm Economics*, Vol. 44, No. 3, pp 700-716. Downloaded from http://www.jstor.org on 4 April 2008.

Pender, J (1999): Rural Population Growth, Agricultural Change and Natural Resource Management in Developing Countries: A Review of Hypotheses and some Evidence from Honduras, EPTD Discussion Paper No. 48, Environment and Production Technology Division, International Food Policy Research Institute, Washington, D.C.

Phangcho, P C (2001): Karbi Anglong and North Cachar Hills – A Study on Geography and Culture, Printwell, Diphu.

Ramakrishnan, P S (1992): Shifting Cultivation and Sustainable development: An Interdisciplinary Study from North-eastern India, Parthenon Publishing Group, New Jersey and UNESCO, Paris.

Reid, R (1944): "The Excluded Areas of Assam", The Geographical Journal, Vol. 103, No.1/2, Jan–Feb, pp 18-29. Downloaded from http://www.jstor.org/stable/1789063 on 28 August 2008.

Ruttan V W and Y Hayami (1971): Agricultural Development: An International Perspective, John Hopkins Press, Baltimore.

Saikia, A (2008): "Forest land and peasant struggles in Assam, 2002-2007", Journal of Peasant Studies, 35:1, pp 39-59. Downloaded from http://www.informaworld.com on 5 August 2008.

Sharma, C K (2001): "Assam – Tribal Land Alienation: Government's Role", Economic and Political Weekly, December 21, pp 4791-4795.

Taher, M and P Ahmed (2001): Geography of North-East India, Mani Manik Prakash, Guwahati.

World Bank (2006): Sustainable Land Management: Challenges, Opportunities, and Trade-offs, Agriculture and Rural Development, International Bank for Reconstruction and Development and World Bank, Washington, DC.

APPENDIX

Table A.1. Correlation between NAS and Irrigation in Assam

		NAS	Irrigation
NAS	Pearson Correlation	1	.831(*)
	Sig. (2-tailed)		.000
	N	23	23
Irrigation	Pearson Correlation	.831(*)	1
	Sig. (2-tailed)	.000	
	N	23	23

* Correlation is significant at the 0.01 level (2-tailed).

Table A.2. Correlation between NAS and Fertilizer Consumption in Assam

		Fertilizer consumption	NAS
Fertilizer Consumption	Pearson Correlation	1	.751(*)
	Sig. (2-tailed)		.000
	N	23	23
NAS	Pearson Correlation	.751(*)	1
	Sig. (2-tailed)	.000	
	N	23	23

* Correlation is significant at the 0.01 level (2-tailed).

Table A.3. No. of Operational Holdings

Farm Size	Hills	Plains
Small	33	23
Medium	17	13
Large	-	14

Farm Size	Tribal Community	Mixed Community
Small	39	17
Medium	5	26
Large	6	7

Farm Size	Tribal Community in Hills	Tribal Community in Plains	Mixed Community in Hills	Mixed Community in Plains
Small	24	15	9	8
Medium	1	4	16	10
Large	-	6	-	7

Table A.4. Average area of the Operational Holdings (in bigha)

Farm Size	Hills		Plains	
	Mean	CV	Mean	CV
Small	2.85	42.84	3.91	26.60
Medium	7.82	18.22	7.36	18.89
Large	-	-	25.54	94.24
Total	4.54	59.54	10.50	143.14

Farm Size	Tribal Community		Mixed Community	
	Mean	CV	Mean	CV
Small	2.87	42.16	4.24	0.75
Medium	7.00	14.29	7.73	1.45
Large	38.83	80.94	14.14	2.73
Total	7.60	203.55	7.44	3.49

Farm Size	Tribal Community in Hills		Tribal Community in Plains		Mixed Community in Hills		Mixed Community in Plains	
	Mean	CV	Mean	CV	Mean	CV	Mean	CV
Small	2.38	42.02	3.67	30.25	4.11	18.98	4.38	16.89
Medium	6.00		7.25	13.10	7.94	17.38	7.40	21.22
Large	-		38.83	80.94	-		14.14	19.31
Total	2.52	48.41	12.68	164.12	6.56	33.69	8.32	51.44

Table A.5. Area Owned and Operational Holdings (in bigha)

	Location	N	Mean	Sig. (2-tailed)	Std. Error Mean
Area Owned	Hills	50	4.540	0.000*	.382
	Plains	50	9.060		.580
Operational Holding	Hills	50	4.540	0.007**	.382
	Plains	50	10.500		2.127

	Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Area Owned	Tribal community	50	5.840	0.657	.742
	Mixed community	23	6.348		.452
Operational Holding	Tribal community	50	7.600	0.701	2.188
	Mixed community	23	6.348		.452

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Area Owned	Tribal community in Hills	25	2.520	0.000*	0.244
	Tribal community in Plains	25	9.160		1.128
Operational Holding	Tribal community in Hills	25	2.520	0.019	0.244
	Tribal community in Plains	25	12.680		4.164

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Area Owned	Mixed community in Hills	25	6.560	0.000*	0.444
	Mixed community in Plains	25	8.960		0.313
Operational Holding	Mixed community in Hills	25	6.560	0.075	0.444
	Mixed community in Plains	25	8.320		0.858

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Area Owned	Tribal community in Hills	25	2.520	0.000*	0.244
	Mixed community in Hills	25	6.560		0.444
Operational Holding	Tribal community in Hills	25	2.520	0.000*	0.244
	Mixed community in Hills	25	6.560		0.444

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Area Owned	Tribal community in Plains	25	9.160	0.865	1.128
	Mixed community in Plains	25	8.960		0.313
Operational Holding	Tribal community in Plains	25	12.680	0.310	4.164
	Mixed community in Plains	25	8.320		0.858

Table A.6. Yields of various crops (kg per bigha)

	Hills	Plains
Rice	232	580
Sesame	12	---
Ginger	1398	---
Maize	43	---
Pumpkin	89	---
Turmeric	50	---
Taro	100	---
Tapioca	50	---
Mustard	---	42
Coriander	---	134
Black Cumin	---	221
Groundnut	---	175
Sugarcane	700	---

	Tribal Community	Mixed Community
Rice	407	572
Sesame	12	---
Ginger	1200	1596
Maize	31	55
Pumpkin	89	---
Turmeric	50	---
Taro	100	---
Tapioca	50	---
Mustard	43	40
Coriander	130	138
Black Cumin	267	175
Groundnut	200	150
Sugarcane	---	700

	Tribal Community in Hills	Tribal Community in Plains	Mixed Community in Hills	Mixed Community in Plains
Rice	231	576	240	585
Sesame	12	---	---	---
Ginger	1200	---	1596	---
Maize	31	---	55	---
Pumpkin	89	---	---	---
Turmeric	50	---	---	---
Taro	100	---	---	---
Tapioca	50	---	---	---
Mustard	---	43	---	40
Coriander	---	130	---	138
Black Cumin	---	267	---	175
Groundnut	---	200	---	150
Sugarcane	---	---	700	---

Table A.7. Share of area under Paddy

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of area under Paddy	Tribal community in Hills	25	71.3016	0.115	4.5543
	Tribal community in Plains	25	82.1983		5.0380

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of area under Paddy	Mixed community in Hills	25	1.3333	0.000*	1.3333
	Mixed community in Plains	25	89.7978		3.4009

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of area under Paddy	Tribal community in Hills	25	71.3016	0.000*	4.5543
	Mixed community in Hills	25	1.3333		1.3333

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of area under Paddy	Tribal community in Plains	25	82.1983	0.217	5.0380
	Mixed community in Plains	25	89.7978		3.4009

Table A.8. Yield of Paddy

	Location and Community	N	Mean (in kg/bigha)	Sig. (2-tailed)	Std. Error Mean
Yield of Paddy	Tribal community in Hills	24	231.67	0.000*	5.89
	Tribal community in Plains	25	576.00		9.52

	Location and Community	N	Mean (in kg/bigha)	Sig. (2-tailed)	Std. Error Mean
Yield of Paddy	Mixed community in Hills	1	240.00	0.000*	.
	Mixed community in Plains	25	585.60		6.48

	Location and Community	N	Mean (in kg/bigha)	Sig. (2-tailed)	Std. Error Mean
Yield of Paddy	Tribal community in Plains	25	576.00	0.409	9.52
	Mixed community in Plains	25	585.60		6.48

Table A.9. Labour Use

	Location and Community	N	Mean (in hrs.)	Sig. (2-tailed)	Std. Error Mean
Male family labour	Tribal community in Hills	25	41.8000	0.000*	1.9253
	Tribal community in Plains	25	18.0200		0.7277
Female family labour	Tribal community in Hills	25	31.5200	0.000*	3.8480
	Tribal community in Plains	25	10.2200		1.1825
Total family labour	Tribal community in Hills	25	73.3200	0.000*	5.2696
	Tribal community in Plains	25	28.2400		1.6900
Male hired labour	Tribal community in Hills	25	22.0400	0.000*	3.1778
	Tribal community in Plains	25	2.2400		0.7768
Female hired labour	Tribal community in Hills	25	1.8800	0.142	1.2601
	Tribal community in Plains	25	0.0000		0.0000
Total hired labour	Tribal community in Hills	25	23.9200	0.000*	3.4443
	Tribal community in Plains	25	2.2400		0.7768
Total labour	Tribal community in Hills	25	97.2400	0.000*	5.2511
	Tribal community in Plains	25	30.4800		1.4912

	Location and Community	N	Mean (in hrs.)	Sig. (2-tailed)	Std. Error Mean
Male family labour	Mixed community in Hills	25	48.0600	0.000*	1.1741
	Mixed community in Plains	25	17.0200		0.5095
Female family labour	Mixed community in Hills	25	48.0600	0.000*	1.1741
	Mixed community in Plains	25	9.5800		1.2233
Total family labour	Mixed community in Hills	25	96.1200	0.000*	2.3483
	Mixed community in Plains	25	26.6000		1.5497
Male hired labour	Mixed community in Hills	25	0.0000	0.000*	0.0000
	Mixed community in Plains	25	5.0000		1.0797
Female hired labour	Mixed community in Hills	25	0.0000	0.089	0.0000
	Mixed community in Plains	25	0.3600		0.2072
Total hired labour	Mixed community in Hills	25	0.0000	0.000*	0.0000
	Mixed community in Plains	25	5.3600		1.1897
Total labour	Mixed community in Hills	25	96.1200	0.000*	2.3483
	Mixed community in Plains	25	31.9600		1.7287

	Location and Community	N	Mean (in hrs.)	Sig. (2-tailed)	Std. Error Mean
Male family labour	Tribal community in Hills	25	41.8000	0.008**	1.9253
	Mixed community in Hills	25	48.0600		1.1741
Female family labour	Tribal community in Hills	25	31.5200	0.000*	3.8480
	Mixed community in Hills	25	48.0600		1.1741
Total family labour	Tribal community in Hills	25	73.3200	0.000*	5.2696
	Mixed community in Hills	25	96.1200		2.3483
Male hired labour	Tribal community in Hills	25	22.0400	0.000*	3.1778
	Mixed community in Hills	25	0.0000		0.0000
Female hired labour	Tribal community in Hills	25	1.8800	0.142	1.2601
	Mixed community in Hills	25	0.0000		0.0000
Total hired labour	Tribal community in Hills	25	23.9200	0.000*	3.4443
	Mixed community in Hills	25	0.0000		0.0000
Total labour	Tribal community in Hills	25	97.2400	0.846	5.2511
	Mixed community in Hills	25	96.1200		2.3483

	Location and Community	N	Mean (in hrs.)	Sig. (2-tailed)	Std. Error Mean
Male family labour	Tribal community in Plains	25	18.0200	0.266	0.7277
	Mixed community in Plains	25	17.0200		0.5095
Female family labour	Tribal community in Plains	25	10.2200	0.708	1.1825
	Mixed community in Plains	25	9.5800		1.2233
Total family labour	Tribal community in Plains	25	28.2400	0.478	1.6900
	Mixed community in Plains	25	26.6000		1.5497
Male hired labour	Tribal community in Plains	25	2.2400	0.043	0.7768
	Mixed community in Plains	25	5.0000		1.0797
Female hired labour	Tribal community in Plains	25	0.0000	0.089	0.0000
	Mixed community in Plains	25	0.3600		0.2072
Total hired labour	Tribal community in Plains	25	2.2400	0.033	0.7768
	Mixed community in Plains	25	5.3600		1.1897
Total labour	Tribal community in Plains	25	30.4800	0.520	1.4912
	Mixed community in Plains	25	31.9600		1.7287

Table A.10. Share of Labour Use

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of Male family labour	Tribal community in Hills	25	62.5147	0.341	3.8044
	Tribal community in Plains	25	67.2332		3.0927
Share of Female family labour	Tribal community in Hills	25	37.4853	0.341	3.8044
	Tribal community in Plains	25	32.7668		3.0927
Share of Male hired labour	Tribal community in Hills	20	90.0926	0.297	5.8163
	Tribal community in Plains	8	100.0000		0.0000
Share of Female hired labour	Tribal community in Hills	20	9.9074	0.297	5.8163
	Tribal community in Plains	8	0.0000		0.0000

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of Male family labour	Mixed community in Hills	25	50.0000	0.000*	0.0000
	Mixed community in Plains	25	68.6319		3.7969
Share of Female family labour	Mixed community in Hills	25	50.0000	0.000*	0.0000
	Mixed community in Plains	25	31.3681		3.7969
Share of Male hired labour	Mixed community in Hills				
	Mixed community in Plains	17	96.4881		1.9714
Share of Female hired labour	Mixed community in Hills				
	Mixed community in Plains	17	3.5119		1.9714

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of Male family labour	Tribal community in Hills	25	62.5147	0.002**	3.8044
	Mixed community in Hills	25	50.0000		0.0000
Share of Female family labour	Tribal community in Hills	25	37.4853	0.002**	3.8044
	Mixed community in Hills	25	50.0000		0.0000
Share of Male hired labour	Tribal community in Hills	20	90.0926		5.8163
	Mixed community in Hills				
Share of Female hired labour	Tribal community in Hills	20	9.9074		5.8163
	Mixed community in Hills				

	Location and Community	N	Mean (in %)	Sig. (2-tailed)	Std. Error Mean
Share of Male family labour	Tribal community in Plains	25	67.2332	0.776	3.0927
	Mixed community in Plains	25	68.6319		3.7969
Share of Female family labour	Tribal community in Plains	25	32.7668	0.776	3.0927
	Mixed community in Plains	25	31.3681		3.7969
Share of Male hired labour	Tribal community in Plains	8	100.0000	0.239	0.0000
	Mixed community in Plains	17	96.4881		1.9714
Share of Female hired labour	Tribal community in Plains	8	0.0000	0.239	0.0000
	Mixed community in Plains	17	3.5119		1.9714

	Location	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of family labour	Hills	50	87.3534	0.837	2.72199
	Plains	50	88.0773		2.22252
Share of hired labour	Hills	50	12.6466	0.837	2.72199
	Plains	50	11.9227		2.22252

	Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of family labour	Tribal community	50	83.2671	0.010	2.73578
	Mixed community	50	92.1636		2.01546
Share of hired labour	Tribal community	50	16.7329	0.010	2.73578
	Mixed community	50	7.8364		2.01546

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of family labour	Tribal community in Hills	25	74.7069	0.001*	4.11418
	Tribal community in Plains	25	91.8274		2.74384
Share of hired labour	Tribal community in Hills	25	25.2931	0.001*	4.11418
	Tribal community in Plains	25	8.1726		2.74384

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of family labour	Mixed Community in Hills	25	100.0000	0.000*	0.00000
	Mixed Community in Plains	25	84.3271		3.38664
Share of hired labour	Mixed Community in Hills	25	0.0000	0.000*	0.00000
	Mixed Community in Plains	25	15.6729		3.38664

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of family labour	Tribal community in Hills	25	74.7069	0.000*	4.11418
	Mixed community in Hills	25	100.0000		0.00000
Share of hired labour	Tribal community in Hills	25	25.2931	0.000*	4.11418
	Mixed community in Hills	25	0.0000		0.00000

	Location and Community	N	Mean	Sig. (2-tailed)	Std. Error Mean
Share of family labour	Tribal community in Plains	25	91.8274	0.092	2.74384
	Mixed community in Plains	25	84.3271		3.38664
Share of hired labour	Tribal community in Plains	25	8.1726	0.092	2.74384
	Mixed community in Plains	25	15.6729		3.38664