

**PROBLEMS AND PROSPECTS OF
AGRICULTURAL SECTOR IN ASSAM- A CASE
STUDY OF SONITPUR DISTRICT**



**THESIS
SUBMITTED FOR THE DEGREE
OF
DOCTOR OF PHILOSOPHY**

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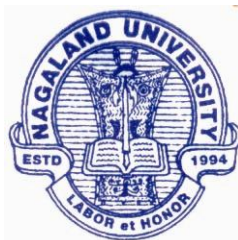
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This is to certify that the work recorded in the thesis titled “**PROBLEMS AND PROSPECTS OF AGRICULTURAL SECTOR IN ASSAM- A CASE STUDY OF SONITPUR DISTRICT**” is submitted by **Mr. Dinesh Sarmah** M.A. (Eco), Research Scholar, Department of Commerce, Nagaland University for the degree of Doctor of Philosophy is faithful and bonafide research work carried out under my personal supervision and guidance.

I certify that this thesis is a record of work done by the candidate himself and that to the best of my knowledge and the contents of the thesis did not form a basis of award of any previous degree to anybody else.

(Dr. Parag Kr. Deka)

Supervisor

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The work is the first attempt to its kind in regard to a complete analysis covering all aspects of the agriculture of the state in general and Sonitpur district in particular. I have tried to make the work quite comprehensive considering the necessity of the study because agriculture is the largest productive sector in the state as well as in the district and it provides livelihood to large mass of population directly and indirectly. The study covers all the different aspects and opportunities of the agricultural sector and focus on the recent trends in productivity with a comparative analysis with the agriculturally competitive districts of Assam, developed states like Punjab and Haryana and the national average, major challenges faced by the sector and suggest some remedial measures that would help to meet the basic objectives and aspiration of farmers of the state in general and the district in particular.

The study has its own limitations. The present study is an attempt to provide more comprehensive analysis of the agricultural growth with selected crops and problems in the state and in the district by interfacing a macro picture describe by secondary data with the realities at the grass root, observe through a field survey in which farms and households are the units of observation. Since the agricultural sector is the unorganized sector of our economy, no records of year-wise production is maintained by farmers even by large farmers also. The primary analysis of the year-wise productivity of the sector is mostly depended on official or departmental data provided by the agricultural department of the government. Again there are inherent limitations in deriving macro policy recommendation from micro studies on

the basis of existing socio- economic conditions of the people and the importance of the agricultural sector on the livelihood of the farmers.

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ABBREVIATIONS

AACP	: Assam Agricultural Competitiveness Project
AAU	: Assam Agriculture University
AC	: Agricultural Census
ACCP	: Assam Agricultural Competitive Project
ADO	: Agricultural Development Officer
AGMARKNET	: Agricultural Marketing Network
AIA	: Aggregate Irrigated Area
ARDC	: Agricultural Refinance and Development Corporation
ASAMB	: Assam State Agricultural Marketing Board
ASC	: Assam Seeds Corporation
ASMIDC	: Assam State Minor Irrigation Development Corporation
ASMIDC	: Assam State Minor Irrigation Development Corporation Limited
ASRTC	: Assam State Road Transport Corporation
BAO	: Block Agricultural Officer
BC	: Before Christ
BCA	: Bio-Control Agent
BDO	: Block Development Officer
BNCA	: Biswanath College of Agriculture
CDB	: Community Development Block
CL	: Crop Loans
CMIE	: Centre for Monitoring Indian Economy
CV	: Co-efficient of Variation
DTW	: Deep Tube Well Scheme
FFS	: Farmers Field School
FIS	: Flow Irrigation Scheme
FMC	: Field Management Committee
FYP	: Five-Year Plan
GDDP	: Gross District Domestic Product
GDP	: Gross Domestic Product
GPCS	: Gaon Panchayat Level Co-operative Societies
GR	: Green Revolution

GSDP	: Gross State Domestic Product
HP	: Horse Power
HTM	: Horticulture Technology Mission
HYV	: High Yielding Varieties
ICAR	: Indian Council of Agricultural Research
IPM	: Integrated Pest Management
KCC	: Kishan Credit Card
LIS	: Lift Irrigation Schemes
MAR	: Mean Annual Rainfall
MAT	: Mean Annual Temperature
MT	: Million Tonnes
NA	: Not Available
NABARD	: National Bank for Agricultural and Rural Development
NAIS	: National Agricultural Insurance Scheme
NCAER	: National Council of Applied Economic Research
NDDP	: Net District Domestic Product
NEDFI	: North East Development Finance Corporation Ltd
NIA	: Net Irrigated Area
NPK	: Nitrogen-Phosphorous-Potassium(Kelium)
RMC	: Regulated Market Committees
RPM	: Rural Primary Markets
RRB	: Regional Rural Banks
SBCL	: State Bio-Control Laboratory
SHG	: Self Help Groups
SLBC	: State Level Bankers' Committee
SMY	: Sub-Market Yards
SRR	: Seed Replacement Rate
SSCA	: State Seed Certification Agency
STW	: Shallow Tube Well
STWS	: Shallow Tube Well Scheme
WTO	: World Trade Organization

CHAPTER 1

1.1. INTRODUCTION

Agriculture constitutes an indispensable contributing sector towards the national income and employment, mainly in third world countries or in developing countries. The word agriculture is the English adaptation of Latin *agricultura*, from *ager*, "a field" and *cultura*, "cultivation" in the strict sense of "tillage of the soil". Thus, a literal reading of the word yields "tillage of a field / of fields". Agriculture refers to the production of food and fiber and other goods through farming and forestry. Agriculture was a key development that led to the rise in civilization rising of domesticated animals. It was developed at least 10,000 years ago, and it has undergone significant developments since the time of the earliest cultivation. Evidences point out to the Fertile Crescent of the Middle East as the site of the earliest planned sowing and harvesting of plants that had previously been gathered in the wild. Independent development of agriculture is also believed to have occurred in Northern and Southern China, Africa's Sahel, New Guinea and several regions of the America.

The Neolithic founder crops of agriculture appear first ever was wheat and einkorn wheat, then hulled barley, peas, lentils, bitter vetch, chick peas and flax. Bitter vetch and lentils along with almonds and pistachios appear in Franchthi Cave Greece simultaneously, about 9,000 BC. Neither is native to Greece, and they appear 2,000 years prior to domesticated wheat in the same location. This suggests that the cultivation of legumes and nuts preceded that of grain in some Neolithic cultures.

By 7000 BC, small-scale agriculture reached Egypt. From at least 7000 BC the Indian subcontinent saw farming of wheat and barley, as attested by archaeological excavation at Mehrgarh in Balochistan. By 6000 BC, mid-scale farming was entrenched on the banks of the Nile. About this time, agriculture was developed independently in the Far East, with rice, rather than wheat, as the primary crop. Chinese and Indonesian farmers went on to domesticate taro and beans including Mung, Soya and Azuki. To complement these new sources of carbohydrates, highly organized net fishing of rivers, lakes and ocean shores in these areas brought in great volumes of essential protein. Collectively, these new methods of farming and fishing are inaugurated a human population boom dwarfing all previous expansions, and is one that continues today. By 5000 BC, the Sumerians had developed core agricultural techniques including large-scale intensive cultivation of land, mono-cropping, organized irrigation, and use of a specialized labour force, particularly along the waterway now known as the Shatt al-Arab, from its Persian Gulf delta to the confluence of the Tigris and Euphrates. Domestication of wild aurochs and mouflon into cattle and sheep, respectively, ushered in the large-scale use of animals for food/fiber and as beasts of burden. The shepherd joined the farmer as an essential provider for sedentary and semi-nomadic societies. Maize, manioc, and arrowroot were first domesticated in America as far back as 5200 BC.

The potato, tomato, pepper, squash, several varieties of bean, tobacco, and several other plants were also developed in the New World, as was extensive terracing of steep hillsides in much of Andean South America. The Greeks and Romans built on techniques pioneered by the Sumerians but made few fundamentally new advances. Southern Greeks struggled with very poor

soils, yet managed to become a dominant society for years. The Romans were noted for an emphasis on the cultivation of crops for trade.

During the Middle Ages, Muslim farmers in North Africa and the Near East developed and disseminated agricultural technologies including irrigation systems based on hydraulic and hydrostatic principles, the use of machines such as norias, and the use of water raising machines, dams, and reservoirs. They also used location-specific farming manuals, and were instrumental in the wider adoption of crops including sugar cane, rice, citrus fruit, apricots, cotton, artichokes and saffron. Muslims also brought lemons, oranges, cotton, almonds, figs and sub-tropical crops such as bananas to Spain. The invention of a three-field system of crop rotation during the Middle Ages, and the importation of the Chinese-invented moldboard plow, vastly improved agricultural efficiency. Another important development towards the end of this period was the discovery and subsequent cultivation of fodder crops that allowed over-wintering of livestock. By the early 1800s, agricultural techniques, implements, seed stocks and cultivated plants selected and given a unique name because of its decorative or useful characteristics had so improved that yield per land unit was many times that seen in the Middle Ages. With the rapid rise of mechanization in the late 19th and 20th centuries, particularly in the form of the tractor, farming tasks could be done with a speed and on a scale previously impossible. These advances have led to efficiencies enabling certain modern farms in the United States, Argentina, Israel, Germany, and a few other nations to output volumes of high quality produce per land unit at what may be the practical limit.

Indian agriculture began by 9000 BC through adoption of early cultivation of plants and domestication of crops and animals. Settled life soon

followed with implementation and techniques being developed for agriculture. The middle age saw irrigation channels reach a new level of sophistication in India. Indian crops were affecting the economies of other region of the world under Islamic Patronage. Land and water management system were developed with an aim of providing uniform growth in the economy. At present, agriculture is considered as the backbone of the Indian economy. More than 60percent of our total population earn their livelihood from agriculture. Besides, the growth of Indian economy requires a high degree of agricultural development to sustain a desirable rate of economic growth. Agricultural development would generally lead to more employment opportunities in the construction of small irrigation works, drainage system, contour bounding, terracing etc. It is well recognized fact that, the agriculture is the largest sector of economic activity and plays a crucial role in India's economic development by providing food and raw materials and employment to a large proportion of the population. Food grains play a major role in agricultural production, which constitutes 65 percent (CMIE, Dec 2008) of the gross cropped area of the country. Rice and Wheat among the cereals and Maize among the millets take a large share in the country's agricultural economy. Pulses are also grown in different quantities in different regions of the country.

However, the importance of development of agriculture in India is to strengthen the rural economy of the country has been emphasized by scholars, administrators since the beginning of the twentieth century. Indian agriculture in the pre-independence period was usually described as a gamble of monsoons. There had been a great deal of uncertainty about crop prospects, as monsoons played a decisive role in determining agricultural output and their failures resulted in widespread famine and misery. At the time of our

independence, the country had to depend on imports to meet the domestic demand for food.

After independence, particularly since 1951, the Planning Commission has initiated various programmes for development of agriculture and the sector was given highest priority so that the country can produce enough food to meet the growing requirement of its burgeoning population. In spite of the fact that agriculture was given the topmost priority on almost every Five Year Plan, the first two decades after independence witnessed a slow pace in the growth of agricultural production. From the base of 50 million tonnes in 1950-51, the food grain production had risen only to 75 million tonnes by mid sixties (Mander & Sharma, 1995) and till then the country had to depend on imports of food, which led to crisis of foreign exchange reserves and balance of payments. The introduction of new technology during the Fourth plan has changed the shape of Indian agriculture. The New Agricultural Strategies (popularly known as Green Revolution) had emerged as a big hope from the cropping session of 1966-67 and consequently India's production of food grains especially that of wheat and rice increased sharply. The total food grains production in 1950-51 was 51 million tonnes, which increased to 82.0 million tonnes in 1960-61, 108.4 million tonnes in 1970-71, 129.6 million tonnes in 1980-81, 176.4 million tonnes in 1990-91, 196.8 million tonnes in 2000-01, 233.9 million tonnes in 2008-09. This shows that the country has definitely achieved considerable improvement in agricultural production.

However, the new technology did not bring about a breakthrough uniformly in agricultural production in all the states of the country. Progress made by some states in this field has been better as compared to others. Such variations in production are also found in different districts of a particular

state. However, in a vast country like India with marked regional diversities in agro-climatic environment, resource endowment and population density is likely to be characterized by uneven development among regions. The performance of agricultural sector of eastern India, which is characterized by rain fed agriculture, had remained somewhat dismal. Uttar Pradesh and west Bengal have shown a strong growth particularly in rice and wheat since early 1980s. In Assam, the yield rates of some principal crops such as rice, wheat, jute, sugarcane, rape and mustard etc have increased slightly from 1960-61 to 2007-08. However, the productivity of major crops in Assam is far less than the national average.

North-Eastern region of India has got its definite identity due to its peculiar physical, economic and socio-cultural characteristics. The economy of North-Eastern India is also full of potentialities as different valuable natural resources are within the possession of this region. The region comprises of eight states namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura having foreign boundary with Bangladesh in the west, Myanmar in the east and Tibet region of China and Bhutan in the north. The region may be safely divided into two broad division—Plain region which comprise of 27 percent (i.e.68.96 lakh hectares) of the total geographical area of NER and Hill region which comprise of the states like Arunachal Pradesh Meghalaya, Mizoram, Manipur, Sikkim, Nagaland and Karbi Anglong and North Cachar hills of Assam. In the region the monsoons usually start in June and last until the end of October. Rainfall in the region is usually heavy due to its peculiar geographical position. The annual rainfall ranges from 70 inches in plains to 250 inches or more in the hills. The soil of NER is normally acidic in nature. There is much acidity on the soil of the hills whereas new alluvial soils

representing the lands on the river banks are less acidic. The phosphoric content of the upper Brahmaputra valley where tea is grown is good but it is low in the lower valley. There is high proportion of nitrogen and organic matters in the soil of hill areas in the region. In the hill states of the region, fruit trees respond quickly as its soil contain heavy clays with a high percentage of organic matter. The development of secondary and tertiary sector in the region is comparatively poor; more than 60 percent of the total population in the region depends on agriculture for its livelihood.

Assam is the North-Easternmost state of the Indian union and is located between 24°08' and 27°58'N latitudes and 89°42'E and 96°01'E longitudes. Geographically, Assam is surrounded by Bhutan and Arunachal Pradesh on the North, Nagaland and Manipur on the East, Meghalaya and Mizoram on the South and Bangladesh, Tripura and West Bengal on the West. Since independence, many changes have taken place in Assam geographically and in many other respects. At present, total land area of it is 78, 523 sq. kms. It accounts 2.4% of the total geographical area of the country. Demographically, Assam is the most populous state in the North East India. Economically, out of the eight North East States, Assam is comparatively more developed than the others. But compared to other states like Maharashtra, Tamil Nadu, Gujarat, Assam lags far behind in almost all economic spheres. The economy of the state is predominantly agricultural with a total cultivable area of 38.39 lakh hectare (2007-08) which constitutes 48.9percent of the total geographical area. Net shown area (more than once) is about 10.86 lakh hectares, which is about 28.3 percent of the cultivable area. The cropping intensity of the state is 139.4percent (2007-08) (Directorate of Agriculture, Govt. of Assam 2011). The average operational holding is 1.15 hectare only and more than 83 per cent of the farmer family is small and marginal farmers. The contribution of

the agriculture sector to the GSDP (at constant prices; 1999-2000 prices) was pegged at 22.85 per cent in 2007-08(Quick estimate) after steady decline from 32.24 per cent in 1999-2000. However, this sector continues to support more than 75 per cent population of the State directly or indirectly providing employment of more than 53 per cent of the workforce. The state is producing both food and cash crops. The main food crops in Assam include rice, wheat, pulses, potato, maize and the cash crops of the state are tea, jute, oil seeds, and sugarcane. The area under food crops in Assam increased up to 26.70 lakh hectare in 2008-09(NEDFI Databank), which accounts for nearly 65.6 percent of the total cultivable area of the state. Among various important crops in the state, the area under rice dominated the position, sharing about 92.2 of total food cropped area in 2007-08.¹

Geographically, Assam is divided into two valley ---- Brahmaputra valley and Barak valley. Sonitpur district is situated in the North bank of Brahmaputra valley. It is an important district from both economic and historical point of view. Sonitpur district lies between 92°16' to 93°43' East longitudes and 26°30' to 27°01' North latitudes. It covers an area of 5324 sq. km. Total geographical area covered by the district was only 6.8% of total geographical area of Assam. The border of the district attach with Arunachal Pradesh in the north, lifeline of Assam river Brahmaputra in the south, Lakhimpur district in the east and Darrang district in the west. The district has 3 Sub-divisions, 14 Development Blocks and 3 Agricultural Sub-division and 1693 villages. Agriculture is the main source of livelihood of the population of the district. More than 60% of population engaged in Agriculture. The main crops of the district are rice, tea, pulses, oil seeds (mustered), jute, and sugarcane. The economy of the district is predominantly agrarian and village

¹ Economic Survey, Assam 2008-09

centric. The total cropped area in the district is 146128 hectare, which is only 3.66% of total cropped area of the state. As per 2011 census total numbers of farmer families was 157118, out of which 37% is small farmers, 35% marginal farmers and 16% landless farmers and 12% big farmers. Tea is the important Cash Crops in the district. There are 88 tea gardens in the district covering 30.6% of total cultivable area under ADO Circle. The main crops cultivated in the district are rice wheat, jute, tea, sugarcane, maize, oilseeds, etc. There is the variation in yearly production of the main crops in the district. The yield rate of some of the crops in the district similar to the state average, but it is quite low in comparison to the leading states in India. For example, the yield rate of wheat in the state is quite low in comparison to the national average i.e. 2762 kg/hect. in 2001-02 and 2700 kg/hect in 2008-09 and in Punjab it was 4179 kg/hect. Similarly productivity of oil seeds is also low (750kg/hect) to national average of 925 kg/hect in 2008-09.

The agriculture, which is the main source of livelihood in the State as well as in the District are suffering from low productivity. The agricultural sector in the district has not developed significantly. Agriculture in Assam solely depends on vagaries of monsoons, which creates unexpected havoc on the agricultural production in the district as well as in the state. Except tea plantation, the annual crop cultivation, the small peasant families who are living in rural societies carry out especially food crops. But it is disappointing to note that they have been facing varieties of problems over which they have little control because of extreme lack of capital, technical know how and other resources. The important problems constraining agricultural development and innovation in the district may be summarized in four categories as --- natural, biological, techno-economic and socio-cultural. The natural problems include flood, drought, soil erosion, etc. The biological problems are pests and

diseases, unhealthy peasants and draught animals; while the problems such as surplus manpower, insignificant use of inputs like improved seeds, fertilizers, pesticides and insecticides, modern implements, irrigation, finance, inadequate market facilities and price incentives, adverse land policy and legislation, lack of agricultural research and inefficient extension services are included in techno-economic problems. Among the multitude of socio-cultural problems, conservative outlook of the farmers, ill fatalism, ignorance, illiteracy and antiquated organization of agriculture are found to be of great importance.

1.2. NEEDS AND SIGNIFICANCE OF THE STUDY

Agriculture is considered as the mainstay of the economy of Assam and thereby it stands as the backbone of the economy of the state. From the very early period agriculture and its allied activities like animal husbandry, forestry fishing etc. has been contributing the major portion to our state income. In 1950-51, agriculture and allied occupations contributed about 52.2% of the total state income. Although the share of agriculture to the state income has been declining gradually due to the growth of other sectors in the economy but the share remain still high in comparison to the comparatively developed states of the country. As for example, the share of agriculture to the state income has declined to 32.1% in 1970-71 and then increased to 44.2% in 1980-81 and then declined to 22.89% in 2008-09(quick estimate) as compared to that of 18% for all India.

In Assam more than two- third of our working population are engaged in agriculture directly and thereby depends for their livelihood. As per 2011 census, about 56% of the total working force is engaged in agriculture and allied activities. In 2001, cultivators alone constitute 52.4% of the total main

workers of the state and taking together the agricultural labourers, they constitute about 70.2% of the total main workers of the state. In an industrially developed states like Maharashtra, Gujarat, Tamil Nadu and West Bengal, the proportion of people depending on agriculture for earning their livelihood is much less in comparison to industrially backward state like Assam.

Another important role of agricultural sector in the state's economy is that it is the only major source of food supply and thereby providing regular supply of food materials to the increasingly growing population of the state. In the pre-independence period, Assam was a food surplus state. But in the post-independence period, the state is turned into a food deficit state due to high rate of population and a comparatively slower growth rate in the production of food grains. Total production of food grains in Assam has increased from 16.79 lakh tonnes in 1960-61 to 35.04 lakh tonnes in 2007-08 (Directorate of Economics and Statistics). Besides agriculture in Assam has been the major source of supply of raw materials to various important agro-based industries of the state. Tea plantation is the source of raw materials for the famous age old tea industry of Assam. Moreover, sugar industry, vanaspati mills, oil crushing mills, rice husking mills, sericulture etc. are also getting their necessary raw materials from the agricultural sector of the state. Besides agriculture can provide a market for industrial products as increase in the level of agricultural income may lead to expansion of market for various industrial production of the state.

The prospect of planning in Assam also depends very much on agricultural sector. A good crop always provides impetus towards a planned economic development of the country by creating a better business climate for

the transport system, manufacturing industries, internal trade etc. A good crop also brings a good amount of finance to the state government for meeting its planned expenditure. Similarly, a bad crop leads to a total depression in the business condition of the state, which ultimately leads to a failure of economic planning. Thus the agricultural sector is playing an important role in the state like Assam. Moreover, the backwardness of the economy of the state has also resulted from poor condition of the state's agriculture and similarly the prosperity of the state's economy still largely depends on agricultural sector.

Similarly, agricultural sector is also playing an important role in the Sonitpur District of Assam. Agriculture is the largest productive sector in the district and it provides livelihood of more than 60% of total population, but are suffering from low productivity. According to District wise physical target of rice under 20 point programme for the year 2007-08, the yield rate of rice is around 1500 kg/hect., whereas national average for year 2006-07 was 2125 kg/hect. The yield rate of wheat in the district is 1600 kg/hect whereas in Punjab it was 4179 kg/hac in 2006-07 and national average is 2700 kg/hect. for the same year. Similarly, the yield rate of rapeseeds and mustard was 750 kg/hect. whereas in national average was 925 kg/hect. in 2006-07. So, productivity of the major crops is quite low in comparison to other states and national average. There are different factors responsible for the low productivity of agriculture sector in the district. The average size of operational holdings is 1.27 hectares. Of the total operational holding 60% are of size less than 1 hectare. This small holding along with growing fragmentation of land stands in the way for modernization of agricultural productivity in the state. Agricultural productivity in the district is also affected by inadequate irrigation facility. Only 11.7% of total cropped area

was under irrigation facility whereas the state average was 17.17%, in Punjab 92.9%, in UP 68.7%, and in Bihar 49.4%. The farmers in the district are still following the orthodox method of cultivation. They are still relying on centuries old wood-plough and other traditional equipments, whereas some other states like Punjab, Haryana, Andhra-Pradesh, they replace their technology with modern technology. The scanty use of HYV seeds and fertilizer also affects the productivity of the district. The seeds replacement rate was below 5% in the district whereas 10% is the state average. In other states this rate is quite high. Similarly, consumption of fertilizer in the district was only 20.55 kg/hect. Consumption of fertilizer in national average, it was 104.5 kg/hect. in 2004-05 and 113.3 kg/hect. in 2006-07. Besides, inadequate credit facility to poor farmers in rural areas of the district also causes low productivity in agricultural sector. The percentage share of rural sector to total credit was only 10.6% in 2000-01. In contrast, the share of agricultural sector in total bank credit was 18.9% in Punjab, 23.2% in Rajasthan, 17.7% in Haryana and 17.9% in Andhra-Pradesh in 2000-01. Due to all these reasons the productivity of the agricultural sector in the district is quite low in respect to other region. So, it is an urgent need to develop agricultural infrastructure in the district so that the constraints regarding low productivity can be minimized.

From the above short analysis it becomes necessary to study the different aspects of constraints and prospects of agricultural development of the district. The study becomes quite significant because, no research work from the agricultural and economic perspective has been carried out in the district so far. Besides, the study is considered to be of great significance not only to the academicians but also to the planners for formulating agricultural development strategy for the district. It is our endeavor to study the

“Problems and Prospects of Agricultural Sector in Assam- A case study of Sonitpur District”. So it is hoped that this study will be of immense importance for all concerns.

1.3. OBJECTIVES OF THE STUDY:

The main objectives of the study are-

1. To study the existing scenario of agricultural sector of Assam as well as Sonitpur district.
2. To examine the productivity of the major crops of Assam in general and Sonitpur district in particular since 1991 (Post reform period).
3. To identify the factors affecting in adoption of modern and improved practices by farmers in the district of Sonitpur.
4. To evaluate the constraints and prospects of agricultural growth in the state as well as Sonitpur district.
5. To suggest how Agricultural development can be expedited.

1.4. HYPOTHESIS FOR THE STUDY:

The proposed hypotheses for the study are as follows-

1. Agricultural productivity can be increased by providing adequate infrastructure and input facility.
2. Agricultural Development in the District has been very much insignificant.
3. The size of land holding and their fragmentation retards efficiency of cultivation in the district.

1.5. RESEARCH METHODOLOGY:

The study attempts to examine the constraints and prospects of agriculture in the District at both micro and macro level. Hence, the study uses both primary and secondary data.

The macro level analysis is mainly based on secondary data. The relevant secondary data will be collected mainly from the Directorate of Economics and Statistics, Department of Irrigation, Directorate of Land Records, Block Development Offices and other Govt. Departments and agencies involved in agriculture and rural development. Land used and cropped data will be collected from the Revenue Circle and District Agriculture Offices. Besides, secondary data will be collected from Five Year Plan documents, journals and periodicals, publications of research articles and nongovernmental publications. On the other hand, population data can be collected from census reports of India.

The micro level analysis is mainly based on Primary data collected by carrying out field survey, interviewing on sampling basis. Data and information from sample villages are collected through questionnaire.

Growth rates are expressed in two forms “linear” and “compound”. In the study, compound growth rates have been estimated for area, production and productivity by fitting a semi logarithmic trend function of the form:

$$Y = e^{a+bt}$$

Where,

Y= Area/Production/Yield

a= Constant

b= Growth Rate

t= Time.

In order to measure variability, co-efficient of variation and standard deviation have been estimated for different period using the following formula:

(i) C.V= Standard Deviation/Mean

$$(ii) S. D = \left[\frac{\sum (X_i - X)^2}{N} \right]^{1/2}$$

Where, N=Total Number of Observation

X_i=Area/Production or Productivity

X=Mean of the Distribution

Further, variance of production is decomposed into its constituent sources viz. area variance, yield variance, area-yield co-variance and higher order interaction between area and yield to examine the source of instability.

In order to study inter-district variation in cropping pattern, percentages of area under principal crops across the state's district at different points of time are calculated. To minimize the influence of seasonal factors triennial averages of the area of principal crop/crop categories are calculated. Percentage change of area under different crops has been worked out.

1.6. PLAN OF STUDY:

The plan of study is based on the following tentative chapters.

Chapter 1: Introduction. This chapter has been exclusively devoted for the introduction of agriculture in the state and the district in particular, its background, needs and objectives etc. the discussion in the chapter is done on the following sub-heads:

- a. The background of the study.
- b. Needs and significant of the study
- c. Objectives of the study.
- d. Hypothesis of the study.
- e. Research methodology.
- f. Chapterisation.
- g. Periodicity of the study.
- h. Review of literature.
- i. Limitations of the study.

Chapter 2: Existing Scenario of Agriculture and Land Use Pattern in Assam as well as Sonitpur District. The present state of agricultural economy of Assam and district has been highlighted in this chapter. The climate, rainfall, quality of soil in the different agro-climatic zones, nature of cropping pattern, land holding system, land use pattern have been examined in this chapter.

Chapter 3: Cropping Pattern and Trends in Productivity of Selected Crops during Post Reform Period in the District. In this chapter variation of cropping pattern under the principal crops in the district and across the state's district has been discussed by using appropriate statistical technique. Trends in productivity of some selected crops also discussed in this chapter.

Chapter 4: Inter-District Variation in Productivity of Selected Crops in Assam. In this chapter variation in productivity of selected crops across the state's districts has been discussed. A comparative study with agriculturally developed state has been done in this chapter.

Chapter 5: Economic Reforms and its Impact on Agricultural Sector in Assam as well as Sonitpur District. This chapter has been exclusively devoted for the study of impacts of economic reforms adopted by Indian government under New Economic Policy 1991, on the agricultural sector of Assam and the district in particular. A comparative study of agricultural production of the state with that of some of the major agricultural state of the country has also been made in this chapter.

Chapter 6: Constraints and Prospects of Agricultural Sector in Assam as well as Sonitpur District. This chapter deals with the factors affecting agricultural productivity in the district and the state as well. It examines the degree of impact of these factors on agriculture and also analyzes the future prospects of the sector.

Chapter 7: Summary of Findings, Recommendations and Conclusions. This is the concluding chapter summarizes the findings of the study. A discussion on policy measure for stepping up agricultural productivity in the district and in the state has been discussed in this chapter.

1.7. PERIODICITY OF THE STUDY:

The study of constraints and prospects of agricultural sector in Assam is mainly concentrated on the agricultural productivity of Sonitpur District. The main emphasis of the study is given on the agricultural productivity and factors affecting the performance of main crops in the district during 2000-2010.

1.8. REVIEW OF LITERATURE:

Although agriculture is an important sector of an economy, importance of formal study on this sector attracted the attention of researchers as early as in the time of Adam Smith. All the classical economists were interested in

studying the growth behaviour of agriculture for explaining the growth of the economy. First attempt of agricultural study was made by Baker (1926), Johnson (1925-26), Jones (1928-30) and Taylor (1930). Their study devoted mainly to agricultural regionalization in order to establish the broad spatial pattern. In Indian agriculture, also many experts have made studies in this field and come out with findings of their own. The findings of these studies are summarized in the following few paragraphs.

Rao (1962) made a study on agricultural production and productivity in India and observed that during the period 1949-50 to 1960-61, agricultural production in India had increased by 36.4%, whereas increase in the average yield per acre was only 18.6%, the rest of the increase in production being accounted by an increase in the area under cultivation. The study revealed that during the period 1949-50 to 1960-61, acreage contribution was more than the agricultural productivity to the total agricultural production of the country. He further pointed out that increase in production by increase in acreage would not be available after the 2nd plan, so the yield per acre had to be increased as this would be the only solid and enduring base for the required progress in our agricultural production in the coming decade. He mentioned that one of the factors contributing to increased productivity during the period had been for the change in the cropping pattern, as the share of the higher yielding crops had increased with one significant exception, namely rice (1.12%).

Sen (1967) in his study on growth and instability in Indian agriculture concluded that certain amount of fluctuation was unavoidable in food grain production because of weather hazards. A study of the data of food grains production during the first twenty-four years of the twentieth century showed that with the rise in food grains production, the instability was also on the

increase. In the next twenty-four years food grain production showed a declining trend but less unstable. An analysis of the data for 30 years period, 1936-37 to 1965-66 also revealed that instability tended to increase with the rate of growth. Sen. suggested that the increased growth after independence up to 1965-66 was primarily based on the expansion of area under cultivation. He hypothesized that the new area being brought under cultivation was land of poorer quality and hence more susceptible to weather fluctuation. In the mid sixties, there had been no significant change in the output growth rate. The main source of growth had been the increase in land productivity, rather than continuing expansion in cultivated area.

Khan (1969) in his study on the growth in the production of food grains crops in Bihar during the period 1950-51 to 1965-66 concluded that the increase in production was due to increased productivity rather than due to expansion in acreage. The productivity per acre of all crops had increased during the period. He also revealed that during the period 1950-51 to 1965-66, the net area sown had been reduced by 3% but there had been an expansion of acreage under food grains crops mainly through increased intensity of cropping as well as shift in acreage from non-food grains to food grains crops.

Srinivasan (1979) studies the trends in agriculture in India for the period 1949-50 to 1977-78, showed that there had been a decline in the rate of growth of gross sown area in particular under non-food crops in the decade starting from 1967-76 compared to the fifteen years ending in 1964-65. However, the output of food crops and all crops grew more or less uniformly over the entire period with no evidence of either acceleration or deceleration since 1967-68. As wheat showed a faster growth in output and yield per unit

area in the later decade, it was concluded that there was no green revolution but it was wheat revolution.

Alagh and Sharma (1980) studied the growth of crop production for the period 1960-61 to 1978-79 by dividing the period into two equal sub period ,1960-61 to 1969-70 (period I) and 1969-70 to 1978-79 (period II). The study concluded that Green Revolution had an appreciable effect on the Indian economy since 1969-70 as the period II showed a higher growth rates for all crops at all India level as compared to period I. The study also revealed that growth in period II was more evenly spread than period I, but the variation around the growth was as large as the first period. Thus, the problem of fluctuations of agricultural output was an extremely serious one for the Indian economy.

Hazell (1982) made a study on instability in India's food grain production for the period 1952-53 to 1977-78 (omitting the drought year 1965-66 and 1966-67). By using variance decomposition method, he found that the lion's share (82%) of increase in production variance was due to increase in the co-variances of production between crops grown in the same and in different states. Furthermore, increase in inter-crop and inter-state yield co-variances was the dominant source of the increase in these production co-variances. He concluded that aggregate production instability was an inevitable consequence of rapid agricultural growth. So, policies such as storage and trade policies should be attempted to stabilize consumption.

Chakrabarti (1982) studied the growth pattern of food grain production in India from 1949-50 to 1975-76 by using cycle- adjusted time series data. He found that with the elimination of cycle, the series had three distinct Segment I from 1949-50 to 1960-61, Segment II: 1958-59 to 1966-67 and

Segment III: 1964-65 to 1975-76. The study revealed that the food grain production was stagnant during the second period. With the introduction of high yielding varieties with associated improved critical inputs, the growth rate in food grains showed a vertical jump from stagnancy at the beginning of the segment III. Subsequently it showed the same behavior as in segment I. thus, the study concluded that through technological breakthrough in the field of food grain production, the country had regained the growth pattern that was prevailing prior to the stagnancy period (segment II) i.e. prior to 1958-59.

Ray (1983) emphasized that for investigation of growth and instability, a model incorporating controllable man-made factors and uncontrollable weather factors in the specification was more illuminating and useful for policy purposes. He concluded that major causes for changes in the pattern of growth and instability in production were (I) an increase in the variability of rainfall and price and (II) an increase in the sensitivity of production to variation in rainfall and price.

Parthasarathy (1984) examined inter-district variation in the growth rates and fluctuation of agricultural production in Andhra Pradesh for the period 1955-56 to 1978-79. He found that the degree of instability in agricultural production was high in all the districts. It was higher for food-grains than for “all crops”. The post Green Revolution period showed a higher degree of instability. The district, which achieved higher growth rates were also subject to greater instability.

Johl (1984) was of the opinion that with reasonable effort and concerned, food grain production and for that matter, agricultural production can be considerably increased through an improvement in productivity. He opined that with the available production technology and the given cropping

pattern in different agro climatic zones of the country, there was tremendous potential for increasing productivity through the application of additional inputs and better management of resource use. Even if no improvement in production technology is assumed, there is an easy possibility of enhancing production by expanding by expanding the horizontal and vertical expansion of crop area. Further he mentioned five set of determinants for growth and development of agriculture- adequate and growing research capacity, extension education through matching delivery and recipient systems, adequate rural infrastructure to interact with socio-economic super structure, conducive agricultural policy environment and responsive and dynamic farming community, in addition, to the independent effects of these determination, have a high degree of interaction effect. Such a framework is pre-requisite for achieving rapid agricultural growth and development of any area, region and state of the country.

Dev (1985) made an analysis to study whether the new strategy of agricultural development, which was identified with HYV technology, had widened regional disparities in agricultural performance. He examined change in regional disparities for all crops in terms of output per area and output per capita (to take account of demographic pressures) and the interconnections between the two measures across agro-climatic region in late 1970s as compared to early seventies and sixties. He concluded that at the level of agro-climatic regions, rich regions are becoming relatively richer in terms of output per unit area. Though poor regions had not become poorer, they had remained relatively poor in terms of output per area. But they had become poorer in terms of output per capita.

Chattopadhyay and Bhattacharya (1986) in their study found that breakthrough in production condition through the evolution of HYV technology around 1965 had taken place in such a scattered and fragmentary way that they had little impact on the country as a whole. The analysis also mentioned that except for some commercial crops like, potato, sugarcane, the new technology in agriculture had no impact on inferior cereals and had little impact on superior food crops. By making a comparative study of growth rate of agricultural production for two states – Punjab and West Bengal, the study concluded that the effects of new technology on agricultural output of different varieties of crops were different in the different regions.

Ranade (1986) made a study on growth of productivity in Indian agriculture by extending late Dharm Narain's article on the sources of agricultural productivity during 1952-53 to 1972-73 in India. Dharm Narain had shown that in the period prior to the Green Revolution, the locational shift of crops had significantly contributed to growth along with the cropping pattern effect, while in the later period; it was the pure yield effects which was mainly responsible for growth. Ranade discovered certain anomalies in the data used by Dharm Narain. By correcting the data for those anomalies and extending the analysis for the period 1972-73 to 1982-83 and examining the locational shift effect to the growth of production of rice, he found that pure yield effect made substantially lower contribution in the post Green Revolution periods as compared to that in the previous period. The locational shift, in fact became important in the Post Green Revolution period as area under short duration rice varieties expanded in Punjab and Haryana.

Dantwala, (1987) remarked that agricultural performance during the period from 1949-50 to 1985-86 had been particularly impressive, especially

in food grains. In fact, the annual compound growth rate of major food grains had registered an increasing trend from 2.16 per cent during 1950-51 to 1967-68 to 2.62% during 1967-68 to 1983-84 and thereafter to 3.00% during 1973-74 to 1983-84.

Pal and Sirohi (1988) studied the sources of growth and instability in the production of commercial crops and changes in their pattern in India. Two time period viz. 1950-51 to 1964-65 and 1967-68 to 1983-84 were considered for the analysis. The study concluded that growth and stability in production of commercial crops were complementary rather than competitive processes in intensively irrigated regions. Instability was more prominent in disaggregate production at the state level and might be much higher at the farm level. As far as sources of variance are concerned, area variability contributed more than 60 percent to the variance of production in sugarcane and jute in both the periods. Conversely, yield variability accounted for nearly 75 percent and 54 percent of the variance of production in groundnut and cotton respectively. They laid emphasis on adopting yield stabilizing policies in groundnut and cotton and area stabilizing policies in sugarcane, jute and potatoes to stabilize production.

Bandopadhyay (1989) in his study found that during the period 1950-51 to 1984-85, the increase in growth rate in the districts in West Bengal was generally associated with instability in the production of rice. Such instability was significantly higher in the post Green Revolution period. In the same study, he found that for Punjab-Haryana, growth rate in production of wheat was higher in the pre Green Revolution as compared to the post Green Revolution period. However, there were definite signs of diminishing year-to-

year fluctuation in the wheat production with adequate irrigation facilities particularly in the districts Punjab.

Mitra (1990) examined the growth and variation of agricultural production in Maharashtra for the period 1956-57 through 1984-85 found that crop production at the state level as well as different regional level's particularly in case of food grains, remained more stagnant till around early 70's. It then picked up and continued showing an increasing trend until the beginning of 80's and, thereafter it again showed a decreasing trend till mid 80's. The study also showed that higher growth rates are associated with higher levels of instability in crop production. The study concluded that development of irrigation and associated new technology had not been effective in reducing the overall instability in the agricultural of the state and in the different regions of the state, especially in the case of food grains.

Kaushik (1993) examined the pattern of growth and variation of crop output in India in general and oilseeds in particular for the period 1968-69 to 1991-92. The study revealed that growth in food grains output was due to increase in productivity. However, for oilseeds the growth was due to the growth in area for the period 1968-69 to 1979-80. However, after 1980, its growth was also due to improvement in productivity. The study also concluded that fluctuations in yield would have to be controlled to bring about stability in output, as it was the major cause for the fluctuation in the output.

Mander and sharma (1995) made a comparative study of the performance of cereal crops in different states of India in the Post-Green Revolution period 1966-67 to 1988-89. The study revealed that during this period the production of major cereal crops namely wheat, rice and maize

increased significantly registering a growth rate of 5.96% for wheat, 2.85% for rice and 1.09% for maize. The major portion of increased production had come from the increased productivity. However, the progress showed by different crops in different states had not been uniform. Uttar Pradesh, Punjab, Haryana, Madhya Pradesh, Rajasthan, Bihar, Gujarat and Maharashtra were the major producers of wheat crops, producing nearly 97% of country's total production and constituting 95% of the country's area under the crop. In Assam production of wheat increased at the rate of 16.99% during the period, which was very small as compared to the country's production. However, in case of rice, Assam was one of the major rice producing states, where production of rice increased the rate of 1.47%.

Sawant and Achuthan (1995) in a study analyzed agricultural growth across crops and regions of India and came to the conclusion that during the period from 1967-68 to 1992-93 (post Green Revolution period), there had been a significant acceleration in the agricultural production which could not be attributed merely to a favorable weather. The role played by yield improvement in including higher output growth had been for more than that of expansion in area, indicating that process of growth had been technologically more dynamic too. It was also noticed that there had been an increasing shift of land from food grains to non-food grains in the latter part of the green revolution. Yet another distinguishing feature of agricultural scenario in the 1980s is that, with the wider dispersal of growth across crops and regions, agricultural growth has become more board-based in recent years.

Raghavan (1995), analyzed the trend rate of growth of crop since independence and concluded that wheat crop in India had exhibited a robust

growth for a considerably long period from the 1950's through two decades of the green revolution. This miraculous performance could be sustained because of an enclave based growth strategy that was pursued since the mid 60's, the main thrust of which included making available to the farmers in these enclaves of subsidized input-cum technology package, free access to marketing and storage of output and a tax free 'cost plus' price. It was noticed that after 1984-85, the production of wheat had started to decline. Therefore, if the wheat crop has to regain its earlier trend, the existing strategy has to be remodeled and targeted towards the weaker farm households, preferably outside the already saturated enclaves.

Singh, Baghel and Gupta (1997) examined the variability of food grains production and its growth rate change in India for the period 1949-50 to 1994-95. They found that during this period area under food grains had increased by 25 percent. Among the years, Kharif crops dominated the cropping scenario, which covered more than 60 percent. However, the productivity of Rabi crops was found higher than that of Kharif crops. The study also revealed that fluctuation in production was due to variation in yield performance. The same scenario of agricultural output for the state of Madhya Pradesh had been observed in the studies of et al (1996) and Pendse et al (1996)

Bhalla and Hazell (1997) attempted to project feed and food demand for India to 2020 under alternative income growth scenario. With the rise in per capita income, direct demand for food grains may not increase as rapidly as earlier, but the derived demand for food grains for feed increases and therefore the total pulses during the period under study. Since the climatic conditions of Assam were quite congenial for the cultivation of pulses, there

was an urgent need to increase productivity of pulses through adoption of modern technology, changing cropping pattern and improved crop management practices.

Rawal and Swaminathan (1998) studied the agricultural growth in West Bengal for 45 years (1950-1996) came to the conclusion that from a path of low growth during the first three decades of this period, in the 1980's agriculture moved to a path of high growth. They viewed that that such acceleration in growth occurred during and after major changes in agrarian institutions and land relations. This indicates the importance of changes in agrarian structure and agrarian reform for economic growth in a backward agrarian economy.

Kurosaki (1999) made a comparative study of the performance of agriculture in India and Pakistan, during the 20th century (1900-1995), on the basis of data that corresponds to the current border. He showed that the growth performance of agriculture in India and Pakistan was a stagnant one in the colonial period. After 1947 sustained improvement occurred in both countries although the performance was better in India than in Pakistan in per capita food production. However, the absolute level of this achievement in terms of per acre productivity and per capita production is not high compared with the international standard.

Ahmed (1999) reviewed the progress of food grains production and productivity in India during the post independence period and found that food grain production had gone up from 52 million tonnes in 1947 to about 192 million tonnes in 1995-96. Though since independence, growth and development of Indian agriculture was remarkable and its production and productivity increased sufficiently, it was far behind when we compare

country's productivity with that of developed countries of the world. Therefore, a lot of efforts are needed for raising the production and productivity of Indian agriculture.

In Assam little works have been done so far on agricultural sector. Mr. Goswami (1963) first attempted to study various aspects of agriculture in Assam. Mahanta and Neog (1968) analyzed the different aspects of agriculture and animal husbandry in Assam.

Das (1978) examined the growth rates and nature and extends of instability both for food grains and total agricultural production in state of Assam, Bihar, Orissa and West Bengal for the period 1950-51 to 1973-74. He found that during the period, the growth rate of agricultural production was falling over time in Bihar, while the growth rate in Assam, Orissa and West Bengal remained constant. The study also revealed that there was increasing instability in the production of food grains in the state of Assam, Bihar and Orissa. While food grains production remain stable in West Bengal, despite the fact that all these states had experienced positive growth rates of 1.75 %, 3.33%, 2.37% and 2.93% respectively during the period.

A.R.M Rehman (1978) made a study on agricultural marketing in Assam with special reference to autumn paddy and jute. S.K.Choudhury (1984) analyzed the agricultural development of Karbi Anlong district since independence. Nath (1984) also made a micro level study on agricultural development in Darrang district of Assam. Bhagabati (1984) analysed the agricultural development of Brahmaputra Valley in Assam. In 1985 K.K.Barman has made a critical study of agricultural productivity in Assam. M.P. Bezbaruah (1989) has analyzed the impact of technological transformation on agriculture in Assam.

Ahmed and Bhowmick (1991), in a study examined the nature of price, productivity and acreage response of some important crops in Assam for the period 1971-72 through 1986-87. The study concluded that acreage under principal crops in Assam is influenced mainly by the yield of crop, lag acreage and area under irrigation. Productivity was noted to be lower than the all India average. Moreover, farmers in this region were not price responsive. Therefore they laid emphasis on the use of improved seeds and post harvest technology in the cultivation of all the crops in the state.

Kalita and Baruah (1991) studied the growth and instability of three types of rice namely autumn rice, winter rice and summer rice for the state of Assam for the period 1951-52 to 1988-89. The study concluded that only in case summer rice, the growth rate was sizeable but instability had been found to the largest. Winter rice was found to be the most stable crop in the case of productivity. The growth rate in area and production of autumn and winter rice were found to be negligible due to slow development of irrigation facilities, gradual degradation of the nutrients status of the soil in state and increasing damage of standing crops by flood.

Barthakur and Bhattacharya (1999) had done a similar type of study for rice in Assam. The study concluded that there had been an increasing trend of production of rice in the state. But the growth rate of production had significantly declined during the post-green revolution period, indicating that Green Revolution was lacking in the state of Assam. To increase productivity, the study suggested adoption of improved technology, intensive use of existing resources and better extension services.

The discussion on agricultural development is not complete unless we throw light on the factors that influence the growth and stability of

agricultural production. Very few empirical studies were undertaken in the past to identify the factors explaining for slow growth and inter-temporal and inter-regional variation in agricultural growth. We now turn to make a summary of the factors responsible for slow growth and instability in Indian agriculture in view of the past studies.

Sharma (1964) was of the opinion that the agricultural development should be assessed not only by the trends in the agricultural production and productivity but also on various physical inputs like labour (human and animal), irrigation, fertilizer, improved seeds, extent of cultivated area etc.

Narain (1977) had analyzed that there are two types of explanatory variables contributing towards increase in productivity in Indian agriculture. According to him, the non price factors particularly, the growth of irrigation facilities, increased use of fertilizer and high yielding varieties of seeds had contributed towards the increase in yields of individual crop in different states.

Das (1978) in his study concluded that increasing instability in agricultural production particularly food grains production may be on precarious rainfall, extension of area under cultivation of inferior crops, use of fertilizer, inadequacy of irrigation facilities, absence of better farming methods etc.

Joshi and Haque (1980) estimated the relative role of technological, institutional and climatic factors in the determination of temporal growth and interregional disparities in India. They concluded that fertilizer consumption and area under HYV seeds were the important determinants of agricultural growth in a majority of Indian states. Next in order were time (indicating technical change) irrigation, rainfall and credit.

Bhatia (1980) showed that more investment on irrigation and greater extension efforts would have to be made for higher use of fertilizer and HYV seeds in backward states for balanced growth of agriculture in different states. More research efforts would also have to be made for accelerating the growth of productivity of pulse and making the sectoral balances in food grains.

Mehra (1981) highlighted the association between increase in yield variability and the use of high yielding varieties (HYV) and larger application of fertilizer per unit of land. Obviously, the area and yield variability result in the variability in agricultural production. The magnitude of variability had grown with the growth in agricultural production.

Barman (1985) mentioned that the backwardness of Indian agriculture is primarily due to institutional, technological and organizational constraints and the intensity of each of the constraints varies from region to region depending on localities, geographical environment, fertility of soil, rainfall, climate, weather, rural infrastructure etc.

Tamhane(1987) believed that the principal cause for low productivity in Indian agriculture was the deterioration of soil fertility owing to erosion and other natural calamities like flood hazards in some areas and drought conditions in other.

Prasad (1998) mentioned that for accelerating growth of food grains production in the coming decade, a multi pronged strategy would be needed with a focus on augmentation of water resources and evolution of improved varieties of seeds for rain fed as well as flood prone areas. This would need to be supplementation by adequate availability of fertilizer, pest management and a regime of incentive prices and timely supply of credit etc.

Singh & Singh (1999) made a comparative study of agricultural development performance of the state of Punjab and Bihar to analyze the factors responsible for imbalances in agricultural development. They concluded that poor land resource distribution, low irrigation potential, low application of fertilizer, low coverage of HYV seeds, and lack of proper infrastructural facilities contributed low agricultural progress in the state of Bihar as compared to Punjab. The analysis suggested that for the development of Bihar there was urgent need to concentrate on the use of fertilizer, high coverage under high yielding varieties, more use of electricity per hectare and increasing the area under irrigation and increase the credit availability.

Bhatia (1999) examined the relationship between infrastructure development and growth in agriculture concluded that there was significant scope for increasing the yield of food grains and agricultural income by improving the rural infrastructure.

From the above overview of literature, the following broad observations can be made on the constraints and prospects of agricultural production and productivity in Assam.

- The agricultural production mainly depends on two factors:
 - (i) Availability of arable land and,
 - (ii) Productivity per unit of land.

As the supply of land is fixed, productivity of land has to be improved in order to increase agricultural production. Thus, productivity of land has to be increased in order to augment agricultural output in the country for the coming decades.

- Productivity per unit of land can be increased with the best and efficient utilization of inputs like labour, water, fertilizer etc. applied to it.
- Agricultural productivity can also be increased by changing the pattern of production towards more intensive system of cultivation or by progressively changing cropping pattern from low value crops to high value crops.
- The Green Revolution had an appreciable effect on the agricultural production in India since 1969-70. But the effects of new technology on agricultural output of different varieties of crops are different in different regions.
- For balanced growth of agriculture in different states of the country, there is urgent need to concentrate on the use of fertilizer, high coverage under high yielding varieties, more investment on irrigation and greater extension efforts and increase the credit availability in the agriculturally backward states.
- Production variability is an inevitable consequence of rapid agricultural growth. For India, the post Green Revolution period showed a higher degree of production variability in a number of states. Further, variability was higher for food grains than other crops.
- Increased variability in agricultural production particularly food grains productions may be explained by factors such as dependence of agriculture on precarious rainfall, extension of area under cultivation of inferior crops , inadequacy of irrigation facilities, absence of better farming methods etc.
- Although since independence, growth and development of Indian agriculture were remarkable and its production and productivity

increased sufficiently, it was far behind when we compare country's productivity with that of develop countries of the world. Therefore the country will have to make extra ordinary efforts by way of investment in irrigation, rural electrification, scientific research and extension and other rural infrastructure for raising its production and productivity in agriculture in general and food grains in particular, in order to meet the demand of its fast growing population.

1.9. LIMITATIONS OF THE STUDY

As mentioned above, a few studies which are available on agricultural sector in the north-eastern region of India based on macro and micro level. In order to get adequate insight to the performance and problems of agricultural sector in the region, it would be necessary to go beyond the overall macro picture presented by aggregate statistics to carry out investigation at the micro level. The present study is an attempt to provide more comprehensive analysis of the agricultural growth and problems in the region by interfacing a macro picture describe by secondary data with the realities at the grass root, observe through a field survey in which farms and households are the units of observation. Since the agricultural sector is the unorganized sector of our economy, no records of year-wise production is maintained by farmers even by large farmers also. The primary analysis of the year-wise productivity of the sector is mostly depended on official or departmental data provided by the agricultural department of the government.

Thus to conclude, agricultural development is the basic precondition of sectoral diversification and development of the states' economy. An increasing marketable surplus of agricultural output is much essential in a poor state like Assam for increasing supply of food and raw materials at non-inflationary prices, widening domestic market for industrial products

through higher purchasing capacities in the rural sector, facilitating inter-sectoral transfers of capital needed for industrial development along with infrastructural development and increasing foreign exchange earnings through increasing volume of agricultural exports. Besides, agriculture in Assam is frequently affected by natural factors like flood, drought etc. It is necessary to develop different agricultural strategies for flood affected and unaffected areas. The study is very much important in this regard to achieve sustainable development in the sector.

CHAPTER II:

EXISTING SCENARIO OF AGRICULTURE AND LAND USE PATTERN IN ASSAM AS WELL AS SONITPUR DISTRICT

Location

Physiography

Climate and rainfall

Demographic Structure of the State and the District

Income and Agriculture

Soil

The Land Use Pattern in Assam and Sonitpur District

Cropping pattern

Cropping Intensity

Agricultural Inputs:

Seeds

Fertilizer

Irrigation

Credit

Agricultural Implements and Machinery

Infrastructure facilities and their impact on Agriculture of Assam

Crop Insurance

Productivity in Agriculture

CHAPTER II

Existing Scenario of Agriculture and Land Use Pattern in Assam as well as Sonitpur District

The economy of Assam is predominantly agrarian. About 99 per cent area of total land mass of the State is rural and almost about 50.0 per cent of the total land area is used for cultivation. The net cultivated area of the State is 28.10 lakh hectares (2008-09) of which 23 per cent area is either flood or draught prone and the per capita availability of net sown area comes to around 0.1 hectare. The average operational holding is 1.15 hectare only and more than 83 per cent of the farmer family is small and marginal farmers (2005-06; Agricultural Census). The contribution of the agriculture sector to the GSDP (at constant prices; 2004-05 prices) was pegged at 22.85 per cent in 2009-10(Quick estimate) after steady decline from 32.24 per cent in 1999-2000. However, this sector continues to support more than 75 per cent population of the State directly or indirectly providing employment of more than 53 per cent of the workforce.²

In view of such a crucial importance of this sector in the state economy, various agricultural programmes have always been assigned a high priority in each successive five year plan. In spite of this importance, agriculture in Assam has recorded tardy progress. Compared with other states of the country, the pace of development of this sector has not been up to the expectations. However, due to strategies adopted by the state government for attaining self-sufficiency in food grains, a positive indication can be seen in the form of growing awareness on the part of the state's cultivators for the use of improved seeds, manures etc.

² Economic Survey, Assam 2010-11

The economy of the Sonitpur District is also based on Agriculture. It has its own pace, trend, tradition and development process. Sonitpur is the trade center for Bomdilla, Tawang, Seppa and Itanagar of Arunachal Pradesh. Tezpur, Dhekiajuli, Rangapara, Biswanath Chariali and Gohpur are important trading centers in the district. Approximately 80 percent of the population depends on agriculture and its allied (primary sector) activities for their livelihood. Rain fed cultivation of single paddy crop still continues in most of areas of the district. However with the help of irrigation facilities like shallow tube wells, high yielding variety of seeds and tractors have made multiple cropping possible. Both Rabi and Kharif cropping is done in the district. Paddy, jute, sugarcane, tea, pulses and mustard are the major crops and tobacco, potato, vegetables and fruits like coconuts, banana, pineapples, oranges, and mangoes are subsidiary crops of the district. Rice is the staple food. The farmers mainly depend upon cultivation of wet paddy. Among the cash crops jute is grown on the low lying areas of the bank of the Brahmaputra.

The following paragraphs highlight the existing scenario from various aspects relating to agriculture of the state and the district economy.

2.1. LOCATION

Assam is situated in the North- Eastern region of India. It is located between the latitudes of 24°08'N and 27°58'N and the longitudes of 89°42'E and 96°01'(Govt. of Assam). The state has a strategic position with more than 400 kilometers of international boundary with Bangladesh and with important roads leading to the areas bordering Burma and China. To the north of the Assam are Arunachal Pradesh and Bhutan, to the east lie Manipur , Nagaland and a part of Arunachal Pradesh again and , to the south, are a number of

states, Viz., Mizoram Tripura and Meghalaya together with the international border of Bangladesh, and western part is bordered by west Bengal and also Meghalaya, Bangladesh and Tripura. The state covers a territory of 78438 sq.kms (Govt. of Assam 2011) of which roughly a fourth of it comprising rugged hills and the rest fertile plains.

After the reorganization of the North-Eastern Region in 1971, the state of Assam was constituted of eight plain districts, namely, Goalpara, Kamrup, Darrang, Lakhimpur, Dibrugarh, Sibsagar, Nagaon and Cachar and, in addition two hill district of Karbi Anglong and North Cachar Hills. This makes a total of ten districts. However, during the years, several new districts have been carved out from time to time of the old district to make a total of 27 districts at present. These districts are Dhubri, Kokrajhar, Bongaigaon, Goalpara, Barpeta, Nalbari, Kamrup Urban, Kamrup Rural, Darrang, Sonitpur, Morigaon, Nagaon, Lakhimpur, Dhemaji, Golaghat, Jorhat, Sibsagar, Dibrugarh, Tinsukia, Cachar, Hailakandi, Karimganj, Karbi Anglong, Baska, Chirang, Udalguri and North Cachar Hills. For administrative and revenue purposes, 27 districts are divided into 56 sub divisions with 155 revenue circles (Govt. of Assam 2011).

Sonitpur district is situated in the North bank of Brahmaputra valley. The District lies between 26° 30'N and 27° 01'N latitude and between 92° 16'E and 93° 43'E longitude. The state of Arunachal Pradesh cover the northern boundary of the district, in the south Morigaon, Nagaon, Jorhat and Golaghat district situated along with mighty Brahmaputra river. East boundary of the district is covered by Lakhimpur district and in the west Darrang district.

2.2. PHYSIOGRAPHY

The state of Assam can be divided into three broad physiographic units namely:

1. The Brahmaputra valley in the North
2. The Barak valley in the South
3. The Hills region that lies between these two valleys.

The Brahmaputra Valley comprises the whole of northern Assam with about 725km long and 80km wide on the average and consists of an area of 56339sq km. representing 72 percent of the total area of the state. The valley derives its name from the mighty river Brahmaputra, which runs from north east to west through a distance of 450 kms.

The Brahmaputra Valley can also be sub-divided into four main divisions depending upon its topography and climatic conditions and cropping pattern. They are:

- The Upper Brahmaputra Valley.
- The Central Brahmaputra Valley.
- The North Bank plains.
- The Lower Brahmaputra Valley

The Upper Brahmaputra Valley covers 1908249 hectares i.e., 20 percent of the total area of the state. This zone consists of Dibrugarh and Sibsagar districts excluding Majuli (Riverrine Island) in the upper Assam, on the south bank of the Brahmaputra. The districts are characterized by heavy rainfalls as they are situated in the humid sub tropical region and rainfall is distributed throughout the year. The soil of this region varies from sandy loam to clayey in nature. Rice is the main food grain crop and Kharif paddy

occupies most of the cropped land. Besides Kharif paddy, wheat, mustered, black gram, lentil, winter vegetables are also grown in this belt. Area under rabi crops and double cropping is insignificant. The major problems facing agriculture in this belt is that large areas are flood affected. Lack of proper irrigation facilities and prevalence of crop diseases are also widespread in this region. The use of pesticides and fertilizer is also low. The tea plantations occupy at least 60 percent of the total agricultural land. The region is economically better off than regions of the state.

The central Brahmaputra valley includes Nagaon and district accounting for 7.05 percent of the total state area. This zone is almost encircled by hills of shillong plateau on the east, west and south and is characterized by a plain topography. The soil of this zone varies from sandy to clay-loam. The soil of riverine char areas of this zone mostly consists of immature new alluvial soil of recent origin and towards the southern part; the soil is clay- loam in texture while in central part of it is a combination of new alluvium and old alluvium. The soil is generally acidic to near neutral in nature. Rainfall in this zone is relatively less except in the North Eastern part, as about 30 per cent of the area comes under the rain shadow belt. Towards the southern part rainfall does not exceed more than 1200mm in a year. This zone gets maximum rainfall during June to August. Rice is the main crop and Kharif crop includes Sali-paddy, bao-paddy, jute, sugarcane and oilseeds. Among these crops, Kharif paddy covers almost 78.11 percent of the total agricultural land. Ahu-paddy, rapeseed, mustard, wheat, arahar and sesamum are the main rabi crops grown in the region. About 3 percent of the land remains fallow due to chronic flood and non-availability of irrigated water during water during the rabi season.

The North Bank plains of Brahmaputra valley cover 18.25 percent of the total state area. The districts which lie in this part of the valley are Lakhimpur, Dhemaji, Sonitpur and Darrang district and also the riverine island of Majuli. The soil of this region is mostly old alluvium and new alluvium. Active flood plains consist of new alluvial soil and central belt comprises of old alluvium. Along the riverine tract the soil varies from weakly acidic to slightly alkaline in reaction. This region gets 50 percent of the total rainfall during the rainy season. Rainfall received during the pre-monsoon period is irregular and ill distributed affecting ahu crops frequently. In this region rice predominant among different food grain crops. Sali paddy accounts for most of the cropped area of the region. Deep water rice, bao grows in the low lying lands and jute grows extensively on the eastern side of the belt. Besides these, in this belt, crops like bodo rice, early ahu, rapeseeds, mustard pulses, oil seeds, wheat and vegetables are also grown. In Lakhimpur district tea plantation also occupies 20 percent of the total agricultural land.

The Lower Brahmaputra Valley comprises of the Kamrup, Goalpara and other lower Assam districts. This zone accounts for 25.68 percent of the total area of the state. Soil of the region consists of new alluvium on both the banks of the Brahmaputra and old alluvium towards the foot hills. The nature of the soil near the hillocks and foothills are mostly sandy to sandy-loam textured and acidic. The riverine char areas are essentially neutral in reaction. Laterite red soil is found in the southern hilly areas. The climate is warm and humid during summer. The region gets heavy rainfall during this period but the water is relatively cool with rather scanty rainfall. The Kharif crops, which cover most of the cropped area includes mainly Sali paddy, bao-paddy and jute. In the flood prone areas jute and bao-paddy are the dominant crops. During rabi season, mustard, pulse, wheat, early ahu and boro-paddy are

mainly grown. This zone has comparatively more intensive and diversified farming system than in the other zones. Fallow land is confined mostly to the flood prone areas. As the chronic problem of floods during the monsoon season seriously affects agriculture, the cropping pattern of the districts is primarily based on the extent of flood prone and flood free areas in the districts.

The Barak Valley comprises of Cachar district. Land surface of the zone is dominated by the hills and hillocks and the plain have a great deal of marshy lands. This zone covers 8.8 percent of the area of the state. The soil in this region varies from alluvial to laterite and the major areas have a clayey-loam to clayey texture. In the riverine tract of Barak and its tributaries, loam to sandy loam soil is found. Laterite soil is generally confined to the hill slopes and hillocks. Soil of the western part is of old alluvium type. This zone gets high rainfall during the rainy season. Apart from the tea gardens located in the hill slopes, the entire central alluvial tract is mono-cropped area, where winter rice (Sali paddy) dominates. Summer rice is also an important crop, which consumes most of the fertilizer used by the farmers. The cropping pattern shows a trend towards double and multiple cropping, but lack of irrigation facilities is a major constraint in this respect. The Kharif crop includes paddy, sugarcane, jute, cotton, maize; rabi crops include paddy, rapeseed, mustard, pulses and vegetables. Jhum cultivation is also practiced here which is confined to the hill areas. This region faces the devastation of flood almost every year.

On the other hand, the hill zone comprising of Karbi Anglong and north Cachar hill district covers 19.53 percent of the total state area. As most parts of the districts are covered with forests, only 10.1 percent of the total area is

used for cultivation. Soil is mainly laterite on the slopes and red loam in the valleys. On the other hand in the plain areas of Karbi Anglong, soil is mostly old alluvium. Jhum or shifting cultivation predominates in the area. Rice is the main crop grown, both in jhum cultivation and in the terraced and valley lands, where wet rice is grown. Rainfall is relatively less in this zone as it falls in the rain shadow belt. The hills also provide suitable condition for growing fruits and vegetables. The Assam Plantation Crops Development Corporation has undertaken plantation of coffee and rubber in the hill slopes of this zone.

Sonitpur district is located between mighty Brahmaputra River and Himalayan foothills of Arunachal Pradesh; which is largely plain with some hills. Brahmaputra River forms the south boundary of the district. A number of rivers which originate in the Himalayan foothills flow southwards and ultimately fall in Brahmaputra River. The central and southern portion of the main plain is dotted with hills and hillocks, especially near the Brahmaputra River. Important hills include the Agnigarh and the Bhomuraguri. The northern portion is made up of Forest Reserves and sparsely populated forest-villages. The region abounds in bio-diversity with evergreen and deciduous trees of several types. There is a National Park (Nameri), a few Wildlife sanctuaries (Sonai-Rupai & Bor-Dikorai), and a number of reserve forests (e.g. Chariduar, Balipara reserve-forest). In the extreme north of the region (Bhalukpong, Sijushah, Pabhoi, etc.), are hills and hillocks marking the starting of the Himalayan foothills. The main-plain of the district is slightly sloping from east to west, and is at an average altitude of 1800 feet from the mean sea level. There are number of River Island in Brahmaputra River, known as Chars in local parlance. They are generally sandy. Some Chars are large enough and fit for habitation and cultivation. Water bodies are in abundance in the District. There are lakes and ponds

dotting every part of the District. The major lakes are Rowmari, Dighali, Borsola, Rongapani and Dhandi. These water bodies along with the rivers and rivulets provide a lot of vistas for fishing in the District. Tourists can also do angling for pleasure, especially over the Bharalu River at Bhalukpong.

2.3. CLIMATE AND RAINFALL

The sub-tropical climate of Assam is characterized by high rainfall and high humidity and is worked by three dominant seasons, viz. winter (November to February), summer (March to May) and monsoon (June to October). Most of the rainfall in the state is received under the influence of the south-west monsoon between June and October. The Brahmaputra valley represents three broad climatic regions, viz. eastern, western and middle. The Mean Annual Rainfall (MAR) of eastern, western and middle regions are 245.2 mm, 1982.5 mm and 1527.4 mm respectively. The Mean Annual Temperature (MAT) is 23.50C, 24.50C and 24.0C with nine months having 20.0C in eastern, western and middle regions respectively.

The MAR of Barak valley is 4103 mm and MAT 24.90 C which are higher than those of the Brahmaputra Valley. In both Brahmaputra and Barak Valley, the natural water availability exceeds the water need during the rainy and summer seasons. This renders the soil moist for seven to nine months and therefore, the climate of these regions qualifies for udic moisture regime. During this period, the low-lying areas remain saturated and the ground water levels remain high. Such localized wet areas qualify for aguic moisture regimes.

Assam receives typical monsoon rains. The south-West monsoon rains start from the third week of June and they continue up to the middle of September. The state receives during this period about 180cm of rainfall on

the average. This constitutes about 80 percent of the average rainfall of the state. It is the period within which most of the agricultural operations including the production of Kharif crops, the harvesting operations of autumn rice, maize and jute are performed. Apart from that, sowing of winter rice, the main food crop of the state is taken up and completed.

Rainfall is almost absent during the winter season (December to February). The harvesting operations of winter rice, rape and mustard, winter vegetables and black gram are performed in this season. The pre monsoon period (March to May) rainfall is scattered and uneven, heavy participation takes place in the month of May, creating conducive climate for the growth of Kharif crops sown in the winter season.

As a facility of irrigation water is not adequate in the state, farmers have to rely on rain water for cultivation of crops. Hence timely and regular rainfall is essential for the crop season. But in Assam, sometimes heavy rainfall creates havoc in the form of floods and on the other hand sometimes farmers are unable to grow any crop due to drought condition. A consequent of the heavy rainfall during the summer months is widespread water logging and several rounds of flood in the plain districts of the state. The flood cause enormous loss of life, crop and property every year. The extent of damage varies from year to year depending on the fury and timing of the floods.

Sonitpur District falls in the Sub-Tropical climatic region, and enjoys Monsoon type of climate. Summers are hot and humid, with an average temperature of 29° C. The highest temperature is recorded just prior to the onset of Monsoon (around May-early June). Summer rain is heavy, and is principally caused from late June to early September by the moisture-laden South-West Monsoon, on striking the Himalayan foothills of the north. Such

rain is both a boon and a bane for the people. A boon, for it provides natural irrigation to the fields; and a bane, as it causes the rivers to overflow their banks and cause floods. Autumns are dry, and warm. It gets cooler as the months progress. Winters extend from the month of October to February, and are cold and generally dry, with an average temperature of 16° C. It gets quite chilling in late December and early January, on account of snowfall in the upper reaches of Arunachal Pradesh. Springs are cool and pleasant, occurring in the months of late March and April. Of course, during these months, flash rains and thunderstorms are at times caused by cyclonic winds, known in local parlance as Bordoichila. The following table provides the records of rainfall in the district in the last few years.

Table: 2.1

Season wise Rainfall in the District since 2004-05 (in mm)

Season	Normal	2004-05	2005-06	2006-07	2008-09
Monsoon	774.08	976.3	994.5	759.8	791.1
Post monsoon	228.24	348.5	164.0	143.8	188.0
Winter	50.85	43.2	33.8	96.2	32.7
Pre-monsoon	279.10	424.4	170.0	265.6	314.1
Total	1332.27	1792.6	1362.3	1265.4	1325.9

Source: Directorate of Agriculture, Government of Assam.

It is clear from the above table is that there is no uniformity in rainfall in the district over the years. Generally during monsoon the district receives heavy rainfall due to its geographical location. The normal rain fall in the district over the year is 1332.27mm, in which monsoon season receives

maximum shower i.e., 774.08mm and the winter receives minimum i.e., 50.85mm.

2.4. DEMOGRAPHIC STRUCTURE OF THE STATE AND THE DISTRICT

Assam has experienced persistently a high rate of population growth during the post independence period. As published result of population census, 2011, revealed that total provisional population of Assam as on 1st march, 2011 stands at 3,11,69,272 out of which 1,59,54,927 are males and 1,52,14,345 are female representing a decadal growth of 16.93percent during the last decade 2001-11. On the other hand, the percentage of the population of the country in the age group 0-6has declined to 14.47 in 2011from 16.87 percent in 2001.the provisional population of the country as a whole, as per Census 2011, stands at 121,01,93,422 out of which male and female population figured at 62,37,24,248 and 58,64,96,174 respectively. Assam provides shelter to 2.57per cent population of the country. The highest growth at the district level is found in Dhubri (24.40). The sex ratio, i.e. number of females per 1000 males in the state show an improvement from 935 in 2001 to 954 in 2011. The density of the population per square kilometer in the state has gone up to 397 as against 340 in 2001 with no change in the state geographical area of 78438 square kilometer. The density is found highest in Kamrup district. The effective literacy rate as per census 2011 for Assam comes to 73.18 percent while it is 78.81 percent for males and 62.27 percent for females.

According to the 2011 Census, the Sonitpur District has a population of 19,25,975, with a density of 365 persons per sq. km. The people here are not a homogeneous lot. Rather, they are a mosaic of ethnic groups, an admixture of

diverse types of people. The literacy rate of the district is 69.96percent with sex ratio of 946. The majority people inhabiting the District are Assamese. They are among the original inhabitants of the place, and the typical culture of the place grew with them. While a majority of the population follow Hindu religion, a significant portion of them are also Muslims. A few of them are also adherents of Sikhism, Christianity, and Buddhism. Prominent castes among the Assamese include Brahmins, Kalitas, Baishya, Koch, Ahoms, Yogis, the Scheduled Castes, et al.

The Nepali community is fairly dominant in the central and southern part of the District, especially in the Biswanath Chariali and Gohpur subdivisions. They speak Nepali, a language of the Indo-Aryan family. Of course, they use Assamese as a common language. While a majority of them follow Hindu religion, a significant portion of them, especially the tribes, are Buddhists.

The Bengali community came from erstwhile undivided Bengal, as officials and clerks of the British administration and the Tea Industry; and stayed back. Later, on account of the partition of India, people coming as refugees added significantly to the community. They speak Bengali, a language of the Indo-Aryan family. Of course, they use Assamese as a common language. They follow the Hindu religion.

The Adivasi people were brought by the British from Chotanagpur area and Orissa to serve as labourers in the Tea Gardens. In course of time, they assimilated themselves in the greater Assamese society, while retaining their basic cultural traits. The Jhumur dance is their contribution to the culture of Assam. They have adopted Assamese as their language, but have retained the language of their forefathers. They are Hindus and Christians.

The district has a considerable Muslim population. Majority of Muslims have emigrated from erstwhile East Bengal (present Bangladesh). They fill up a large portion of riverine areas of the district. Over the years they have adopted Assamese language.

The Mishing people live in a scattered manner in the northern part of the Naduar and Biswanath Circles, i.e. east of the Bhoralu River; and form a significant portion of the population of Gohpur sub-division. They generally speak the Mishing language, belonging to the Sino-Tibetan family. But a lot of them also speak the Assamese language as a common language. A majority of them follows the Hindu religion along with its variant forms. They have their own distinct culture, but many of them have also adopted Assamese culture.

The Bodo dominated areas include the northern part of Dhekiajuli, Chariduar, Naduar, Helem and Gohpur (Sadar) Circles. They generally speak the Bodo language, belonging to the Sino-Tibetan family. But the Assamese language is the common language. for them. While a majority of them follows Hindu religion along with its variant forms, a certain portion of them follow Christianity. The Bodos perform Bathow puja. They have their own distinct culture, but many of them have also adopted Assamese culture.

Other major tribes of the District include the Rabhas, Mechs, Nyishis, Garos, Adis, Apatanis, Lamas etc. Their population is sparse, and mainly confined to the foothills of the Himalayas near Arunachal Pradesh. They speak either their tribal language, or their variant of Assamese. Of course, they use Assamese as a common language. The Rabhas and Mechs follow Hindu religion; Lamas and Nyishis are Buddhists; Garos are Christians; Adis and Apatanis either follow their traditional form of religion.

2.5. INCOME AND AGRICULTURE

As predominantly agrarian state, Assam derives nearly 22.9(at constant prices; 2004-05 prices) percent in 2010-11(Quick estimate) of the state domestic product from agriculture and this sector extends employment opportunities to a major portion of the working population. Though income from other sector like industry, community services have began to increase steadily, still agriculture remains the main source of income for the state.

Table: 2.2

Sectoral Contributions to GSDP at constant (2004-05) prices

Sector/year	Primary sector	Industry	Services	Total GSDP
2004-05	1365566	1470509	2503697	5339772
2005-06	1400591	1418571	2702195	5521356
2006-07	1427368	1417783	2933101	5778253
2007-08	1467602	1427424	3161725	6056750
2008-09	1560458	1474138	3435093	6469688
2009-10	1626141	1510495	3855729	6992365
2010-11(p)	1725901	1539107	4243199	7508207

Source: Economic survey of Assam 2010-11.

The sectoral composition of GSDP both at current and constant (2004-05) prices has undergone considerable change during the past few years. In 2004-05, at constant (2004-05) prices the share of agriculture and allied sector was 26%, industry 27% and service sector was 47%. It is evident from the

above that over the years the share of agriculture and allied sector in the GSDP has declined from 26 percent to 22.9 percent by 2010-11. The industry sector has also shown a gloomy picture of downfall to 20 percent in 2010-11 from 27 percent in 2004-05 in the share to the GSDP, while the share of Services sector has progressed from 47 percent in 2004-05 to 57 percent by 2010-11. Thus, that the state economy has experienced a picturesque change over the periods the primary sector witnessed a shift to service sector and service sector has flourished very rapidly in the state's economy. The following table shows the per capita income of Assam at constant and current prices in comparison with national level since 1960-61.

Table: 2.3

Per-Capita Income of Assam and India (In Rupees)

Year	Assam		India	
	At current Prices	At Constant (1999-2000) Prices	At current Prices	At Constant (1999-2000) Prices
1960-1960	433	8769	359	7121
1970-1971	743	9351	742	8091
1980-1981	1673	9334	1784	8594
1990-1991	5315	10915	5440	11535
1999-2000	12282	12282	15881	15881
2000-2001	12803	12447	16688	16172
2003-2004	15487	13675	20895	18317
2004-2005	16900	13946	23199	19325
2005-2006	18396	14419	27123	20858
2006-2007	19737	15152	31198	22580
2007-2008	21290	15857	35820	24295
2008-2009	24195	NA	40605	NA
2009-2010	27197	NA	46492	NA
2010-2011	30413	NA	54527	NA

Source: Economic Survey Assam 2010-11.

As per estimates for 2007-08 the per capita income at constant (1999-2000) prices is Rs. 15857 as against Rs. 15152 in 2006-07 and Rs. 14419 in 2005-06. In terms of growth rate, it increased by 4.65 per cent in 2007-08 and 5.08 per cent in 2006-07. At current prices per capita State Income is worked out at Rs. 30413 during 2010-11 as against Rs. 27197 in 2009-10 and Rs. 21290 in 2007-08 and registered a growth of 11.82 per cent in 2010-11 and 12.41 in 2009-10.

Sonitpur is the trade center for Bomdilla, Tawang, Seppa and Itanagar of Arunachal Pradesh. Tezpur, Dhekiajuli, Rangapara, Biswanath Chariali and Gohpur are important trading centers in the district. Agriculture and its allied activities is the main source of the income and employment in the district. Secondary or manufacturing sector is not so developed in the district and whatever units are present, they are mostly located in the urban areas. Therefore, the contribution of agriculture and its allied activities i.e., primary sector is more in proportion in comparison to manufacturing sector. The contribution of service sector or tertiary sector is highest in the district in recent years in both current prices as well as constant prices. The following table gives the clear picture of the contribution of different sector towards GDDP and NDDP at current as well as constant prices.

Table: 2.4

District Income at Current and Constant Price (in lakh)

Gross District Domestic Product at Factor Cost 2008-09 (in lakh)		
Sectors	At Current Prices	At Constant (1999-00) prices
Primary	126384	86405
Secondary	52210	34927

Tertiary	147599	124231
Total	326193	245563
Per Capita GDDP (in Rs)	19435	14631
Net District Domestic Product at Factor Cost 2008-09 (in lakh)		
Primary	117882	83553
Secondary	44049	27504
Tertiary	134847	115376
Total	296778	226433
Per Capita NDDP (in Rs)	17683	13491

Source: Economic Survey of Assam 2008-09.

In the District, traditional economy provides a big source of income to the people for their livelihood. People rich in traditional activities, like and prefer their traditional job. Tribals and other weaker sections of the society are traditionally involved in pig rearing in the district. Pig is one of the most efficient feed converting animals having the shortest generation intervals high prolificacy and faster growth rate; all these traits are directly and positively correlated with the overall economy in production. The poultry production in district is mainly Desi bird oriented and is mainly in the hands of the rural people who rear mostly the desi or non desi type of poultry. Fishing in the district is a tradition rather than commerce, as 90.0 percent of fish products are imported. In the district fishery is quite popular commercial activity but it is also not developed to the desired level. River Brahmaputra and about 1000 number of ponds provide huge scope of fish production.

Handloom weaving is an important cottage industry that has been flourishing in Assam from ancient times. It still occupies a place of pride in every Assamese household which invariably maintains a handloom besides

other articles for spinning and weaving. It is universally practised cottage industry by rich and poor alike and has no stigma of caste or creed attached to it. Most of its products are of utility value. Muga Mekhala and Riha, decorated blouse piece, Eri chadar etc. are of some of the best specimen of handloom products which show the creative genius of the weavers in Assam that is called “Fabrics of delicate textures and designs”. Sericulture is the most important cottage industry not only of the district but also of the state of Assam. Extensively practiced during the agricultural off season as a subsidiary occupation, it occupies an important place in the rural economy of the district. Sonitpur has tremendous scope to develop sericulture.

Gold and silver smithy industry is very traditional one. The industry is mainly concentrated in the urban areas. The artisans are from families who have been traditionally associated with the industry. The indigenous jewelers exhibit considerable amount of skill and artistic refinement in making golden ornaments such as Dugdugi, Galpata, Jonbiri, Keru, Thuria, Gamkharu etc. Carpentry in the rural areas is more or less a subsidiary occupation. Village carpenters do all types of works like furniture making, house building, wooden agricultural equipments like plough, harrow, yoke etc. Among the traditional crafts the making of bamboo and cane products is perhaps most universally practiced by all sections of the people throughout the state. Its products have wide range of uses and as such commonly found in every household. This craft has been mainly a household industry and occupied an important place among the handicrafts of the district. It provides a subsidiary occupation of the cultivators and full time occupation to these highly skilled artisans who produce only fine decorative baskets, furniture and mats etc on commercial scale. Mainly it has been a rural industry that is commonly pursued by the agriculturists in their spare time as a subsidiary

occupation; but now a great professional and commercial approach can be seen in this business.

In Sonitpur a lot of small scale industries are established that engage a huge employment and make good attribute to the economy. The district is rich in forest resources and offers ample opportunity for the development of the timber industry like saw mills, plywood factories and manufacture of furniture fixtures. The other small scale industries are Rice mills, Flour mills, Oil mills, Soap factories, Ice factories, Wax factories, Incense factories, Engineering industries, and Printing press. Stone crushers, Hume Pipe Industries, Brick kiln etc. are found in a large number. Nezone Foods Pvt. Ltd., Madhabi Biscuits and Sonitpur Biscuits are good bakeries that produce good quality of cakes and biscuits. *T&I* (TRADE AND INDUSTRIES Pvt. Ltd, Tezpur) is a major industry of Sonitpur district. It manufactures tea machineries and exports to foreign countries.

2.6. SOIL

Broadly speaking the soil of Assam is acidic in character with a satisfactory content of nitrogen and organic matter. The hills soils are more acidic than those of plains. The soil of Assam has been generally classified into three types: (1) Alluvial soil, (2) Laterite soil and (3) Hill soil.

Alluvial soil is the most fertile and extensively distributed throughout the Brahmaputra valley. The alluvium soil is divided into new and old alluvium soils. The new alluvium varies mostly from clayey to sandy loam in texture and slightly acidic in reaction. It is deficient in phosphoric acid, nitrogen and humus but rich in lime and potash. This type of soil is found in the middle plains both in the north and south Brahmaputra. The old alluvium

is of more clayey composition and generally dark in colors. The soil of Sonitpur district is mostly alluvial soil. The plain of the district is very good for production of food crops. Due to presence rich minerals, the production of tea is also done extensively in the district. The production of tea covers more than 30.6percent of the total cultivable area in the district.

The alluvial soil is responsive to fertilizer and manures and capable of fixing nitrogen rapidly through leguminous crops. But the main defect of the alluvial soil is that it cannot retain moisture for a long time and so becomes physiological in fertile in the absence of rainfall. Wide variety of crops such as rice, wheat, sugarcane, banana, jute, oilseeds, pulses, tobacco and vegetables grow well in alluvial soil. Therefore, this soil area is densely populated and constitutes the rice bowls and jute belts of Assam.

The soil is generally deficient in nitrogen, potash, phosphoric acid and lime. But such soils are readily responsive to nitrogen and phosphate and hence capable of producing good crops. The soil is found in the hill slopes of Barak valley, south-eastern corner of Nagaon and in a small patch along the southern hill slopes of Sibsagar district. These are dark coloured fertile loams and can produce under irrigation excellent crops like cotton rice, maize, coarse millets, pulses, potatoes, vegetables and fruits especially orange and pineapple. The hill soils are found in the slopes and ridges of the hills of Karbi-Anglong and North-Cachar Hill.

2.7. THE LAND USE PATTERN IN ASSAM AND SONITPUR DISTRICT

Land utilization in a given region is one of the most important factors as the production and productivity of different crops mainly depend upon the

availability of land or the distribution of land among different crops. The following table shows the land use pattern of Assam for the years 1951-52, 1981-82, 1999-00 and 2009-10 and of Sonitpur district for 2009-10.

Table: 2.5

Land use pattern in Assam and in Sonitpur district (in thousand hectares)

Sl. NO.	Classification of Area	ASSAM				SONITPUR
		1951-52	1981-82	1999-00	2009-10	2009-10
1.	Total Geographical Area	8820.0	7852.0	7843.8	7843.8	532.4 (7.0)
2.	Forest	2820.0 (38.5)	1984.0 (25.3)	1931.0 (24.6)	1932.7 (25.0)	154.56 (29.0)
3.	Land put to non-agricultural use	245.0 (3.9)	914.0 (11.6)	1069.0 (13.6)	1081.0 (14.0)	165.02 (31.0)
4.	Barren and uncultivable land	1208.0 (13.1)	1541.0 (19.6)	1461.0 (18.6)	1453.0 (19.0)	21.89 (4.0)
5.	Land under misc. tree & groves	236.0 (3.8)	247.0 (3.1)	234.0 (3.0)	209.0 (3.0)	7.82 (1.0)
6.	Cultivable wasteland	380.0 (5.3)	104.0 (1.3)	80.0(1.0)	76.6(1.2)	0.25
7.	Net sown area	2873.0 (30.0)	2706.0 (34.5)	2734.0 (34.9)	2774.0 (35.36)	146.13 (27.0)
8.	Area sown more than once	312.0 (5.0)	754.0 (9.6)	1352.0 (17.2)	1210.0 (15.0)	92.05 (17.0)
9.	Total cropped area	2185.0 (35.0)	3460.0 (44.1)	4087.0 (52.1)	3984.0 (51.0)	238.17 (45.0)

Source: Statistical Hand book of Assam 2011

Note: figure in the brackets indicate percentage to total geographical area.

It appears from the above table that there has been an increase of area under non- agricultural uses, current fallow and net area sown in 2009-2010 as compared to 1981-82. This has resulted in a decline in the area under forests, cultivable waste land, barren and uncultivable land and fallow and other than current fallow. Due to increase in developmental activities in recent years, more and more land are being used for industrial, housing, transport, recreation purposes etc. this has resulted on increase in the area put to non- agricultural uses.

The proportion of area under forest has been declining during the period. The forest are covering around 25 percent of total geographical area during the present days which is inadequate to maintain the ecological balance of the state as per National Forest Resolution of 1952. The net area sown has increased from 2706 thousand hectare in 1981-82 to 2774 thousand hectare in 2009-2010.

The district covers only 7.0 percent of the total geographical area of the state. From the above table it is clear that the land use pattern in the district varies slightly in proportion to Assam. In 2009-10, total forest cover in the district is 29.0percent which is more than state proportion (i.e, 25.0percent). Similarly, net sown area in the district is less in proportion i.e, 27.0percent in comparison to state level which is 35.0percent of the total geographical area. Total cropped area covers only 45.0percent of the total area of the district while state average is 51.0percent.

Thus, from the above analysis of the pattern of land utilization in Assam and the district, it is observed that the scope for horizontal expansion of land under the present land-use pattern is very limited. Therefore, the

vertical expansion of land, through the intensive use of inputs embodied with advanced technology is a vital necessity in the state and in the district keeping in view the unprecedented growth rate of population in recent years.

2.8. Cropping Pattern

Cropping pattern means the proportion of areas devoted to under different crops at a particular point of time. By and large, the cropping pattern in Assam is similar to that of other states of the country. Food crops occupy an overwhelming proportion of the total cropped land. In 1950-51, out of the total cultivated area in Assam, 77.8 percent was under food grains and the rest, 20.2 percent was under minor crops, like vegetables, potatoes, cotton etc.

During the early years of planning, the state had a highly unbalanced cropping pattern with rice as the dominant crop. Therefore, during the long decades of planning the proportion of cropped land under food grains has remained more or less unaltered. In comparison to rice, increase of area under other food grains is not significant. Again non-food grains occupy a small segment of the total cropped area, which has increased marginally over the years. Roughly 52% of the total geographical area of the state is used for cultivation according to land utilization statistics (2010-11, Govt. of Assam). The scope for extension of cropped area is severely limited in the state because a good part of the land is covered by forests, hills, rivers and water-logged areas; besides industrialization, growing urbanization and increasing soil erosion.

Of the total cropped area in the state the area under food grains account about 79 percent in 2008-09. Among the important crops, the area under rice dominates the position occupying around 70 percent of the gross cropped area

and more than 90 percent of the total area under food grains (Govt. of Assam 2008-2009). About 90 percent of the populations of Assam consume rice. Generally, three varieties of rice are grown in Assam i.e., winter rice (Sali), Autumn rice (Ahu) and Summer rice (Boro). The winter rice is grown by transplantation method. There is another variety of winter rice locally called 'Bao', which is generally grown in low flood plains. This crop has the special ability to grow higher with the rise of water level during flood. It is sown by the broad cast method during February - March and harvested in November-December.

Table: 2.6

Area under principal crops in Assam (area in '000hectares)

Crops	1951-52	1981-82	1999-2000	2007-08	2008-09
Total rice	1547.38	2255.10	2645.87	2324.00	2484.00
Wheat	1.88	99.51	76.31	56.00	50.00
Maize	1.57	21.42	19.71	18.00	17.00
Other cereals	2.17	18.68	10.68	NA	5.00
Total pulses	81.17	115.94	119-6.18	105.00	114.00
Rape & mustard	117.90	221.41	286.24	235.00	226.00
Total oil seeds	199.07	337.34	402.42	255.00	265.00
Jute	123.38	106.97	73.55	60.00	60.00
Cotton	1.20	4.28	1.64	NA	1.00
Sugarcane	13.60	49.53	29.51	26.00	29.00
Potato	18.10	39.60	76.75	75.00	78.00
Tobacco	7.63	5.61	1.37	NA	NA
Chillies	3.55	10.51	14.42	15.00	17.00

Source: Statistical Handbook of Assam 2010.

Besides rice, wheat and maize are two other cereal crops in the state. But the areas under these crops are very small. Wheat was introduced in the state only in the middle of the sixties. After the introduction of high yielding varieties of wheat, the area under wheat has grown at fast rate and it has spread to all districts. Almost the entire area under wheat is covered by HYV seeds. Maize is mainly cultivated in the two hill districts Karbi-Anglong and N C Hills.

Pulses are also important food crops in Assam grown mainly in the district of Goalpara, Kamrup, Darrang and Nagaon. The major pulses grown in the state are Arahar, summer green gram and black gram, which are cultivated during the Kharif season. Other pulses crops like green gram, pea, lentil etc. are grown during the rabi season. The cash crops grown in the state of Assam are jute, mesta, sugarcane, rape and mustard. Among the fiber crops, jute plays an important position in fiber production. Rape and mustard are the major oilseeds crop grown in the state and account for about 80 percent of the total oilseed production in the state. With the large scale introduction of groundnut and sunflower and adoption of improved technology and inputs, good results in the production of oilseeds have been achieved. A new oilseed crop, Nizer has been introduced in Assam since 1997-08.

Sugarcane, another important cash crop is grown in a very limited area of around 35 thousand hectares and grown mostly in Kharif season. The other crops grown in the state are potato and other vegetables, fruits like banana, pineapple, orange, papaya, guava etc., chilies and different spices. Tea is an important crop in the districts in upper Assam and Cachar.

Cropping pattern of Sonitpur is almost similar with the state pattern. Around 80.0percent of total cultivable area is used for production of food crops and rice dominates the maximum proportion in the district. All the three types of paddy i.e., autumn, winter and summer are cultivated in the district and among which production of winter paddy covers maximum area of the total cultivable area of the district. The following table gives a clear picture of cropping pattern and yield rate of major crops of Sonitpur district in 2008-09.

Table: 2.7

**Crop statistics of Sonitpur District (cropping pattern and yield rate)
2008-09**

Name of crop	Area in hectare	Average yield (kg/hect)
Autumn Paddy	33000	1850
Summer Paddy (Ahu)	13023	2380
Winter Paddy	125040	2280
Sugarcane	3210	4200
Pulses	786	540.0
Jute	2390	2100
Maize	1000	700
Rape & Mustard	20785	750
Wheat	3000	1600
Potato	6760	26000

Source: Office of the Joint Director, Agriculture, Tezpur.

Cultivation of oilseed (rape & mustard) occupied the second position after the paddy in terms of area covered. The area covered by the production of oilseed was 20785 hectares in 2008-09 and productivity per hectare was 750kg which was much less than national average (i.e., 950kg/hectare). Potato, sugarcane and wheat also includes in main agricultural product of the district covering 6760, 3210 and 3000hectares respectively. But like other districts of the state the district has remained as mono-cropped area producing rice. Therefore, there is no significant variation of cropping pattern between the district and other regions of the state. Like the district, the state has remained as mono-cropped area, the produce being predominantly cereals and among cereals mostly rice.

2.9. CROPPING INTENSITY

One of the major features of Assam's agriculture is low cropping intensity. The traditional habit of keeping the paddy fields fallow till the next winter paddy crops still persists due to a variety of reasons. One of the main reasons is low irrigation facilities. Double or multiple cropping areas in the state is very low and compares unfavorably with other states of the country. In the year 1998-99, 45.9 percent of the net area sown is put under double or multiple cropping, giving a cropping intensity of 145.9percent compared to all India proportion of 135 percent. Crop intensity can be increased with extension of irrigation facilities, protection from flood and drought and other measures to ensure cultivation throughout the year. It may be noted that multiple cropping is higher in other north eastern state like Tripura, Manipur than in Assam. As the gross cropped area in Assam is more than 2.5 times of that in other states of the region, Assam can easily increase its crop

production by raising its intensity of cropping to the levels of Manipur and Tripura.

Net cropped area of Sonitpur district 146128 hectare and the area sown more than once are 92045hectares. Percentage of area under irrigation facilities (agricultural department) is only 11.7 which is slightly greater than all Assam average (i.e. 11.17%). A large part of the total cultivable area in the district is under mono-cropped. But cropping intensity of the district is 162.9 percent which is higher than state average.

2.10. AGRICULTURAL INPUTS

The department of agriculture, Assam has identified the following inputs (i) Quality seeds i.e. HYV seeds, (ii) Fertilizers/Manure, (iii) Irrigation, (iv) Credit, (v) Implements/Machinery, (vi) Technology, as the primary inputs needed for agricultural growth. These are inter-dependent and inter linked with one another. Timely available of these inputs in adequate quantity near the farmers fields is absolutely essential for agricultural production and productivity to rise.

2.10.1. SEEDS

Improved seeds are one of the components of the improved agricultural practices. In Assam, the multiplication and distribution of improved seeds started with the establishment of the rice experimental station at the Karimganj in 1921 and the Rice Experimental Station at Titabar in 1923. Although these stations released a few improved varieties of paddy, yet a systematic programme of multiplication and distribution of improved seeds started only since 1951.

In Assam, procurement, distribution and sale of seeds have been undertaken by the Assam Seed Corporation Limited. Except paddy and mustard seeds to some extent, the state is entirely dependent on other states for quality seeds. Presently, the Assam Seeds Corporation and the Department of Agriculture are producing certified seeds in the state of Assam. However, Private Seed Traders are being encouraged to take up seed and seedling production taken up with State Seed Certification Agency. The following table shows the area and yield of HYV of rice in Assam from 2000-01.

Table: 2.8

Area and yield of HYV of rice in Assam (area: hectare; Yield: kg/ hectare)

YEAR	Autumn		Winter		Summer	
	Area	Yield	Area	Yield	Area	Yield
2000-01	251514	1804	971857	2154	259471	2459
2001-02	250182	1720	920015	2308	259025	2445
2002-03	253295	1839	937474	2262	244905	2518
2003-04	216221	1778	929144	2263	221330	2220
2004-05	222290	1851	863494	2303	234000	2296
2005-06	234716	1866	950450	2281	265532	2192
2006-07	214980	1686	863052	1990	267045	2228
2007-08	223000	1958	984000	2152	278000	2509
2008-09	224022	1959	974742	2256	313629	2371
2009-10	240000	1858	1050000	2152	336000	2509

Source: Statistical Handbook of Assam 2010.

It is encouraging to observe that the use of HYV seeds, particularly in respect of paddy, is steadily gaining popularity in the state. As per information available from the agricultural department, the total HYV coverage under paddy was only 5.5 lakh hectares in 1980-81, which has increased to 16.26 lakh hectares during 2009-10. This gradual increase in area under HYV rice is mainly attributable to the productivity, which is much higher than the common variety of rice.

Total area under HYV of rice in the district in 2008-09 was 103546 hectares out of which high yielding varieties of Autumn, Winter and Summer Rice cover 21135, 68068 and 14343 hectares respectively. The area under HYV of rice increases year after year but productivity fluctuates due different reasons in the district. The following table shows the area and yield rate of HYV of rice season wise in the district.

Table: 2.9

Area and yield of HYV of rice in Sonitpur district (area: hectare; Yield: kg/ hectare)

Year	Autumn		Winter		Summer	
	Area	Yield	Area	Yield	Area	Yield
2003-04	15140	1825	66450	2258	8500	2371
2006-07	16465	1435	51350	1823	11810	2216
2008-09	21135	1850	68068	2280	14343	2380

Source: Compiled from Statistical Handbook of Assam.

The productivity of some other crops except rice i.e., wheat, pulses etc in the district is not so significant in comparison to national level. The

productivity of wheat (HYV) in the district in 2008-09 was only 1603 kg/hectare but national average was much higher (i.e., 2891kg/hectare).

2.10.2. FERTILIZER

Fertilizer is considered as one of the most essential inputs for increasing the agricultural production. However, consumption of fertilizer in the state is still low. Although an increasing trend is observed as regards consumption of fertilizer in absolute terms in Assam, its consumption in NPK is far below the level achieved by other states as well as national level. According to the data available from the state Agricultural Department, the total consumption of NPK fertilizer in the state was 213.94 thousand MT in 2007-08. The following table shows the season wise consumption of fertilizers in Assam.

Table: 2.10

Season wise Consumption of Fertilizers (in'000MT)

Year	Season	Consumption in terms of materials					Consumption in terms of Nutrients			
		Urea	SSP	MOP	DAP	Total	N	P	K	Total
2005-06	Kharif	77.19	51.09	35.42	37.61	201.31	42.28	25.48	21.25	89.01
	Rabi	94.43	66.92	45.53	41.37	248.23	51.34	29.74	27.32	108.40
2006-07	Kharif	95.53	40.95	32.24	29.08	197.80	49.08	20.19	19.44	88.71
	Rabi	93.47	65.06	50.63	38.92	248.08	53.44	30.89	30.55	114.45
2007-08	Kharif	92.88	62.55	44.14	37.34	236.91	49.44	28.52	26.49	104.45
	Rabi	195.41	113.23	92.43	74.83	475.91	103.36	54.61	55.97	213.94
2008-09	Kharif	103.67	49.36	46.66	31.16	229.85	53.30	22.69	28.00	103.99
	Rabi	119.81	37.77	46.39	48.60	252.57	61.70	29.85	31.15	122.69
2009-10	Kharif	111.73	51.07	44.53	26.26	233.59	56.12	20.78	26.72	103.62
	Rabi	139.58	59.38	65.91	38.47	303.34	68.75	28.58	39.54	136.87

Source: Economic Survey 2011, Assam

Both chemical and bio-fertilizer is used in the Sonitpur District in agricultural field to increase the productivity of crops. But average consumption of fertilizer is less in comparison of the other district of Assam. The use of some of the chemicals like plant protection chemicals, pesticides etc, is very insignificant. The following table shows the year-wise consumption and chemicals in the district in past few years.

Table: 2.11

Consumption of fertilizers and chemicals in Sonitpur district (in MT)

Fertilizers	2004-05	2005-06	2006-07	2008-09
Nitrogenous	1859	1908	1421	1813
Phosphates	1688	2264	1197	1507
Potassic	1172	1257	784	1050
Micro-nutrients	0.15	0.22	0.14	0.30
Bio-fertilizers	2.67lakh MT	3.56 lakh MT	1.32 lakh MT	3.81 lakh MT
Chemicals	Liquid-2120 lit powder-0.826	L-2335 lit P-0.828	L-1210 lit P-0.512	L-1812 lit P-0.716
Bio-pesticides	0.001	0.003	0.005	0.009

Source: Department of Agriculture, Sonitpur Assam.

The consumption of chemical fertilizers and other chemicals in the district in 2006-07 decreases in comparison to previous year. In comparison to other districts of the state, the consumption of fertilizers in the Sonitpur district is average in terms of both chemical and bio-fertilizer.

2.10.3. IRRIGATION

Agricultural development depends a great deal on the availability of adequate and assured irrigation facilities. Assured irrigation especially during winter months is an imperative need for the optimum utilization of chemical fertilizers and HYV seeds. Irrigation also enables diversification of crop. Unfortunately agriculture in Assam has continued to be determined by rainfall, which is unequally distributed through the seasons. Sometimes, heavy rainfall during monsoon causes floods, sometimes, long dry spell occurs even during the monsoon. Hence expansion of irrigation facilities to bring more areas under assured and controlled water supply has been the main element of strategy for development of agriculture in the state. This is also necessary to induce the farmers to change their existing cropping pattern and to go for a second crop in dry winter.

The state has the potential of 24.72 billion cubic meter of be-stackable ground water of which 21.01 billion cubic meter is not available for irrigation due to geographical restriction. As per assessment of the Central Ground Water Board, there is potential of 8.0 lakh Shallow Tube Wells (STW) in the state.

In spite of its location in the high rainfall area, the surface water is rarely utilized in Assam. The irrigation projects of the state are not providing expected impact. However, the Agriculture Department has so far been taken various schematic programmes and created 3.97 lakh hectares (10% of gross cropped area) of command area by installing 184653 nos. of STWs and 13707 nos. of LLPs.

Table: 2.12**Irrigation Schemes in Assam**

Department/Agency	Gross irrigation potential created up to 2007-08(in hectares)		
	Major and medium irrigation sector	Minor irrigation sector	Total
1. Irrigation Department	222652	339257	561909
2. Assam State Minor Irrigation Development Corporation Limited (ASMIDC)	Nil	149205	149205
Total	222652	488462	711114

Source: Economic Survey 2008-09.

Out of total geographical area of 78.44 lakh hectares, the gross cropped area of Assam is 40.87 lakh hectares. Against this, the ultimate irrigation potential i.e., the ultimate Gross Irrigation Potential (Annually Irrigable Area) has been estimated at about 27 lakh hectares, which constitutes 66.06 percent of the gross cropped area. Out of the estimated ultimate Irrigation potential of 27 lakh hectares, necessary plan has been taken up to irrigate 10 lakh hectares through Major and Medium irrigation projects and 17 lakh hectares through Minor Irrigation schemes (including ground water schemes).

Agricultural activity in the Sonitpur district is mainly rain fed. In recent years the irrigation department of state government takes some steps to create some irrigation facilities in the district. Irrigation potential created through government irrigation schemes cover 61533 hectares in total, out of which

28878 hectares under minor irrigation scheme and 32655 hectares under in major and medium irrigation in 2009-10.

Table: 2.13

**Crop-Season-Wise and Year-wise area irrigated in Sonitpur District
(area in hectare)**

Year	Year-wise gross irrigated area in Sonitpur District			Net Irrigated area
	Kharif	Rabi and pre-rabi	Total	
2002-03	3946.00	12.72	3958.72	3946.00
2005-06	2815.00	11.40	2826.40	2815.00
2006-07	11880.00	136.55	12016.55	11880.00
2007-08	3365.23	183.00	3548.00	3365.23
2008-09	1466.00	13.00	1479.00	1466.00
2009-10(p)	11981.00	15.50	11996.50	11981.00

Source: Compiled from Statistical handbooks of Assam (P-provisional)

In the above table, year-wise and crop-wise irrigated area is shown. There is no uniform trend seen in the year-wise as well as crop-wise irrigated area in the district. Irrigated Area under Kharif crops in 2009-10 is 11981 hectares which is much more in comparison to the year 2008-09 i.e., only 1466 hectares. Similarly the irrigated area under rabi crops in 2009-10 is only 15.50 hectares whereas in 2007-08 it was 183 hectares. Improved irrigation facilities will reduce the dependence of farmers on rain-fall for their farm activities in the district.

Moreover, to utilize the surface water from perennial sources in the state different practices of natural resource management are being taken up. Further rain fed area is also characterized by the degraded watershed, waste land inhabited by resource poor farm families. Special attention is needed

for the rain fed areas through different schemes for which the Govt. is taking up Watershed Development Programme in these areas.

2.10.4. CREDIT

Agricultural credit provides the necessary means to buy agricultural inputs and technology. However, it has been observed that the various institutions, which are associated with agricultural finance in Assam, have not been able to perform their roles satisfactorily. Despite urgent credit needs among the agriculturists, the demand for loans is observed low. Non adoption of improved methods of cultivation, traditional shyness to borrow loans from financing institutions and procedural difficulties are some of the impediments explaining low volume of credit sanctions/disbursement in the state.

As against the target of ₹652.83 crore of credit flow to agriculture and allied activities(including crop loans) under the annual Credit Plan for 2007-08, banks operating in the state has disbursed ₹566.70 crore as on 31st March 2008 achieving 87 percent of the target. On the other hand, target achievement in case of crop loans, which constitute only 21 percent of the total agriculture advances, was calculated as 61 percent during the year.

During the period 2003-03 to 2009-10, the flow of credit for agriculture and allied activities registered a growth rate of 41.66 percent (table 2.14). In case of crop loans, the growth was calculated as 42 percent. During 2009-10, the flow of credit for agriculture and allied activities had a significant growth of 55.7 percent over 2008-09. During the said period, the crop loans had a significant growth of 67.02 percent. The following table shows the credit flow to agriculture and allied activities under Annual credit Plan in Assam.

Table: 2.14**Credit flow to agriculture and allied activities under Annual Credit Plan**

Year	Agriculture & allied (in crores)	Crop Loans (CL) (in crores)	% share of CL to agricultural advances	Per capita crop loan (in rupees)	Crop loan per farmer family (in rupees)
2003-04	100.81	43.82	43	16.44	161
2004-05	243.76	79.46	33	29.81	293
2005-06	331.89	84.31	25	31.63	311
2006-07	468.91	79.44	17	29.80	293
2007-08	566.71	121.61	21	45.62	448
2008-09	523.38	203.12	39	76.20	749
2009-10	814.69	359.39	44	134.82	1307
CAGR*(%) 2004-2010	41.66	42.00	--	42.00	41.77
Growth % 2009-10 over 2008-09	55.7	67.02	--	76.9	74.5

Source: Economic Survey 2010-11, Assam. *Compound Annual Growth Rate.

The Kishan Credit Card (KCC) scheme was introduced in 1998-99 to cater adequate timely, cost effective and hassle free credit support to the farmers from the formal banking system. During the year 2009-10, 149822 numbers of KCCs were issued and ₹430.55 crores were sanctioned by the banks operating in the state. Since inception of the scheme, cumulatively about 6.30lakh KCCs have been issued in the state up to March 2010. Thus, the scheme could cover only 23.0 percent of the total farmer family of the state.

A low credit facility in agricultural sector is one of the important constraints of development of the sector in the district. Credit is the most

important input in agricultural sector for farm mechanization and modernization of agriculture. Most of the farmers of the district are marginal and subsistence level farmer. Their economic condition is so poor that they cannot think about adoption of modern implements in their farming activity. Now a day's Commercial Banks come forward under initiative of NABARD in the district to provide short and medium term financial assistance for farm mechanization and adoption of modern implements. But this effort is not sufficient to meet the current requirement of the district. Number of KCC (32743 nos. up to 2007) in the district is much less in comparison to other agriculturally developed districts of the state.

2.10.5 AGRICULTURAL IMPLEMENTS AND MACHINERY

One of the important modern inputs for agricultural growth is the improved farm machineries and implements like iron plough, tractors, harvesters, oil engines and electric pumps. The present availability of farm power in the state is 0.69HP (Economic Survey 2010-11) per Hectare (against national average of 1.20 HP hectares) of which mechanical power is around 50 percent. The growth of mechanism in Assam is slow. The Department of Agriculture has given a major thrust on farm mechanization. In order to boost up farm mechanization the department has so far provided 2361 Tractors, 10493 Power Tillers to the farmers and 62 Power Threshers. The Department has taken initiative for introduction of new farm machineries like Rotovator, Reaper/ Binder, Xero Tillage Planter and Combined harvester. Seven Rotovator have already been provided to farmers.

Farm mechanization is an important element of modernization of agriculture in the district. Farm productivity is positively correlated with the availability of farm power coupled with implements and their judicious

utilization. Proper agricultural mechanization not only enables efficient utilization of various inputs such as HYV seeds, fertilizers, plant protection chemicals and water for irrigation but also it helps in poverty alleviation in the district by making farming an attractive enterprise. In the district total number of tractors is 521 and 1263 nos. of sprayer machines available for the use of farmers but it is not sufficient. Total number of diesel operated tube wells in the district was 7988 up to 2009.

Improved agricultural implements and machinery enable efficient use of farm power and help farmers to derive optimum results out of the application of input. Improved implements create better field environment for plant growth at low cost harvesting, threshing machines speed up harvesting operations, thereby increasing cropping intensity besides saving food grains from sudden natural calamities at harvesting time.

Unfortunately, despite the attempts made for modernizing agriculture during the plan period, the most common agricultural implements being used by the cultivator is the power plough. In this context it can be pointed out that the average size of land (1.27hectares) in the state and in the district is not at all economical and convenient for mechanized cultivation.

2.11. INFRASTRUCTURE FACILITIES AND THEIR IMPACT ON AGRICULTURE OF ASSAM

Modernization of agriculture along with spread of literacy in rural areas is not possible without good infrastructure facilities like good road and communication system, adequate marketing facilities, bank services, assured supply of electricity, timely supply of inputs, adequate research and extension service etc. but in Assam, these services are not adequate as per the requirements of the state.

The roads of Assam in the rural areas are mainly Kutcha roads and in the rainy season the conditions of these roads are so deplorable that the timely supply of essential inputs to these areas become impossible. The poor means of transport and communication is a major cause of the underdeveloped marketing infrastructure of the state. The Govt. has attempted to establish regulated markets in rural areas but still the traditional market dominates the rural marketing system with all its malpractices. The weekly 'Hats' act as the main market places for the villagers and the middle men are also active as before in these 'Hats'. Improved agricultural marketing is an important condition for agricultural development of a particular region, but in Assam, the government is not successful to establish regulated market and to identify the malpractices prevalent in the trade.

There is a network of 224 regulated markets, 1175 rural and wholesale markets in the state. The Assam State Agricultural Marketing Board (ASAMB) has established 24 Regulated Market Committees, 20 Primary Market Yards, 204 Sub-Market Yards, 831 Rural Primary Markets and 344 Wholesale Markets. The regulated markets have been covered under AGMARKNET. Besides, 20 rural wholesale markets and 50 rural hats are being developed in 20 districts under the Assam Agricultural Competitiveness Project (AACP). 33 wholesale and rural markets for horticulture products are also being created under Horticulture Technology Mission.

Regular supply of electricity is also essential for the use of modern technology. Electricity is necessary to energize pump sets for irrigation. With the prevailing irregularity and uncertainty, it has become difficult to ensure irrigation even when pump set are available with the farmers. In Assam only 3 percent of the total electricity consumed has been used for agricultural

purpose compared to about 18 percent for all India. The state level consumption of electricity in the agricultural sector for irrigation and other agricultural work is only 6998 MWH during the year 2009-10 which only 0.21 percent of total consumption of electricity in the state.³

The widening network of schedule commercial bank has been playing a crucial role in mobilization of savings and investment in the state. According to the Quarterly Statistics of deposits and credit of Schedule Commercial Banks of Reserve bank of India, march,2008, the number of reporting bank offices of all scheduled commercial banks in Assam stood at 1317, of which, 403 were Regional Rural Banks. The average population covered per bank branch office (based on the census population 2001) in the state stands just above 20,000 in March 2008 which is however quite unsatisfactory in comparison to the all India average of 14,000 population during the same period.

An adequate infrastructure facility is the backbone of economic development of a state or a region. Total road length in the Sonitpur district is 2485 km in 2009-10 out of which 1969 km is rural road, 59 km urban road, 402 km major district road and 55 km state highway (Statistical Handbook of Assam 2010). Total number of bank branches in the district is 118 out of which 88 branches is the Schedule Commercial Bank and 30 Regional Rural Banks. Total deposits in the Schedule commercial banks are 1721 crores and credit provided by the banks is 819 crores in 2010. Similarly total deposits in the rural banks in 2010 are 229 crores and credit is 120 crores. Total outstanding credit in agricultural sector in the district in 2009 was 113.50 crores. Another important requirement of agricultural development is research

³ Economic Survey of Assam 2010-11

and extension services, which is very poor in Assam in comparison to its need.

2.12. CROP INSURANCE

The state of Assam has been experiencing flood in almost every year and around 4.75 lakh hectares is chronically flood prone area. Moreover, due to heavy deforestation around 0.94lakh hectare is drought prone. Therefore, risk hedging has become very important in view of high cost of agriculture and recurring natural calamities in the state.

Crop insurance is another area to help the farmers when there is crop damage due to natural calamities, severe infestation of pest and diseases in notified crops. Govt. of India launched a massive programme of Crop Insurance under the National Agricultural Insurance Scheme (NAIS). The National Agricultural Insurance Scheme unfortunately has not been able to provide desired solution to the risk hedging in the agriculture sector in the state. At present, NAIS is covering only 7 crops and some important horticulture crops like ginger etc. are not covered under NAIS. The scheme need to be modified and premium rates should be kept at the affordable level to make it more attractive to the farmers.

Although the scheme has covered 2.15 lakh farmers out of the total 27.12 lakh farmer family of the state, only 42000 farmers have been actually benefited. During 2006-07, the Government has released only ₹2.45 lakh keeping a balance of ₹82.46 lakh to clear the claims. During 2007-08, there is a provision of ₹4.20 lakh, out of which ₹57.00 lakh has been released to the Insurance Company.

2.13. PRODUCTIVITY IN AGRICULTURE

It is observed from above discussion that though state and the district is endowed with ideal conditions for attaining high agricultural productivity, the state has not attained high productivity level due to many impediments. Agricultural production has not kept pace with the growing population and its growing demand in the state. Till the early years of planning, Assam was a food surplus state. Excessive growth of population and slow rate of growth in agricultural production has turned the state into a deficit state. Moreover, the agricultural productivity in the state has shown a great degree of variability over the years. The following table shows the area, productivity and yield rate of major crops in Assam during the year 2008-09 and 2009-10.

Table: 2.15

Area, production and average yield of major crops in Assam (area in '000 hectares, production in '000 tones and average yield in kg/hectares)

crops	2008-09			2009-10		
	Area	Production	Av. Yield	Area	Production	Av. Yield
Autumn Rice	351	374	1084	346	335	982
Winter Rice	1773	2866	1641	1789	3214	1824
Summer Rice	360	768	2133	4	6	1554
Wheat	50	55	1090	60	65	1087
Maize	17	13	726	19	14	718
Pulses	114	62	545	119	66	558
Oil seeds	247	136	550	269	142	530

Source: Economic Survey of Assam 2010-11.

From the above table it is clear that the yield rate of major crops in the state is not consistent. It shows frequent ups and downs in the state due to vagaries of natural factors and inadequacy of agricultural inputs. As mentioned above the main crops cultivated in the district are rice wheat, jute, tea, sugarcane, maize, oilseeds, etc. There is the variation in yearly production of the main crops in the district. The following table shows the variation in the productivity of main crops.

Table: 2.16

Crops productivity during last 4 years in Sonitpur district (kg/hect)

Crops	Conditions	2004-05	2005-06	2006-07	2007-08
Paddy Summer	HYV – 100%	2371	2216	2006	2380
Paddy Autumn	HYV – 70%, Local – 30%, Irrigated – 40%	1825	1435	1100	1850
Paddy Winter	HYV – 70%, Local – 30%, Irrigated – 40%	2258	1823	1600	2280
Wheat timely	Irrigated – 70%, HYV – 100%	1150	1200	1200	1603
Wheat Late	Irrigated – 40%, HYV – 100%	840	785	712	837
Pulses K	Rainfed – 100%, HYV – 40%, Local – 60%	850	760	618	713
Pulses – R	Rainfed – 100%, HYV – 60%, Local – 40%	650	630	410	474

Source: Base line information (2008-09) Sonitpur District, Department of Agriculture.

Besides the crop mentioned in the table the productivity of some other crops like sugarcane in the district was 4200 kg/hect. In 2007-08 and it covers 3210 hectares of land, which is quite low in comparison to the yield rate of other district like Karbi Anglong and Lakhimpur. Jute, one of the important cash crops of the district cover 2390 hectare of land and yield rate was 2100 kg/hect in 2007-08.

Similarly, yield rate of maize and oilseeds in state are 700 kg/hect. and 750 kg/hect. in 2007-08 which is also quite low with respect to other states of India. The yield rate of some of the crops in the district similar to the state average, but it is quite low in comparison to the leading states in India. The yield rate of wheat in the state is quite low in comparison to the national average i.e. 2762 kg/hect. in 2001-02 and 2700 kg/hect in 2007-08 and in Punjab it was 4179 kg/hect. Similarly productivity of oil seeds is also low to national average of 925 kg/hect in 2007-08.

From the above discussion it is clear that despite of better soil quality and ideal conditions for attaining high agricultural productivity, the state as well as the district has not attained high productivity level due to many impediments in comparison to some of agriculturally developed states like Punjab, Haryana and Western UP.

CHAPTER III:

CROPPING PATTERN AND TRENDS IN PRODUCTIVITY OF SELECTED CROPS DURING POST REFORM PERIOD IN THE DISTRICT

Cropping pattern in Assam (1951 – 52 to 2010-11)

Cropping Intensity

Trend analysis of the productivity of major crops

Food production

Trend in production of major crops in Sonitpur District in 1999-2000 to
2009-10

CHAPTER III

Cropping Pattern and Trends in Productivity of Selected Crops during Post Reform Period in the District

Agricultural land use in Assam is characterized by a low Percentage of cultivable land, extraordinarily high percentage of Rice hectareage in the total area sown, low crop intensity and a low yield of crops per unit area. A large number of crops are grown in Assam such as rice, wheat, maize etc. Pulses, oil seeds like rape and mustard, castor etc. fiber crops such as jute, cotton etc. and a variety of vegetables and fruits. The share of area under different crops in a particular region during an agricultural year determines the cropping pattern of the region. The cropping pattern of a region reflects its state of agriculture development. A change in cropping pattern in right direction increases the rate of agriculture development of the region. The two most important ways of achieving agriculture development through changes in cropping pattern are:

- (a) Adoption of new crops and,
- (b) Intensification of cultivation of land through multiple cropping.

Considering the importance of cropping pattern in agriculture, this chapter makes an attempt to study the cropping pattern of Sonitpur District and the state as well. The study makes an analysis if there is any change in the cropping pattern in the state of Assam during the period 2001-02 2010-11. The study also includes change in cropping pattern over the years across the districts. Though a large variety of crops are grown in the district and in the state, time series data for all these crops are not available for all the years. Therefore, the study has been done on the basis of available data from

different sources. For the purpose of study, triennial average of the area of Principal crop/ crop categories have been calculated at five different points of time i.e. ending 1960, 1970, 1980, 1990, 2000 and 2010. This is done to minimize the influence of seasonal factors. Based on the share of each crop/crops categories to the total cropped area, percentage distribution of cultivated area by different crop / crops categories for each district as well as for the state as a whole had been worked out. To study the trends in productivity of selected crops in Assam, time series data for year-wise production and productivity of the district as well as of Assam has been used. To analyze the variation of area, production and productivity of the major crops of the district and Assam as whole co-efficient of variation (C.V) has been calculated.

3.1. CROPPING PATTERN IN ASSAM (1951 – 52 TO 2010-11)

There has been a very slow increase in area under different crops in Assam over the last six decades (1951-2010).The gross area under crops has increased from 22.0 lakh hectares in 1951- 52 to 39.99 lakh hectares in 2009-10. Table 3.1 depicts the share of area under major crops to the gross cropped area at five different time periods for the state of Assam.

Table 3.1

Percentage area under different crops in total cropped area of Assam

Crops	1959-60	1969-70	1979-80	1989-90	1999-2000	2009-10
Autumn Rice	19.1	21.2	20.1	18.2	16.7	9.0
Winter Rice	60.2	58.2	54.4	51.2	49.2	45.0
Summer Rice	0.5	1.3	1.3	1.9	6.6	10.0

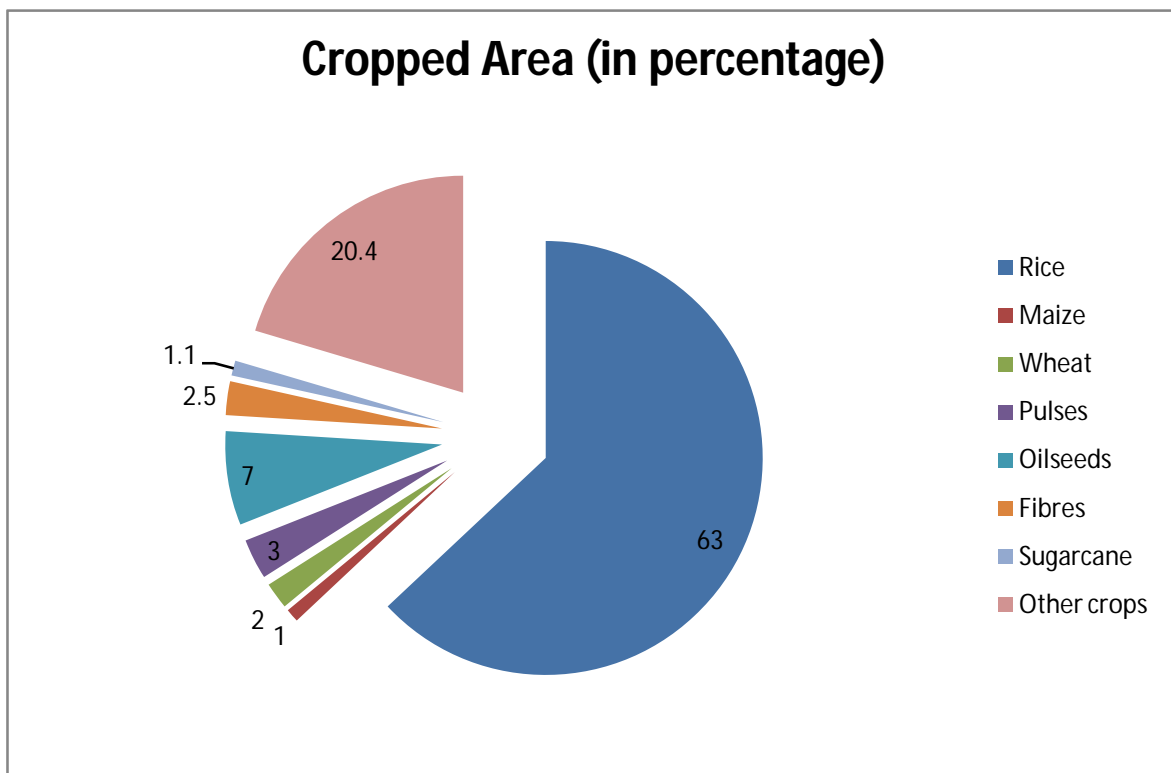
Total Rice	79.8	80.7	75.8	71.3	72.6	63.0
Maize	0.3	0.5	0.8	0.5	0.6	1.0
Wheat	0.2	0.3	2.4	3.0	2.4	2.0
Other cereals	0.1	0.2	0.7	0.3	0.3	0.3
Total cereals	80.5	81.6	79.6	75.1	75.8	68.0
Total pulses	3.8	3.7	3.4	3.7	3.4	3.0
Total foodgrains	84.3	85.4	83.1	78.8	79.2	71.0
Total oil seeds	6.2	6.0	6.6	10.4	8.9	7.0
Jute	6.1	5.0	3.6	2.9	2.3	2.0
Total fibre	6.5	5.6	4.1	3.2	2.6	2.5
Sugarcane	1.3	1.3	1.6	1.2	0.9	1.1
Potato	1.0	1.1	1.1	1.7	2.2	NA
Chillies	0.2	0.3	0.4	0.4	0.4	NA
Non food grains	15.7	14.6	16.9	21.2	20.8	NA

Source: Directorate of Agriculture, Khanapara, Assam, Economic Survey 2010-11 Assam.

It can be observed from the table that a significant feature of the cropping pattern of agriculture in Assam is that. Food grains occupy overwhelming portions of the total cropped area. In 1951- 52, 16.34 lakh hectares of area was under food grains, which have increased to 27.35 lakh hectares in 2009-10. The above table indicates that about 84.3 per cent of the total cropped area of the state is occupied by food grains in 1960, which is found to have remained stagnant at 85.4 per cent in 1970, 83.0 per cent in 1980 and then declined to 78.7 per cent in 1990, 79.1 per cent in 1999 – 2000

and 71.0percent in 2009-10. The crop-wise distribution area of major crops in Assam is shown for the triennium ending 2007-10 in the following pie chart.

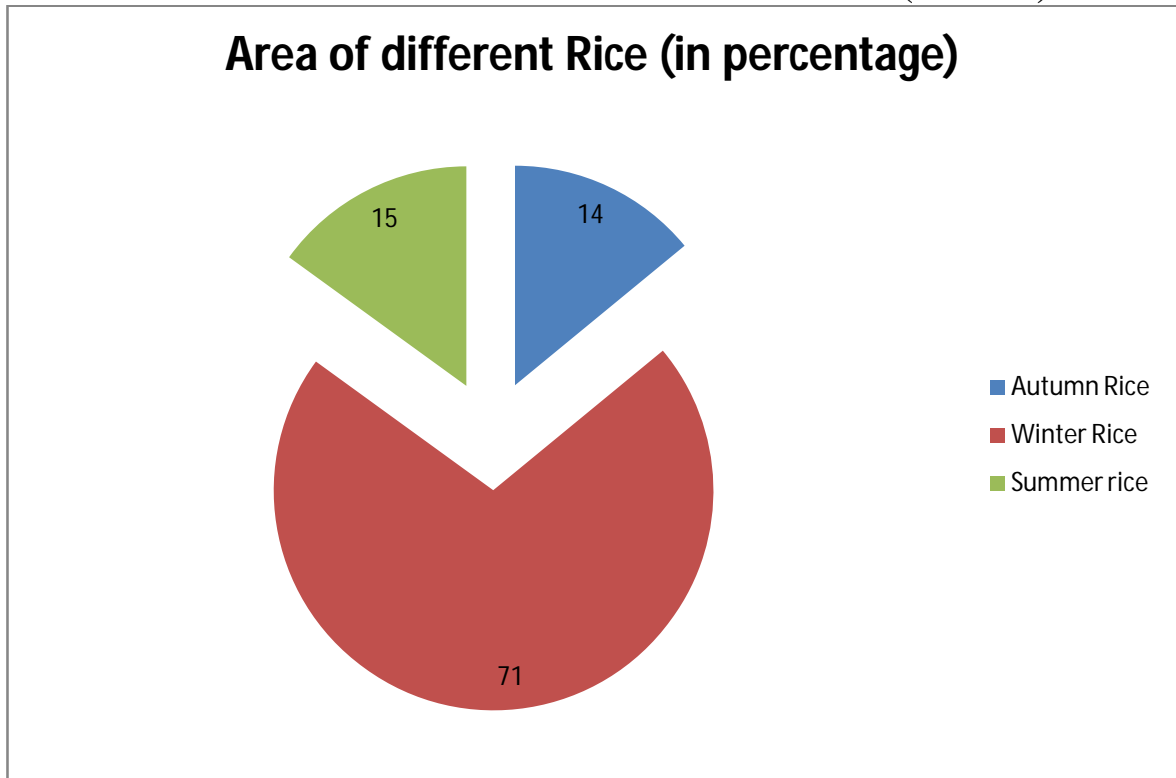
Figure 3.1
Area under different crops in total cropped area of Assam (2009-10)



It was noted that during the period of 2007-10 (triennium ending with 2009-10), out of the total cropped area of 28.10 lakh hectares under principal crops (excluding tea and other minor crops), 71.0 per cent was under food – grains, 7.0 per cent under oil seeds, 2.5 per cent under fibre crops, 1.1 per cent under sugarcane, 3.0 per cent under pulses and 20.4 per cent under potato and other crops such as tobacco, sweet potato, chilies etc. Total area under rice cultivation in 2009-10 in Assam was 25.30 lakh hectares, out of which 3.46 lakh hectares (14 percent of total rice cultivation) under autumn rice and 3.94 lakh hectares (15 percent) under summer rice and remaining 17.89 lakh hectares (71.0 percent) under winter rice. The following pie chart shows the

percentage distribution of area under rice among different rice crops in 2009-10 in Assam.

Figure 3.2
Area of different rice in total rice area of Assam (2009-10)



However, it is observed that after five decades, the percentage of area under food grains has marginally declined to 71.0 per cent in 2009-10. This has clearly demonstrated that agricultural land in Assam has been increasingly used for growing food grains in response to the food requirement of the rapidly growing population. The predominance of food – grains crops in the state agricultural fields indicate little commercialization of agriculture in Assam. Among others, the share of oil seeds and potato is found to have increased, while the share of fibre crops and sugarcane has declined in 2009-10. The following table gives clear picture about percentage of area of major food-grains since 1959-60.

Table 3.2**Percentage area of major food grains in total food grains in Assam during 1959-60 to 2009-10**

Crop	1959-60	1969-70	1979-80	1989-90	1999-2000	2009-10
Total rice	94.7	94.5	91.3	90.5	92	93.0
Maize	0.4	0.5	0.9	0.7	0.7	1.0
Wheat	0.18	0.36	2.9	3.8	3.0	2.0
Total pulses	4.5	4.4	4.1	4.6	4.3	4.0

Source: Directorate of Agriculture, Khanapara, Assam & Economic Survey 2010-11 Assam.

Among The food grains, rice is the most important food grain crops as it is the staple food of the people of Assam. As the soil, topography, rainfall and climate of Assam are conducive for cultivation of rice crop, it occupies about 70 per cent of the total cropped area but its share is more than 90 per cent of the total cropped area under food grains (Table3.2) Assam is one of the very few states of India, where farmers are dependent so largely on rice alone for their living (Das; 1983). The share of rice in the total cropped area of Assam was 80 per cent in 1959 – 60, has declined marginally to 75.8 per cent in 1979 – 80, further declined to 71.3 per cent in 1989 -90,72.6 per cent in 1999 – 2000 and 63.0 percent in 2009-10. The share of other crops such as vegetable, spices and fruits is found to have increased from a very negligible percentage to 5.7 per cent during 1959 – 60 and 1999 -2000.

In Assam, the soil, topography, rain fall and climate in general are congenial for agricultural activities mainly for paddy cultivation occupies 91.9 percent of the net cropped area and 65.9 percent of the grossed cropped

area in the state during 2009-10. As per final estimates, the average area covered for normal paddy cultivation during the year was 25.30 lakh hectares or about 92.5 percent of the total area under food grains in the state.

However, there has been a gradual decline in respect of area covered for cultivation of autumn rice, which has switched over to the summer rice due to its higher productivity and hazard risk. During period 2001-02 to 2009-10, the area under autumn rice cultivation recorded 30.24 percent decline over the period of nine years. During the year 2001-02, the area under autumn rice was 4.96 lakh hectares and declined to 3.46 lakh hectares during 2009-10.

Table 3.3

Area under crops in Assam during the period 2001-02 to 2009-10 (in lakh hectares)

Crop	2001 -02	2002 -03	2003 -04	2004 -05	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10
Autumn rice	4.96	4.64	4.41	4.36	3.98	3.79	3.54	3.51	3.46
Winter rice	17.15	17.49	17.69	16.36	17.07	14.98	16.47	17.73	17.89
Summer rice	3.26	3.27	3.19	3.11	3.15	3.12	3.23	3.60	3.94
Total rice	25.37	25.40	25.29	23.83	24.20	21.89	23.24	24.84	25.30
Wheat	0.72	0.69	0.70	0.64	0.50	0.60	0.56	0.50	0.60
Total pulses	1.18	1.11	1.14	1.08	1.00	1.07	1.13	1.14	1.19
Total food grains	27.55	27.48	27.41	25.82	25.97	23.82	25.18	26.71	27.35
Total oilseeds excl. coconut	2.99	2.87	2.89	2.68	2.35	2.60	2.57	2.47	2.69

Source: Economic Survey 2010-1, Assam.

The area covered under winter rice, the principal Kharif crop of the state, which was declined due to serious drought like situation experienced by the state during the year 2006-07 (14.98 lakh hectares) had increased to 16.47 lakh hectares during 2007-08 due to improvement of normal seasonal rainfall, weather condition and irrigation support. However, the area coverage under the crop further increased to 17.89 lakh hectares during 2009-10. The area coverage under the crop recorded 19.43 percent (i.e, 2.91 lakh hectares) increased during 2009-10 compared to the area under the crop during 2006-07. The area coverage under pulses and oilseeds in 2009-10, as final estimates, has been expected to reach the level of 1.19 lakh hectares and 2.69 lakh hectares respectively against 1.14 and 2.47 lakh hectares in 2008-09. It is evident from the table 3.3 that while the area under pulses has been gradually increasing from 1.0 lakh hectare in 2005-06 to 1.19 lakh hectares in 2009-10, the area coverage under oilseeds recorded moderate increase from 2.47 lakh hectares in 2008-09 to 2.69 lakh hectares in 2009-10 irrespective of overall scanty rainfall experienced during the rabi season of 2009-10.

Total geographical area of Sonitpur district is 532400 hectares. Out of which gross cropped area occupies only 45.0 percent (i.e, 241227 hectares). Net cropped area in the district is 147982 hectares which is only 28.0 percent of total area. Cropping pattern of Sonitpur is almost similar with the state pattern. Around 80.0 percent of total cultivable area is used for production of food crops and rice dominates the maximum proportion in the district. All the three types of paddy i.e., autumn, winter and summer is cultivated in the district and among which production of winter paddy covers maximum area of the total cultivable area of the district. Total rice production in the district occupied maximum proportion of the total cropped area i.e., 171063 hectare in 2008-09 and 167422 hectares in 2009-10. The following table shows the

cropping pattern and yield rate of major crops of Sonitpur district during 2008-09 and 2010-11.

Table: 3.4

**Crop statistics of Sonitpur district (cropping pattern and yield rate)
2008-09 and 2010-11**

Name of crop	Area in hectare		Average yield (kg/hect)	
	2008-09	2009-10	2008-09	2009-10
Autumn rice	33000	24472	1850	1050
Summer rice (Ahu)	13023	19750	2380	2720
Winter rice	125040	123200	2280	1850
Total rice	171063	167422	2170	1873.3
Sugarcane	3210	2500	4200	4400
Pulses	786	10030	540.0	727
Jute	2390	2900	2100	2400
Maize	1000	NA	700	NA
Rape & Mustard	20785	26243	750	600
Wheat	3000	3157	1600	1100
Potato	6760	7881	26000	12000

Source: Office of the Joint Director, Agriculture, Tezpur, Statistical Handbook of Assam 2010

It is worth mentioning that, cultivation of oilseed (rape & mustard) occupied the second position after the paddy in terms of area covered. The area covered by the production of oilseed was 20785 hectares in 2008-09 and 26243 hectares in 2010-11 and productivity per hectare was 750kg and 600kg respectively which is much less than national average (i.e., 950kg/hectare).

Potato, sugarcane and wheat also include in main agricultural product of the district covering 6760, 3210 and 3000 hectares in 2008-09 and 7881, 2500 and 3157 hectares in 2010-11 respectively. But like other districts of the state the district has remained as mono-cropped area producing rice. The total mono-cropped area in the district is 71884 hectares which is 30.0 percent of the gross cropped area.

Table 3.5

Percentage of area under major crops to gross cropped area of the district in 2010-11

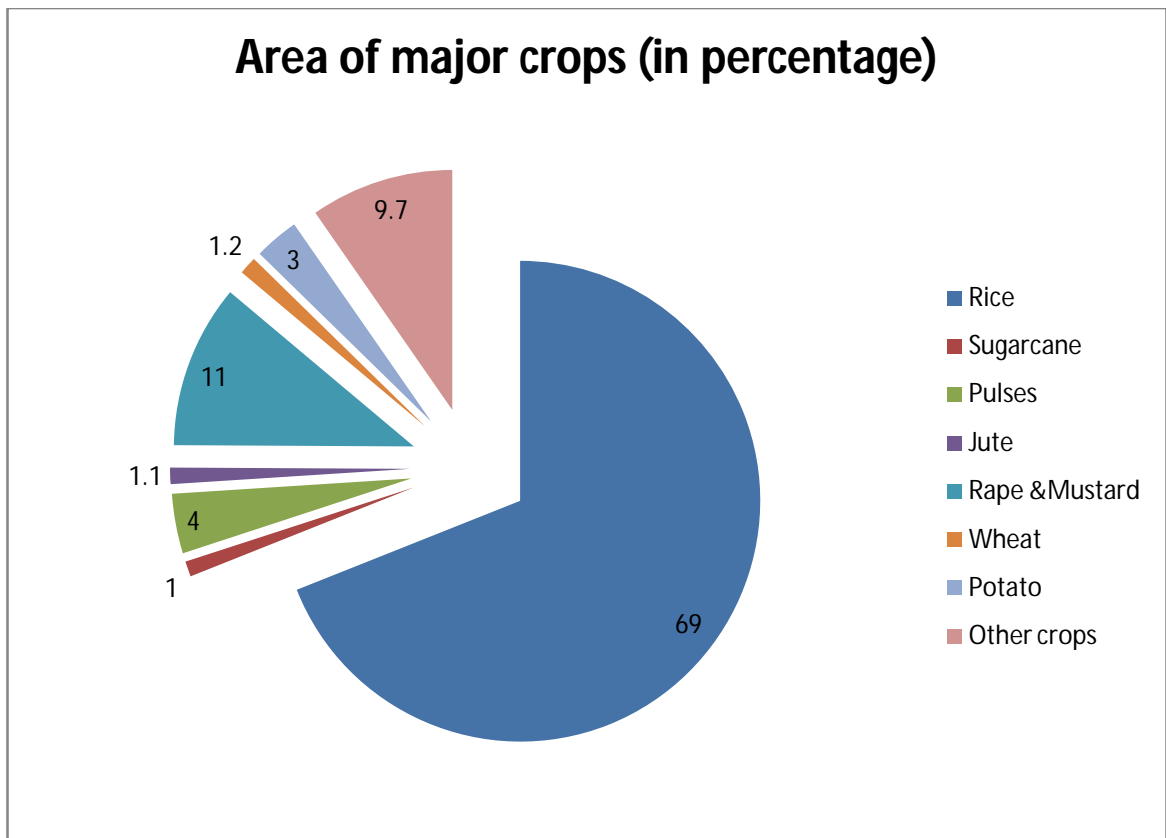
Name of crop	2008-09		2010-11	
	Area	Percentage	Area	Percentage
Autumn rice	33000	12.0	24472	10.0
Summer rice (Ahu)	13023	5.0	19750	8.0
Winter rice	125040	47.0	123200	51.0
Total rice	171063	65.0	167422	69.0
Sugarcane	3210	1.4	2500	1.0
Pulses	786	0.3	10030	4.0
Jute	2390	1.0	2900	1.1
Maize	1000	0.4	NA	NA
Rape & Mustard	20785	8.0	26243	11.0
Wheat	3000	1.4	3157	1.2
Potato	6760	3.0	7881	3.0

Source: Office of the Joint Director, Agriculture, Tezpur, Statistical Handbook of Assam 2010.

The percentage of area under total rice marginally increases from 65 percent in 2008-09 to 69 percent in 2010-11 to the gross cropped area of the district. The significant change is that the percentage of area under autumn rice decreases in to 10.0 percent in 2010-11 from 12.0 percent in 2008-09 and percentage of the area under summer rice increases to 8.0 percent in 2010-11 from 5.0 percent in 2008-09. The following pie chart shows clear picture of crop-wise distribution of land in percentage to gross cropped area.

Figure 3.3

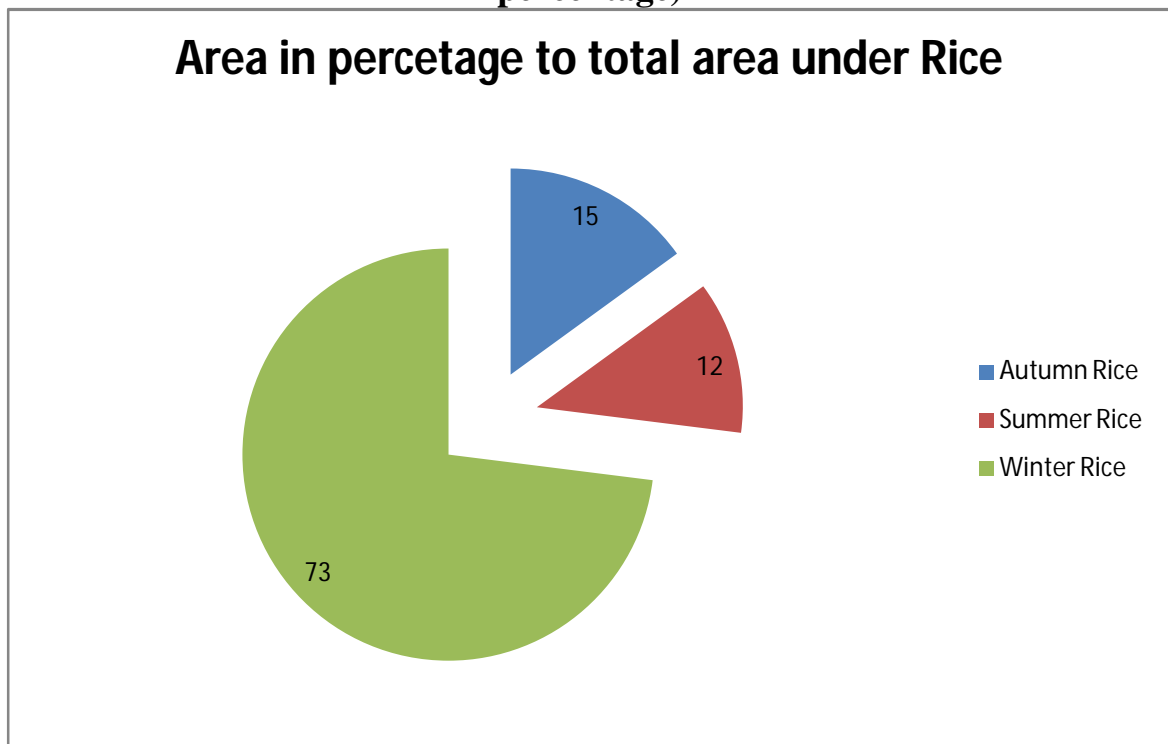
Area of major crops to the gross cropped area in 2010-11 of the district (in percentage)



Rice dominates the major share of the area like other districts and the state as a whole. It covers 65.0 percent of the gross crop area in 2008-09, which increases to 69.0 percent in 2010-11. Like the state, in the district three

types of rice i.e, autumn, summer and winter are cultivated and out of which winter rice dominates the share of land out of total area under rice. The area under autumn, summer and winter rice in percentage to the total area under rice production is 15.0, 12.0 and 73.0 percent respectively in 2010-11. The following pie chart shows the distribution of area under different rice crops to the total area of rice in percentage of the district.

Figure 3.4
Area under different rice crop to total area under rice in 2010-11 (in percentage)



As mentioned above, there are three varieties of rice are grown in the district as well as in the state as a whole. They are winter rice (Sali), Autumn rice (Ahu), and summer rice (Boro). The winter rice is grown by transplantation method. There is another variety of winter rice locally called 'Bao', which is generally grown in low flood plain. This crop has the special

ability to grow higher with the rise of water level during flood. However, time series data on area, production and yield of the 'Bao' crop are not available as it is considered to be a minor crop mostly confined to small pockets of very few low lying areas. Sali (winter rice) is the major rice grown during the kharif season (June - October). Ahu (autumn rice) is early rice grown between February and June. Boro rice (summer rice) is grown between November and May. Autumn rice is grown as a normal Ahu crop under rain fed condition and as an early Ahu under irrigated condition. The varieties used for early Ahu are mostly improved. This variety of rice is sown in early February and harvested in late May. Because of its higher productivity, there has been some shift in area from normal Ahu in recent years. Flood generally affects the Ahu rice during the maturity stage and Sali and medium low lands are the important land types where Ahu and Sali rice are usually grown. Boro rice is also two types. Boro rice grown in low – lying rain fed areas that contain enough soil moisture is known as “typical” boro. Boro rice grown under irrigated condition is known as “irrigated” Boro. The area under irrigated Boro has increased since 1980. Among the three varieties of rice the share of winter rice is found to be the higher. In Assam, in 1959 – 60 (Triennium ending with 1959 - 60) 75.3 per cent of the total area under rice was under winter (Sali) crop, against 23.9 per cent under autumn (Ahu) and only 0.6 per cent was under summer (Boro) crop. During the period 1959 – 60 and 1999 – 2000, Autumn rice has remained more or less stagnant 26.2 per cent in 1969 – 70, 26.5 per cent in 1989 – 90 and 23.07 per cent in 1999 – 2000 but in 2009-10 it decreases to only 14.0 percent to total area under rice. While the share of winter rice has gradually declined from 75.3 per cent in 1959 – 60 to 72 per cent in 1969 – 70, 71.6 per cent in 1979 – 80, 71.6per cent in 1979 – 80, 71.7 per cent in 1989 – 90 , 67.8 per cent in 1999 – 2000 and 71.0 percent in 2009-

10. On the other hand, the share of summer rice increased from 1.57 per cent in 1969 – 70 to 2.6 per cent in 1989 – 90, 9.09 per cent in 1999 – 2000 and 15.0 percent in 2009-10.

Besides rice, wheat and maize is the two important cereal crop grown in the district and the state. But the areas under these crops are very small. Wheat is gradually becoming an important crop in Assam. From only 1.8 thousand hectares in 1951 – 52, the total area under wheat increased to 60.0 thousand hectares in 2009-10. Not only wheat has attracted the attention of the farmers in Assam, but also the Department of Agriculture, has been successful in saturating the entire area under wheat with high yielding varieties by 1973 – 74. Yet, the share of wheat in the state at present is very meager in comparison to other principal crops. The area under wheat in 2009-10 represents only 2.0 per cent of the total cropped area (Table 3.1) and only 2.0 per cent of the total food grain area (Table 3.2). In the district total area under wheat was 3157 hectares in 2010-11 which is more in comparison to the area in 2008-09.

Like wheat, the cultivation of maize has also spread very rapidly in the state. From as low as 1.5 thousand hectare in 1951 – 52, the area under maize has risen to about 15.0 thousand hectares in 1973 – 74. Since then the increase in area under this crop is very slow. The share of this crop is very meager only 1.0 per cent of the total cropped area and 1.2 per cent of the total food grain area of the state in 2009-10. The production of maize in the district is not so significant. In 2008-09, total area under maize crop was 1000 hectares which was only 0.4 percent of the total cropped area of the district.

Pulses are also important food crops in the district. It occupies nearly 4.0 per cent of the total cropped area under all principal crops of the district in

2010-11. Among the pulses, gram, tur (arhar) and rabi pulses such as lentil (masur) black gram (Mali kalai), green gram (Moong), pea (motor) etc. are grown. In Assam, it occupies 3.0 percent of total cropped area and about 4.0 per cent of the total food grain area in the state (Table 3.2). About 90 per cent of the area under all pulses is occupied by the crop, which are grown as rabi crop.

Among the cash crops, which occupies more than 1 per cent of the total hectareage under all principal crops in Assam are jute, sugarcane and rape and mustard. The most important cash crop in respect of its contribution to the agricultural economy of Assam as well as to the state's overall economy is jute. In 1959 – 60, jute occupied the second largest area accounting 6.1 per cent of the total cropped area in the state. But the share of this crop has shown a declining trend during the period from 1959 – 60. In 1959 – 60 this crop occupied the 2nd position in respect of cropped area, which declined to 5.0 per cent, 3.5 per cent, 3.0 per cent, 2.3 per cent and 2.0 percent in 1969 – 70, 1979 – 80, 1989 – 90, 1999 – 2000 and 2009-10 respectively. In the district, jute occupies 2390 hectares and 2900 hectares in 2008-09 and in 2010-11 which was only 1.0 percent and 1.1 percent of the total cropped area respectively. Besides jute, cotton and mesta are the two other fibre crops grown in the state. But these crops are not very significant in terms of acreage. Cotton is not an important crop in the state. It is cultivated mainly in the hill districts under jhum system. Due to deterioration of jhum cultivation, the acreage under this crop is also falling.

Oilseeds are important crops grown in the district and its share is found to have increased over the years. In 2010-11, oil seeds occupied area accounting 26243 hectares which was 11.0 per cent of the total cropped area

in the district. This share is found to have increased from 20785 hectares (which was only 8.0 percent to the total cropped area) in 2008-09. In Assam, it occupied only 6.2 percent to total cropped area in 1960. The share of oilseeds found to be increased to 6.6 per cent in 1980, 10.3 per cent in 1989-90 and 9.0 per cent in 1999-2000 and 7.0 percent in 2009-10. Among the oil seeds, rape and mustard occupies the highest area accounting for 90 per cent of the total area under oil seeds. Though the crop occupies second position among the crops in respect to area, Assam is deficit in this important oilseed. This crop is grown under rain-fed condition in the rabi season and as such there is much uncertainty on the productivity of this crop. Other oil seeds grown in the state and in the district in smaller areas are sesamum, linseed and castor. In 1995-96, a new oil crop, nizer has been introduced in the state. Sesamum has been growing as an important oil seed next only to rape and mustard in the state.

Sugarcane is considered as an important cash crop in the cropping pattern of the district as well as of Assam. In the district, it occupied 1.4 percent of total cropped area (3210 hectares) in 2008-09 which was decrease to 1.0 percent (2500 hectares) in 2010-11. In Assam, as against 13.6 thousand hectares in 1951-52, the area under this crop is found to have increased marginally to 1.6 per cent in 1979-80, but declined to 0.9 per cent in 1999-2000 and 1.1 percent in 2009-10.

Besides, others cash crops viz. tobacco, chilies, ginger turmeric, spices and a variety of vegetables such as potato, sweet potato, cabbage, cauliflower, radish, brinjal, tomato, onion, etc. are also grown in the district as well as in Assam in limited areas either for domestic consumption or for sale in small quantities. Two groups of farmers are particularly associated with growing

vegetables for sale. Firstly, the Muslim immigrant farmers living in the fertile 'Charland' and other low lying areas and secondly, local peasants, who live around large urban centers (Das,1983). It is to be noted that the variety and quantity of vegetables grown by these two groups depend on the trend of market prices. Among these crops, potato alone occupies an area of more than 3.0 per cent under all principal crops in 2008-09 and 2010-11 in the district. In Assam as a whole potato occupied only 1.0 percent in 1959– 60, which has increased to 2.2 per cent of the total cropped area in 1999 – 2000.

The soil and climatic condition of many parts of Assam are favourable for the cultivation of coffee, rubber, etc. The major horticultural crops grown in the State are banana, orange, pineapple arecanut; coconut etc. and minor crops is guava, lemon, papaya, litchi, jackfruit, mango and the like.

3.2 CROPPING INTENSITY

While discussing the cropping pattern of a region, it is necessary to throw light on the cropping intensity, which refers to the gross cropped area as a percentage of net area sown.

Thus, **cropping intensity= (Gross cropped area/Net area sown) x 100**

One of the major features of Assam's agriculture is low cropping intensity. The traditional habit of keeping the paddy fields fallow till the next winter paddy crops still persists due to a variety of reasons. One of the main reasons is low irrigation facilities. Double or multiple cropping areas in the state is very low and compares unfavorably with other states of the country. In the year 1998-99, 45.9 percent of the net area sown is put under double or multiple cropping, giving a cropping intensity of 145.9percent compared to all India proportion of 135 percent. Crop intensity can be increased with

extension of irrigation facilities, protection from flood and drought and other measures to ensure cultivation throughout the year. It may be noted that multiple cropping is higher in other north eastern state like Tripura, Manipur and in Assam. As the gross cropped area in Assam is more than 2.5 times of that in other states of the region, Assam can easily increase its crop production by raising its intensity of cropping to the levels of Manipur and Tripura. The cropping intensity of Assam in 2009-10 was 142 which were much less than cropping intensity of the state 149 in 1999-2000.

On the other hand, net cropped area of Sonitpur district 146128 hectare and the area sown more than once are 92045hectares. Percentage of area under irrigation facilities (agricultural department) is only 11.7 which is slightly greater than all Assam average (i.e. 11.17%). A large part of the total cultivable area in the district is under mono-cropped. The cropping intensity of the district was 163 percent in 2009-10, which was comparatively higher than the state average.

3.3. TREND ANALYSIS OF THE PRODUCTIVITY OF MAJOR CROPS

Agricultural production in Assam is growing at a very slow rate the index of agricultural production of the year 1970-71 (1956-57=100) for Assam was 126 as against all India index of 147. But during economic reform period the index number of agricultural production (base- triennium ending 1881-82=100) has increased from 143.09 in 1992-93 to 155.0 in 1997-98 and then to 151.0 in 1998-99. The following table gives a comparison of agricultural production index of Assam with all India production during the post reform period.

Table: 3.6**Index of agricultural production in Assam and India (base- triennium ending 1881-82=100)**

Year	Assam			India		
	Food	Non-food	Total	Food	Non-food	Total
1991-92	142	143	142	138	159	146
1992-93	144	142	143	144	164	152
1993-94	148	149	148	150	170	157
1994-95	146	154	150	156	181	165
1995-96	150	157	153	146	185	161
1996-97	148	157	153	161	201	176
1997-98	149	161	155	156	183	165
1998-99	143	170	157	165	200	178
1999-2000	168	163	166	170	189	177
2000-01	174	162	168	161	178	167
2001-02	169	160	164	172	186	177
2002-03	164	166	165	140	168	151
2003-04	170	162	166	171	194	180
2004-05	152	154	153	160	206	177
2005-06	155	148	153	169	230	192
2006-07	128	156	142	176	241	200
2007-08	145	161	153	187	247	207
2008-09	174	167	170	190	221	193
2009-10	192	180	186	177	206	180

Source: Economic Survey, Assam, 2006-07 and 2010-11

The index of agricultural production (base- triennium ending 1881-82=100) for the state has been showing a steady upward trend over the last couple of years. The general index for all crops stands at the point of 186 in 1991-92 as against 168 in 2000-01 and 142 in 1991-92. Thus in recent years, the agricultural production in the state has shown a gradual increasing trend. The table 3.6 reveals that the index of food crops production in Assam (base- triennium ending 1881-82=100) has shown a slowly rising trend from 142 in 1991-92 to 162 in 2000-01 and then to 192 in 2009-10 as compared to that of 138, 161 and 177 during the aforesaid years for all India. Again the index of non food crops has also increased from 143 in 1991-92 to 162 in 2000-01 and then to 180 in 2009-10 as compared to 159, 178 and 206 for all India during the respective years.

3.3.1 FOOD PRODUCTION

The land in Assam is quite suitable for the production of food grains. The major portion of the total cropped area i.e., more than 70 percent in 2009-10 is being utilized for the production of food grains in Assam. This percentage is quite high i.e., around 80.0 percent during 2004-05. Major food grains produced in Assam includes rice, wheat, maize, other cereals and pulses. Total production of food grains in Assam in Assam, which was 16.79 lakh tonnes in 1960-61 has increased to 33.80 in 1991-92 and then to 45.57 lakh tones in 2009-10. The trends in production of food grains during post reform period of Assam can be represented in the following table.

Table: 3.7

Trends in total production of food grains in Assam (in lakh tonnes)

Year	Production	Year	production
1991-92	33.80	2001-02	40.23
1992-93	34.47	2002-03	38.94
1993-94	35.36	2003-04	40.34
1994-95	34.90	2004-05	36.17
1995-96	35.60	2005-06	36.80
1996-97	35.31	2006-07	30.60
1997-98	35.84	2007-08	34.68
1998-99	34.39	2008-09	41.42
1999-2000	40.42	2009-10	45.57
2000-01	41.73		

Source: Economic Survey, Assam, 2006-07 and 2010-11

Standard deviation of year-wise production of food grains in Assam during the period of 1999-2000 to 2009-10 was 3.52 and mean production during the period was 37.19 lakh tonnes.

Co-efficient of variance= (standard deviation/ mean) x 100

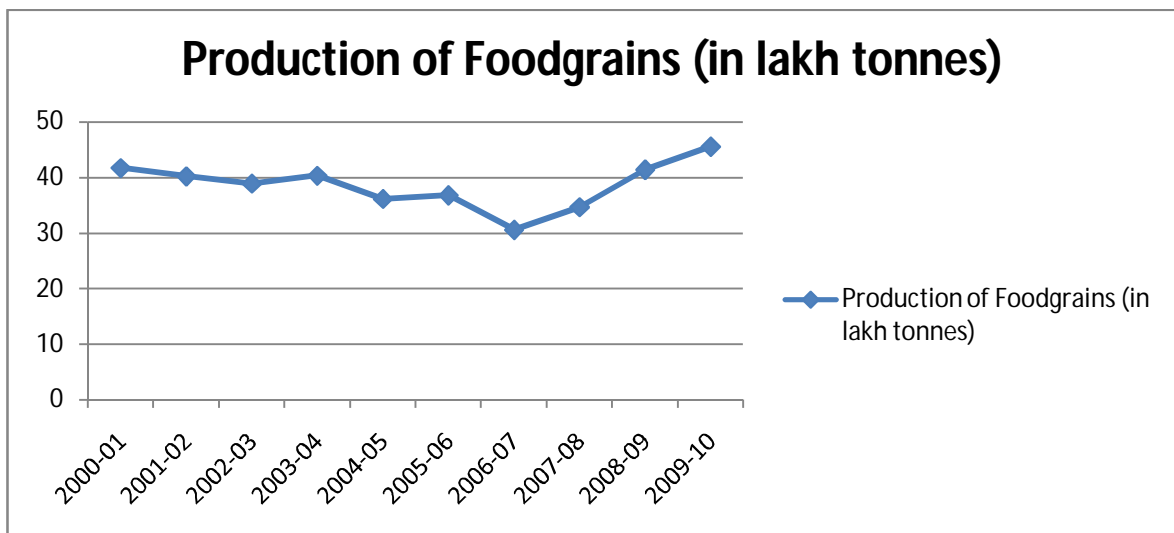
$$=9.46$$

Since co-efficient of variance is very high i.e., 9.46 which reflect the higher fluctuation in food grains productivity in the state during the aforesaid period.

Total productivity of food grains in Assam during the post reform period no doubt increases but increasing trend is not smooth uprising. The production of food grains increases from 33.8 lakh tonnes in 1991-92 to 36.80 lakh tonnes in 2005-06 with slight variation. But in the year 2006-07 become lowest to 30.60 lakh tonnes during the past two decades. In recent years productivity starts increases and reached the highest level of 45.57 lakh tonnes in 2009-10 which was not only the highest production during the post reform period but also during post independence period. The following diagram shows the variation in the production trends of food grains in Assam during last ten years.

Figure 3.5

Trends in production of food-grains in Assam (in lakh tonnes) during last 10years



Assam is backward in respect of production of non food crops or commercial crops excepting jute. Total production of oilseeds in Assam has increased from 48 thousand tonnes in 1960-61 to 191 thousand tonnes in 1991-92 and finally declined to 151 thousand tonnes in 2001-02. In 2009-10 the production of oilseeds further decreases to 142 thousand tonnes. The

production jute has decreased from 866 thousand bales in 1991-92 to 713 thousand bales in 2009-10. Total production of sugarcane has increased from 856 thousand in 2005-06 to 1062 thousand in 2009-10. Total production of potato in Assam has increased significantly from 144 thousand tonnes in 1960-61 to 621 thousand tonnes in 2002-03 and then decreased to 600 thousand tonnes in 2009-10.

In Assam, procurement, distribution and sale of seeds have been undertaken by the Assam Seed Corporation Limited. Except paddy and mustard seeds to some extent, the state is entirely dependent on other states for quality seeds. Presently, the Assam Seeds Corporation and the Department of Agriculture are producing certified seeds in the state of Assam. However, Private Seed Traders are being encouraged to take up seed and seedling production taken up with State Seed Certification Agency.

Table: 3.8

Area and yield of HYV of Rice in Assam (area: hectare; Yield: kg/ hectare)

YEAR	Autumn		Winter		Summer	
	Area	Yield	Area	Yield	Area	Yield
2000-01	251514	1804	971857	2154	259471	2459
2001-02	250182	1720	920015	2308	259025	2445
2002-03	253295	1839	937474	2262	244905	2518
2003-04	216221	1778	929144	2263	221330	2220
2004-05	222290	1851	863494	2303	234000	2296

2005-06	234716	1866	950450	2281	265532	2192
2006-07	214980	1686	863052	1990	267045	2228
2007-08	223000	1958	984000	2152	278000	2509
2008-09	224022	1959	974742	2256	313629	2371

Source: Statistical Handbook of Assam 2010.

It is encouraging to observe that the use of HYV seeds, particularly in respect of paddy, is steadily gaining popularity in the state. As per information available from the agricultural department, the total HYV coverage under paddy was only 5.5 lakh hectares in 1980-81, which has increased to 16.26 lakh hectares during 2009-10. This gradual increase in area under HYV rice is mainly attributable to the productivity, which is much higher than the common variety of rice.

3.3.2 TREND IN PRODUCTION OF MAJOR CROPS IN SONITPUR DISTRICT IN 1999-2000 TO 2009-10

Since the land of the district is quite suitable for the production of food grains, the major portion of the total cropped area i.e. around 80.0 percent in 2009-10 is being utilized for the production of food grains. Various types of food grains produced in the district including rice, wheat, maize, other cereals and pulses. Total production of major food grains of the district i.e., rice was 220.5 thousand tonnes in 1999-2000 increase marginally to 236.7 thousand tonnes in 2005-06. The total productivity of the rice in district decreased to decade's minimum level to 129.6 thousand tonnes in 2006-07 and then to increased up to 347.3 thousand tonnes in 2009-10.

Table: 3.9

Trends in production of major food grains in the District during 1999-2000 to 2009-10 (P: production in '000tonnes, Y: yield rate in tonne/hectare)

Year	Rice		Wheat		Maize		Pulses	
	P	Y	P	Y	P	Y	P	Y
1999-2000	220.5	1.38	5.85	1.64	0.63	0.61	6.2	0.59
2000-01	226.3	1.34	4.08	1.11	0.66	0.60	4.4	0.6
2001-02	171.6	1.21	4.97	1.35	0.69	0.61	7.02	0.57
2002-03	214.2	1.31	4.93	1.31	0.62	0.58	3.56	0.39
2003-04	250.0	1.47	4.15	1.06	0.58	0.58	4.1	0.54
2004-05	235.9	1.40	2.89	0.85	0.59	0.58	3.86	0.57
2005-06	236.7	1.40	3.05	0.95	0.51	0.59	3.98	0.65
2006-07	129.6	1.02	3.65	0.91	0.56	0.58	4.88	0.66
2007-08	220.0	1.32	6.77	1.40	0.52	0.58	3.67	0.58
2008-09	256.8	1.48	6.58	1.56	0.54	0.57	4.20	0.54
2009-10	347.3	1.87	3.47	1.10	0.71	0.60	7.29	0.73

Source: Directorate of Agriculture, Khanapara, Assam, Economic Survey 2010-11 Assam.

Analysis of Co-efficient of variance in production and yield rate of food grains during 1999-2000 to 2009-10

Co-efficient of variance of rice production= 22.46

Co-efficient of variance of yield rate of rice = 14.28

Co-efficient of variance of wheat production= 28.17

Co-efficient of variance of yield rate of wheat = 21.08

Co-efficient of variance of maize production= 10.67

Co-efficient of variance of yield rate of maize= 2.21

Co-efficient of variance of pulses production= 26.71

Co-efficient of variance of yield rate of pulses = 13.72

From the above statistical analysis it is clear that during the last decade the production of maize and its yield rate is more consistent in comparison to other food grains followed by yield rate of pulses and rice. The production of wheat and its yield rate is highly inconsistent during the last decade.

Similarly total productivity of wheat also decreases from 5.9 thousand tonnes in 1999-2000 to 2.9 thousand tonnes in 2004-05 and then to increased to 6.6 thousand tonnes in 2008-09. It should be worth noted that the total production of pulses in Assam increased to 0.63 thousand tonnes in 1999-2000 to 0.71 thousand tonnes in during 2009-10. But the productivity of maize remains stagnant over the last decade. Total productivity of maize was 0.63 thousand tonnes in 1999-2000 increased marginally with slight variation to 0.71 thousand tonnes in 2009-10. The figure 3.6 and 3.7 shows the year-wise variation in production of major food grains i.e., rice, wheat, maize and pulses during the last decade.

Figure 3.6

**Trends in production of RICE and WHEAT in SONITPUR DISTRICT
(in '000 tonnes) during last 10years**

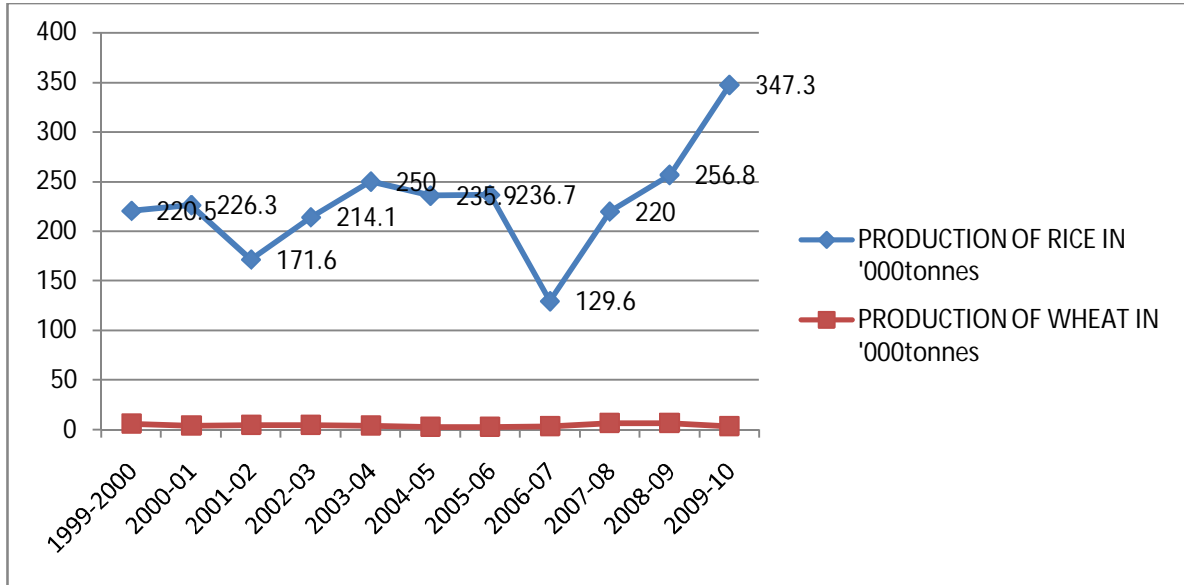
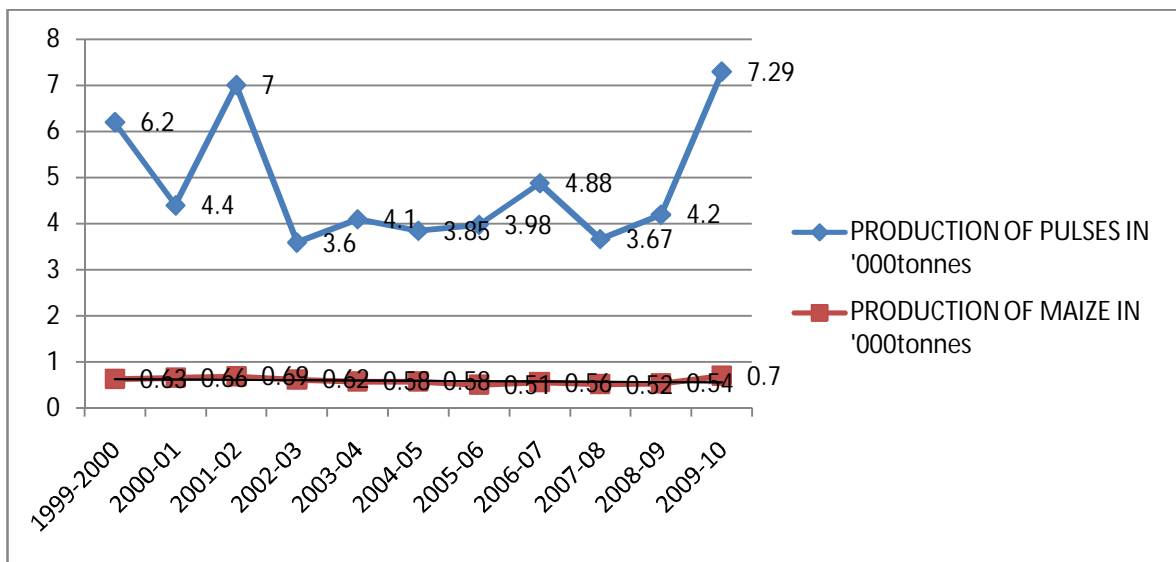


Figure 3.7

**Trends in production of PULSES and MAIZE in SONITPUR DISTRICT
(in '000 tonnes) during last 10years**



The major non-food grains or cash crop products of the district include rape and mustard, jute, potato and sugarcane. The production of oilseeds in

the district did not show significant trend during the last decade. Total production of oilseeds was 13.4 thousand tonnes in 1999-2000 decreased to 8.2 thousand tonnes in 2005-06 and to increase to 15.7 thousand tonnes in 2009-10. The production of jute in the district registered continuous falling in both production and yield rate during the last decade. Total productivity of jute was 29.4 thousand bales and yield rate was 12.66 bales per hectare in 1999-2000 decreased to 6.96 thousand bales with yield rate 6.60 bales per hectare in 2009-10 with a little variation during the period.

Table: 3.10

Trends in production of major non-food grains in the district during 1999-2000 to 2009-10 (P: production in '000 tonnes, Y: yield rate in tonne/hectare, jute: production in '000 bales and yield in bales/hectare)

Year	Rape seeds & mustard		Jute		Potato		sugarcane	
	P	Y	P	Y	P	Y	P	Y
1999-2000	13.4	0.54	29.4	12.66	72.9	11.43	72.8	45.38
2000-01	15.2	0.60	22.8	10.18	58.3	9.05	64.7	40.1
2001-02	16.9	0.69	20.7	9.29	50.2	7.90	60.8	37.8
2002-03	11.9	0.59	18.8	9.46	45.3	7.12	62.2	38.4
2003-04	11.4	0.55	19.8	9.57	41.4	6.61	63.6	39.1
2004-05	11.1	0.59	16.9	8.75	53.9	7.95	81.3	36.3
2005-06	8.2	0.44	18.1	9.31	48.9	7.17	96.4	38.5
2006-07	9.33	0.47	9.38	6.00	53.9	7.05	98.5	39.1
2007-08	9.78	0.49	12.8	6.79	54.4	7.04	86.4	35.2
2008-09	15.59	0.75	5.02	6.67	115.8	16.0	135.0	42.0
2009-10	15.7	0.60	6.96	6.60	94.6	12.0	110.0	44.0

Source: Directorate of Agriculture, Khanpara, Assam, Economic Survey 2010-11 Assam.

Analysis of co-efficient of variance in production and yield rate of non food grains during the 1999-2000 to 2009-10

Co-efficient of variance of rape and mustard production= 22.24

Co-efficient of variance of yield rate of rape and mustard = 15.79

Co-efficient of variance of jute production= 42.00

Co-efficient of variance of yield rate of jute = 21.82

Co-efficient of variance of potato production= 34.97

Co-efficient of variance of yield rate of potato= 31.01

Co-efficient of variance of sugarcane production= 26.56

Co-efficient of variance of yield rate of sugarcane = 7.44

From the above statistical analysis it is clear that during the last decade the production of rape and mustard is more consistent in comparison to other products followed by production of sugarcane and potato. The production of jute is highly inconsistent during the last decade. In case of yield rate, sugarcane registered highly consistent yield rate during the period followed by rape and mustard and jute. The yield rate of potato is highly inconsistent in the district.

It is observed from the analysis of variance of both food crops and non food crops in the district during the last decade that the production and yield rate of the food crops is more consistent than non food crops.

Similarly the production of potato decreased from 72.9 thousand tonnes (yield rate 11.43 tonne/hectare) in 1999-2000 to 48.9 thousand tonnes in 2005-06 and then to increase to 115.8 thousand tonnes which was decade maximum in 2008-09 with highest yield rate i.e., 16.0 tonne/hectare. But the production of sugarcane registered an increasing trend with some variation

during the last decade. Total production of sugarcane was 72.8 thousand tonnes with the highest yield rate of 45.38 tonne per hectare in 1999-2000 has increased to 110.0 thousand tonnes with yield rate 44.0 tonne per hectare in 2009-10. The figure 3.8 and 3.9 shows the year-wise variation in production of major non-food grains i.e., oilseeds, jute, potato and sugarcane during the last decade.

Figure 3.8

Trends in production of OILSEEDS (in '000 tonnes) and JUTE (in '000 bales) in SONITPUR DISTRICT during last 10 years

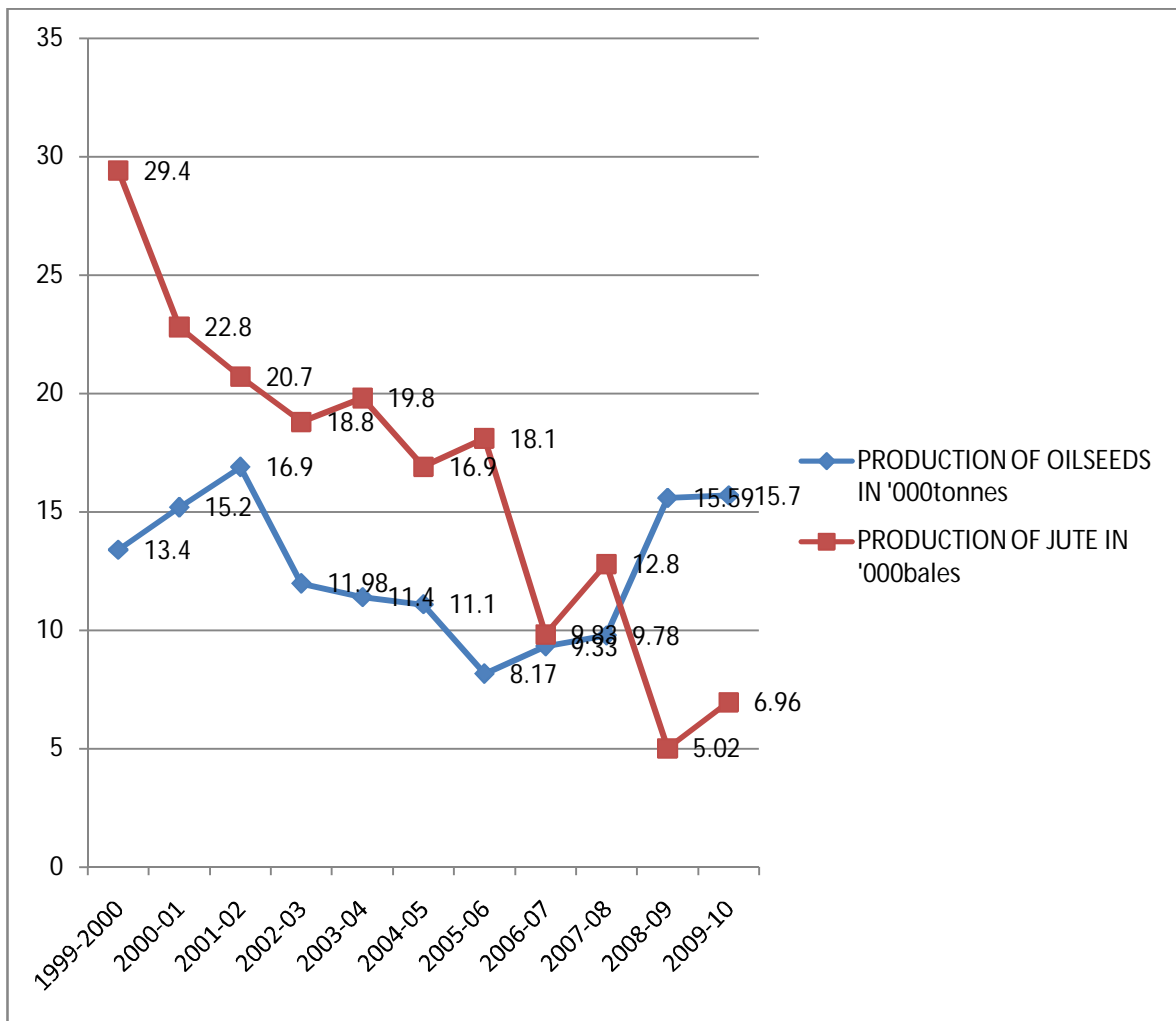
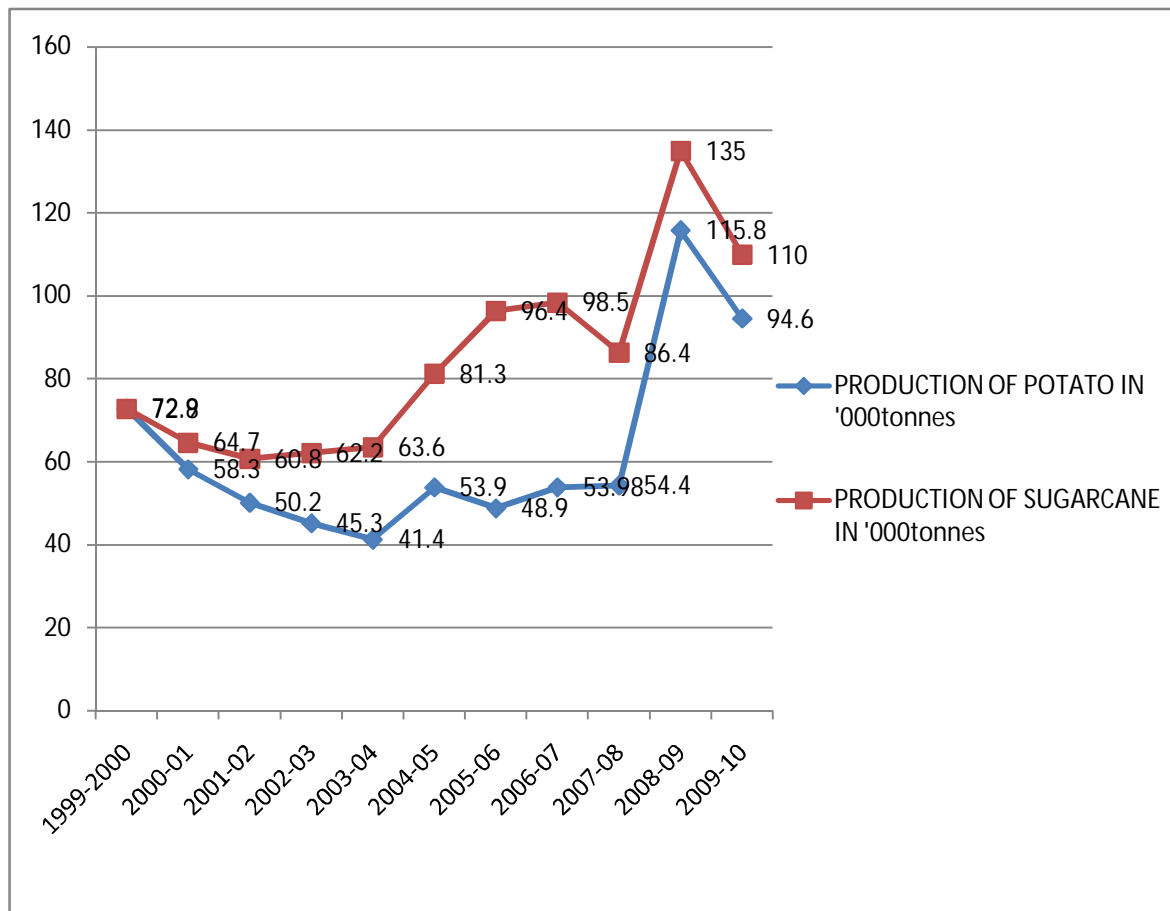


Figure 3.9
Trends in production of POTATO and SUGARCANE in SONITPUR
DISTRICT (in '000 tonnes) during last 10years



The productivity of HYV seeds of rice and other cereals is comparatively high in comparison to traditional seeds. Total area under HYV of rice in 2008-09 was 103546 hectares out of which High Yielding Varieties (HYV) of Autumn, Winter and Summer Rice cover 21135, 68068 and 14343 hectares respectively (table 3.11). The area under HYV of rice increases year after year but productivity fluctuates due different reasons in the district. The following table shows the area and yield rate of HYV of rice season wise in the district.

Table: 3.11

Area and yield of HYV of rice in Sonitpur district (area: hectare; Yield: kg/ hectare)

Year	Autumn		Winter		Summer	
	Area	Yield	Area	Yield	Area	Yield
2003-04	15140	1825	66450	2258	8500	2371
2006-07	16465	1435	51350	1823	11810	2216
2008-09	21135	1850	68068	2280	14343	2380

Source: Compiled from Statistical Handbook of Assam.

The productivity of Summer rice is highest in the district in comparison to Autumn rice and Winter rice. In 2008-09, the productivity of Autumn, Winter and Summer Rice was 1850, 2280 and 2380 kg per hectare in the district. The productivity of some other crops except rice i.e., wheat, pulses etc in the district is not so significant in comparison to national level. The productivity of wheat (HYV) in the district in 2008-09 was only 1603 kg/hectare but national average was much higher (i.e., 2891kg/hectare).

From the forgoing analysis, relating to the cropping pattern and trends in productivity of major crops in Assam and the district, the following observations can be made:

- There has been no change of cropping pattern in the state as well as the district even after the technological change taking place in the country.

- The cropping pattern of the state and the district is dominated by food grains particularly the cereal crops. Among the cereal crops rice occupies the largest area of the cultivated area.
- The share of rice in gross cropped area has decreased marginally in the last few decades due to increase in the share of gross cropped area under other crops. Hence the share of rice in the total cropped area has declined, but the absolute rice area in the state and the district remained unchanged by and large.
- Among rice, winter rice occupied the major area. But the share of winter rice in the gross cropped area has shown a declining trend in recent years due to switching over to the summer rice. During last decade the production of total Rice increases in the district with some yearly variation.
- Area under wheat has recorded an increase especially during 1980-90 and their after started declining in the state. But in the district the area under wheat registered an increasing trend during the post reform period. The production of wheat and its yield rate fluctuates during the last decade in the district.
- Pulses are an important food grain crop. But its share in the total cropped area has remained more or less unchanged during the entire period under study. Production of total pulses has registered an increasing trend with some yearly fluctuation in the district as well as in the state.
- Oilseeds crops are, no doubt, important crops with respect to area but its share, particularly rape and mustard has increased, while the share of fibre crops particularly jute and mesta decreased due to decline in area and productivity. Production of oilseeds increases during the last few

decades but the production of jute registered continuous falling in production and yield rate.

- Non food crops occupy a small segment of the total cropped area but its share is found to have increased marginally both in the state and the district.
- Among other crops, sugarcane and vegetables like potato have improved their position in the total cropped area and production.
- Production and yield rate of food crops in the district is more consistent in comparison to the production and yield rate of non food crops.
- Cropping intensity in the state in recent years decreases in comparison to 1999-2000, but in the district it was much higher than state average.

Cropping intensity= (Gross cropped area/Net area sown) x 100

Co-efficient of variance= (standard deviation/ mean) x 100

CHAPTER IV:

INTER-DISTRICT VARIATION IN PRODUCTIVITY OF SELECTED CROPS IN ASSAM (A comparative study with a developed state like Haryana)

Analytical study on: Variation in Area, Production and Yield of main food grains

Analysis of variation in Area, Production and Yield of major non-food grains

Inter-district variation in Area, Production and Yield rate of major crops

Inter-State Variation in Yield Rate of major crops

CHAPTER IV

Inter-District Variation in Productivity of Selected Crops in Assam (A comparative study with a developed state like Haryana)

Fluctuation in crop output may cause price instability, which in turn may adversely affect further growth in crop output, employment and income distributions. Johnson and Mellor (1978) opined that since food grains, as wage-goods, have high income elasticity of demand and total food grains constitute bulk of total agriculture production in less developed regions, the relative shift in food grains prices may critically affect the real income of low wage earners which has serious welfare consequences. It is, therefore necessary to take appropriate measures to stabilize agriculture prices and agricultural prices and agricultural production. Fluctuations in crop output particularly in the food grains production happens to be a regular feature in agriculture of Assam. The main reason for this is the dependence on nature i.e. rainfall for the cultivation crops in the State. Natural hazards like flood and drought are also responsible for such fluctuation. Inadequate irrigation facilities and lack of permanent measure to control flood and erosion have further compounded the problem in the state. Therefore, an attempt has been made in this chapter to measure the fluctuation in area, production and productivity of four principal food crops and four non food crops. An attempt has also been made to analyze the extent variability in the production of food grains and non food grains in the state as well as for selected districts for the period of 1999-2000 to 2009-10.

To study the Inter-district variation in productivity of selected crops in Assam, six agriculturally competent districts i.e., Darrang, Nagaon, Barpeta, Dhubri and Golaghat was selected along with Sonitpur district and Assam as

a whole. For measuring fluctuation, co-efficient of variance of area, production and yield rate have been calculated for the four main food crops i.e., rice, wheat, maize and pulses and four major non-food crops i.e., oilseeds, jute, potato and sugarcane for the period of study i.e., 1999-2000 to 2009-2010. Tables 4.1 to table 4.8 depict the district wise variation (C.V) of area, production and productivity of food crop and table 4.9 to table 4.16 depict the district wise co-efficient of variation (C.V) of area, production and productivity of non-food crop respectively. A comparative analysis of inter district variation of major food grains and non-food grains of selected districts have been made with comparison with state average. To study the inter-state variation in productivity of major crops two agriculturally developed state Haryana and Punjab was selected and analysis is done on the basis of co-efficient of variance in productivity during the period of 1999-2000 to 2009-10 with country and district average.

4.1. ANALYTICAL STUDY ON:

VARIATION IN AREA, PRODUCTION AND YIELD OF MAIN FOOD GRAINS

Fluctuations in area, production and yield of major food grains during the period in the selected district are not uniform. In Sonitpur district, variation in area of rice was comparatively more consistent than its yield rate and production. The co-efficient of variation of total production of rice was very high i.e., 22.5 (table: 4.1) percent during the period. It was due to variation of yield rate (i.e., 14.3), natural factor and shifting of crop land for other use. Wheat production in the state fluctuates more in comparison to rice. The co-efficient of production of wheat was 28.2 percent with variation of 21.1 percent in yield rate. Production of maize, area and yield shows comparatively more consistent in terms of other crops. Though it occupies

less than one percent of total cropped area of the district, the variation in area, production and yield of maize is 9.00, 10.7 and 2.2 percent respectively. Pulses in the district was now a day's getting importance but variation in area production and yield during the period was very high i.e., 25.5, 26.7 and 13.7 percent respectively. The following tables show the year-wise variation in area, production and productivity of major food-grains of the selected districts of Assam.

Table: 4.1

Production of major food grains in the Sonitpur District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	159.6	220.5	1.38	3.58	5.85	1.64	1.04	0.63	0.61	9.23	6.2	0.67
2000-01	168.7	226.3	1.34	3.69	4.08	1.11	1.10	0.66	0.60	6.79	4.4	0.60
2001-02	142.2	171.6	1.21	3.67	4.97	1.35	1.15	0.69	0.61	12.4	7.02	0.57
2002-03	163.6	214.2	1.31	3.75	4.93	1.31	1.05	0.62	0.58	5.91	3.56	0.39
2003-04	169.9	250.0	1.47	3.92	4.15	1.06	1.00	0.58	0.58	6.11	4.1	0.54
2004-05	168.7	235.9	1.40	3.38	2.89	0.85	1.01	0.59	0.58	6.72	3.86	0.57
2005-06	169.3	236.7	1.40	3.21	3.05	0.95	0.87	0.51	0.59	6.12	3.98	0.65
2006-07	127.3	129.6	1.02	3.99	3.65	0.91	0.88	0.56	0.58	7.39	4.88	0.66
2007-08	167.1	220.0	1.32	4.83	6.77	1.40	0.90	0.52	0.58	6.43	3.67	0.58
2008-09	173.4	256.8	1.48	4.22	6.58	1.56	0.91	0.54	0.57	7.11	4.20	0.54
2009-10	167.4	347.3	1.87	3.16	3.47	1.10	1.10	0.71	0.60	10.0	7.29	0.73
C.V	8.33	22.5	14.3	12.23	28.2	21.1	9.00	10.7	2.2	25.5	26.7	13.7

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11, Assam.

Table: 4.2

Production of major food grains in the Darrang District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	186.6	210.1	1.13	4.35	5.21	1.20	0.82	0.50	0.61	10.3	6.63	0.64
2000-01	200.8	248.1	1.24	3.89	5.11	1.31	0.80	0.49	0.61	11.5	6.69	0.58
2001-02	188.2	268.0	1.42	4.48	5.58	1.24	0.73	0.44	0.61	19.3	11.0	0.57
2002-03	170.5	255.6	1.21	5.61	6.68	1.19	0.73	0.45	0.61	8.40	4.60	0.52
2003-04	156.6	215.4	1.38	6.04	5.49	0.91	0.71	0.44	0.61	8.87	5.15	0.58
2004-05	144.9	156.2	1.08	6.20	5.44	0.88	0.63	0.39	0.62	10.2	6.96	0.69
2005-06	75.20	108.8	1.45	1.53	2.21	1.45	0.45	0.27	0.60	4.58	2.13	0.46
2006-07	50.30	67.90	1.35	1.44	1.77	1.23	0.27	0.17	0.60	2.85	5.66	0.58
2007-08	58.69	96.70	1.65	2.00	2.11	1.05	0.27	0.16	0.61	4.48	2.32	0.52
2008-09	73.64	131.8	1.79	2.34	2.40	1.03	0.31	0.18	0.58	5.53	2.99	0.54
2009-10	79.67	141.0 2	1.77	2.37	2.68	1.13	0.39	0.21	0.54	6.68	4.14	0.62
C.V	44.24	39.00	16.4	47.0	42.3	14.1	37.3	38.8	3.5	51.4	45.9	10.5

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.3

Production of major food grains in the BARPETA District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	206.8	239.1	1.16	10.10	10.95	1.08	0.046	0.030	0.65	10.6	6.89	0.65
2000-01	195.9	239.3	1.22	10.17	13.13	1.29	0.040	0.026	0.65	12.6	8.10	0.64
2001-02	172.5	199.2	1.16	10.17	10.48	1.03	0.045	0.029	0.64	22.9	13.6	0.59
2002-03	179.2	185.0	1.03	9.52	8.83	0.93	0.045	0.029	0.64	10.9	6.21	0.51
2003-04	175.7	208.5	1.19	10.13	9.23	0.92	0.045	0.029	0.64	11.2	6.39	0.57
2004-05	142.6	115.6	0.81	10.31	11.77	1.14	0.043	0.026	0.60	11.9	7.68	0.65
2005-06	118.2	135.6	1.15	6.05	6.26	1.04	0.038	0.025	0.66	9.53	5.97	0.63
2006-07	111.9	114.3	1.02	8.79	9.49	1.08	0.042	0.027	0.64	9.81	5.66	0.58
2007-08	104.2	119.6	1.15	9.48	10.3	1.09	0.046	0.029	0.63	10.6	7.67	0.68
2008-09	164.3	223.5	1.36	6.07	6.25	1.03	0.049	0.030	0.64	10.8	7.02	0.65
2009-10	169.4	228.7	1.35	6.17	6.48	1.05	0.052	0.033	0.65	11.1	7.44	0.67
C.V	20.7	26.8	13.0 4	19.5	23.35	8.96	8.20	7.86	2.34	29.5	27.4	7.90

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4. 4

Production of major food grains in the NAGAON District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	247.6	457.3	1.85	6.19	6.99	1.13	0.50	0.33	0.66	12.7	4.95	0.39
2000-01	248.0	444.9	1.79	5.34	4.57	0.85	0.52	0.34	0.66	11.6	4.90	0.42
2001-02	231.9	413.9	1.78	5.69	5.96	1.04	0.56	0.37	0.66	19.5	8.89	0.46
2002-03	251.3	430.3	1.71	5.54	5.12	0.92	0.53	0.35	0.65	10.7	4.63	0.43
2003-04	252.7	453.3	1.79	5.73	4.58	0.80	0.60	0.39	0.64	9.24	3.44	0.37
2004-05	228.4	400.3	1.75	5.76	4.90	0.85	0.55	0.36	0.65	11.9 8	5.07	0.42
2005-06	213.7	338.7	1.59	3.63	3.94	1.09	0.48	0.32	0.66	8.01	5.97	0.63
2006-07	169.3	271.7	1.60	4.21	4.48	1.06	0.41	0.28	0.67	9.24	4.02	0.44
2007-08	192.6	316.8	1.65	3.10	2.87	0.93	0.39	0.27	0.68	7.00	2.78	0.39
2008-09	195.2	317.9	1.63	3.57	3.92	1.10	0.43	0.29	0.67	9.11	3.83	0.42
2009-10	199.6	327.3	1.64	3.48	3.86	1.11	0.45	0.31	0.68	10.1	4.24	0.42
C.V	12.35	16.6	5.0	23.0	22.7	11.8	13.0	11.1	1.8	29.5	32.1	14.9

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4. 5

Production of major food grains in the DHUBRI District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	151.7	220.4	1.45	13.36	19.47	1.46	0.275	0.165	0.60	10.5	6.51	0.62
2000-01	132.6	194.7	1.47	13.21	17.61	1.33	0.269	0.161	0.60	9.63	6.09	0.63
2001-02	131.0	196.1	1.50	13.46	15.66	1.16	0.268	0.161	0.60	17.3	11.1	0.64
2002-03	128.9	200.0	1.55	11.69	13.78	1.18	0.128	0.076	0.59	8.82	4.82	0.55
2003-04	125.9	190.5	1.51	10.70	14.47	1.35	0.124	0.081	0.60	9.02	5.27	0.58
2004-05	105.9	164.4	1.55	8.70	7.37	0.85	0.120	0.070	0.59	7.51	4.17	0.55
2005-06	93.30	145.8	1.56	7.89	7.12	0.90	0.109	0.065	0.60	6.03	3.42	0.57
2006-07	88.90	150.9	1.70	7.13	8.92	1.25	0.110	0.066	0.60	5.79	3.37	0.58
2007-08	89.12	160.7	1.80	6.72	9.17	1.36	0.095	0.056	0.60	6.21	3.42	0.55
2008-09	88.51	151.2	1.71	6.49	9.65	1.48	0.102	0.060	0.59	6.65	3.79	0.57
2009-10	94.21	164.9	1.75	6.37	9.49	1.49	0.101	0.060	0.61	7.02	4.14	0.59
C.V	19.36	13.4	7.3	29.03	33.9	16.5	46.2	46.2	0.95	36.5	42.3	5.31

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4. 6

Production of major food grains in the JORHAT District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	111.0	193.7	1.74	1.39	1.70	1.23	0.024	0.024	0.53	3.56	1.57	0.44
2000-01	91.7	164.6	1.79	1.39	1.66	1.19	0.068	0.035	0.51	2.44	0.99	0.41
2001-02	95.9	168.1	1.75	1.69	2.18	1.29	0.065	0.034	0.52	12.6	5.3	0.42
2002-03	77.8	122.2	1.57	0.76	1.00	1.32	0.022	0.011	0.50	4.42	1.84	0.42
2003-04	85.2	143.6	1.69	1.09	1.38	1.26	0.023	0.012	0.52	6.22	2.43	0.39
2004-05	81.5	134.7	1.65	0.75	0.88	1.17	0.022	0.011	0.54	4.99	2.01	0.40
2005-06	88.2	140.8	1.60	1.30	1.40	1.08	0.026	0.014	0.54	5.38	2.13	0.39
2006-07	75.1	86.6	1.15	0.34	0.47	1.38	0.017	0.009	0.53	3.71	1.33	0.59
2007-08	86.6	116.1	1.34	0.34	0.47	1.33	0.026	0.014	0.52	5.87	2.38	0.46
2008-09	86.9	139.7	1.61	0.35	0.22	0.62	0.029	0.020	0.53	5.98	2.81	0.47
2009-10	89.2	141.8	1.59	0.33	0.34	1.02	0.033	0.021	0.54	5.89	2.71	0.46
C.V	10.4	19.1	1.02	55.2	58.4	17.3	51.6	45.7	2.26	45.2	46.9	12.2

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4. 7

Production of major food grains in the KARBI ANGLONG District during 1999-2000 to 2009-10 (A: Area in '000hectare P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	114.5	170.4	1.49	1.38	2.06	1.50	10.56	8.22	0.78	4.41	2.60	0.59
2000-01	125.7	183.7	1.96	1.36	2.15	1.57	10.62	8.51	0.80	4.45	2.51	0.57
2001-02	124.8	175.7	1.41	1.35	2.08	1.54	10.21	7.95	0.78	4.08	2.52	0.62
2002-03	125.9	188.4	1.50	1.35	1.89	1.39	10.65	8.37	0.79	3.35	1.92	0.57
2003-04	131.9	181.8	1.38	1.28	1.71	1.34	10.73	8.46	0.79	3.44	2.03	0.59
2004-05	129.3	183.8	1.42	1.42	2.07	1.46	10.66	8.53	0.80	3.52	2.14	0.61
2005-06	127.2	185.3	1.46	1.13	1.45	1.28	10.78	8.47	0.75	3.43	2.02	0.59
2006-07	124.2	179.5	1.45	1.33	1.69	1.27	10.78	8.47	0.79	3.71	2.17	0.59
2007-08	122.7	190.5	1.55	1.25	1.74	1.39	10.78	8.46	0.78	1.86	1.05	0.56
2008-09	125.9	193.0	1.53	1.23	1.98	1.62	10.77	8.08	0.75	2.02	1.15	0.57
2009-10	127.2	203.5	1.60	1.27	2.03	1.60	10.73	8.48	0.79	2.23	1.34	0.60
C.V	3.33	4.58	9.87	6.00	11.0	8.24	1.49	2.21	2.10	26.1	26.6	3.03

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

It can be observed from table 4.2 that, production of rice is highly fluctuated i.e., 39.0 percent due to 44.24 and 16.4 percent variation in area under rice crop and yield rate in Darrang district during the period. This high fluctuation was also due to shifting of land of food crops to the production of vegetables and other cash crops in the district which were getting more importance in recent years. Fluctuation in area, production and yield rate of wheat, maize and pulses were also very high in the district. But the coefficient of variation of pulses was the highest among food crops i.e., 45.9 percent followed by wheat 42.3 percent, rice 39.0 percent and maize 38.8 percent. Lowest variation in yield of food crops registered by maize i.e., 3.5 percent followed by pulses 10.5, wheat 14.1 and rice 16.4 percent respectively.

From the table 4.3, it can be observed that variation in production in of pulses in Barpeta district was maximum i.e., 27.4 percent followed by rice 26.8 percent, wheat 23.35 and maize 7.86 percent respectively. Variation in yield rate was highest in rice i.e., 13.04 percent followed by wheat, pulses and maize i.e., 8.96, 7.90 and 2.34 percent respectively. Maize though it was not so significant in food product in the district but it registered as most consistent food crops in terms of area under maize, production and yield rate during the period. The main cause of the variation is natural, technological and use of land for other purpose.

Nagaon district is one of the agriculturally competent districts in Assam. From the table 4.4, it is clear that variation of production of pulses is highest i.e., 32.1 percent followed by wheat 22.7 percent, rice 16.6 percent and maize 11.1 percent. Lowest variation yield rate was observed in maize i.e., 1.8 percent followed by rice 5.0 percent, wheat 11.8 percent and pulses

14.9 percent respectively. In case of variation of area, rice registered lowest percentage i.e., 12.35 followed by maize, wheat and pulses respectively. Natural factors are the main cause of variation in the district.

In Dhubri district, lowest variation can be observed in production of rice i.e., 13.4 (table 4.5) percent followed by wheat 33.9 percent, pulses 42.3 and maize 46.2. Rice registered lowest variability in area i.e., 19.36 followed by wheat, pulses and maize. Highest variation in area and production is registered by maize in the district i.e., 46.2 percent each but has lowest variation in yield rate i.e., 0.95 percent. The co-efficient of variation of yield rate of pulses is 5.31 percent followed by rice and wheat i.e., 7.3 and 16.5 percent respectively.

Jorhat district of Assam registered lowest variation in production, area and yield i.e., 19.1, 10.4 and 1.02 (table 4.6) percent respectively during the period. But in case of production of maize, pulses and wheat has very high variation i.e., 45.7, 46.9 and 58.4 respectively. The area and production of maize has very high variation during the period, but the variation of yield rate was low i.e., 2.26 percent. In Jorhat district yield rate, area and production of rice was more consistent than the other food product is due to favourable natural and technical factors and inputs.

It can be observed from table 4.7, that Karbi Anglong was one of the districts of Assam which showed very less variation in production of food crops in terms of production, area and yield rate. The variation of production of maize registered lowest i.e., 2.21 percent followed by rice 4.58, wheat 11.0 and 26.6 percent of pulses respectively. Lowest variation in yield rate was observed in maize i.e., 2.10 percent followed by 3.03, 8.24 and 9.87 percent of pulses, wheat and rice respectively. Variation in area was lowest in maize

crop i.e., 1.49 percent and highest in pulses i.e., and 26.1 percent. From the above analysis, it is clear that variation in area under major crops and their production and productivity is more or less inconsistent in the selected districts in Assam. The following table (table: 4.8) shows the variation in area under major food-grains and their production and productivity in Assam as a whole.

Table: 4.8

Production of major FOOD GRAINS in Assam during 1999-2000 to 2009-10 (A: area in lakh hectare, P: production in '000tonnes, Y: yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

Year	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	25.77	3762.0	1.46	0.68	87.7	1.29	0.199	14.0	0.70	1.10	61.0	0.55
2000-01	26.46	3998.4	1.53	0.70	85.7	1.22	0.202	14.6	0.72	1.11	62.9	0.56
2001-02	25.37	3854.0	1.52	0.72	85	1.18	0.196	13.9	0.71	1.18	66	0.560
2002-03	25.40	3738.0	1.47	0.69	78	1.13	0.198	14.2	0.72	1.11	60	0.54
2003-04	25.29	3880.0	1.53	0.70	73	1.04	0.196	14.1	0.72	1.14	63	0.55
2004-05	23.83	3470.0	1.46	0.64	68	1.06	0.192	14.0	0.71	1.08	61	0.59
2005-06	24.20	3552.0	1.47	0.50	54	1.08	0.189	13.7	0.73	1.00	56	0.55
2006-07	21.89	2916.0	1.33	0.60	67	1.12	0.187	13.6	0.74	1.07	59	0.56
2007-08	23.24	3319.0	1.43	0.56	71	1.27	0.183	13.3	0.73	1.13	61	0.56
2008-09	24.84	4008.0	1.61	0.50	55	1.10	0.185	13.7	0.74	1.14	62	0.55
2009-10	25.30	4408.0	1.74	0.60	65	1.08	0.201	14.0	0.72	1.19	66	0.56
C.V	5.02	10.2	6.67	12.1	15.4	7.02	3.26	2.35	1.53	4.55	4.5	2.16

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Assam as a whole more consistent in production of maize (i.e., low C.V: 2.35 percent) though it was not produced in large scale. Variation of production was lowest in maize followed by pulses, rice and wheat i.e., 4.5, 10.2 and 15.4 (table4.8) percent respectively. Variation in yield rate was lowest in maize i.e., 1.53 percent followed by 2.16, 6.67 and 7.02 percent of pulses, rice and wheat respectively. Lowest variation of area also registered by maize i.e., 3.26 percent then 4.55 percent of pulses, 5.02 percent of rice and 12.1 percent of wheat. Variation of production of wheat was highest in Assam among the food crops during the period followed by rice. These variations are mainly due to natural, technological and socio-economic factors.

4.2. ANALYSIS OF VARIATION IN AREA, PRODUCTION AND YIELD OF MAJOR NON-FOOD GRAINS

Like food-crops the fluctuation of area production and yield rate of the selected districts were not also uniform. Some districts showed very high variation in area, production and yield rate than the other. In Sonitpur district among the selected non food grains rape seeds and mustard has low variability in production i.e., 22.2 (table 4.9) percent during the period followed by sugarcane 26.6 percent, potato 34.9 percent and 42.0 percent in jute. Lowest variation in yield rate was registered by sugarcane i.e., 7.44 percent followed by 15.8 percent in rape seeds and mustard, 21.8 percent in jute and 31.0 percent in potato respectively. In case of area under the non-food crop, potato has lowest variability (8.45 percent) followed by rape seeds and mustard (12.2 percent), jute (14.9 percent) and sugarcane (24.77 percent respectively). In the district highest variation in production was observed in jute whose production continuously falling during the period. The following

tables show the trends and variation in area under major non food-grains and their production and productivity in Sonitpur district along with selected districts of Assam.

Table: 4.9

Production of major non-food grains in the SONITPUR District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tonne/hectare, jute: production in '000bales and yield in bales/hectare, C.V:Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	25.1	13.4	0.54	2.32	29.4	12.7	6.38	72.9	11.43	1.60	72.8	45.38
2000-01	25.2	15.2	0.60	2.24	22.8	10.2	6.44	58.3	9.05	1.61	64.7	40.1
2001-02	24.3	16.9	0.69	2.23	20.7	9.29	6.36	50.2	7.90	1.61	60.8	37.8
2002-03	20.4	11.9	0.59	1.99	18.8	9.46	6.36	45.3	7.12	1.62	62.2	38.4
2003-04	20.8	11.4	0.55	2.07	19.8	9.57	6.25	41.4	6.61	1.63	63.6	39.1
2004-05	18.9	11.1	0.59	1.93	16.9	8.75	6.78	53.9	7.95	2.24	81.3	36.3
2005-06	18.6	8.2	0.44	1.94	18.1	9.31	6.82	48.9	7.17	2.50	96.4	38.5
2006-07	19.9	9.33	0.47	1.64	9.38	6.00	7.66	53.9	7.05	2.52	98.5	39.1
2007-08	19.9	9.78	0.49	1.89	12.8	6.79	7.72	54.4	7.04	2.45	86.4	35.2
2008-09	20.8	15.6	0.75	2.39	5.02	6.67	6.76	115.8	16.0	3.21	135.0	42.0
2009-10	26.2	15.7	0.60	2.90	6.96	6.60	7.88	94.6	12.0	2.50	110.0	44.0
C.V	12.2	22.2	15.8	14.9	42.0	21.8	8.45	34.9	31.0	24.7	26.6	7.44

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.10

Production of major non-food grains in the DARRANG District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tones/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	30.2	10.6	0.35	8.24	80.9	9.83	7.19	55.4	7.70	1.08	39.5	36.6
2000-01	25.6	11.2	0.44	9.96	75.3	7.56	8.10	56.5	6.98	1.12	33.7	30.1
2001-02	24.7	11.6	0.47	7.90	84.6	10.7	8.77	60.9	6.95	1.14	36.2	31.6
2002-03	23.2	9.39	0.40	8.76	129.7	14.8	8.50	52.4	6.16	1.09	37.5	34.4
2003-04	26.6	11.7	0.44	11.6	157.1	13.6	9.59	59.9	6.26	0.99	40.3	40.7
2004-05	26.3	12.4	0.47	9.44	69.7	7.38	9.78	96.5	9.86	1.08	37.4	34.6
2005-06	12.5	4.21	0.34	4.00	35.1	8.77	1.71	9.44	5.52	0.47	13.3	28.2
2006-07	10.9	3.70	0.34	3.08	19.98	6.48	2.74	24.4	8.91	0.24	7.59	31.6
2007-08	7.04	3.08	0.44	2.53	17.85	7.06	3.15	14.1	4.47	0.34	11.7	34.7
2008-09	11.7	6.30	0.54	3.26	21.37	6.56	5.26	27.7	5.28	0.48	18.4	38.7
2009-10	13.2	6.86	0.52	3.34	22.31	6.68	6.31	31.42	4.98	0.43	14.75	34.3
C.V	40.4	41.0	15.2	48.3	69.0	30.6	42.4	54.9	23.9	45.4	47.1	10.2

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.11

Production of major non-food grains in the BARPETA District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tones/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	25.9	13.6	0.53	8.00	51.6	6.45	8.92	122.7	13.8	0.245	9.71	39.67
2000-01	25.9	15.1	0.59	5.80	42.7	7.36	10.7	113.9	10.7	0.165	6.09	36.90
2001-02	24.0	7.86	0.33	7.94	72.4	9.12	10.8	94.24	8.72	0.226	8.41	37.23
2002-03	24.0	12.9	0.53	7.96	70.9	8.92	8.75	73.99	8.46	0.205	7.47	36.42
2003-04	28.7	17.9	0.62	7.78	77.5	9.97	9.52	83.07	8.73	0.208	8.02	38.59
2004-05	20.7	11.5	0.56	7.58	51.1	6.74	8.64	76.25	8.83	0.218	8.05	36.92
2005-06	14.8	4.28	0.29	7.00	65.7	9.38	5.19	21.46	4.13	0.315	11.72	37.19
2006-07	18.5	8.56	0.46	6.29	63.6	10.1	7.29	37.57	5.18	0.325	12.84	39.64
2007-08	18.8	9.93	0.53	3.77	39.2	10.4	6.72	63.01	9.38	0.337	12.83	38.01
2008-09	12.6	7.27	0.58	5.67	46.0	8.11	6.69	54.26	8.11	0.280	10.75	38.39
2009-10	14.2	8.38	0.59	5.35	48.7	9.11	7.21	64.11	8.89	0.321	12.37	38.55
C.V	24.7	35.3	20.2	19.8	22.0	14.8	20.4	39.4	27.9	22.01	23.17	2.79

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.12

Production of major non-food grains in the NAGAON District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tones/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	26.4	12.3	0.46	9.15	105.2	11.5	6.21	57.27	9.22	9.38	353.5	35.4
2000-01	26.3	13.9	0.53	10.3	118.1	11.4	6.63	69.72	10.5	9.09	317.8	34.9
2001-02	28.8	13.3	0.46	10.7	148.2	13.9	6.07	58.88	9.69	9.14	313.6	34.3
2002-03	28.8	13.8	0.48	11.3	137.8	12.2	5.85	65.31	11.2	8.59	286.1	33.3
2003-04	27.9	14.3	0.51	9.68	140.5	14.5	5.66	42.02	7.42	8.04	290.8	36.2
2004-05	27.1	12.4	0.46	8.55	106.9	12.5	5.43	54.69	10.1	6.87	226.8	33.0
2005-06	16.2	8.72	0.54	7.74	98.32	12.7	4.09	31.47	7.69	6.13	205.9	33.6
2006-07	18.3	9.98	0.54	8.45	103.0	12.2	4.92	29.74	6.04	6.12	214.5	35.1
2007-08	16.2	9.41	0.58	9.55	138.2	14.5	5.15	29.90	5.81	6.29	221.5	35.2
2008-09	12.9	6.75	0.52	9.51	138.9	14.6	4.84	24.80	5.13	7.77	283.9	36.5
2009-10	13.3	7.32	0.55	9.22	123.6	13.4	4.98	27.09	5.44	7.89	280.1	35.5
C.V	28.4	25.7	7.75	10.4	13.9	8.79	12.8	36.02	26.3	15.2	16.9	3.13

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.13

Production of major non-food grains in the DHUBRI District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tones/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	13.3	5.39	0.41	16.2	122.4	7.56	6.02	61.15	10.2	0.216	8.57	39.66
2000-01	12.9	6.20	0.48	15.6	142.7	9.13	5.92	58.10	9.81	0.307	11.33	36.90
2001-02	12.0	6.16	0.51	16.2	131.1	8.12	5.63	54.62	9.61	0.184	6.85	37.23
2002-03	10.1	4.73	0.46	15.9	117.5	7.39	5.41	48.39	8.94	0.174	6.34	36.42
2003-04	10.3	7.46	0.72	13.5	86.6	6.40	5.14	45.25	8.80	0.106	4.09	38.58
2004-05	11.2	7.01	0.63	12.2	73.2	6.01	4.87	44.19	9.08	0.093	3.43	36.91
2005-06	7.15	3.39	0.47	10.9	90.6	8.24	3.79	11.33	2.99	0.075	2.79	37.19
2006-07	8.33	3.95	0.47	10.1	87.3	8.69	4.06	42.32	10.4	0.075	2.97	39.64
2007-08	8.89	4.22	0.48	12.2	114.1	9.35	3.86	30.76	7.96	0.092	3.50	38.01
2008-09	11.3	5.97	0.53	11.2	100.8	9.00	4.18	38.97	9.33	0.092	3.53	38.39
2009-10	11.2	6.16	0.55	11.8	108.9	9.23	4.22	34.27	8.12	0.098	3.87	39.54
C.V	17.1	22.5	16.1	16.7	18.9	13.5	16.6	31.4	22.4	51.8	50.3	3.01

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.14

Production of major non-food grains in the JORHAT District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tones/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	13.1	6.98	0.53	0.100	0.89	8.92	3.67	34.18	9.32	0.58	16.66	28.72
2000-01	10.4	4.32	0.42	0.113	1.09	9.61	4.08	39.83	9.76	0.42	14.22	33.78
2001-02	10.2	5.88	0.58	0.163	1.61	9.90	3.29	23.33	7.08	0.42	14.43	34.35
2002-03	8.79	6.17	0.70	0.135	1.37	10.2	1.44	8.59	5.96	0.19	6.09	32.45
2003-04	8.09	3.23	0.40	0.43	1.49	10.4	1.49	8.55	5.75	0.22	7.49	34.22
2004-05	7.23	4.13	0.57	0.109	0.77	7.08	1.32	8.01	6.09	0.21	6.64	32.39
2005-06	1.77	0.83	0.47	0.145	1.48	10.2	2.24	11.77	5.24	0.24	7.80	32.51
2006-07	8.48	5.23	0.62	0.136	1.32	9.68	1.97	10.83	5.51	0.23	7.72	33.41
2007-08	8.48	7.29	0.86	0.121	1.33	10.9	1.49	5.83	3.90	0.36	12.01	35.33
2008-09	11.4	7.69	0.67	0.142	1.51	10.6	2.03	10.72	5.29	0.37	11.34	30.89
2009-10	11.2	8.06	0.72	0.122	1.24	10.2	1.99	11.9	5.98	0.33	11.29	34.22
C.V	31.3	38.2	22.3	56.4	19.5	10.1	40.5	69.2	26.3	35.5	32.6	5.38

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Table: 4.15

Production of major non-food grains in the KARBI ANGLONG District during 1999-2000 to 2009-10 (A: Area in '000hectare, P: production in '000tonnes, Y: yield rate in tones/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage).

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	17.1	7.28	0.43	2.02	23.55	11.6	0.83	6.28	7.57	4.23	198.2	46.85
2000-01	17.1	8.29	0.53	2.01	26.18	13.0	0.82	6.62	8.04	4.27	175.9	41.25
2001-02	17.2	11.2	0.65	2.00	21.71	10.8	0.83	7.29	8.79	4.72	208.6	44.16
2002-03	17.2	8.63	0.50	1.99	24.00	12.0	0.83	8.03	9.65	4.32	170.0	39.38
2003-04	17.3	6.91	0.41	1.95	23.39	11.9	0.77	4.48	5.82	5.24	231.3	44.15
2004-05	16.9	7.58	0.45	1.99	14.08	7.08	0.83	8.74	10.5	4.38	180.3	41.16
2005-06	16.7	6.57	0.39	1.04	13.25	12.8	0.77	5.69	7.37	4.43	179.7	40.58
2006-07	16.8	9.44	0.56	1.87	20.07	10.8	0.84	7.94	9.47	6.87	320.0	46.62
2007-08	16.8	7.31	0.43	1.71	18.78	10.9	0.84	7.07	8.44	6.88	324.7	47.22
2008-09	17.1	9.04	0.53	1.71	19.00	11.1	0.84	7.18	8.54	7.27	332.9	45.79
2009-10	17.3	9.00	0.52	1.72	18.58	10.8	0.88	8.10	9.21	7.33	340.8	46.50
C.V	1.18	15.5	15.1	15.0	19.1	13.4	3.60	16.5	14.3	23.4	28.2	6.27

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11, Assam.

From the data represented in table 4.10, it is observed that in Darrang district the variation in production, area and yield rate of non food crops is

very high. The highest 69.0 percent variation was seen in production of jute during the period followed by 54.9 percent in potato, 47.1 percent in sugarcane and 41.0 percent in rape seeds and mustard. The variation in yield rate was highest in jute i.e., 30.6 percent and lowest 10.2 percent in sugarcane. Jute also registered highest variability i.e., 48.3 percent in area followed by 45.4 percent in sugarcane, 42.4 percent in potato and 40.4 percent in rape seeds and mustard. From the table 4.10 it was observed that jute has highest variability in production, yield and area in the district during the period. In recent years the cropping pattern of the district has changed due to getting more importance in the production of vegetables and other horticultural crops. On the other hand in Barpeta district, the variation in production of potato is highest i.e., 39.4 (table 4.11) percent followed by 35.3 percent in rape seeds and mustard, 23.17 percent in sugarcane and 22.0 percent in jute during the period. The yield rate of sugarcane was comparatively more consistent (i.e., 2.79 percent) than jute (14.8 percent), rape seeds and mustard (20.2) and potato (27.9 percent). The variability of area in the district was highest in rape seeds and mustard i.e., 24.7 percent followed by sugarcane, potato and jute i.e. 22.01, 20.4 and 19.8 percent. In the district jute was more consistent in production and area in terms of other crops.

However, from the table 4.12 it is observed that in Nagaon district the highest variation in production is seen in potato i.e., 36.02 percent and lowest variation in jute i.e., 13.9 percent. Rape seeds and mustard has variation of 28.4 percent and sugarcane 16.9 percent during the period. The yield rate of sugarcane shows more consistency (i.e., lowest C.V. 3.13 percent) than rape seeds and mustard (7.75 percent), jute (8.79 percent) and potato (26.3 percent). The variation in area was highest in rape seeds and mustard i.e., 28.4

percent during the period followed by 15.2 percent in sugarcane, 12.8 percent in potato and 10.4 percent in jute respectively. In the district jute was more consistent in production and area under jute than the other crops. But, Dhubri district showed highest variability in production and area of jute ie 50.3 and 51.8 (table 4.13) percent but lowest in yield rate i.e., 3.01 percent during the period in comparison to other crops. In case of rape seeds and mustard the variability in area production and yield rate during the period were 17.1, 22.5 and 16.1percent respectively. Similarly, 16.7, 18.9, 13.5 percent and 16.6, 31.4, 22.4 percent were the co-efficient of variation area production and yield rate of jute and potato in the district respectively. It was observed from the table that in Dhubri district production of jute was more consistent during the period in comparison to other non-food crops.

It is observed from the table 4.14 that in Jorhat district production of jute registered lowest variability i.e., 19.5 percent during the period and potato registered highest variability i.e., 69.2 percent. Lowest variation in yield rate during the period observed in sugarcane i.e., 5.38 percent followed by 10.1 percent in jute, 22.3 percent in rape and mustard and 26.3 percent in potato. Variation in area was highest in jute i.e., 56.4 percent followed by 40.5 percent in potato, 35.5 percent in sugarcane and 31.3 percent in rape and mustard. So during the period sugarcane was more consistent in yield rate and jute was more consistent in production in comparison to other crops. However, Karbi Anglong district was comparatively more consistent in production of rape and mustard (lowest C.V. 15.5 percent, table 4.15) and in area (lowest C.V. 1.18 percent) than the other crops. But the lowest variation in yield rate was registered by sugarcane as 6.27 percent followed by 13.4 percent in jute, 14.3 percent in potato and 15.1 percent in rape seeds and mustard. Highest variation in area was observed in sugarcane as 23.4 percent

then in 15.0 percent in jute in the district. In comparison to the selected districts, Assam as a whole during the period showed more consistency in production and productivity of some of non food-grains. The following table shows the trends and variability in the area under non-food-grains and their production and productivity in Assam as a whole.

Table: 4.16

Production of major NON-FOOD GRAINS in ASSAM during 1999-2000 to 2009-10 (A: area in lakh hectare, P: production in '000tonnes, Y: yield rate in tonne/hectare, jute: production in '000bales and yield in bales/hectare, C.V: Co-efficient of variance in percentage)

Year	Rape seeds & mustard			Jute			Potato			sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
1999-2000	2.98	134.1	0.45	0.68	656.8	9.66	0.79	649.4	8.22	0.26	956.8	36.8
2000-01	3.10	159.9	0.52	0.69	668.1	9.61	0.80	652.5	8.25	0.27	959.7	36.9
2001-02	2.99	151	0.51	0.68	974.6	9.89	0.80	620.6	7.78	0.27	1011.4	37.2
2002-03	2.87	144	0.50	0.68	690.6	10.2	0.75	589.9	7.82	0.25	916.1	36.4
2003-04	2.89	152	0.53	0.64	665.1	10.4	0.78	543.1	6.97	0.25	981.4	38.6
2004-05	2.68	142	0.54	0.58	410.4	7.06	0.77	531.3	6.90	0.24	883.9	23.9
2005-06	2.35	110	0.46	0.567	578.8	10.2	0.69	353.6	5.08	0.23	871.2	23.4
2006-07	2.60	129	0.51	0.577	558.6	9.67	0.78	504.6	6.49	0.25	1055.3	39.6
2007-08	2.56	135	0.49	0.598	656.8	10.9	0.79	514.6	6.51	0.26	979.9	38.0
2008-09	2.47	137	0.55	0.601	647.5	10.7	0.78	515.7	6.58	0.29	1099.7	38.4
2009-10	2.69	142	0.53	0.65	713.0	10.9	0.80	528.0	6.60	0.27	1062.0	39.1
C.V	8.32	9.09	5.88	7.13	20.0	10.2	3.94	14.69	12.8	6.12	7.14	15.8

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Assam as a whole during the period showed more consistency in production of sugarcane (lowest C.V. 7.14 percent, table 4.16) and in yield rate of rape seeds and mustard (lowest C.V: 5.88 percent) than the other crops. Highest variation in production was registered by jute as 20.0 percent and in area rape seeds and mustard as 8.32 percent during the period. The coefficient of variation in yield rate was highest in sugarcane (15.8 percent) followed by potato (12.8 percent), jute (10.2 and rape) and rape seeds and mustard (5.88 percent).

4.3. INTER-DISTRICT VARIATION IN AREA, PRODUCTION AND YIELD RATE OF MAJOR CROPS

Inter district variation of production, yield rate and area of selected district of Assam can be studied by observing the co-efficient of variation of selected crops during the period. From the table 4.17 it was observed that in rice production Karbi Anglong district was highly consistent (lowest C.V: 4.58 percent) during the period which was less than state level variability (10.2 percent). Highest variability was observed in Darrang district (39.0 percent) then in Barpeta district (26.8 percent). The co-efficient of variation in production of rice in Sonitpur district was 22.5 percent which was more than double of state level variation. Variation in yield rate of rice during the period was lowest in Jorhat district (1.02 percent) followed by Nagaon (5.0 percent) and Dhubri (7.3 percent). The highest variation in yield rate was observed in Darrang district (16.4 percent) followed by Sonitpur (14.3 percent) which was much higher than the state level variation (6.67 percent). In variation of area Karbi Anglong is most consistent district with lowest variation of 3.33 percent followed by Sonitpur district (8.33 percent). The highest variation was seen in Darrang district (44.24 percent) followed by Barpeta (20.7

percent). The variation in area in Assam as a whole was 5.02 percent during the period. The data represented in table 4.17, gives clear picture of inter-district variation of food-grains over the period 1999-2000 to 2009-10.

Table: 4.17

Inter-district variation in AREA, PRODUCTION AND YIELD RATE major food gains during the period 1999-2000 to 2009-10 of selected districts of Assam, (Co-efficient of variance in percentage)

District	Rice			Wheat			Maize			Pulses		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Darrang	44.24	39.00	16.4	47.0	42.3	14.1	37.3	38.8	3.5	51.4	45.9	10.5
Barpeta	20.7	26.8	13.04	19.5	23.35	8.96	8.20	7.86	2.34	29.5	27.4	7.90
Nagaon	12.35	16.6	5.0	23.0	22.7	11.8	13.0	11.1	1.8	29.5	32.1	14.9
Dhubri	19.36	13.4	7.3	29.03	33.9	16.5	46.2	46.2	0.95	36.5	42.3	5.31
Jorhat	10.4	19.1	1.02	55.2	58.4	17.3	51.6	45.7	2.26	45.2	46.9	12.2
Karbi Anglong	3.33	4.58	9.87	6.00	11.0	8.24	1.49	2.21	2.10	26.1	26.6	3.03
Sonitpur	8.33	22.5	14.3	12.23	28.2	21.1	9.00	10.7	2.2	25.5	26.7	13.7
Assam	5.02	10.2	6.67	12.1	15.4	7.02	3.26	2.35	1.53	4.55	4.5	2.16

Source: Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11, Assam.

In case of wheat, the most consistent district in production was Karbi Anglong with 11.0 percent variation during the period which was less than state level (15.4 percent). Highest variation was observed in Jorhat district (58.4 percent) followed by Darrang district (42.3 percent). The co-efficient of variation in production of wheat in Sonitpur district was 28.2 percent which is much higher than state level variation. Most consistent district in yield rate of wheat during the period is Karbi Anglong (8.24 percent) followed by Barpeta (8.96 percent). In Sonitpur district the variation in yield rate was highest 21.1percent which is much higher than state level (7.02 percent). Highest variation in area is observed in Darrang district (47.0) and lowest in Karbi Anglong (6.00). Variation in area in Sonitpur district was 12.23 percent which nearly equal to state level of 12.1 percent during the period. In maize production Karbi Anglong was the most consistent district with lowest variation of 2.21 percent during the period which is nearly equal to state variation (2.35 percent). Highest variation was observed in Dhubri district (46.2 percent) followed by Jorhat (45.7 percent) and Darrang (38.8). In Sonitpur district co-efficient of variation in production of maize was 10.7 percent was higher than Karbi Anglong and Barpeta district (7.86 percent). In case of yield rate highly consistent district was Dhubri (0.95 percent) who's co-efficient of variation was less than state level (1.53percent), followed by Nagaon (1.8 percent), Karbi Anglong (2.10percent), Sonitpur (2.20percent) and Barpeta (2.34 percent). The highest variation in area was observed in Jorhat district (51.6 percent) followed by 46.2 percent in Dhubri, 37.3 percent in Darrang district. Lowest variation in area was in Karbi Anglong (1.49 percent), followed by Barpeta (8.20) and Sonitpur (9.0 percent) during the period. However, in production pulses, most consistent district was Karbi Anglong with lowest variation of 26.6 percent followed by Sonitpur district

(26.7 percent) and Barpeta (27.4 percent). The highest variation was observed in Jorhat with variation 46.9 percent whereas state level variation was only 4.5 percent. In yield rate Karbi Anglong was the most consistent district with lowest variation of 3.03 percent followed by Dhubri (5.31 percent) and Barpeta (7.90 percent). The co-efficient of variation in yield rate in Sonitpur district was 13.7 percent which was much higher than state level variation (2.16 percent). In area the highest variation was observed in Darrang district (51.4 percent) and lowest in Sonitpur district as 25.5 percent which was much higher than state level (4.55 percent).

On the other hand, in case of non-food grains inter district variation in area, production and yield rate can be analyzed on the basis of the table 4.18. It can be observed from the table that Karbi Anglong districts was most consistent in production of rape seeds and mustard with lowest variation of 15.5 percent during the period followed by Sonitpur district with 22.2 percent variation. The highest variation was observed in Darrang (41.0percent) then to Jorhat (38.2 percent) and Barpeta (35.3 percent). In yield rate lowest variation was in Nagaon (7.75 percent) followed by Karbi Anglong (15.1 percent) and Darrang (15.2 percent). In Sonitpur district it was 15.8 percent which was much higher than state level (5.88 percent). In case of area Darrang district has highest variation (40.4 percent) and Karbi Anglong has lowest (1.18 percent). The variation in Sonitpur district was 12.2 percent which was the second lowest during the period. In jute production highest variation was observed in Darrang district (69.0 percent) and lowest was in Nagaon (13.9 percent). The variation in Sonitpur district was 42.0 percent which was much higher than many districts and the state level (20.0 percent) during the period. In yield rate lowest variation was observed in Nagaon (8.79 percent) followed by Jorhat (10.1 percent) and Karbi Anglong (13.4 percent).

In Sonitpur district it was 21.8 percent which higher than state level (10.2 percent). In area most consistent district was Nagaon with lowest variation of 10.4 percent during the period followed by Sonitpur with variation 14.9 percent whereas state level variation was only 7.13 percent. In case of non food-grains also the variation in area, production and productivity in between the districts are not uniform. The following table shows the inter-district variation of non-food-grains over the period 1999-2000 to 2009-10.

Table: 4.18

Inter-district variation in AREA, PRODUCTION AND YIELD RATE major non-food gains during the period 1999-2000 to 2009-10 of selected districts of Assam, (Co-efficient of variance in percentage)

District	Rape seeds and Mustard			Jute			Potato			Sugarcane		
	A	P	Y	A	P	Y	A	P	Y	A	P	Y
Darrang	40.4	41.0	15.2	48.3	69.0	30.6	42.4	54.9	23.9	45.4	47.1	10.2
Barpeta	24.7	35.3	20.2	19.8	22.0	14.8	20.4	39.4	27.9	22.01	23.17	2.79
Nagaon	28.4	25.7	7.75	10.4	13.9	8.79	12.8	36.02	26.3	15.2	16.9	3.13
Dhubri	17.1	22.5	16.1	16.7	18.9	13.5	16.6	31.4	22.4	51.8	50.3	3.01
Jorhat	31.3	38.2	22.3	56.4	19.5	10.1	40.5	69.2	26.3	35.5	32.6	5.38
Karbi Anglong	1.18	15.5	15.1	15.0	19.1	13.4	3.60	16.5	14.3	23.4	28.2	6.27
Sonitpur	12.2	22.2	15.8	14.9	42.0	21.8	8.45	34.9	31.0	24.77	26.6	7.44
Assam	8.32	9.09	5.88	7.13	20.0	10.2	3.94	14.69	12.8	6.12	7.14	15.8

Source: Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11, Assam.

It is observed that in production of potato, highest variation was shown by Jorhat district (69.2 percent) followed by Darrang (54.9 percent) and lowest in Karbi Anglong (16.5 percent) during the period. The variation in Sonitpur district was 34.9 percent during the period which was much higher than state level (14.69 percent). In yield rate, lowest variation was observed in Karbi Anglong (14.3 percent) followed by Dhubri (22.4 percent). The variation in yield rate was highest in Sonitpur district (31.0 percent) during the period whereas in state level it was only 12.8 percent. In case of area highest variation was observed in Darrang district (42.4 percent) followed by Jorhat (40.5 percent). The variation in Sonitpur district was 8.45 percent which was second lowest among districts but higher than state level (3.94 percent).

However, in case of sugarcane, highest variation in production was observed during the period in Dhubri (50.3 percent) then in Darrang district (47.1 percent). Nagaon was most consistent district in production of sugarcane with lowest variation 16.9 percent followed by 23.17 percent in Barpeta, 26.6 percent in Sonitpur district. In yield rate lowest variation was in Barpeta (2.79 percent) followed by Dhubri (3.01 percent) and Nagaon (3.13 percent). The variation in Sonitpur was 7.44 percent which was less than state level. The variation in area during the period was highest in Dhubri (51.8 percent) followed by Darrang (45.4 percent) and Jorhat (35.5 percent). The variation was lowest in Nagaon district as 15.2 percent and in Sonitpur district it was 24.77 percent which was much higher than state level (6.12). In case of sugarcane most consistent district in yield rate was Barpeta and in area was Nagaon.

4.4. INTER-STATE VARIATION IN YIELD RATE OF MAJOR CROPS

To study the inter-state variation in yield rate of major crops, a comparative study of co-efficient of variance was done with country and district average. From the table 4.19, it was observed that most consistent state in production of rice was Haryana with co-efficient of 0.12 percent. It is due to better inputs and agricultural infrastructure and modern implement. The country's co-efficient of variance in yield rate was 6.29 percent whereas in Sonitpur district it was 14.3 percent for the period. The rate of variation of Assam (6.67 percent) was more than Punjab (6.19 percent) and country's variation level. In case of yield rate of wheat, Haryana was the most consistent state with lowest variation of 3.73 percent followed by Punjab with variation 3.98 percent. The level of variation in the country as a whole was 3.41 percent whereas the variation in Assam was quite high 7.02 percent. The co-efficient of variation in yield rate of Sonitpur district was 21.1 which were unexpectedly high in comparison to the states and the country. If we compare year-wise productivity of wheat in Assam as well as the district, it was quite low in comparison to Punjab and Haryana. Low productivity and Variation in Assam as well as in the district was high because of inadequate inputs and insufficient infrastructure. The data represented in the following table gives us a clear picture about inter-state variations in yield rate of major crops during the period of 1999-2000 to 2009-10.

Table: 4.19

Inter-state variation in YIELD RATE of major food grains during the period 1999-2000 to 2009-10 of selected districts of Assam, (yield rate in tonne/hectare, C.V: Co-efficient of variance in percentage)

RICE												
STATE	1999-2000	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	C.V
ASSAM	1.46	1.51	1.52	1.47	1.53	1.46	1.47	1.33	1.43	1.61	1.58	6.67
HARYANA	2.39	2.56	2.65	2.72	2.75	2.94	3.05	3.24	3.36	2.73	3.01	0.12
PUNJAB	3.35	3.51	3.55	3.51	3.69	3.94	3.86	3.87	4.02	4.02	4.01	6.19
INDIA	1.99	1.90	2.08	1.74	2.08	1.98	2.10	2.13	2.20	2.18	2.13	6.29
SONITPUR	1.38	1.34	1.21	1.31	1.47	1.40	1.40	1.02	1.32	1.48	1.87	14.3
WHEAT												
ASSAM	1.29	1.22	1.18	1.13	1.04	1.07	1.07	1.12	1.27	1.09	1.16	7.02
HARYANA	4.17	4.11	4.10	4.05	3.94	3.90	3.84	4.23	4.16	4.39	4.21	3.73
PUNJAB	4.69	4.56	4.53	4.20	4.21	4.22	4.18	4.21	4.51	4.46	4.31	3.98
INDIA	2.78	2.71	2.76	2.61	2.71	2.60	2.62	2.71	2.80	2.91	2.83	3.41
SONITPUR	1.64	1.11	1.35	1.31	1.06	0.85	0.95	0.91	1.40	1.56	1.10	21.1
MAIZE												
ASSAM	0.70	0.72	0.70	0.70	0.70	0.72	0.72	0.78	0.72	0.72	0.73	1.53
HARYANA	2.40	2.27	2.61	1.81	2.41	2.50	2.13	2.29	2.64	2.16	2.25	9.74
PUNJAB	2.58	2.79	2.72	2.04	2.98	2.74	2.72	3.12	3.41	3.40	3.42	13.79
INDIA	1.79	1.82	2.00	1.68	2.04	1.91	1.94	1.91	2.34	2.41	2.00	10.56
SONITPUR	0.61	0.60	0.61	0.58	0.58	0.58	0.59	0.58	0.58	0.57	0.60	2.2
PULSES												
ASSAM	0.55	0.56	0.56	0.54	0.56	0.57	0.54	0.56	0.56	0.57	0.39	2.16
HARYANA	0.57	0.62	0.79	0.66	0.72	0.79	0.62	0.82	0.60	0.98	0.76	16.2
PUNJAB	0.69	0.74	0.67	0.78	0.82	0.80	0.80	0.85	0.80	0.91	0.89	9.01
INDIA	0.64	0.54	0.61	0.54	0.64	0.58	0.59	0.61	0.63	0.66	0.63	6.23
SONITPUR	0.67	0.60	0.57	0.39	0.54	0.57	0.65	0.66	0.58	0.54	0.73	13.7

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of economics and statistics and Department of Agriculture, Govt. of India.

From the above data represented in the table 4.19; it is observed that Assam is the most consistent producer of maize in the country with lowest variation of 1.53 percent in comparison to Haryana and Punjab and the country as a whole. In Sonitpur district the variation level was only 2.2 percent for the period. But if we compare the year-wise yield rate the productivity of maize in the state and in the district is quite low in comparison with Haryana and Punjab. It was so because maize was not cultivated in large scale in the state. Less than one percent of total cropped area of the state was used for production of maize during the period. The co-efficient of variation of Haryana (9.74 percent) was less than country's variation (10.56 percent), but the variation in Punjab (13.79 percent) was more than the country's level.

In case of productivity of pulses Assam was becoming as a more consistent state with 2.16 percent variation during the period in comparison to Haryana (16.2 percent), Punjab (9.01 percent) and the country as a whole (6.23 percent). But the variation of the district is quite high i.e., 13.7 percent. But year-wise yield rate of the state and the district was less than Punjab and Haryana but almost equal to country's average. Low variation in pulse productivity in Assam was due to low percentage of land and traditional technique for production was used for the production of pulses during the period. Only 3 percent of total cropped land was used for production of pulses in the state during the period.

In case productivity of rape seeds and mustard Assam became a more consistent producer with lower variation of 5.88 (table 4.20) percent in comparison with Haryana with variation of 14.7 percent and Punjab 8.68 percent during the period. But the variation in the district was quite high in comparison to states and the national variations. But the year-wise

productivity of Assam and the district was quite low in comparison to Haryana and Punjab as well as national average. Lowest variation in productivity in Assam was due to low percentage of land used for production and traditional inputs and techniques of production. During the period only around 7.0 percent of total crop land in Assam was used for production of rape seeds and mustard. In case of non-food-grains, inter-state variation in productivity of major crops in Assam is quite high than the other agriculturally competent states in India. The following table shows the clear picture about inter-state variations in yield rate of major non-food grains during the period of 1999-2000 to 2009-10.

Table: 4.20

Inter-state variation in YIELD RATE of major non-food gains during the period 1999-2000 to 2009-10 of selected districts of Assam, (yield rate in tonne/hectare, for jute yield rate: bales/hectare, C.V: Co-efficient of variance in percentage)

RAPE SEEDS AND MUSTARD												
STATE	1999- 2000	2000 -01	2001 -02	2002 -03	2003 -04	2004 -05	2005 -06	2006 -07	2007 -08	2008 -09	2009 -10	C.V
ASSAM	0.45	0.51	0.50	0.49	0.52	0.53	0.46	0.49	0.52	0.54	0.55	5.88
HARYANA	1.32	1.37	1.49	1.15	1.56	1.18	1.12	1.34	1.19	1.74	1.65	14.7
PUNJAB	1.13	1.21	1.20	0.91	1.19	1.03	1.10	1.12	1.18	1.22	1.29	8.68
INDIA	0.96	0.94	1.00	0.85	1.16	1.04	1.12	1.09	1.00	1.14	1.16	9.33
SONITPUR	0.54	0.60	0.69	0.59	0.55	0.59	0.44	0.47	0.49	0.75	0.60	15.8
SUGARCANE												
ASSAM	36.8	36.9	37.2	36.4	38.6	23.9	23.4	39.6	38.0	38.4	39.1	15.8

INDIA	70.9	68.6	67.4	63.6	59.4	94.8	66.9	69.0	68.9	64.6	66.1	4.6
SONITPUR	45.38	40.1	37.8	38.4	39.1	36.3	38.5	39.6	38.0	38.4	39.1	7.44
JUTE												
ASSAM	9.66	9.61	9.89	10.2	10.4	7.06	10.2	9.67	10.9	10.7	10.9	10.2
INDIA	10.2	10.3	11.1	10.8	11.1	11.2	12.0	12.0	11.6	11.5	12.5	5.50
		7	5	9	6	2	7	6	7	1	1	
SONITPUR	12.7	10.2	9.29	9.46	9.57	8.75	9.31	6.00	6.79	6.67	6.60	21.8

Source: Compiled and Estimated from data collected from basic agricultural statistics, Directorate of economics and statistics and Department of Agriculture, Govt. of India.

From the above table it can be observed that, in case of productivity of sugarcane, the yield rate of national level is quite high in comparison with the year-wise productivity of Assam and the district. The yield rate of nation is quite consistent (C.V:4.6 percent) in comparison to Assam with level of variation 15.8 percent and the district 7.44 percent during the period. Similarly, the productivity of jute (bales per hectare) in national level is quite high in comparison to Assam and the district during the period. The coefficient of variation in yield rate in national level was 5.50 percent which was quite low in terms of Assam (10.2 percent) and the district (21.8 percent).

From the forgoing analysis, relating to Inter-District and inter-state Variations in Productivity of Selected Crops in Assam and in the district, the following observations can be made:

- The variation of yield rate of rice in the district was quite high during the period in comparison with the state level as well as the districts like

Karbi Anglong, Dhubri, Nagaon, Barpeta and Jorhat. But variation area was comparatively low.

- The variation in production, yield rate and area of wheat crop was comparatively high in the district during the period.
- In case of maize productivity the co-efficient of variation of yield, area and production of the district was low in comparison to other district except Karbi Anglong.
- The variation of area and production of pulse production of the district was high but low in comparison to other district but yield rate is not so consistent like Karbi Anglong and state level.
- In case of production of selected non food grains in the district, the coefficient of variation of area, production and yield rate was higher than the variation in state level except yield of sugarcane.
- In terms of inter-state variation, the productivity of rice in Assam and the district was quite low in comparison with Haryana and Punjab and the national level.
- In productivity of maize and pulses Assam seemed to be more consistent than Haryana and Punjab because lower percentage of land and traditional inputs and techniques used for production of these crops during the period.
- In production of oilseeds, year-wise productivity of Assam and the district was quite low in comparison with Haryana and Punjab but showed more consistency in yield rate during the period.
- Productivity of sugarcane and jute in Assam and the district was quite low with higher variability in yield rate in comparison with national average during the period.

It was observed that, the year-wise production and productivity of main crops in Assam and in the district was not consistent. This is due to natural, technical and socio- economic factors which are responsible for dismal growth in the sector. But since the sector provides livelihood to major portion of population in Assam it is very necessary to attain a sustainable growth in productivity. The inconsistency in production and productivity of food grain creates economic instability among the farmers because large proportions of farmers are marginal and subsistence level farmers. Besides, it also creates insecurity among the farmers in the maintenance of their family since farming is only the source of livelihood in rural Assam. These variations are mainly due to natural, technological and socio-economic factors. The economic development of the state can sustain a reasonable growth rate of development if the productions of main crops attain a consistent return over the years.

Co-efficient of variance= (standard deviation/ mean) x 100

CHAPTER V:

ECONOMIC REFORMS AND ITS IMPACT ON AGRICULTURAL SECTOR IN ASSAM AS WELL AS SONITPUR DISTRICT

Growth rates in Area, Production and Productivity of major food grain and non-food grains

Productivity gain through technical efficiency and input growth during the period

Sectoral Contribution to GSDP

CHAPTER V

Economic Reforms and its Impact on Agricultural Sector in Assam as well as Sonitpur District

The economic (both micro and macro) reforms was introduced in India since the middle of 1991 have received wide attention globally. Specifically, structural reforms were introduced in industrial, trade and financial sectors to increase productivity by improving efficiency and to increase the competitiveness of the Indian manufacturing sector. Though these reforms are welcome but they have attracted some criticism. One such criticism is that agriculture and allied sectors which provide livelihood for the majority of the population, were largely left untouched by reform measures. When agriculture is given a wider and stronger commercial orientation through diversification and value addition, this would encourage both public and private investment in the sector. The profitability in agriculture would induce further technological progress and rising productivity. Such improvement in output, productivity and income would further fuel manufacturing sector growth through increased demand for inputs and consumer goods. It is also argued that improvements in agricultural productivity would induce resource flows from agriculture to the manufacturing sector, thereby stimulating its growth. These arguments are based on the assumption that a two-way relationship exists between agriculture and manufacturing sectors in India, and that the initial stimulus for accelerated growth should be initiated within the agricultural sector. If these assumptions are valid, then the government's approach of concentrating on the industrial sector is not wrongly focused, as suggested by some critics, but rather should be balanced with a higher priority for agriculture.

India, which is one of the largest agricultural-based economies, remained closed until the early 1990s. By 1991, there was growing awareness that the inward-looking import substitution and overvalued exchange rate policy coupled with various domestic policies pursued during the past four decades, limited entrepreneurial decision making in many areas and resulted in a high cost domestic industrial structure that was out of line with world prices. Hence the new economic policy of 1991 stressed both external sector reforms in the exchange rate, trade and foreign investment policies, and internal reforms in areas such as industrial policy, price and distribution controls, and fiscal restructuring in the financial and public sectors. In addition, India's membership and commitment to World Trade Organization (WTO) in 1995 was a clear sign of India's intention to take advantage of globalization and face the challenge of accelerating its economic growth.

The initiation of economic reforms in India in 1991 brought about major changes in the macroeconomic policy framework of the planned economy that existed in India during 1950-51 to 1990-91. Although no direct reference was made to agriculture, it was argued that the new macroeconomic policy framework, in particular, changes in exchange and trade policy, devaluation of the currency, gradual dismantling of the industrial licensing system and reduction in industrial protection would benefit tradable agriculture by ending discrimination against it and by turning the terms of trade in its favour. This, in turn, was supposed to promote exports leading to rapid agricultural growth

It is worth mentioning that Agricultural sector occupies a very important place in the economy of the state of Assam and the district because large proportion of the population engaged them in agriculture and allied activities. To a large extent, agriculture in Assam and the district means the

growing of paddy, which occupies about 70 percent of the gross cropped area and more than 90 percent of the total area under food grains. The other important food grain crops are maize, wheat and other millets, pulses etc. The agriculture is mainly dependent on monsoon rains that cause severe flooding and submergence. The climatic risk is a major factor constraining the adoption of improved technology, the state is lagging behind in the production and productivity of both food grains and non-food grain crops as compared to agriculturally developed states of the country. Though agriculture sector was not directly referred in economic reform adopted by India in 1991, but its cumulative effects can be seen on the sector in recent years. It is in the light of the impact of economic reform on agriculture, the present chapter is an attempt to analyze the sectoral contribution of the sector and growth performance of selected food grains and non-food grains for the period of 1999-2000 to 2009-10. Compound growth rates of area, production and productivity of four major food grains namely rice, wheat, maize and pulses and four major non-food grains namely rape seeds and mustard, jute, potato and sugarcane were calculated for the aforesaid period. Besides this, it was tried to analyze the productivity gain through technical efficiency, input growth and technological progress and infrastructural development index.

To evaluate the impact of reforms whether it was positive or negative on the agriculture in Assam in general and Sonitpur district in particular, it is necessary to analyze growth of area, production and productivity during the study period. Different experts have used different methodology to measure the agricultural growth rates. In the study, compound growth rates have been estimated for area, production and productivity by fitting a semi logarithmic trend function of the form:

$$Y = e^{a+bt}$$

Where, $Y = \text{Area/Production/Yield}$

By taking logarithms of both sides of the equation, it takes the following form:

$$\mathbf{\text{Log } y = a + bt}$$

Where,

$Y = \text{Area/Production/Yield}$

$a = \text{Constant}$

$b = \text{Growth Rate}$

$t = \text{Time.}$

A brief analysis have also done on productivity gain due to technical efficiency and input growth on the basis of available information and data regarding the district and the state as a whole.

To analyze the impact of economic reform on state domestic product, sectoral contributions of different sectors in percentage have been done on the basis of secondary data published by government.

5.1. GROWTH RATES IN AREA, PRODUCTION AND PRODUCTIVITY OF MAJOR FOOD GRAIN AND NON-FOOD GRAINS

Rice is the most important food grain crop occupying more than 70.0 percent of total food grains area in the district and the state. But due to various constraints deep rooted in the process of agricultural production, the production and productivity of rice could not be raised to the highest possible

extent. The following table gives detail picture about compound growth rate in production and productivity of Assam as well as Sonitpur district.

Table: 5.1

Compound Growth Rate in area, production and productivity of selected crops in Assam and Sonitpur district (in percentage) during 1999-2000 to 2009-10

crops	ASSAM			SONITPUR		
	Area	Production	Productivity	Area	Production	Productivity
Autumn Rice	-0.19	-17.43	0.0038	-0.39	-0.18	0.01
Winter Rice	-0.06	8.51	0.01	0.06	4.44	0.02
Summer Rice	0.04	18.48	0.03	0.79	2.66	0.09
Total Rice	-0.21	-2.81	0.01	0.54	6.37	0.02
Wheat	-0.02	-2.9	-0.01	0.03	-0.00145	-0.002
Maize	-0.0013	-0.06	0.0026	-0.0152	-0.007	-0.002
Pulses	0.0018	-0.02	0.00045	-0.09	-0.02	0.01
Rape and mustard	-0.06	-1.56	0.0037	-0.26	-0.06	-0.00045
Jute	-0.01	-10.05	0.11	0.02	-2.7	-0.51
Potato	-0.0008	-16.66	-0.21	0.15	3.42	0.26
Sugarcane	0.00073	0.55	0.10	0.15	5.90	-0.06

Source: Estimated from data collected from basic agricultural statistics, Directorate of Agriculture, Khanapara, Assam and Economic Survey 2010-11 Assam.

Figure 5.1

Growth in area, production and productivity of RICE in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10

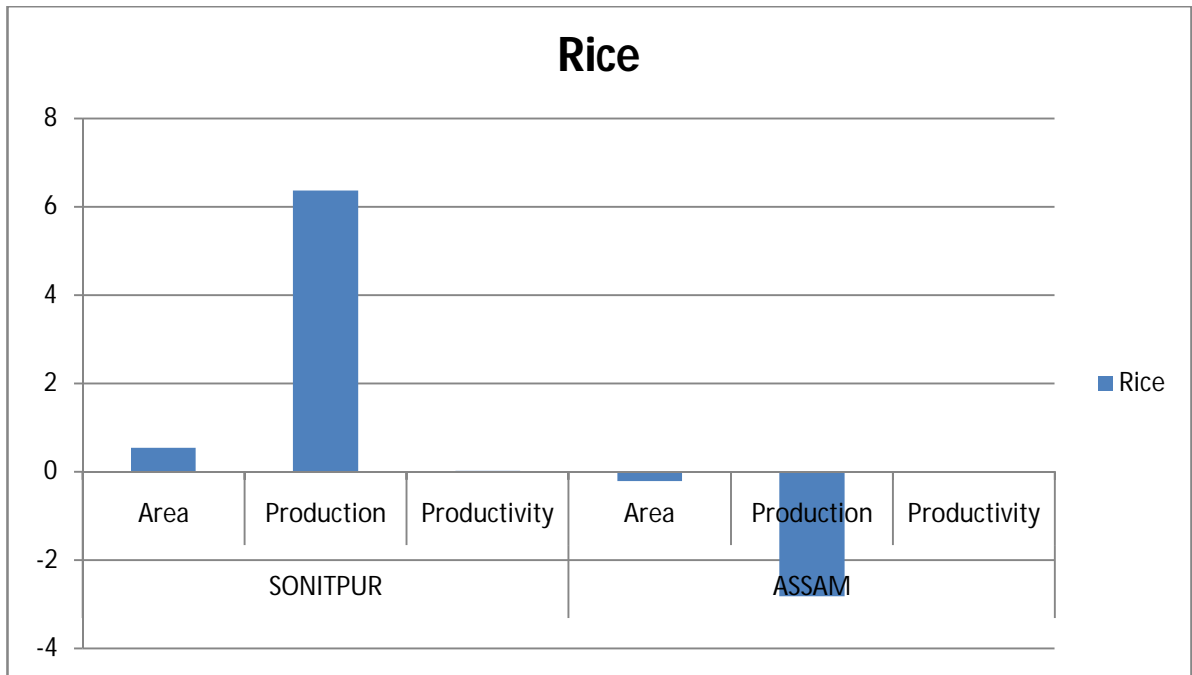


Figure 5.2

Growth in area, production and productivity of WHEAT in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10

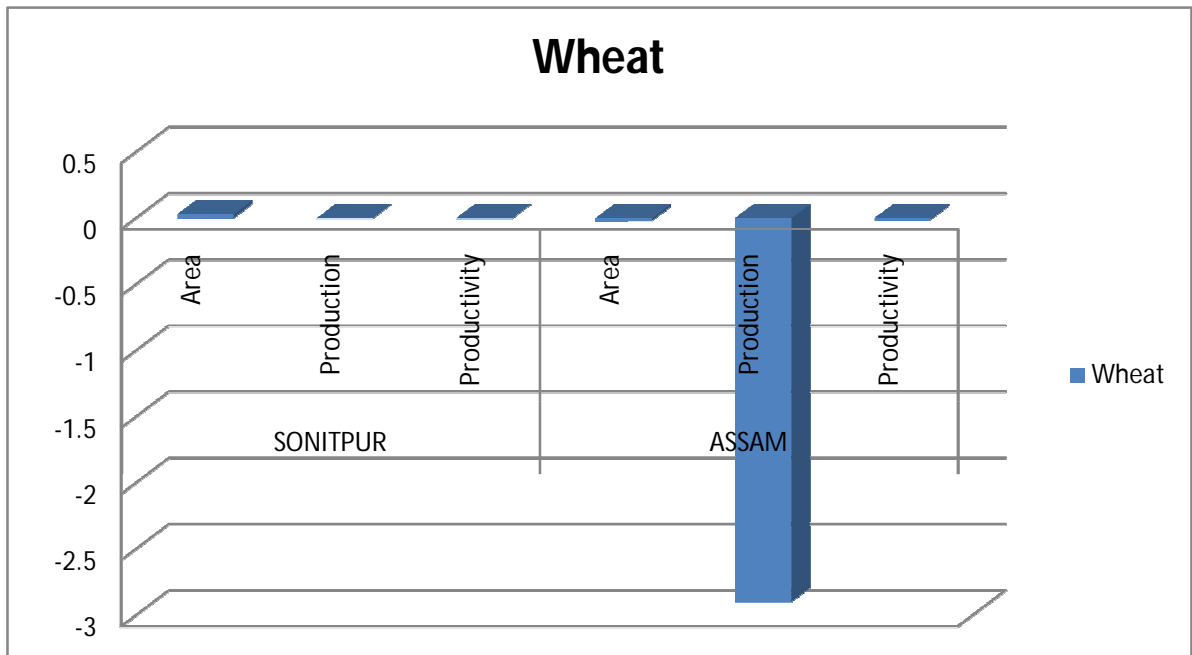


Figure 5.3

Growth in area, production and productivity of MAIZE in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10

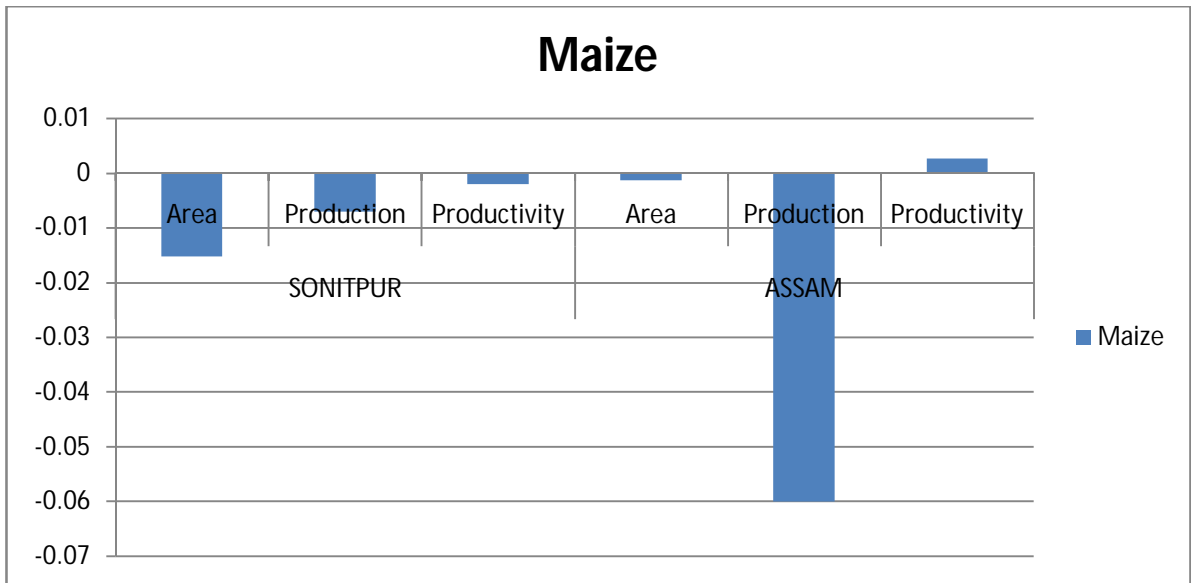
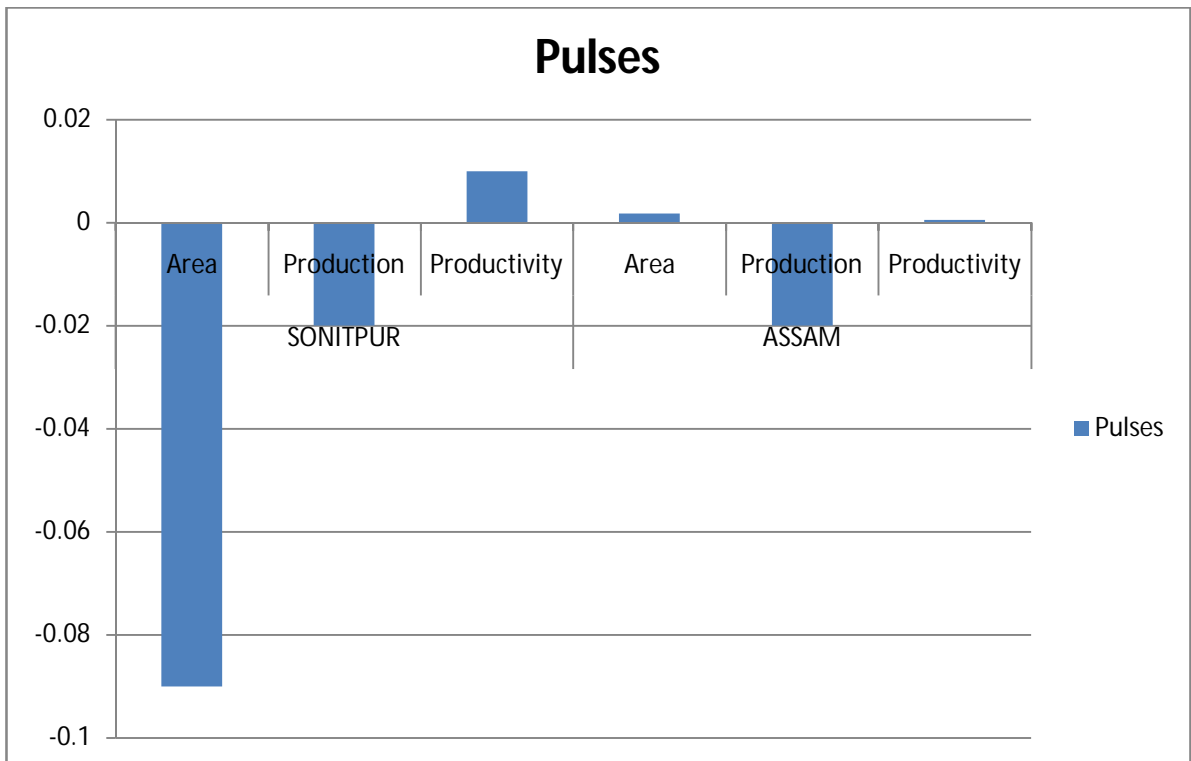


Figure 5.4

Growth in area, production and productivity of PULSES in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10



From the table 5.1, it is evident that the growth rate of rice in terms of area, production and productivity in Sonitpur district was positive during the period. During the period the growth rate of area under rice and productivity was 0.54 and 0.02 percent but the production growth rate was very significant. The growth rate of production of rice recorded as 6.37 percent which was the highest growth rate among the crops in the district during the period. But the picture of growth of production, productivity and area in state level is not satisfactory. The growth rate of area and production was negative (-0.21 and -2.18 percent) but growth rate of productivity of rice was positive (0.01 percent). This is because some districts of the state chronically affected by flood and other natural hazards during the period. The productivity of Autumn rice registered negative growth rate in the district as well as in the state. But the growth rate of production in the state was highly significant because it decreases at the rate of -17.43 percent during the period. The area expansion under the Autumn rice also has negative growth both in the district and the state but yield rate showed positive growth during the period. The growth rate of area, production and productivity of Winter rice in the district registered positive growth during the period. Production of rice during the period in the district increases at the rate of 4.44 percent with 0.06 and 0.02 percent increase in area and productivity respectively. The production and productivity of the winter rice in the state showed positive growth rate except the area. Increase in production (8.51 percent) was highly significant in the state. The Summer rice in the district and in the state as a whole registered positive growth in area, production and productivity during the period. The growth rate of production of Summer rice was highly significant for the district and for the state as a whole because in the district it was increases at

the rate of 2.66 percent and in the state its growth rate was 18.48 percent during the period. The growth rate of area was 0.79 percent for the district and 0.04 percent for the state. The productivity of the Summer rice during the period increases at the rate of 0.09 percent in the district and 0.03 percent for the state as a whole. The increase in growth rate the area, production and productivity of Summer rice during the period in Assam and in the district was due to its higher productivity and low risk of natural hazards, pest attack etc.

Although Wheat is not the main food crops of the district and the state, but the growth rate of area in the district was positive during the period. Growth rate of area in the district was 0.03 percent for the period but production and productivity registered negative growth rate (-0.00145 and -0.02 percent). In the state as a whole the performance of wheat was not satisfactory. It registered negative growth rate in expansion of area, production and productivity. The growth rate of area of wheat during the period was -0.02 percent and production and productivity was -2.9 percent and -0.01 percent. Maize is also one of the main food crops of Assam as well as of the district. But the performance of maize was also not satisfactory in Assam and the district. In the state as a whole the growth rate of area and production during the period was negative only productivity growth rate was positive. The growth rate of area and production in Assam was -0.0013 and -0.06 percent and growth rate of productivity was 0.0026 percent. The performance of maize in the district during the period was not at all satisfactory. The area, production and productivity of maize in the district registered negative growth rate as -0.015, -0.007 and 0.002 percent respectively during the period. This is because of giving more importance in rice and its production in the district.

The growth performance of pulses in the state was comparatively better than wheat and maize during the period. Though growth rate of pulses was negative (-0.02 percent) in the state but growth rate of area and productivity was positive. The growth rate of area and the productivity in the state was 0.0018 and 0.00045 percent in the state. But in the performance of pulses in the district was not like performance of rice. Only the growth rate of productivity of pulses was positive (0.01 percent) in the district and growth rate of area and production (-0.09 and -0.02 percent) was negative during the period. The main cause of negative growth of area and production of pulses was dominancy of rice in crop field of the district.

NON-FOOD GRAINS

According to table 5.1, the growth rate of productivity of rape seeds and mustard in the state as a whole was positive (0.0037 percent) but the growth rate of area and production in the state was negative during the period. The performance of rape seeds and mustard in the district was not satisfactory during the period. The growth rate of area was -0.26 percent, productions - 0.06 percent and productivity 0.00045 percent during the period. Although Jute is one of the main non-food crops in Assam and the district but it was observed that the area and production of jute continuously decreases in the state during the last few decades. In the period of 1999-2000-2009-10, no doubt this trend was maintained but the growth rate of productivity of jute become positive as 0.11 percent. The growth rate of area and production of the jute in Assam was -0.01 and -10.05 percent during the period. The growth rate of production of jute was highly significant because it decreased sharply during the period. In the district jute registered positive growth rate (0.02 percent) in area expansion but negative growth in production and

productivity. The production of jute in the district also declined sharply at the rate of -2.7 percent during the period.

Figure 5.5

Growth in Area, Production and Productivity of RAPE SEEDS AND MUSTARD in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10

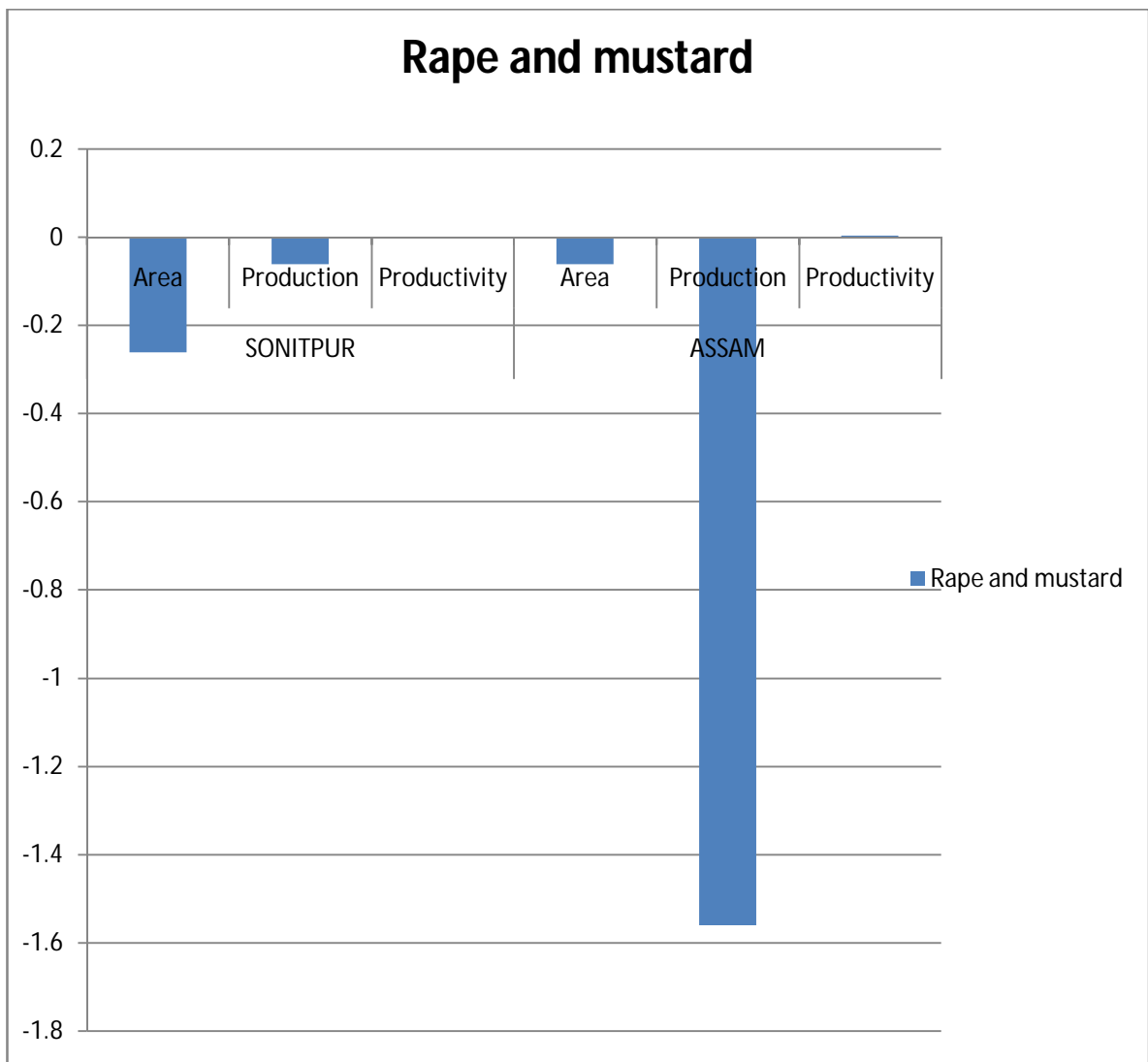


Figure 5.6

Growth in area, production and productivity of JUTE in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10

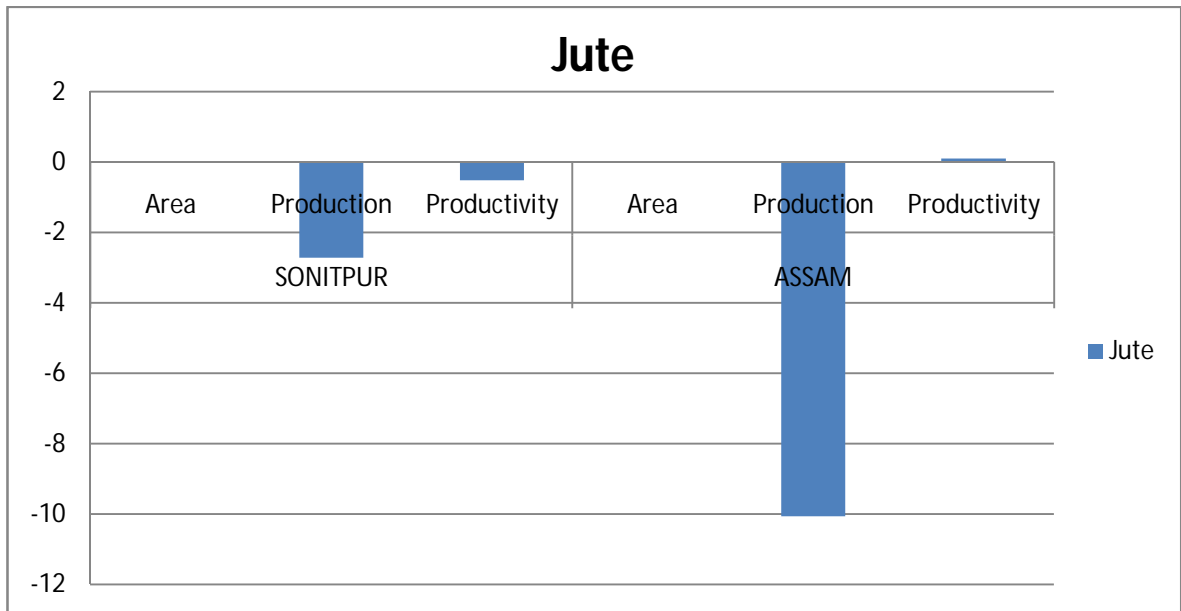


Figure 5.7

Growth in area, production and productivity of POTATO in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10

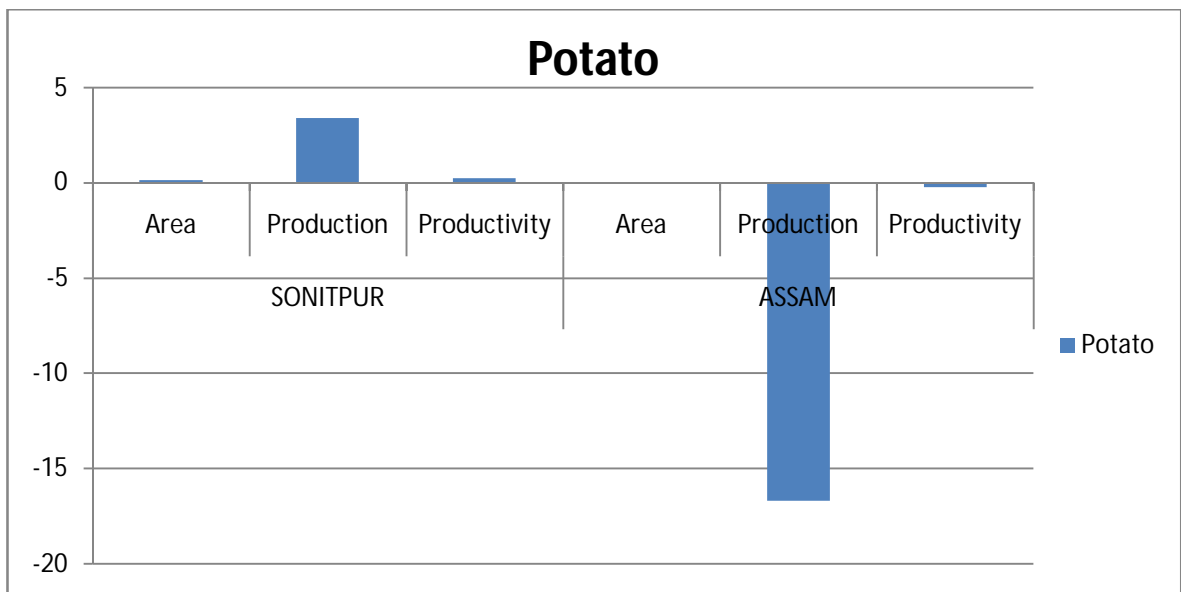
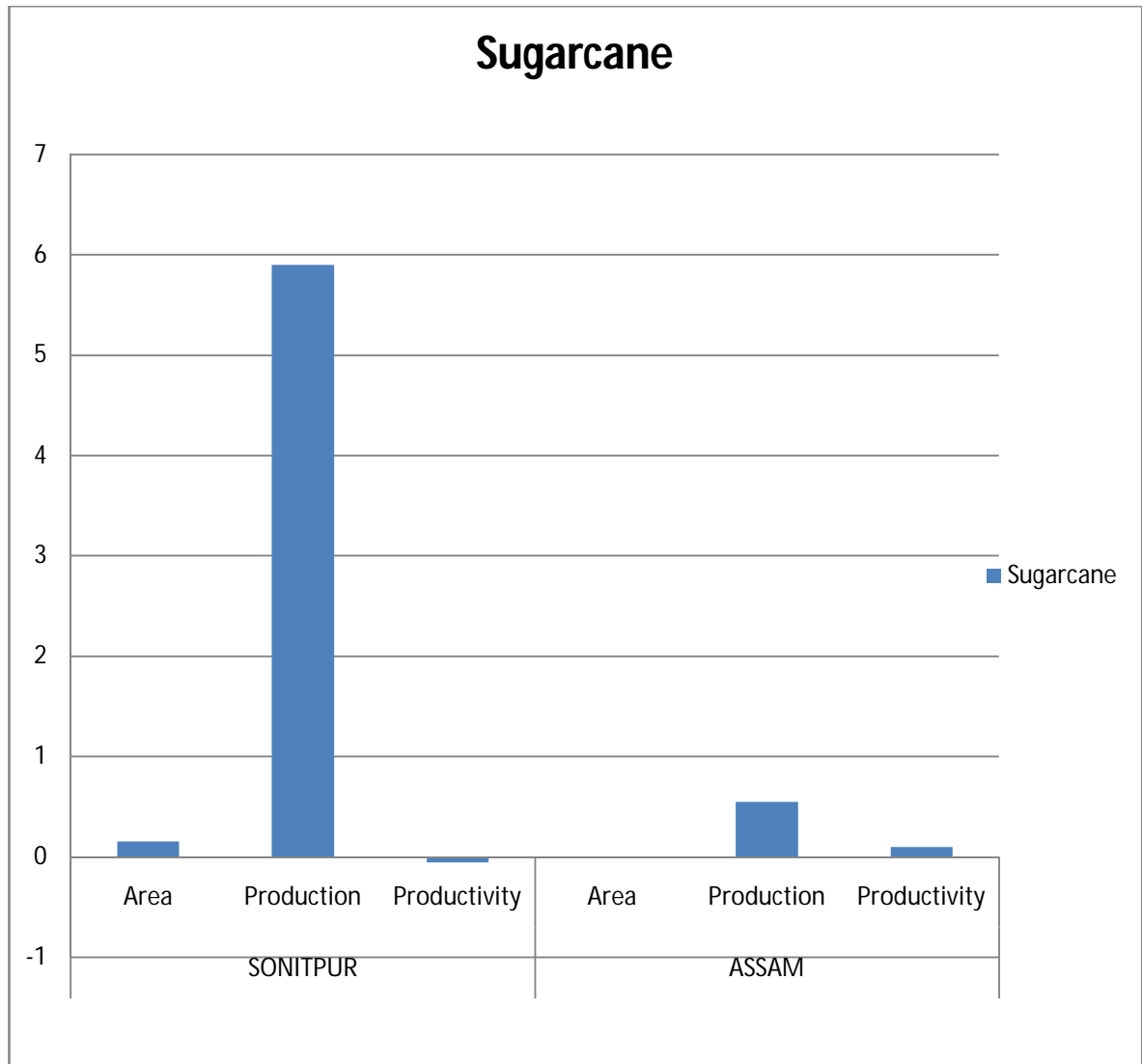


Figure 5.8

Growth in area, production and productivity of SUGARCANE in Sonitpur district and Assam (in percentage) during 1999-2000 to 2009-10



On the other hand, the performance of potato in the state was not also satisfactory. The decrease in area during the period was not so significant but decrease in production at rate of -16.66 percent was highly significant. The productivity of potato in Assam was also negative (-0.21 percent) during the period. But in the district, performance of potato was comparatively satisfactory during the period. The production of potato increased at 3.42 percent during the period in the district. The growth rate of area and

productivity was also positive. The area under potato increased at the rate of 0.15percent and the productivity at the rate of 0.26 percent. The growth performance of sugarcane in Assam as a whole was comparatively satisfactory during the period. The production of sugarcane in the state was increased at the rate of 0.55 percent during the period with increase in productivity at the rate of 0.10percent. The area under sugarcane in the state also increased marginally in the state during the period. In the district the production of sugarcane increased at rate of 5.90 percent during the period, which was highly significant for district agriculture. The area under sugarcane also increased at the rate of 0.15 percent but the growth rate of productivity of sugarcane registered negative (-0.06 percent) rate during the period.

5.2. PRODUCTIVITY GAIN THROUGH TECHNICAL EFFICIENCY AND INPUT GROWTH DURING THE PERIOD

Agricultural development of any state depends a great deal on the availability of adequate and assured irrigation facilities. Assured irrigation especially during winter months is an imperative need for the optimum utilization of chemical fertilizers and HYV seeds. Irrigation also enables diversification of crop. Unfortunately agriculture in Assam has continued to be determined by rainfall, which is unequally distributed through the seasons. Sometimes, heavy rainfall during monsoon causes floods, sometimes, long dry spell occurs even during the monsoon. Hence expansion of irrigation facilities to bring more areas under assured and controlled water supply has been the main element of strategy for development of agriculture in the state. This is also necessary to induce the farmers to change their existing cropping pattern and to go for a second crop in dry winter.

The state agriculture department has prioritized improvement of irrigation facilities in the state and accordingly created irrigation potential of 4.57 lakh hectares through distribution of Sallow tube wells and low lift pumps etc., with support from/state sponsored schemes. However, there exists gap between irrigation potential created and actual utilization. It was evident from the table 5.2 that the irrigation facilities in the state was highly fluctuates during the period. According to provisional report total area under irrigation facilities provided through canals and tube wells in 2009-10 was 168853.56 hectares. The irrigation facility in Assam over the period of 2001-02 to 2009-10 is represented in the following table.

Table: 5.2

Gross area irrigated under govt. irrigation facilities in Assam (area in hectare)

Year	Irrigation facilities		
	Canals	Tube wells	Total
2001-02	110514.77	2964.86	113479.63
2002-03	77595.85	1781.60	79377.45
2003-04	68594.78	802.5	69397.28
2004-05	60182.34	580.03	60762.37
2005-06	66437.71	701.45	67139.16
2006-07	121409.41	5046.41	126455.82
2007-08	86522.53	2747.46	89269.99
2008-09	94137.67	1533.02	95670.69
2009-10 (provisional)	162089.52	6764.06	168853.58

Source: Statistical Handbook of Assam 2010.

Agricultural activity in the Sonitpur district is mainly rain fed. In recent years the irrigation department of state government takes some steps to create

some irrigation facilities in the district. Irrigation potential created through government irrigation schemes cover 61533 hectares in total, out of which 28878 hectares under minor irrigation scheme and 32655 hectares under in major and medium irrigation in 2009-10. From the table 5.4.2 and 5.4.3, it was evident that crop area of operating Minor Irrigation Schemes (FIS/LIS/DTW/STWS) under Tezpur Division and Biswanath Chariali Division which were completed during the period in different block was not sufficient for targeted development of agriculture. The following tables show the minor irrigation schemes of Tezpur sub-division and Biswanath Chariali Division in Sonitpur district.

Table: 5.3

List of operating Minor Irrigation Schemes (FIS/LIS/DTW) under Tezpur Division (FIS: Flow Irrigation Scheme, LIS: Lift Irrigation Schemes, DTW: Deep Tube Well Scheme, STWS: Shallow Tube Well Scheme, NIA: Net Irrigated Area, AIA: Aggregate Irrigated Area)

Name of scheme	Name of Block	Estimated potential (in hectare)			
		NIA	Rabi	Kharif	AIA
Panbari FIS	Dhekiajuli	784	Nil	784	784
Koloney FIS	Balipara	500	Nil	500	500
Dherai FIS	Dhekiajuli	1004	Nil	1004	1004
Benganajuli FIS	Dhekiajuli	350	100	350	450
Borsola FIS	Borsola	800	Nil	800	800
Panchnoi FIS	Dhekiajuli	548	Nil	548	548
Monai FIS	Naduar	300	200	200	400
Chataichapori LIS	Gabharu	120	72	120	192
Ulubari Naharbari DTW,I/S	Dhekiajuli	80	48	80	128

Dekargaon DTW.I/S	Balipara	80	48	80	128
Bindukuri DTW.I/S	Balipara	80	48	80	128
Bihaguri DTW.I/S	Bihaguri	80	48	80	128
New Tarajan DTW.I/S	Dhekiajuli	120	72	120	192
Morabharali DTW.I/S	Gabharu	40	24	40	64

Source: Office of the Superintending Engineer, Tezpur Circle (Irrigation).

Table: 5.4

Completed Schemes under Biswanath Chariali Division (Irrigation)

Name of the scheme	Block	Potential in hectare		
		Kharif	Rabi	AIA
Moujuli FIS	Sakomatha	1950	780	2730
Dirring FIS	Sakomatha	1200	--	1200
Pavi FIS	Baghmara/ Sakomatha	800	--	800
Sakomatha FIS	Sakomatha	1100	--	1100
Sadharu FIS	Sakomatha	1000	--	1000
Burigong FIS	Baghmara/Biswanath	1000	--	1000
Gelapukhuri FIS	Baghmara	1000	--	1000
Jingia FIS	Baghmara	400	--	400
Behali FIS	Behali	880	--	880
Mornoi FIS	Sootea	300	--	300

Panibharai LIS	Biswanath	520	234	754
Sootea LIS	Sootea	160	40	200
Dhanibeel LIS	Pud-Chayduar	300	126	426
Petulibari DTWS	Sakomatha	80	14	94
Areamola DTWS	Sootea	40	10	50
Buroi Helem DTWS	Chayduar	80	10	90
Kathonobari STWS	Baghmara	21	5	26
Japoriguri STWS	Baghmara	22	8	30
Botiamari STWS	Behali	12	4	16
Sialmari STWS	Behali	30	2	32
Brahmajan STWS	Chayduar	12	2	14
Thalipukhuri STWS	Chayduar	18	2	20

Source: Office of the Executive Engineer, Biswanath Chariali Division (Irrigation).

However, fertilizer is considered as one of the most essential inputs for increasing the agricultural production. However, consumption of fertilizer in the state is still low. Although an increasing trend is observed as regards consumption of fertilizer in absolute terms in Assam, its consumption in NPK is far below the level achieved by other states as well as national level. According to the data available from the state Agricultural Department, the total consumption of NPK fertilizer in the state was 213.94 thousand MT in 2007-08. The following table shows the season wise consumption of fertilizers (in '000MT) in Assam.

Table: 5.5**Season wise consumption of fertilizers (in '000MT)**

Year	Season	Consumption in terms of materials					Consumption in terms of Nutrients			
		Urea	SSP	MOP	DAP	Total	N	P	K	Total
2005-06	Kharif	77.19	51.09	35.42	37.61	201.31	42.28	25.48	21.25	89.01
	Rabi	94.43	66.92	45.53	41.37	248.23	51.34	29.74	27.32	108.40
2006-07	Kharif	95.53	40.95	32.24	29.08	197.80	49.08	20.19	19.44	88.71
	Rabi	93.47	65.06	50.63	38.92	248.08	53.44	30.89	30.55	114.45
2007-08	Kharif	92.88	62.55	44.14	37.34	236.91	49.44	28.52	26.49	104.45
	Rabi	195.41	113.23	92.43	74.83	475.91	103.36	54.61	55.97	213.94
2008-09	Kharif	103.67	49.36	46.66	31.16	229.85	53.30	22.69	28.00	103.99
	Rabi	119.81	37.77	46.39	48.60	252.57	61.70	29.85	31.15	122.69
2009-10	Kharif	111.73	51.07	44.53	26.26	233.59	56.12	20.78	26.72	103.62
	Rabi	139.58	59.38	65.91	38.47	303.34	68.75	28.58	39.54	136.87

Source: Economic Survey 2011, Assam

Both chemical and bio-fertilizer is used in the Sonitpur District in agricultural field to increase the productivity of crops. But average consumption of fertilizer is less in comparison of the other district of Assam. The use of some of the chemicals like plant protection chemicals, pesticides etc, is very insignificant. The following table shows the year-wise consumption and chemicals in the district in past few years.

Table: 5.6**Consumption of fertilizers and chemicals in Sonitpur district (in MT)**

Fertilizers	2004-05	2005-06	2006-07	2008-09
Nitrogenous	1859	1908	1421	1813
Phosphates	1688	2264	1197	1507
Potassic	1172	1257	784	1050
Micro-nutrients	0.15	0.22	0.14	0.30
Bio-fertilizers	2.67lakh MT	3.56 lakh MT	1.32 lakh MT	3.81 lakh MT
Chemicals	Liquid-2120 lit powder-0.826	L-2335 lit P-0.828	L-1210 lit P-0.512	L-1812 lit P-0.716
Bio-pesticides	0.001	0.003	0.005	0.009

Source: Department of Agriculture, Sonitpur Assam.

The consumption of chemical fertilizers and other chemicals in the district in 2006-07 decreases in comparison to previous year. In comparison to other districts of the state, the consumption of fertilizers in the Sonitpur district is average in terms of both chemical and bio-fertilizer.

Agricultural credit facilities another important area for development of agricultural productivities of a region or a state. It provides the necessary means to buy agricultural inputs and technology. However, it has been observed that the various institutions, which are associated with agricultural finance in Assam, have not been able to perform their roles satisfactorily. Despite urgent credit needs among the agriculturists, the demand for loans is observed low. Non adoption of improved methods of cultivation, traditional shyness to borrow loans from financing institutions and procedural difficulties are some of the impediments explaining low volume of credit sanctions/disbursement in the state. As against the target of ₹652.83 crores of credit flow to agriculture and allied activities (including crop loans) under the

annual Credit Plan for 2007-08, banks operating in the state have disbursed ₹ 566.70 crores as on 31st March 2008 achieving 87 percent of the target. On the other hand, target achievement in case of crop loans, which constitute only 21 percent of the total agriculture advances, was calculated as 61 percent during the year. During the period 2003-03 to 2009-10, the flow of credit for agriculture and allied activities registered a growth rate of 41.66 percent. In case of crop loans, the growth was calculated as 42 percent. During 2009-10, the flow of credit for agriculture and allied activities had a significant growth of 55.7 percent over 2008-09. During the said period, the crop loans had a significant growth of 67.02 percent

Table: 5.7

Credit flow to agriculture and allied activities under Annual Credit Plan

Year	Agriculture & allied (in crores)	Crop Loans (CL) (in crores)	% share of CL to agricultural advances	Per capita crop loan (in rupees)	Crop loan per farmer family (in rupees)
2003-04	100.81	43.82	43	16.44	161
2004-05	243.76	79.46	33	29.81	293
2005-06	331.89	84.31	25	31.63	311
2006-07	468.91	79.44	17	29.80	293
2007-08	566.71	121.61	21	45.62	448
2008-09	523.38	203.12	39	76.20	749
2009-10	814.69	359.39	44	134.82	1307
CAGR*(%) 2004-2010	41.66	42.00	--	42.00	41.77
Growth % 2009-10 over 2008-09	55.7	67.02	--	76.9	74.5

Source: Economic Survey 2010-11, Assam.*Compound Annual Growth Rate.

The Kishan Credit Card (KCC) scheme was introduced in 1998-99 to cater adequate timely, cost effective and hassle free credit support to the farmers from the formal banking system. During the year 2009-10, 149822 numbers of KCCs were issued and ₹430.55 crores were sanctioned by the banks operating in the state. Since inception of the scheme, cumulatively about 6.30lakh KCCs have been issued in the state up to March 2010. Thus, the scheme could cover only 23.0 percent of the total farmer family of the state.

It is observed that the low credit facility in agricultural sector is one of the important constraints of development of the sector in the district. Credit is the most important input in agricultural sector for farm mechanization and modernization of agriculture. Most of the farmers of the district are marginal and subsistence level farmer. Their economic condition is so poor that they never think about adopting modern implements in their farming activity. Now a day's commercial bank come forward under initiative of NABARD in the district to provide short and medium term financial assistance for farm mechanization and adoption of modern implements. But this effort is not sufficient to meet the current requirement of the district. Number of KCC (32743 nos. up to 2007) in the district is much less in comparison to other agriculturally develop district of the state.

One of the important modern inputs for agricultural growth is the improved farm machineries and implements like iron plough, tractors, harvesters, oil engines and electric pumps. The present availability of farm power in the state is 0.69HP per Hectare (against national average of 1.20 HP hectares) of which mechanical power is around 50 percent. The growth of

mechanism in Assam is slow.⁴ The Department of Agriculture has given a major thrust on farm mechanization. In order to boost up farm mechanization the department has so far provided 2361 Tractors, 10493 Power Tillers to the farmers and 62 Power Threshers. The Department has taken initiative for introduction of new farm machineries like Rotovator, Reaper/ Binder, Xero Tillage Planter and Combined harvester. Seven Rotovator have already been provided to farmers. Farm mechanization is an important element of modernization of agriculture in the district. Farm productivity is positively correlated with the availability of farm power coupled with implements and their judicious utilization. Proper agricultural mechanization not only enables efficient utilization of various inputs such as HYV seeds, fertilizers, plant protection chemicals and water for irrigation but also it helps in poverty alleviation in the district by making farming an attractive enterprise. In the district total number of tractors is 521 and 1263 nos. of sprayer machines available for the use of farmers but it is not sufficient. Total number of diesel operated tube wells in the district was 7988 up to 2009. Improved agricultural implements and machinery enable efficient use of farm power and help farmers to derive optimum results out of the application of input. Improved implements create better field environment for plant growth at low cost harvesting, threshing machines speed up harvesting operations, thereby increasing cropping intensity besides saving food grains from sudden natural calamities at harvesting time. Unfortunately, despite attempts at modernizing agriculture during the plan period, the most common agricultural implements being used by the cultivator is the power plough. In this context it can be pointed out that the average size of land (1.27hectares) in the state and in the district is not at all economical and convenient for mechanized cultivation.

⁴ Economic Survey of Assam 2010-11

Modernization of agriculture along with spread of literacy in rural areas is not possible without good infrastructure facilities like good road and communication system, adequate marketing facilities, bank services, assured supply of electricity, timely supply of inputs, adequate research and extension service etc. but in Assam, these services are not adequate as per the requirements of the state. The roads of Assam in the rural areas are mainly Kutchra roads and in the rainy season the conditions of these roads are so deplorable that the timely supply of essential inputs to these areas become impossible. The poor means of transport and communication is a major cause of the underdeveloped marketing infrastructure of the state. The Govt. has attempted to establish regulated markets in rural areas but still the traditional market dominates the rural marketing system with all its malpractices. The weekly 'Hats' act as the main market places for the villagers and the middle men are also active as before in these 'Hats'. Improved agricultural marketing is an important condition for agricultural development of a particular region, but in Assam, the government is not successful to establish regulated market and to identify the malpractices prevalent in the trade. There is a network of 224 regulated markets, 1175 rural and wholesale markets in the state. The Assam State Agricultural Marketing Board (ASAMB) has established 24 Regulated Market Committees, 20 Primary Market Yards, 204 Sub-Market Yards, 831 Rural Primary Markets and 344 Wholesale Markets. The regulated markets have been covered under AGMARKNET. Besides, 20 rural wholesale markets and 50 rural hats are being developed in 20 districts under the Assam Agricultural Competitiveness Project (AACP). 33 wholesale and rural markets for horticulture products are also being created under Horticulture Technology Mission.

Regular supply of electricity is also essential for the use of modern technology. Electricity is necessary to energize pump sets for irrigation. With the prevailing irregularity and uncertainty, it has become difficult to ensure irrigation even when pump set are available with the farmers. In Assam only 3 percent of the total electricity consumed has been used for agricultural purpose compared to about 18 percent for all India. The state level consumption of electricity in the agricultural sector for irrigation and other agricultural work is only 6998 MWH during the year 2009-10 which only 0.21 percent of total consumption of electricity in the state (Economic Survey of Assam 2010-11).

The widening network of schedule commercial bank has been playing a crucial role in mobilization of savings and investment in the state. According to the Quarterly Statistics of deposits and credit of Schedule Commercial Banks of Reserve bank of India, march,2008, the number of reporting bank offices of all scheduled commercial banks in Assam stood at 1317, of which, 403 were Regional Rural Banks. The average population covered per bank branch office (based on the census population 2001) in the state stands just above 20,000 in March 2008 which is however quite unsatisfactory in comparison to the all India average of 14,000 population during the same period.

An adequate infrastructure facility is the backbone of economic development of a state or a region. Total road length in the Sonitpur district is 2485 km in 2009-10 out of which 1969 km is rural road, 59 km urban road, 402 km major district road and 55 km state highway (Statistical Handbook of Assam 2010). Total number of bank branches in the district is 118 out of which 88 branches is the Schedule Commercial Bank and 30 Regional Rural

Banks. Total deposits in the Schedule commercial banks are 1721 crores and credit provided by the banks is 819 crores in 2010. Similarly total deposits in the rural banks in 2010 are 229 crores and credit is 120 crores. Total outstanding credit in agricultural sector in the district in 2009 was 113.50 crores. Another important requirement of agricultural development is research and extension services which is very poor in Assam in comparison to its need.

The state of Assam has been experiencing flood in almost every year and around 4.75 lakh hectares is chronically flood prone area. Moreover, due to heavy deforestation around 0.94lakh hectare is drought prone. Therefore, risk hedging has become very important in view of high cost of agriculture and recurring natural calamities in the state. Crop insurance is another area to help the farmers when there is crop damage due to natural calamities, severe infestation of pest and diseases in notified crops. Govt. of India launched a massive programme of Crop Insurance under the National Agricultural Insurance Scheme (NAIS). The National Agricultural Insurance Scheme unfortunately has not been able to provide desired solution to the risk hedging in the agriculture sector in the state. At present, NAIS is covering only 7 crops and some important horticulture crops like ginger etc. are not covered under NAIS. The scheme need to be modified and premium rates should be kept at the affordable level to make it more attractive to the farmers. Although the scheme has covered 2.15 lakh farmers out of the total 27.12 lakh farmer family of the state, only 42000 farmers have been actually benefited. During 2006-07, the Government has released only ₹2.45 lakh keeping a balance of ₹82.46 lakh to clear the claims. During 2007-08, there is a provision of ₹ 4.20 lakh, out of which ₹57.00 lakh has been released to the Insurance Company.

5.3. SECTORAL CONTRIBUTION TO GSDP

The sectoral composition of GSDP both at current and constant (2004-05) prices has undergone considerable change during the past few years. In 2004-05 at constant (2004-05) price the share of agriculture and allied sector was 26 percent, industry 27 percent and services sector was 47 percent. It is evident from the above that over the years the share of agriculture and allied sector in the GSDP has declined from 26 percent in 2004-05 to 23 percent by 2010-11. Though share of contribution of agriculture and allied sector to GSDP decreases in percentage but in absolute sense increases during the period. The industry sector has also shown a gloomy picture of downfall to 20percent in 2010-11 from 27 percent in 2004-05 in the share of the GSDP, while the share of services sector has progressed from 47 percent in 2004-05 to 57 percent in 2010-11. Thus that the state economy has experienced a picturesque change over the periods the primary sector witness a shift to service sector and service sector has flourished very rapidly in the state's economy. The data represented in the table 5.8 can give us a clear picture of sectoral contribution to GSDP.

Table: 5.8

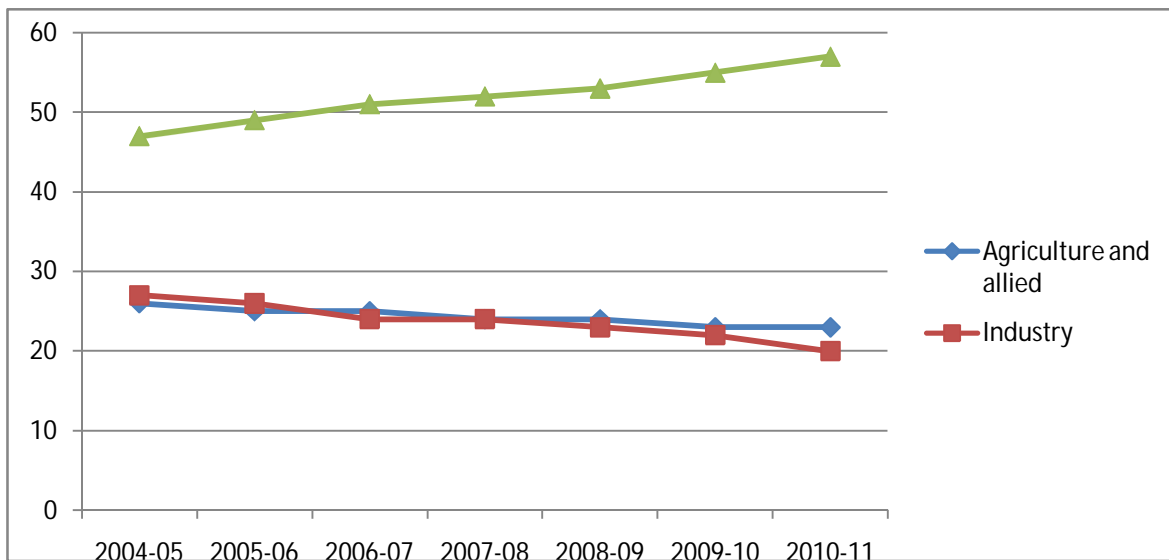
Sectoral Contribution in percentage to Gross State Domestic Product at constant (2004-05) prices

Sector/ Year	Agriculture and allied	Industry	Services
2004-05	26	27	47
2005-06	25	26	49
2006-07	25	24	51
2007-08	24	24	52
2008-09	24	23	53
2009-10	23	22	55
2010-11	23	20	57

Source: Economic Survey 2010-11, Assam.

Figure: 5.9

Sectoral Composition of GSDP (in percentage)



The Assam economy has been growing with the average growth rate at 5.9 percent (Economic Survey, Assam, 2010-11) per annum during the last seven years. Except industry sector agriculture and allied sector and Services sector witnessed notable growth during the period. The agriculture and allied sector recorded 3.97 percent growth as compared to 1.89 percent growth registered by the industry sector during the years.⁵

From the forgoing analysis, relating to the Economic Reforms and its Impact on Agricultural Sector in Assam as well as Sonitpur District, the following observations can be made:

- As it explained above, though agriculture sector was not directly referred in Economic Reform adopted by India in 1991, but its cumulative effect can be seen in production, productivity, technology, agricultural implements and inputs and changes in structural composition of the economy in recent years.

⁵ Economic Survey of Assam 2010-11

- During the period the production of rice in the district was highly significant because it was increased at the rate of 6.37 percent in total. But in the state the growth rate of Winter rice and Summer Rice was highly significant but in total its growth rate was not satisfactory.
- The production of wheat, maize, pulses, rape seed and mustard and jute registered negative growth rate during the period in the state as well as in the district but the growth rate in productivity and in area of some of these crops were positive.
- The production of potato and sugarcane has registered positive growth in the district but in the state the growth rate of sugarcane was positive whereas growth rate of potato was negative.
- It is clear from the above discussion that production can be increased by adopting modern technology, improved inputs and infrastructure with institutional reforms in the agricultural sector.
- During the period there was the change in structural composition in GSDP in the state. The share of services sector continuously increases while the share of primary sector decreases during the period. The share of agriculture and allied sector decreased not in absolute sense but in relative share in comparison to secondary and tertiary sector.

Growth rate was calculated by using semi- logarithmic model of time series analysis in the form of $Y = e^{a+bt}$

i.e, **Log y= a+bt,**

Where, Y= Area/Production/Yield, **a**= Constant, **b**= Growth Rate and t= Time.

CHAPTER VI:

CONSTRAINTS AND PROSPECTS OF AGRICULTURAL SECTOR IN ASSAM AS WELL AS SONITPUR DISTRICT

Institutional Factors:

Land Tenure System

Size of Land Holdings and Sub- Division of Land

Physical Factors:

Rainfall

Flood and Drought

Techno-Economic Factors:

Irrigation

Use of Fertilizer

Use of HYV Seeds

Plant Protection Measure

Mechanization

Rural Electrification

Agricultural Credit

Agricultural Marketing

Transport and Communication

Agricultural Research, Education and Extension Services

CHAPTER VI

Constraints and Prospects of Agricultural Sector in Assam as well as Sonitpur District

Several studies have been made to show that with the growth of production of crops under the impact of modern technology leads to increase in variability in production. Growth capacity depends upon the ability of modern technology to push up the yields while instability is characterized by the degree of assuredness of irrigation and climatic factor (Jain, 1990). The possibility of increased production variability with an increased in yield was first raised in the late 1960's in the context of food grain production in India (Sen, 1967), (Rao, 1968). Sen (1967) suggested that production variability is likely to increase if output growth is achieved through an expansion of cultivation to marginal areas. In addition he hypothesized that this production instability would tend to rise with an increased use of purchased inputs such as fertilizer. Rao (1968) suggested that production variability is likely to increase with the increasing importance of yield growth as the source of output growth. Several other researchers have opined that the increase in variability of food-grains production in India is associated with the spread of modern varieties (Mehra, 1981). Production of a particular crop in any region is the result of area under the crop and its yield per unit area. Yield rate in a region depends on a number of controlled variables like fertilizer, pesticides, irrigation etc., and an uncontrolled set of variables comprising various climatic factors like rainfall, temperature etc. Variation in agricultural production can thus be either man-made or nature made (Jain, 1990). Though

Mehra (1981) and Hazell (1982) made major efforts to identify the sources of instability, yet they have not made any attempt to identify the factors causing instability. Hazell (1982) observed that more likely causes are changes in weather pattern and the more widespread use of irrigation and fertilizer at a time when the supplies of fertilizers and electric power for irrigation perhaps became less reliable.

In the context of the state of Assam as well as Sonitpur district the area, production and productivity of some of crops had significant growth during the period of 1999-2000 to 2009-10. Along with the increase in productivity rate, the variability in yield was also found to have increased during the period. Although the productivity of some agricultural crops has shown a rising trend during the period but it is much lower in comparison to some other states of the country (chapter V). Since the inception of Five Year Planning, various programmes have been undertaken to increase the agricultural production in the state, but till now the yield per hectare in the state is at low level. The agriculture in Assam suffers from various constraints like structural, technological, organizational and socio-economic constraints. Moreover, natural problems also hinder the development of agriculture in the state to a considerable extent. Factors like inadequate agricultural credit, limited supply of irrigation facilities and fertilizers, inadequate extension services were mainly responsible for the poor performance of the agricultural sector in the state. The various development projects, grow more food programme etc. initiated by the government of Assam could not make any substantial impact on the growth of agriculture in the state and in the district. The various factors, which are found to be responsible for low agricultural productivity, are briefly discussed in the following paragraphs.

6.1. INSTITUTIONAL FACTORS

6.1.1. LAND TENURE SYSTEM

Land tenure system has direct impact on the utilization of land and its productivity. Unfortunately, the land tenure system in Assam is not satisfactory. The tenancy system prevailing in the state is not favour of the poor farmers. So it is extremely essential to change the existing agrarian structure to ensure the achievement of the desired objectives in agricultural production in conformity with the accepted concept of social justice. During the plan period, various measures have been undertaken by the government, including different tenancy act to bring about the desired changes in the prevailing tenancy system. These acts provide security for tenants including adhiars, fixation of ceiling on land holdings, reducing inequalities by redistribution of excess land and by consolidation of land holding. These policies are inclusive of land reform measures and the government has tried to make these policies popular and effective among the farmers of the state. But the land reform initiated so far during the plan period has proved to be unsuccessful in Assam. It has been observed (Alam 1989) that one common thing which characterizes the land reform scenario in the various state including Assam is the non- implementation and non- realization of the basic objectives of such policies. Illiteracy and desperate atmosphere of the rural area and lack of proper government initiative are equally responsible for the poor implementation of the land reform policies. The farmers cannot realize the ultimate benefit from those land reform measures. Fragmentation of holdings stands out as one of the chief responsible factors hampering the implementation of the modern technology in agriculture. The consolidation of

land holding is a very important measure of land reforms policy, but the government has not given serious attention for its implementation.

The aim of the Assam Fixation of Ceiling on Land Holding Act 1956 was to reduce inequality in the ownership through redistribution of surplus lands among the landless farmers. The act fixed the ceiling limit as 150 bighas of land which was brought down to 70 bighas and finally to 50 bighas. Though the implementation of the act started in 1961, acquisition of the ceiling surplus land became possible only after 1972. The act was again amended in 1976 to simplify the procedure but for the insincerity in implementation, the act proved to be futile. The tenancy act of 1971 provided for better protection measures for the tenants and share croppers. But it also failed to provide protection to the needy farmers due to lack of proper administrative mechanism to enforce the provision. Total failure on the part of the government in the implementation of land reform measures proved to be one of the main reasons of low production and productivity of main crops particularly rice in the state, because agricultural development is possible only through the improvement of the economic status of the marginal and landless cultivators.

6.1.2. SIZE OF LAND HOLDINGS AND SUB- DIVISION OF LAND

As the family is the unit of labour for agricultural operations in India, land holdings per family and the nature of these holdings affect the economic efficiency of farming. An important feature revealed by the agricultural census. 1991, is that the size of operational holdings in the state recorded a declining trend over the successive censuses. According to the world agricultural census 1970-71, about 60 percent of the operational holdings in Assam are below 1 hectare and 24 percent are in between 1 to 2 hectares.

Thus, nearly 84 percent of the operational holdings are below the minimum economic size of holdings. The following table shows the distribution of agricultural holdings according to the agricultural censuses 2000-01 and 2005-06.

Table: 6.1

**Agricultural Holdings According to Agricultural Censuses of Assam
2000-01 and 2005-06**

Size class (in hectare)	Number of holding		Percentage increase/decrease over 2000-01	Area operated (in hectare)		Percentage increase/decrease over 2000-01
	2000-01	2005-06		2000-01	2005-06	
Marginal (below 1.0)	1699107	1752989	(+)3.17	662780	760145	(+)14.69
Small (1.0-2.0)	561039	591431	(+)5.42	730513	718383	(-)1.66
Semi-medium (2.0-4.0)	351521	317859	(-)9.60	957959	846006	(-)11.69
Medium (4.0-10.0)	95500	82933	(-)13.2	498797	425403	(-)14.71
Large (10.0 and above)	4970	4902	(-)1.4	263529	298606	(+)13.31
Total	2712137	2750114	(+)1.4	3113578	3048543	(-)2.09

Source: Economic Survey, Assam, 2010-11.

According to the Agricultural Census, 2005-06 there were 27.5 lakh operational holdings in Assam covering an area of 30.49 lakh hectares of land in 2000-01. As per the agricultural census, 2005-06, the marginal holdings with less than one hectare of land accounted for 63.7 percent of the total holdings and 24.9 percent of the total operated area of the state in 2005-06. The small holding with size class between 1.0-2.0hectares, shared 21.5 percent of the total holdings and 23.6 percent of the total operated area. On

the other hand, the large holdings (10.0 hectares and above) constituted only 0.18 percent of the total number of holdings and 9.8 percent of the total operated area in the state. The average size of the holdings in Assam decreases continuously from 1.47 hectares in 1970-71 to 1.15 hectares in 2000-01 and 1.11 hectares in 2005-06.

In Sonitpur district, total number of farm families was 154441 operating on the area of 165129 hectares during the said year. The per capita land holding in the district was 1.06 hectare which was less than state average. The following table shows the clear picture of distribution of operational land holding in the district.

Table: 6.2

Operational land holdings in Sonitpur District

Category	Parameter (in hectare)	No. of farm family	Area involved (in hectare)
Very large	Above 4.0 hectare	1817	8401
Large	3.0-4.0	5614	18402
Medium	2.0-3.0	11181	26137
Small	1.0-2.0	53288	35760
Marginal	0.4-1.0	56288	35760
Landless	Less than 0.4	25804	5744
Total		154441	165129

Source: Office of the District Agriculture Officer, Tezpur, Sonitpur.

In the district, 15.0 percent farmers are landless whereas large farmers constitute only 12.0 percent. The percentages of small and marginal farmers are 37.0 and 36.0 percent respectively in the district.

6.2. PHYSICAL FACTORS

In Assam, physical factors like flood and drought are responsible for both low productivity rate and variability in yield of food grain crops particularly rice. Excessive rainfall brings flood while erratic and inadequate rain causes drought in different areas of the states. Flood and subsequent soil erosion, earthquake, drought are classified as the main regular problems in the state.

6.2.1. RAINFALL

Rainfall is considered as the most critical factor affecting the cropping pattern and agricultural productivity. As irrigation is not sufficiently developed in the study period in the state, rainfall plays the significant role in agricultural productivity in Assam. The state receives typical monsoon rain, which is not uniformly regular and adequate in all the seasons and all the regions of the state. The South-west monsoon rains start from the third week of June and they continue up to the middle of September. The state receives during this period about 180 cm of rainfall which constitute about 80 percent of the average rainfall of the state while the remaining 20 percent come in the form of occasional rains from January to May. Though there is copious rainfall in Assam, it varies from year to year in an unpredictable manner. The absence of timely rainfall hampers adversely the agricultural production in the state. For example, if the onset of rain is delayed, sowing of crops is delayed, leading to decreased production of these crops. On the other hand, early showers in March-April are beneficial for some of crops. The following table shows the season-wise rainfall pattern in Assam and in Sonitpur district for the period of 2007 to 2009.

Table: 6.3**Season-wise Rainfall Pattern in Assam and Sonitpur District (in mm)**

Season		Assam			Sonitpur
		2007	2008	2009	2009
Winter (Jan-Feb)	Actual	77.6	41.7	14.2	43.5
	Normal	49.6	50.7	45.8	20.0
	Deviation(%)	56.5	(-17.7)	(-69)	54
Summer (Mar-May)	Actual	410.1	463.9	370.5	490.3
	Normal	654.3	654.3	597.9	384.4
	Deviation(%)	(-37.3)	(-29.1)	(-38)	(-22)
Monsoon (Jun-Sept)	Actual	1432.2	1418.4	1181.9	1290.7
	Normal	1550.0	1469.9	1434.1	1087.6
	Deviation(%)	(-7.6)	(-3.5)	(-18)	(-16)
Post Monsoon (Oct-Dec)	Actual	156.4	124.1	133.6	154.2
	Normal	178.0	178.0	178.0	147.4
	Deviation(%)	(-12.1)	(-30.3)	(-25.0)	(-4)
All Season (Jan-Dec)	Actual	2076.3	2048.1	1700.2	1978.3
	Normal	2431.9	2352.9	2255.8	1639.5
	Deviation(%)	(-14.6)	(-13.5)	(-25.0)	20.7

Source: Compiled from Statistical Handbook of Assam, 2010

From the above table, it was clear that there was deficit in total rainfall in Assam since 2007 which has negative impact on some of the seasonal crops. In 2009, Assam was suffering from 25.0 percent deficit rainfall over

the normal level whereas Sonitpur district receives 20.7 percent additional rainfall over its normal level. This was due to 54.0 percent additional rainfall during the winter season in the district. But in Summer, Monsoon and Post Monsoon season the district registered 22.0 percent, 16.0 percent and 4.0percent deficit in rainfall over the normal level.

6.2.2 FLOOD AND DROUGHT

Flood and drought are the two major natural calamities having profound impact on agriculture Vis-a-vis the entire economy of the state. Unlike the other states in India, agricultural production in Assam suffers mostly from flood than from drought. No district in the plains of Assam is completely immune from flood. Of course, through the time, intensify and duration of flood varies from place to place. Even some areas of two hill districts suffer from time to time flood. Table 6.1 shows the crop-wise flood prone areas in Assam.

In Assam, flood occurs as an annual phenomenon and affects the crop production to a considerable extent. Flood is usually caused by the increased rainfall during the monsoon seasons. The flood problem in the state increased particularly after the earthquake of 1950. Flood damage is more intense on either side of the river Brahmaputra and Barak and their tributaries. Based on the incidence and extent of flood, the state is categorized into two broad areas—chronically flood prone area and occasionally flood prone areas. According to the Department of Agriculture, Assam, flood affected areas of the state was 187.14 thousand hectares in 2010. Total flood affected area in the Sonitpur district was 6.85 thousand hectares in 2010. The following table shows the crop-wise area affected due to flood in Assam 2010 (area in hectare)

Table 6.4**Crop-wise Area Affected Due to Flood in Assam 2010 (area in hectare)**

District	Paddy	Jute	vegetable	Sugarcane	Others	Total
Dhubri	18742	11514	1946	0	2065	34267
Kokrajhar	2235	970	300	0	0	3505
Bongaigaon	2131	1149	465	0	446	4191
Chirang	0	706	640	0	863	2209
Goalpara	9664	1200	410	0	35	11309
Barpeta	12970	1500	1600	0	0	16070
Nalbari	7514	2563	490	0	0	10567
Kamrup (R+M)	7352	842	2971	436	3991	15592
Darrang	13966	1881	2055	49	2014	19965
Udalguri	0	345	1000	0	0	1345
Sonitpur	4889	605	1029	237	88	6848
Lakhimpur	4023	0	90	0	0	4113
Dhemaji	683	0	0	0	0	683
Morigaon	15033	2863	475	0	623	18994
Nagaon	2040	150	80	0	0	2270
Jorhat	10066	0	360	49	75	10550
Dibrugarh	922	0	2382	0	22	3326
Karimganj	8168	0	1127	0	0	9295
Hailakandi	1838	0	156	0	0	1994
Cachar	10045	0	0	0	0	10045
Total crop area affected	132281	26288	17576	771	10222	187138
Anticipated productivity (Kg/hectare)	7541	2100	15940	40257	1442	
Total loss of production (MT) (=>50%)	141370	27602	140081	15519	3508	328080
Estimated loss in terms of money (in crores)	141.46	55.20	140.08	4.66	14.64	356.04

Source: Statistical Handbook of Assam 2010

There may be early floods in April-May or late flood in September-October. Both early and late floods affect crops adversely. However the intensity of floods vary from year to year causing immense suffering to the people by destroying life and property including agricultural assets like standing crops. The extent of flood damage in agriculture in 2010 was ₹ 356.04 crores out of which total damage in paddy were ₹141.46 crores (table 6.4). It clearly indicated that the losses due to flood have was not small in amount. Flood cause damage to agricultural lands in several different ways reducing drastically their productivity. Flood may wash away the nutrient—rich top soil. It may wash away or damage the irrigation facilities (structures). It may also damage the grazing lands and fodder crops, affect grains as well as seeds stored in granaries and destroy cattle population and livestock. However, the extent caused by floods depends on the time of their occurrence. In 2010, total number of flood affected farmers families in was 495.2 thousand out of which 411.01 thousand farmers were small and marginal farmer. In Sonitpur district 148 villages affected by flood during 2010 and of which 12297 farmers families was affected out of which 10207 farmers are small and marginal farmer (table 6.4) Unfortunately, flood occurs in Assam during the main cropping season (i.e., from June to November). The floods that occur during the period of July to September have the most devastating effect on the agriculture of the state as these floods affect the Sali crops that occupy more than 70 percent of the total cropped area. As the damage done to Sali paddy is extensive in the state to change the cropping pattern by shifting emphasis from Kharif to Rabi crops and to practice multiple cropping. The following table shows district-wise agricultural & horticultural crop area of Small & Marginal Farmers (SMF) affected due to flood in Assam, 2010.

Table 6.5**District-wise Agricultural & Horticultural Crop Area of Small & Marginal Farmers (SMF) Affected due to Flood in Assam, 2010**

District	Nos. of villages	Nos. of farmer families	Total crop area (in hectare)	Nos. of SMF	Total cropped area where damage is more than 50%
Dhubri	1084	97313	34267	80770	34267
Kokrajhar	150	3000	3505	2490	3505
Bongaigaon	298	13767	4191	11427	4191
Chirang	33	410	2209	340	2209
Goalpara	110	22018	11309	18275	11309
Barpeta	1307	23150	16070	19215	16070
Nalbari	199	21564	10567	17898	10567
Kamrup (R+M)	601	29088	15592	24143	15592
Darrang	523	79154	19965	65698	19965
Udalguri	775	45250	1345	37558	1345
Sonitpur	148	12297	6848	10207	6848
Lakhimpur	270	12166	4113	10098	4113
Dhemaji	32	1465	683	1216	683
Morigaon	238	38827	18994	32226	18994
Nagaon	43	3064	2270	2543	2270
Jorhat	156	16232	10550	13473	10550
Dibrugarh	296	17002	3326	14112	3326
Karimganj	383	21597	9295	17926	9295
Hailakandi	120	5982	1994	4965	1994
Cachar	230	31848	10045	26434	10045
Assam	6996	495194	187138	411014	187138

Source: Statistical handbook of Assam 2010.

Assam also frequently affected by drought like situation. In the year of 2009-10 total number of villages affected by drought like situation was 15362 in which total number of farmer's families affected was 1595493. Total area affected under Sali paddy was 869342 hectares during the year. In Sonitpur district 1305 villages was affected by the drought like situation during the year and in which 104307 numbers of farmers families was affected. Total area of 41229hectares under Sali paddy was affected due to drought like situation (table 6.6.). The following table shows the district-wise Area damaged due to drought-like situation in Assam in 2009-10.

Table 6.6

District-wise Area Damaged Due to Drought-like Situation in Assam in 2009-10

District	Nos. of villages affected	Nos. of farmer families affected	Total Sali paddy area affected (in hectare)
Dhubri	729	98984	32257
Kokrajhar	1007	107825	65000
Bongaigaon	330	10920	7261
Chirang	308	20430	12628
Goalpara	82	2220	451
Barpeta	718	124705	62930
Nalbari	410	26500	22100
Kamrup (R+M)	1020	96545	80360
Darrang	463	105824	46654
Udalguri	495	31249	18727

Sonitpur	1305	104327	41229
Lakhimpur	570	59725	54400
Dhemaji	523	31700	15015
Morigaon	572	69682	34745
Nagaon	888	292811	93217
Jorhat	215	36074	9284
Dibrugarh	388	18233	4336
Karimganj	607	64830	35200
Hailakandi	300	2400	11850
Cachar	865	80000	30200
Baska	235	5346	2673
Golaghat	953	107131	81160
Sivasagar	335	18335	16442
Tinsukia	800	41000	49000
Karbi Anglong	637	26230	34041
Dima Hasao	607	12467	8182
Assam	15362	1595493	869342

Source: Statistical Handbook of Assam 2010

To sum up, the problem of flood and drought in Assam is a serious and complex in character. It is a major factor contributing to low productivity and instability in production of agriculture in the state. Although various measures have been undertaken by the state government to control the menace of flood

in Assam, the state has not been free from the occurrence of widespread floods, which adversely affect the production behavior of the state.

6.3. TECHNO-ECONOMIC FACTORS

6.3.1 IRRIGATION

Irrigation is the main input of agricultural economy of the state. To cope with the growing problem of food shortage due to formidable increase of population and natural calamities etc., multiple cropping, modernization of agricultural practice in agricultural sector is highly essential. For a sustained development in the agricultural sector availability of assured irrigation facility is undoubtedly the most important prerequisite. Thus, the importance of irrigation development bears special significance in the context of efforts towards economic development of the state.

Assam gets maximum rainfall but the distribution is not even throughout the year. Most of the rainfall occurs during the monsoon period and that too in erratic manner. Moreover, rainfall varies from year to year and place to place. Under such a situation, in absence of irrigation facilities the agrarian economy of the state will be totally dependent on vagaries of nature. Therefore to develop agriculture in the state utmost importance must be given to bring more and more areas under assured and controlled water supply. Unfortunately, the irrigation facilities in Assam continue to be extremely limited till date. The state has abundant water resources and only surface water will be more than adequate for providing irrigation facilities in the state. But unfortunately no concrete efforts were made in this part to harness the water resources for irrigation purpose.

Implementation of irrigation plans and programmes started in Assam from the Third Five Year Plan. During the first and second plans expenditure on irrigation in the state was very insignificant. In the third plan period expenditure allotted for irrigation was ₹2.28 crores. A number of medium size irrigation projects were also taken up during this period. The irrigation potential created in Assam so far covers roughly 17.17 per cent of the total cropped area, which is very poor in comparison to the potential created in some other states of India. In Punjab 92.9%, in UP 68.7%, and in Bihar 49.4% of total cropped area was under irrigation system which were much higher than that of Assam. This indicates that Assam is lagging behind the other states of the country in providing irrigation facilities to the farmers successfully.

The development programmes for improvement of irrigation facility in Assam taken up under two broad heads, viz., Major and Medium Irrigation and Minor Irrigation. While the Irrigation Schemes are classified as Major, Medium and Minor, they are categorized as Surface Flow, Surface Lift (for Major/Medium and Minor) and Ground Water Lift (for Minor only). Three Departments, viz, Irrigation, Agricultural and Panchayat and Rural Development are associated with development of irrigation facilities in the state. While the Irrigation Department, being the nodal department for development of irrigation in the state, executes and maintains Major, Medium and Minor Irrigation Schemes, the irrigation works of the other two departments are confined to minor schemes like Shallow Tube Wells, Low Lift Points and Temporary Minor Irrigation Schemes only.

Out of the gross cropped area of 39.99 lakh hectare of the state the Irrigation Department created potential of 7.76 lakh hectares up to 2009-10 of

which 2.39 lakh hectares through Major and Medium Irrigation Projects and the rest 5.37 lakh hectares Minor Irrigation Schemes including the Shallow Tube Wells and Low Lift Points implemented through Assam State Minor Irrigation Development Corporation (ASMIDC). Gross Irrigation Potential created up to 2009-10 was 239239 hectares under Major and Medium Irrigation Scheme and 536675 hectares under Minor Irrigation scheme.⁶ The following table shows the crop season-wise area Irrigated during the year 2009-10 (provisional) (in hectares)

Table 6.7

**Crop Season-wise Area Irrigated during the year 2009-10 (provisional)
(in hectares)**

District	Kharif	Rabi and pre-kharif	Total
Dhubri	624.0	447.6	1071.6
Kokrajhar	6325.0	16.0	6341.0
Bongaigaon	263.2	34.26	297.46
Chirang	5592.0	1363.0	6955.0
Goalpara	1752.0	411.6	2163.6
Barpeta	12286.0	4088.33	16374.33
Nalbari	189.0	78.55	267.55
Kamrup (R+M)	4540.1	1656.5	6196.6
Darrang	6163.0	1572.0	7735.0
Udalguri	20820.0	790.0	21610.0
Sonitpur	11981.0	15.5	11996.5

⁶ Economic Survey, Assam 2010-11

Lakhimpur	289.0	272.0	561.0
Dhemaji	--	606.0	606.0
Morigaon	554.0	654.5	1208.5
Nagaon	33011.0	6522.85	39533.85
Jorhat	977.0	85.45	1062.65
Dibrugarh	1232.0	6.0	1238.0
Karimganj	131.0	13.0	144.0
Hailakandi	290.0	--	290.0
Cachar	2130.0	--	2130.0
Baska	14837.0	207.0	15044
Golaghat	1731.5	255.21	1986.71
Sivasagar	817.5	27.13	844.63
Tinsukia	1085.0	36.10	1121.10
Karbi Anglong	16233.5	1926.0	18159.5
Dima Hasao	3915.0	--	3915.0
Total	147769.0	21084.58	168853.58

Source: Economic Survey, Assam 2010-11.

Agricultural productivity in the Sonitpur district is affected by inadequate irrigation facility. Only 11.7 percent of total cropped area was under irrigation facility whereas the state average was 17.17 percent. During 2009-10, Crop Season-wise area irrigated in the district was 11996.5 hectares out of which 11981.0 hectares under Kharif crops and 15.5 hectares under Rabi and pre- Kharif crops (table: 6.7).

Agricultural activity in the Sonitpur district is mainly rain fed. In recent years the irrigation department of state government takes some steps to create some irrigation facilities in the district. Irrigation potential created through Government Irrigation Schemes covers 61533 hectares in total, out of which 28878 hectares under minor irrigation scheme and 32655 hectares under in major and medium irrigation up to 2009-10. In the table: 5.3 and 5.4, (Chapter V) it was evident that crop area of operating Minor Irrigation Schemes (FIS/LIS/DTW/STWS) under Tezpur Division and Biswanath Chariali Division which were completed during the period in different block was not sufficient for targeted development of agriculture.

Thus, it seems that irrigation has so far played only a marginal role in the agricultural scenario of Assam and in the district. Therefore, it can be concluded that lack of assured water supply has been an important constraint in raising agricultural productivity and cropping intensity in the agrarian state of Assam.

6.3.2 USE OF FERTILIZER

Fertilizer is an important input, which plays a dominant role in augmenting the productivity of crops. Constant cultivation of land causes deterioration of its fertility, which requires application of fertilizer. Therefore, chemical fertilizer is considered as an important input to increase agricultural productivity. But the farmers in Assam are not applying sufficient quantity of fertilizer on their lands. During the early years of planning the use of fertilizer was confined to the tea gardens only and there was very limited use of it for agricultural purpose. This may be ascribed partly to the ignorance, prejudice and partly to the limited purchasing power of the cultivators. Further,

inadequate irrigation facilities and uncertainty of rain restricted the use of fertilizers in the state.

The trend of fertilizer consumption in the state in terms of nutrient (NPK) per hectare is much lower than the national average consumption. According to the State Agricultural Department consumption of fertilizer in the state was at 63.16 kg per hectare during the year 2009-10. It reveals from the table: 5.6 (Chapter V) that the consumption of chemical fertilizer is low during the Kharif season than that of Rabi season. The reason behind the lesser consumption is that the farmers are reluctant to use fertilizers during Kharif season fearing monetary loss due to heavy rainfall and flood. Moreover, disruption of transport movement fertilizers cannot reach destination in time for delivery to farmers. However, the level of consumption of fertilizer can be increased substantially by making timely availability of fertilizer in the season of the state.

It was observed that during the First Five-Year Plan the consumption of fertilizer was highly insignificant. Efforts were made to increase the fertilizer consumption during the Second Five Year Plan. The Third Plan took some positive steps in this regard but failed to achieve the plan target. Against the target of 85 thousand tonnes of chemical fertilizer only 19 thousand tonnes was actually distributed among the farmers. During the period of Adhoc Annual Plans, the propagation of fertilizer consumption was intensified, because of the introduction of HYV programme during this period. Thus, under the different plan the programme for fertilizer distribution was intensified and attempts have been made to popularize the use of fertilizers among the farmers. But still the use of fertilizer in the state agriculture is extremely poor. It is evident from table: 6.8 that per hectare consumption of

fertilizer in Assam were less than 50 percent of the per hectare consumption of fertilizer in national average.

Table 6.8

Consumption of Fertilizer per hectare (kg/hectare)

Year/state	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10
Assam	42.65	50.66	52.27	56.20	57.80	63.16
India	96.59	104.50	113.26	116.50	127.20	135.30

Source: Economic Survey, Assam 2010-11, Economic Survey, India 2010-11

The consumption of fertilizer in the district was only 40.0 kg/hectare in 2009-10 whereas Consumption of fertilizer in the state was 63.16 kg/hectare and national average was 135.30 kg/ hectare. So it is clear that in terms of state average and national average the consumption of fertilizer per hectare in the district is quite insignificant. There are several reasons for low level of fertilizer consumption in agriculture in Assam and in the district. Firstly, assured water is a must for the application of fertilizer, which is not properly and adequately available in the state. Absence of proper agencies to supply fertilizer at required time to the farms is also considered as an important bottleneck. Distribution system itself is also defective. Deplorable condition of roads in rural areas and inadequate storage facilities further aggravate the position in the state. Credit is not adequately available in rural areas; as such the poor farmers are not able to acquire costly fertilizer from the market. Flood is a natural hazard, which affects the state almost regularly. Fertilizer cannot be used in areas inundated by floodwater. Sometimes heavy rain washes away the fertilizer applied in the paddy fields. Again all types of

fertilizer are not suitable for all types of soil, proper testing in this regard is absolutely essential which is not available in the state. Absence of proper guidance in this matter is also one of the reasons of low fertilizer use in Assam. Primitive techniques of cultivation also limit the scope of using fertilizer in agriculture in the state.

6.3.3. USE OF HYV SEEDS

One of the most important inputs used for agricultural production is high yielding varieties (HYV) of seeds. HYV seeds are highly responsive to fertilizer and they have a short maturity period, thereby they can increase the yield rate of crops if supported by the package of practices i.e., fertilizer, assured water supply and pesticides. The HYV programme was initiated in 1966-67 in a limited scale in the state and continued to receive highest priority during the subsequent plan programmes. By the end of 1972-73, the entire area under wheat has been covered with HYV seeds. Lack of irrigation facilities, non availability of HYV seeds within the state, limited use of fertilizer are the main constraints in the way of rapid adoption of HYV of seeds for cultivation by the farmers. Although the entire area under wheat is under HYV, it covers very small proportion of the total cropped area of the state. The proportion of area under HYV paddy in Assam remained stagnant up to 1975-76. It was after the 80's the area under HYV in the state is showing an increasing trend. The total area under HYV rice, which stood at 8.37 lakh hectares in 1981-82, has increased to 14.01lakh hectare in 1999-2000 and 16.26 lakh hectares in 2009-10. The gradual increase in area under HYV rice is mainly attributable to the productivity, which is much higher than the common variety of rice.

Although the area under HYV seeds (paddy) has increased in absolute sense, the coverage of area under it still remains insignificant as compared to other states. Total area under HYV of rice in 2008-09 was 103546 hectares out of which high yielding varieties of Autumn, Winter and Summer Rice cover 21135, 68068 and 14343 hectares respectively. The slow progress in the HYV programme in the state can be attributed to several factors. Firstly, the supply of seeds is very less in Assam. So the farmers use mostly the traditional variety of seeds whose average yield is just half of the yield of improved variety. Secondly, absence of assured water supply, and other factors like fertilizers, pesticides are also major factors responsible for limited use of HYV seeds in the state. Thirdly, ignorance and poverty of farmers is also considered as a factor for the limited use of HYV seeds in the state. Further, farmers interested in using HYV seeds have to contact various agencies such as Assam Seed Corporation for fertilizer, irrigation department for irrigation facilities and block staff for other necessary help and suggestions. But there is no such agency either at the village level or block level to coordinate all these agencies for smooth functioning of HYV programme. Moreover, most of the HYV seeds are imported. So they are not flood and drought resistant and are also not adaptable to local soil, climate and environment. Therefore, farmers need help from extension services, which are found to be inadequate and sometimes totally absent. This also limits the use of HYV seeds in the state.

Besides, in Assam Seed Replacement Rate (SRR) is not so significant. SRR improves the productivity of crops to a large extent. The actual seed replacement rate of paddy, wheat, pea and oilseeds (rape and mustard) during 2009-10 was 33 percent, 51 percent, 51percent and 60 percent respectively.

6.3.4. PLANT PROTECTION MEASURES

Adequate plant protection measures such as pesticides and insecticides in proper time are very essential for increasing agricultural production. It has been proved by agronomists that 10 to 30 percent of the crop losses due to pests and weeds can be reduced by timely and adequate plant protection measures (Das, 1983). Since the climate of Assam is very much humid, the chances of incidence of pests and diseases are higher in Assam compared to the semi-arid regions like Haryana and Punjab. Hence, appropriate measures should be taken in Assam to protect the plant from pest and diseases. In order to protect crops from pest and diseases, pesticides and insecticides were used. But due to harmful effects of these chemical agents to the crops, their use has declined drastically in India. Instead of using chemical pesticides, 'Bio Basis method' has become popular in India to protect plants from pest and weeds. In Assam also the use of pesticides has reduced drastically in the last few years as the Bio Basis method becomes popular among the farmers. As the bio- agent laboratory has not developed in Assam, Govt. should take necessary steps to develop such laboratory in the state to make available this facility to every farmer of the state.

Integrated Pest Management (IPM) is the key component of sustainable agricultural production. Assam having a diverse eco-system with sub tropical climate, the crop production is associated with loss of biotic stress problem which share 20-30 percent of the yield loss (Economic Survey, Assam 2010-11). Excessive and injudicious use of chemical pesticides in the field as well as horticultural crops result into development of pest resistance, pest resurgence, pest replacement and pesticides residue problem. Intensification of agriculture with the introduction of HYV, Hybrid, STW, Mechanization

and other advance inputs also enhance the pest population dynamics and pest status. In order to facilitate the availability of the Bio-Control Agent (BCA) in the Biological Pest Management Intensive IPM (BIPM), the thrust has been given to increase production of the already established BCA and newly introduced BCA in the State Bio-Control Laboratory (SBCL). Therefore, steps have been taken to strengthen the SBCL by State Government during the year 2008-09. Emphasis has also given for establishment of Plant Health Clinic for identification and management of biotic stress.

6.3.5. MECHANIZATION

Farm mechanization is a critical input as it facilitates timely agricultural operation. But in Assam the growth of mechanization is slow. The low availability of farm power has become constraints for double or multiple cropping in the state. In order to boost up farm mechanization, special thrust has been given by the State Agriculture Department in a systematic/ schematic manner. In Assam as well as in the district traditional technique of cultivation has continued to be practiced on large scale. The small size subsistence farming and limited economic resources are mainly responsible for the low level of mechanization in the state. Mechanization of agriculture becomes a must as it helps in various aspects like reclamation of barren lands, reduction of costs, increased use of fertilizer and pesticides etc., which ultimately help to increase the productivity of the land. But the use of modern implements in agricultural fields is not encouraging in the state. Mechanization of agriculture has been criticized sometimes on the ground that it will displace the existing labour on agriculture and thus will aggravate the unemployment problem. But mechanization is considered essential in

modern economic context because it increases the output and employment and thereby growth.

There are tremendous potentialities exist for increasing efficiency in agriculture sector of Assam as well as Sonitpur district. The successive plans have also emphasized selective mechanization to increase cropping intensity and farm productivity. Though the number of tractor s and other agricultural implements like iron plough and power tillers used in agriculture has increased during the plan period, it is not encouraging as these implements are used only by small segment of the rich farmers.

6.3.6. RURAL ELECTRIFICATION

It is a well-known fact that the present agricultural development is mainly based on the use of diesel and electrical energy. Diesel having heavy import content, its availability is very much affected by the forces beyond the control of our country. But electrical energy being generated indigenously can be used in the place of diesel if necessary infrastructure is created in the rural areas. It is therefore essential that more and more electricity is provided in the rural areas for irrigation, threshing, crushing, processing, storage etc. But Assam is not self sufficient in the generation of electric power. It accounts only a small fraction of the total generation of electricity in the country. On the contrary the consumption of electricity in the state has been increasing in absolute terms over the years. So the state has to import power from the neighboring states to meet the domestic demand.

Like most of the states of the country, Assam is lagging behind in respect of rural household's electrification. In Assam, out of the total 25124 numbers of inhabited villages (as per 2001 population census) 16814 (67.0

percent) villages have been electrified till the end of March, 2010.⁷ In Sonitpur district out of 1784 inhabited villages, only 1198 (67.15 percent) villages are electrified till March, 2009-10.⁸ But the major problem lies with the fact that supply of power in rural areas is very irregular. Erratic and inadequate power supply brings uncertainty and risk in using machines for agricultural purposes in the villages. With prevailing irregularity and uncertainty, it has become difficult to ensure irrigation even when pump sets are available with the farmers.

6.3.7. AGRICULTURAL CREDIT

Credit is an essential requirement for revitalizing agriculture sector. Since the late 1960's it was felt that our country should follow a new strategy of agricultural development in order to stimulate agricultural productivity. Such a strategy would involve increasing use of sophisticated and more efficient inputs. These inputs are very expensive and require financial resources, which are considerable compared to the yearly income of an average farmer. So the farmers require timely and adequate financial help from government or any other sources. Hence, credit is regarded as the most important input for modern agriculture. In Assam, the bulk of agricultural credit is supplied through the Gaon Panchayat Level Co-operative Societies (GPCS), State Co-operative Banks, Land Development Banks, Commercial Banks, Regional Rural Banks, Agricultural Refinance and Development Corporation (ARDC) and National Bank for Agricultural and Rural Development (NABARD). The Co-operative credit societies have come in a big way to meet the credit requirements in the rural sector after independence. With a view to ensuring steady flow of credit, the entire organizational set up

⁷ Economic Survey, Assam 2010-11

⁸ Statistical Handbook 2010

of the rural credit has been refashioned with the Assam Co-operative Apex bank at the top and the primary Co-operative Credit Societies at the base. There were seven district Central Co-operative banks at Dhubri, Guwahati, Nagaon, Tezpur, Jorhat, Dibrugarh and Silchar which were merged with the Assam Co-operative apex bank Ltd. by the end of July, 1976.

Regional Rural Banks (RRBs) were established under the Regional Rural Banks Act, 1976 with a view to give a boost to rural economy by providing rural credit to farmers, agricultural labourers, artisans and small entrepreneurs etc. At present, the state has presence of two RRBs—Assam Gramin Vikash Bank and Langpi Dehangi Rural Bank. While the Assam Gramin Vikash Bank is operating both in the Brahmaputra Valley and Barak Valley covering 25 districts with 356 bank branches, the service area of the Langpi Dehangi Rural Bank is confined within the two hill district of Assam with 42 bank branches as on March 2010.⁹

Apart from the Co-operative Societies and Apex Bank and RRBs, agricultural finance is also provided by the Commercial Banks. After the nationalization of the 14 big commercial bank in July, 1969 and introduction of the Lead Bank Scheme, there has been noticeable expansion of bank branches in the state, but in comparison to other states and all India, Assam lags far behind in respect of credit for agricultural development. Although within the priority sector, share of agriculture advances in the state had been the highest with 21.9 percent as on March 2009 and 34.19 percent as on March 2010, the agricultural credit constitutes 18.5 percent of the total bank credit as per the figures published by the State Level Bankers' Committee, Assam i.e, the agricultural credit has marginally surplus the all India Bench

⁹ Economic Survey, Assam 2010-11

Mark of 18.0 percent as on March 2010. According to the State Level Bankers' Committee Report, banks operating in the state have disbursed ₹ 814.69 crore during the year 2009-10 in agriculture sector against the annual target of ₹956.66 crore which was 85.0 percent of the targeted amount. While the annual growth rate of advances to agriculture and allied activities during the year 2009-10 was 55.7 percent over the previous year, the growth of crop loans recorded more than 67.0 percent during the said period.¹⁰

Though the credit provided to priority sector in Assam was marginally above the all India bench mark of 18.0 percent but it is not sufficient to fulfill the total demand for credit in rural Assam. Thus it can be concluded that farmers are not getting adequate credit for purchasing farm implements, fertilizers and other agricultural inputs. Banks spreading to the rural areas extend credit only against security, but the majority of the cultivators have no such tangible assets to mortgage as security. Moreover traditional shyness to borrow loans from financing institution, procedural difficulties to which the farmers have to go through to procure loans are also some of the impediments responsible for low volume of credit sanctioning disbursement in the state. Consequently the poor and marginal farmers of Assam are deprived of getting adequate credit facilities from the financial institutions, which can be considered as an important factor contributing to low agricultural productivity in the state.

6.3.8. AGRICULTURAL MARKETING

The existence of an efficient marketing system is an important pre-requisite for the better performance of agriculture. Because it is through an efficient marketing system the farmers get remunerative prices for their

¹⁰ Economic Survey, Assam 2010-11

products and they are encouraged to produce surplus for sale. But unfortunately the marketing infrastructure is not properly developed in Assam. Still a major portion of the marketed surplus of the farmer is usually sold in the village market called “Hats”, which are generally running either on congested space without having infrastructural facilities or on National Highways or State roads. Under this type of free marketing system, the small farmers do not get reasonable prices for their crops because the marketed produce of the farmers move from rural markets to the large secondary markets in the urban areas through a number of middlemen, who generally indulge in malpractices. Higher prices paid by the consumers to the middlemen do not reach the actual producers. Generally three classes of middlemen are engaged in purchasing the products of the farmers at the village level. They are the commission agents of the rice millers, village traders locally called ‘Bepari’ and the itinerant traders. The itinerant traders collect the products from the farmers from village to village and bring them to the nearest markets. In case of non-perishable goods, the traders purchase the crops from the village markets at very cheap prices and sell them, when the prices rise. Because of the lack of transport facilities, storage facilities and fear of being cheated in the market place, the small farmers gladly offer their products to the middlemen at cheap price.

In order to eradicate these malpractices prevailing in the trade and also to establish an efficient marketing system, the Govt. of Assam passed “The Assam Agriculture Produce Act”, 1972, with the aim that the actual producer gets the remunerative prices for their products. Again, the Assam State Agricultural Marketing Board was constituted in Assam in 1977 with a view to establish regulated markets in the state. Under this, there will be a market committee consisting of representatives of growers, traders and

merchants, local bodies and government nominees. The aim of this Act was to organize systematically the agricultural produce market so that the growers selling goods and businessman buying them get adequate facilities for carrying on their business transaction. With this objective in view, 24 regulated markets have been established in Assam till now. But unfortunately, none of the above markets has given the expected results.

The Assam State Agricultural Marketing Board has taken steps for improving all the markets of all the districts of Assam except Karbi Anglong and N.C.Hill districts. But due to unorganized method of agriculture and prevalence of age old traditional marketing system, the expected co-operation from the agriculturists has not been obtained. As a result, the controlled marketing scheme has not given the expected result. Even now a major portion of the agricultural goods, sales and purchases are affected in the traditional free market system. Still transaction, in case of paddy about 60.0 percent, in case of cereals about 50.0 percent, in case of jute, about 30.0 percent are made in the traditional market system (Assam State Agricultural Marketing Board. 2005).

The Assam Agricultural Produce Market Act, 1972 has been amended in 2006 to make provisions for Private Marketing, Direct Marketing, Consumer-Farmer Market and Contract Farming as per guidelines of Govt. of India. The act also empowers Market Boards to levy cess and relieve existing restrictions on movement, storage and transportation etc of agricultural produces. At present the act is under implementation in 25 out of 27 districts of Assam. The Assam State Agricultural Marketing Board (ASAMB) has established 24 Regulated Market Committees, 20 Primary Market Yards, 206 Sub-Market Yards, 735 Rural Primary Markets and 405 Wholesale Markets.

The Regulated Markets have been covered under AGMARKNET. The following table shows the Market Infrastructure and Processing Units Developed in Assam in recent years.

Table 6.9

Market Infrastructure and Processing Units Developed in Assam

1.	Regulated Market Committees	24 nos.
2.	Principal Market Yard	20 nos.
	Sub-Market Yard	206 nos.
	Total Regulated Market	226 nos.
3.	Wholesale Market	405 nos.
	Rural Primary Market	735 nos.
	Total Market	1140 nos.
4.	Organic Market	1 no. (Being established).
5.	Godown	Rural Godown: 22 nos. Rural Seed Storage Godown: 18 nos. Other Godown: 29 nos.
6.	Cold Storage	25 nos.
7.	Processing Unit	6 nos.
8.	Drying Platform	33 nos.
9.	Grocery Society	680 nos.
10.	Auto Vans for Transportation	224 nos.

Source: Economic Survey, Assam, 2010-11

Availability of above marketing, storing and processing infrastructure, however, appears to be insufficient to fulfill the marketing aspects. As a result farmers of the state are facing problem in disposing their produces.

- During peak harvesting season of Rabi vegetables i.e., from January to march, the markets are overloaded with vegetables and the farmers have to dispose their produce at a very low price on the very market day due to non availability of cold storage facility near the market.
- Inadequate availability of processing units/cold storage / post harvesting infrastructure like godowns.
- Inability of small and marginal farmers to transport their produces to the markets where they can fetch justified market price.
- Inadequate transfer of off season vegetable technology.
- In Sonitpur district, the number of cold-storage is only 2, which are quite insufficient and insignificant for district.

Besides, the above problems illiteracy, poverty, lack of information on prevailing marketing prices of agricultural commodities within or outside the state are some of the factors responsible for underdeveloped agricultural marketing in the state. Therefore, it is necessary to improve/establish agricultural markets within the distance of farmer's accessibility, which will promote market demand farming.

6.3.9. TRANSPORT AND COMMUNICATION

Transport and communication is the vital infrastructure of a modern economy. An efficient transport system integrates remote, backward and urban areas and plays a vital role in increasing productivity and improving quality of life. A developed transport and communication system is an

important infrastructure for the proper and efficient functioning of agricultural markets. If farmers are unable to bring their surplus products to the market centers then they were deprived of reasonable and remunerative prices of the products. This will have adverse effects on the agricultural productivity of the region. Hence, existence of an efficient marketing system is very important for the development of agriculture of a region.

But unfortunately, the transport and communication in the state is not properly developed, commensurate to the requirements of agricultural marketing. The existing means of transport in Assam consists of Roads, Railways, Waterways and Airways. The road system in Assam plays the vital role in transporting the agricultural products from the villages to the nearest market centers. But the large proportion of roads connecting the villages, are in very deplorable conditions. These roads are unmetalled, which become unmotorable during the summer. Still there are some interior villages in the state, which have no transport facilities at all. Only a small percentage of total villages of the state are connected by all-weather roads. The roads in the urban and semi urban areas are also over crowded. In Assam, both the public sector and private sector organizations are operating transport services. Assam State Road Transport Corporation (ASRTC) is the only one public sector organization, which provides both goods and passengers traffic in selected routes. There has been a considerable increase in the number of vehicles on the roads in Assam, both in the private and public sector over the past few years. The following table shows the different types of road network in Assam.

Table 6.10**Road Network in Assam (in km)**

Item	2007-08	2008-09	2009-10
Surfaced Road*	10488	13734	13163
Un-surfaced Road	24458	23187	24338
National Highway	2754	2755	2841
State Highway	3134	3134	3134
Major District Road	4414	4413	4413
Rural Road	26221	27283	28753
Urban Road	1177	1173	1202

Source: Economic Survey, Assam, 2010-11. *excluding National Highway

The above table represents the different types of road network of Assam till 2010. In Sonitpur district total length of State Highway is only 55 km, Major District Road 402 km, Rural Road 1969 km and Urban Road 59 km out of which only 645 km is Black Topped and remaining 1840 km is Earthen/Gravel (Statistical Hand Book of Assam, 2010). The recent development of National Highways, linking the important places of Assam with some big cities of Northern India, seems to facilitate the movement of agricultural produce from Assam to outside and vice-versa. The other means of transport such as Railways, Airways and Waterways have been playing an insignificant role so far in transporting the agricultural products of the farmers as these are not within the easy reach of the farmers.

6.3.10. AGRICULTURAL RESEARCH, EDUCATION AND EXTENSION SERVICES

Agricultural research and its education based on local conditions and its spread through a well organized extension services play an important role in achieving higher, improved and diversified production. In Assam, the agricultural education in the real sense started in 1948, when the Assam Agricultural College was started in Jorhat. In 1969, the Assam Agricultural University was established at Jorhat. Till its establishment, it has to bear the responsibility of agricultural education, research and extension services in the state. Valuable research works on soil science, plant breeding, fertilizer use, plant diseases and pests were conducted under the university. The Rice Research Station situated at Titabar has made some positive contribution in evolving some new varieties of rice adaptable to local conditions.

In 1967-68, the farmers training programme was introduced in Nagaon district to educate the farmers on the package of practices. This programme includes training in cultivation along with application of improved agricultural practices like improved seeds, chemical fertilizers, pesticides and other package of practices. Farmers are also trained in handling various farm machineries and their practical application.

In 1979, the Agriculture Extension Services has been re-organized and overall charge has been given to the Additional Director of Agriculture (Extension) under the direct control of Director of Agriculture. Farmer's training services have been formed to serve the farmers in different Agro climatic zones of the state. Besides these, zonal training programmes are also held in collaboration with Assam Agricultural University, Jorhat at least for one cropping season for the zone. Monthly training programmes are also

organized for upgrading technical knowledge at district and sub-divisional level. Besides, the Agricultural Extension Officers are to visit the farmers' field regularly.

For overall development of agriculture and its allied fields in the state of Assam in general and the entire north bank valley of the state in particular, the Govt. of Assam during eighties felt the need for setting up the second constituent college of the Faculty of Agriculture, AAU. Agriculturally developed Biswanath Chariali of Sonitpur district was selected for the purpose and the "Biswanath College of Agriculture (BNCA)" was functionally started on 2nd February, 1988. The College was established to widen the institutional base of agricultural education in the state. Besides the agriculture stream, a forestry programme was also initially introduced in the college with the objective of generating manpower leading to graduation in agriculture and forestry and to carry out research and extension activities with relevance to the state in general and the entire north bank of the state in particular. It should be mentioned here that a developed Agricultural education, Research based on local condition and its Extension to the farmers' field is very essential for the development of agricultural scenario of the region. But it is observed that most of the agricultural researches have been confined to the varietal development. Very little attention has been paid to the crucial areas such as sustainability, efficiency, credits, marketing and trade, export is necessary. These researches are very important to Assam in the context of fast changing global agricultural order.

Besides, the programme of extension services has been almost unsuccessful in providing timely help to the needy farmers of the state. Due to some problems such as poor transport and communication facilities, lack of

time etc. the Agricultural Extension Officers cannot visit all the villages attached to him. As a result, many farmers are deprived of the services supposed to be offered by the Extension Officers.

Thus to conclude, the foregoing analysis which reveals that after the adoption of economic planning, Government of Assam adopted various agriculture development programmes like land reforms, development of infrastructure such as roads and communication, banking services, irrigation, rural electrification etc., input intensification programme by providing improved tools and implements, HYV seeds, fertilizers etc. to the farmers, plant protection measures, development of agricultural research and its extension services and flood control measures etc. but due to improper implementation of the farmers, these programmes fail to give any tangible results. As a result, the agricultural productivity in general in the state and in the district is very low as compared to some other agriculturally developed states of the country. In view of the various problems associated with growth and instability in production of crops in the state of Assam, the next chapter is devoted to findings from field survey in the district and some policy prescription in order to remove these constraints and raise the food grains production in the state and in the district at a stable rate in the near future.

**CHAPTER VII:
SUMMARY OF FINDINGS, RECOMMENDATIONS AND
CONCLUSIONS**

Analysis of Primary Data and Testing of Hypothesis

Testing of Hypothesis:

Testing of hypothesis I

Testing of hypothesis II

Testing of hypothesis III

Major Findings of the Study

Recommendations and Suggestions:

Land Reform Measures

Development of Agricultural Research, Education, Training and
Extension Services

Use of HYV seeds

Pest Management

Use of Fertilizer

Irrigation and Water Management

Farm Mechanization

Agricultural Marketing

Agricultural Credit

Natural Hazards

Liberalization and Market Economy

Conclusions

CHAPTER VII

Summary of Findings, Recommendations and Conclusions

Assam is the Easternmost state of the Indian Union and is located between the latitudes of 24°08'N and 27°58'N and the longitudes of 89°42'E and 96°01'(Govt. of Assam). For administrative and revenue purposes, Assam is divided into 27 districts and the 27 districts are divided into 56 sub divisions with 155 revenue circles (Govt. of Assam 2011). Sonitpur district is situated in the North bank of Brahmaputra valley. The District lies between 26° 30'N and 27° 01'N latitude and between 92° 16'E and 93° 43'E longitude. The economy of the state and the district is predominantly agricultural. Both the state as well as the district has immense potentiality for increasing agricultural production with suitable climatic condition, rich and fertile soil and enough water resources.

Agricultural sector and allied activities played an important role in the socio-economic development of the state of Assam as this sector is the major contributor to the state economy as well as providing livelihood to a significant proportion of the population of the state. About 99.0 percent area of the total land mass of the state is rural and almost 50.0 percent of the total land area is utilized for cultivation. The net cultivated area of the state is 25.33 lakh hectares (2009-10) and the per capita availability of net sown area comes to around 0.1 hectare. On the top of it, 23 percent of the net sown area is either flood or drought prone. The average operational is 1.11 hectare only and more than 83.0 percent of the farmer family is small and marginal farmers (2005-06, Agricultural Census). The contribution of the agriculture sector to the GSDP (at constant 2004-05 prices) was pegged at 4.1 per cent in 2009-10 (Quick estimate) recorded showing a growth from 2005-06 but

remained lower over 2008-09. However, this sector continues to support more than 75.0 per cent population of the state directly or indirectly providing employment of more than 53.0 percent of the workforce.¹¹

The sectoral growth of the state economy it has been observed that the growth of the agriculture and allied sector was not encouraging during the last three consecutive Five-Year Plan (8th, 9th and 10th FYP) periods. This depressing performance was continued even during the first year of 11th FYP, but made some recovery over the average growth of the 10th FYP. However, the growth of this sector shoots up and reached a comfortable level at 6.4 percent [GSDP at constant (2004-05) price] during 2008-09 surpassing the targeted annual growth of the sector at the rate of 2.00percent set for the plan period. The main reason of achievement of this growth is due to the sufficient production of rice (mainly Winter rice). As per quick estimates, the growth rate is due to the adverse weather condition experienced during 2009-10. The growth of the agriculture and allied sector is projected at 6.6 percent in 2010-11(A) as the state has experienced sufficient rainfall during the Kharif season which is congenial for rice cultivation in the state.

The state agriculture department has given more focus of attention to increase production of food grains to provide food security to the growing population through increasing productivity of crops and cropping intensity. Accordingly, the state agriculture department has prioritized optimum and efficient use of available resources to enhance the production and productivity of the crops including the horticultural crops by harnessing the best in frontier technologies. The department has formulated District/state specific plan depending on agro-climatic condition, growth potential and specific

¹¹ Economic Survey, Assam 2010-11

requirement of the Districts through improved farm mechanization and assured irrigation, use of quality certified seeds of HYV, popularizing the integrated nutrient and pest management with the special use of bio-fertilizer and bio-pesticides and organic farming etc.

Assam has been experiencing very high population growth since 1901. During the period from 1951 to 2011, population of Assam has increased from 80 lakh to 311 lakh. Due to low productivity and absence of diversification of agriculture in Assam, the high growth in population has created food problem in the state. The land use pattern of Assam highlights that there is little scope for further physical expansion of arable land in the state. At present the total area available for cultivation is almost 50.0 per cent the total land area of the state.¹² Forest covers 22 per cent of land area; the cropping intensity in the state is 149 per cent. During the period from 1951 – 52 to till the end of seventies, the net area sown in Assam has increased considerably by extending of cultivation to new areas, but since 1981, net area sown in the state has remained more or less stagnant.

As mentioned in previous chapters, Assam produces both food crops and cash crops. But the cropping pattern of the state is dominated by food grains particularly paddy crops. Rice is a staple food of the people of Assam and it is grown everywhere by all sections of the hills and the plains. But the productivity of rice as well as other food grains is low as compared to other states of the country due to various constraints. Increasing production of food grains at a rapid rate has become an urgent need in Assam in the face of unparallel population growth in the state. The fact is that the state has by and large fallen in a situation of “food-trap” in the post independence period,

¹² Economic Survey, Assam 2010-11

where growth in consumption demand of food grains persistently exceeds the production growth for a long period. The result is – once a surplus state has become a importer of rice from the early 1970s. Though there have been some achievements in the productivity during eighties and nineties, it is much lower as compared to agriculturally developed states like Punjab, Haryana etc. In these circumstances, the state must intervene by investing heavily on the strategic research on newer production frontier. In this chapter, analysis of primary data has been done with the objective of diagnose the actual grass-root problems faced by the farmers in the district as well as in the state and their economic status with the help of field survey done with the help of a schedule.

7.1. ANALYSIS OF PRIMARY DATA AND TESTING OF HYPOTHESIS

For collection of primary data 300 farmers are selected from different level of land holdings (maximum weight is given to small and marginal and medium farmers because their proportion is very high in the district) from 20 villages randomly selected from 14 blocks of the district. The primary informations are collected with the help of a schedule including all the aspects of agricultural activities of the farmers along with their socio-economic status. In the following tables the result of the field work analyzed and discussed.

ANALYSIS AND RESULTS

Data collected in field survey are first tabulated according to their characteristics for analysis and interpretation. In the table: 7.1, the demographic structure of the district was shown with respect to the age of the respondent. According to the 2011 Census, the Sonitpur District has a population of 1925975, with a density of 365 persons per sq. km. The people

here are not a homogeneous lot. Rather, they are a mosaic of ethnic groups, an admixture of diverse types of people. The following table shows the demographic characteristics of the district under study.

Table: 7.1

Demographic Characteristics of the Sample Respondents (Age & Sex Composition of the Sample Respondent) (figure in bracket is in % term)

Sl. No	Size group of farmers	No. of household	Total population	Male	Female	Less than 15 years age	15-50years age	>50 years age
1.	Small	86	519(100)	284 (54.7)	235 (45.2)	158 (30.4)	256 (49.3)	105 (20.2)
2.	Medium	125	870(100)	518 (59.5)	352 (40.46)	285 (32.8)	445 (51.2)	139 (16.0)
3.	Large	89	741(100)	397 (53.5)	344 (46.4)	224 (30.2)	375 (50.6)	142 (19.2)
4.	All groups	300	2130(100)	1199 (56.3)	931 (43.7)	668 (31.36)	1070 (50.5)	386 (18.1)

Demographic characteristics of the district reveals that 50.5 percent of total farm population lies between age group of 15-50 years, 31.4 percent less than 15 years age and 18.1% is more than 50years age. In the district, the proportion of dependent population is very high. The economically productive population constitutes more than 50.0 percent of the district.

Table: 7. 2

Distribution of Respondent According to Educational Standard (figure in bracket is in % term)

Sl. No	Size group of farmers	No. of household	Total population	Illiterate	Literate			
					Upto primary	Secondary	Graduate and above	Total
1.	Small	86	519(100)	163 (31.4)	126	191	39	356 (68.6)
2.	Medium	125	870(100)	195 (22.4)	248	369	58	675 (77.6)
3.	Large	89	741(100)	181 (24.4)	196	303	61	560 (75.6)
4.	All groups	300	2130(100)	539 (25.3)	570 (26.8)	863 (40.9)	158(7.4)	1591 (74.7)

According to census 2011 the literacy rate of the district is 69.96 percent with sex ratio of 946. The majority people inhabiting the District are Assamese. They are among the original inhabitants of the place, and the typical culture of the place grew with them. But, The table: 7.2 showed the educational standard of the respondents under study. Around 74.7% of farm populations of the district are literate and literacy among medium class farm population is highest i.e., 77.6 percent and 68.6 percent in small farmer group and 75.6 percent in large farmer group are literate.

The district covers only 7.0 percent of the total geographical area of the state. The land use pattern in the district varies slightly in proportion to Assam. In 2009-10, total forest cover in the district is 29.0 percent which is more than state proportion (i.e., 25.0 percent). Similarly, net sown area in the

district is less in proportion i.e., 27.0percent in comparison to state level which is 35.0percent of the total geographical area. Total cropped area covers only 45.0percent of the total area of the district while state average is 51.0percent. The following table can helps us to analyze the farm structure of the district in respect of different size groups.

Table: 7.3

**Farm Structure with Respect to different Size Group (land in hectare)
(figure in brackets are in percentage)**

Sl. No	Size group of farmers	No. of house hold	Owned land	Leased land	Leased out land	Total operational holding	Av. operational holding	Area under home stead	Cultivable land	Av. Cultivable land
1.	Small	86	151.36	12.5	0.0	163.86	1.91	14.56 (8.9)	149.3 (91.1)	1.74
2.	Medium	125	443.75	41.94	0.0	485.69	3.89	23.0 (4.7)	462.7 (95.3)	3.70
3.	Large	89	605.2	0.0	27.59	577.21	6.49	18.6 (3.12)	559.2 (96.9)	6.28
4.	All groups	300	1200.3 1	54.44	27.59	1226.76 (100)	4.09	55.6 (4.53)	1171 (65.47)	3.90

The table: 7.3 showed the Farm Structure with Respect to different Size Group of the respondent. It was revealed from the study that in average of all groups; only 65.47 percent of the total land in the district is cultivable land. The average cultivable land in the district was only 3.90 hectare per farm family in all groups but Average cultivable land holding in the district of small, medium and large farmers are 1.74, 3.70 and 6.28 hectare respectively.

Livestock husbandry is an important source of economic activity in the agricultural sector contributing a major portion of GDP to India and improving the socio-economic conditions for people in general and rural people in particular. Livestock husbandry has been practiced, usually in rural areas, since ancient times. The increasing urbanization of the growing population and the changing food habits of people has enhanced the demand of livestock products worldwide. Thus, the world's livestock sector is growing at an unprecedented rate in developing countries. India is one developing country that shares the largest number of livestock and has a top position in milk production in the world. The livestock in India with 185 million cattle and 98 million buffaloes possesses 20% of the world's bovine and 14% of the world's cattle population. The following table shows the distribution of livestock among the different size group of farm family.

Table: 7. 4

Distribution of Livestock among the different size group of farm (in bracket av. no. per household)

Sl. No	Size group of farmers	No. of household	No. of cow	No. of bullock	No. of buffalo	No. of goat	No. of pig	No. of birds
1.	Small	86	98	83	31	267	22	1119
2.	Medium	125	164	129	42	531	35	1750
3.	Large	89	127	155	54	382	43	1157
4.	All groups	300	389 (1.3)	367 (1.22)	127 (0.42)	1180 (3.93)	100 (0.33)	4026 (13.42)

According to table 7.4 the distribution of Livestock among the different size group of farm of the farm family was not so significant in the district. According to the table: 7.4, the average number of cow, bullock, buffalo and

pig per household was 1.3, 1.22, 0.42 and 0.33 respectively but average no of birds was 13.42 in the district.

Farm mechanization is an important element of modernization of agriculture. Farm productivity is positively correlated with the availability of farm power coupled with implements and their judicious utilization. Proper agricultural mechanization not only enables efficient utilization of various inputs such as HYV seeds, fertilizers, plant protection chemicals and water for irrigation but also it helps in poverty alleviation in the district by making farming an attractive enterprise. The following table represents the distribution of farm implements in the district under study.

Table: 7.5

Distribution of farm implements (in bracket av. no. per household)

Sl. No	Size group of farmers	No. of house hold	No. of plough	No. of power tiller	No. of pumps set	No. of sprayer	No. of duster	No, of weeder	Laveler	Other implem ents
1.	Small	86	182	3	15	46	2	11	186	516
2.	Medium	125	346	9	41	114	6	24	331	875
3.	Large	89	379	14	51	110	12	48	305	1067
4.	All groups	300	907 (3.02)	26 (0.09)	107 (0.36)	270 (0.9)	20 (0.07)	83 (0.28)	822 (2.74)	2458 (8.19)

Farm mechanization and implements are not satisfactory at all. The distribution of farm implements like plough, power tiller, pump set, sprayer, duster, weeder leveler etc are quite insignificant in the district. The average

(table: 7.5) number of power tiller, pump set and sprayer per household in the district are only 0.09, 0.36 and 0.90 respectively. Similarly, average number of duster, weeder and leveler per household of the farm family in the district are only 0.07, 0.28 and 2.74 respectively.

Cropping pattern of Sonitpur is almost similar with the state pattern. Around 80.0percent of total cultivable area is used for production of food crops and rice dominates the maximum proportion in the district. All the three types of paddy i.e., autumn, winter and summer is cultivated in the district and among which production of winter paddy covers maximum area of the total cultivable area of the district. The following table gives a clear picture of cropping pattern of major crops of district in different farm groups under the study.

Table: 7.6

Cropping Pattern and Cropping Intensity with respect to different size groups during 2010-11(area in hectare)

Sl. No.	Crops	Small	Medium	Large	All groups
Rabi crops					
1.	Paddy (Boro)	14.2	30.43	14.51	59.14
2.	Wheat	10.2	20.43	32.54	63.25
3.	Potato	6.81	9.20	11.19	26.9
4.	Rape and mustard	3.50	35.74	32.27	71.51

5.	Maize	3.81	4.16	3.94	11.91
Kharif crops					
1.	Paddy (sali)	100.43	341.14	420.51	862.08
2.	Maize	3.83	4.40	4.11	12.34
3.	Sugarcane	3.19	3.75	3.63	10.57
Summer crops					
1.	Paddy (ahu and bao)	24.30	67.09	91.91	183.30
2.	Jute	3.3	17.7	40.8	61.8
Net Cropped Area		231.54	745.32	963.7	1940.56
Cropping Intensity (in percent)		155.68	161.08	172.34	165.7

Food grains mainly cereals production dominates the cropping pattern of the district. The large proportion of the cultivable land are used for the production of cereals mainly rice. The cropping intensity of the district in 2009-10 for all groups was 165.7 percent (table: 7.6). But it was observed that the cropping intensity among small farmer group is less i.e., 155.68 percent in comparison to 161.08 percent and 172.34 percent in medium and large farmer group.

Fertilizer is considered as one of the most essential inputs for increasing the agricultural production. However, consumption of fertilizer in

the state is still low. Although an increasing trend is observed as regards consumption of fertilizer in absolute terms in Assam, its consumption in NPK is far below the level achieved by other states as well as national level. Both chemical and bio-fertilizer is used in the District in agricultural field to increase the productivity of crops. But average consumption of fertilizer is less in comparison of the other district of Assam. The use of some of the chemicals like plant protection chemicals, pesticides etc, is very insignificant. The following table shows the consumption and chemicals in the district under the study.

Table: 7.7

Utilization of different Farm Inputs used in Production of Rice

Sl. No.	Farm inputs	Unit	Small	Medium	Large	Average
1.	Seeds	Kg/hect	76	79	72	75.67
2.	Farm Yard Manure (FYM)	Cart load/hect	13.65	12.75	15.00	13.80
3.	Fertilizers					
	N		13.5	12.46	14.14	13.37
	P	Kg/hect	8.15	6.37	7.48	7.33
	K		--	--	3.45	1.15
4.	Insecticides/pesticides	Litre/hect	1.00	0.69	0.75	0.81

Use of HYV seeds, fertilizers and pesticides in the district is also quite insignificant. In average 75.67kg/hect seeds, 13.8 cart load/hect of FYM,

21.85kg/hect fertilizers and 0.81liter/hect pesticides (table: 7.7) are used which are quite insignificant in comparison to state and national level. This scanty use of farm inputs in farming is one of the main causes of low productivity in the district. The poor economic conditions of the farmers and lack of financial assistance is responsible for the scanty use of farm inputs.

The agriculture, which is the main source of livelihood in the District as well as in State are suffering from low productivity. The agricultural sector in the district has not developed significantly. Agriculture in Assam solely depends on vagaries of monsoons, which creates unexpected havoc on the agricultural production in the district as well as in the state. But it is disappointing to note that they have been facing varieties of problems over which they have little control because of extreme lack of capital, technical knowhow and other resources. The important problems constraining agricultural development and innovation in the district may be summarized in four categories as - natural, biological, techno-economic and socio-cultural. The natural problems include flood, drought, soil erosion, etc. The biological problems are pests and diseases, unhealthy peasants and draught animals; while the problems such as surplus manpower, insignificant use of inputs like improved seeds, fertilizers, pesticides and insecticides, modern implements, irrigation, finance, inadequate market facilities and price incentives, adverse land policy and legislation, lack of agricultural research and inefficient extension services are included in techno-economic problems. Among the multitude of socio-cultural problems, conservative outlook of the farmers, ill fatalism, ignorance, illiteracy and antiquated organization of agriculture are found to be of great importance. The following table shows the Farmer's Response to different Production Problems according to different size groups under the study.

Table: 7.8**Farmer's Response to different Production Problems according to different size group (response in percentage)**

Sl. No.	Production problems	Small farm	Medium farm	Large farm	All farm (average)
1.	Heavy flood	34.88	20.0	21.35	24.67
2.	Drought	61.6	56.0	69.6	61.67
3.	Pest and diseases	40.7	48.0	59.5	49.3
4.	Limited credit support	95.35	95.2	87.64	93.0
5.	Agricultural input supply	56.98	66.4	68.5	64.3
6.	Lack of mechanization	58.14	68.8	74.16	67.33
7.	Lack of training on scientific production	91.86	94.4	92.13	93.0

The farmer's response to different Production Problems according to different size group is quite important in diagnose the main problems of the agriculture in the district. In the district 24.67, 61.67 and 49.3 percent (table: 7.8) area was affected by flood, drought and pest and diseases. In the district 93.0 percent farmers are not getting adequate credit facility, 64.3% deprived of getting agricultural inputs, 67.33% are suffering from adequate mechanization and 93.0 percent are not getting any type of training till date.

Besides the farmers are also sufferings from inadequate infrastructural facility in post harvesting period. The roads of Assam in the rural areas are mainly Kutcha roads and in the rainy season the conditions of these roads are so deplorable that the timely supply of essential inputs to these areas become impossible. The poor means of transport and communication is a major cause of the underdeveloped marketing infrastructure of the state. The Govt. has

attempted to establish regulated markets in rural areas but still the traditional market dominates the rural marketing system with all its malpractices. The weekly ‘Hats’ act as the main market places for the villagers and the middle men are also active as before in these ‘Hats’. Improved agricultural marketing is an important condition for agricultural development of a particular region, but in Assam, the government is not successful to establish regulated market and to identify the malpractices prevalent in the trade. The following table represents the Farmer’s Response to different Post Harvesting and Marketing Problems in the district under study.

Table: 7.9

**Farmer’s Response to different Post Harvesting and Marketing Problems
(response in percentage)**

Sl. No.	Post harvesting and marketing problems	Small farm	Medium farm	Large farm	All farm (average)
1.	Lack of transport facility	50.0	60.0	49.4	54.0
2.	Low marketable surplus	53.49	74.4	31.46	55.67
3.	Absence of domestic market	69.7	68.0	73.03	70.0
4.	Price uncertainty	87.2	92.8	96.63	92.67
5.	Poor marketing facility	82.5	76.8	92.13	81.67
6.	Presence middlemen	62.79	65.6	70.79	66.33
7.	Absence of sales promoting agencies	74.4	78.4	80.9	78.0
8.	High marketing charge	51.16	49.6	48.3	49.67
9.	Lack of storage facility	90.7	96.2	94.38	94.0
10.	Lack of market knowledge of farmers	70.0	73.6	76.4	70.33

According to the table 7.9, in the district 54.0percent of farm family in average are affected by inadequate transport facility, 70.0% due to absence of domestic market, 66.33% due to presence of middlemen, 81.67% due to inadequate marketing facility and 70.33% was affected by Lack of market knowledge. In the district, 92.67 percent and 94.0 percent of the farmers are affected by price uncertainty of the agricultural produce and lack of adequate storage facility.

7.2. TESTING OF HYPOTHESIS

The entire research work is followed by following three pre-determined hypothesis:

4. Agricultural productivity can be increased by providing adequate infrastructure and input facility.
5. Agricultural Development in the District has been very much insignificant.
6. The size of land holding and their fragmentation retards efficiency of cultivation in the district.

7.2.1. TESTING OF HYPOTHESIS I

Agricultural infrastructure and input facility includes adequate Irrigation facility, Agricultural Credit, Farm Mechanization, Rural Electrification, Agricultural Marketing, Transport and Communication, Agricultural Research, Education and Extension Services, Fertilizers, HYV Seeds, Plant Protection Measures etc. In Assam available infrastructure and input facilities are not sufficient to fulfill the requirement of farmers which ultimately reflects in low productivity of agriculture. As explained in Chapter VI, the irrigation potential created in Assam so far covers roughly 17.17 per cent of the total cropped area, which is very poor in comparison to the

potential created in some other states of India. In Punjab 92.9%, in UP 68.7%, and in Bihar 49.4% of total cropped area was under irrigation system which were much higher than that of Assam. Agricultural productivity in the Sonitpur district is affected by inadequate irrigation facility. Only 11.7 percent of total cropped area was under irrigation facility whereas the state average was 17.17 percent. The credit provided to priority sector in Assam was marginally above the all India bench mark of 18.0 percent but it is not sufficient to fulfill the total demand for credit in rural Assam. In case of farm mechanization, the district as well as the state are still depends on traditional techniques and implements. According to the field survey (table: 7.5) total average number of power tiller/tractor and pump set in the district was 0.09 and 0.36 which was quite insignificant. Similarly agri-marketing system in Assam is not developed, only 24 regulated markets are present but their performance was not satisfactory. The rural areas of Assam and the district still not connected with all weather roads and this communication gap reflects in distress selling of agri-products by the farmers. Agricultural research and extension services still have to develop to achieve the target. Consumption of fertilizers in the state is quite low i.e, 63.16kg/hect whereas all India level was 135.30kg/hect in 2009-10. In Assam Seed Replacement Rate (SRR) is not so significant. SRR improves the productivity of crops to a large extent. The actual seed replacement rate of paddy, wheat, pea and oilseeds (rape and mustard) during 2009-10 was 33 percent, 51 percent, 51percent and 60 percent respectively. So, it is clear that existing infrastructural facilities are not sufficient to increase the productivity of agricultural sector in the district and the state. Therefore, the proposed hypothesis can be proved to be correct that in the district as well as in the state, agricultural productivity can be increased by providing adequate infrastructure and input facilities.

7.2.2. TESTING OF HYPOTHESIS II

Agricultural development of the district can be determined by studying the productivity trends and variation in yield rate of major crops with comparison to some other agriculturally competent districts and the state level. In Chapter III trends in productivity of major crops in the district was explained and in Chapter IV inter district variation in production and productivity was explained. The productivity of Autumn, Summer and Winter rice in the district in the year 2009-10 was 1050, 2720 and 1850 kg/hectare whereas in the state as whole it was 982, 2180, and 1824 kg/hectare (chapter III, table: 3.4). Similarly, in some other crops yield rate in the district is little bit higher than that of state level. In case of consistency in production and productivity of major food grains, the district was more consistent in production of rice in comparison with neighbouring district Darrang and Barpeta (chapter IV, table: 4.17, C.V: 22.5), in case of yield rate it is more consistent than Darrang district. In productivity of maize the district is more consistent (C.V: 2.2) than Darrang (C.V: 3.5), Barpeta (C.V: 2.34), and Jorhat (C.V: 2.26). Similarly, in production of pulses it is comparatively consistent than Darrang, Barpeta, Nagaon, Dhubri, and Jorhat district. In case of major non food grains, the district is comparatively consistent (C.V:15.8, chapter IV, table: 4.18) in productivity of rape seeds and mustard in comparison with Barpeta (C.V: 20.2), Dhubri (C.V: 16.1) and Jorhat (C.V: 22.3) district. In case of potato, the variation in yield rate is very high in the district but in production (C.V: 34.9) it is comparatively consistent than Darrang (C.V: 54.9), Barpeta (C.V: 39.4), Nagaon (C.V: 36.02), and Jorhat (C.V: 69.2) district. In production of sugarcane, the yield rate of the district during the period shows more consistency (C.V: 7.44) than the state level (C.V: 15.8). So, from the above analysis, it is clear that the agricultural performance in the

district is not so high like agriculturally developed states like Punjab and Haryana, but the development and performance of agriculture in the district is not so insignificant in comparison to other agriculturally competent districts of Assam. Therefore, the proposed hypothesis second is proved to be wrong.

7.2.3. TESTING OF HYPOTHESIS III

Agricultural development and its performance in any region very much depend on the size of the land holdings of the household farmers. In Sonitpur district, total number of farm families was 154441 operating on the area of 165129 hectares during the said year. The per capita land holding in the district was 1.06 hectare which was less than state average. In the district, 15.0 percent farmers are landless whereas large farmers constitute only 12.0 percent. The percentages of small and marginal farmers are 37.0 and 36.0 percent whose landholding is 0.4-1.0 hectare and 1.0-2.0 hectare respectively in the district (chapter VI, table: 6.2). This is mainly due to the defective law of inheritance of agricultural land and land tenure system in the state. Fragmentation of holdings stands out as one of the chief responsible factors hampering the implementation of the modern technology in agriculture. In the small area of operational holdings, it is practically not possible to implement modern techniques of production and inputs. Since the percentage of small and marginal farmers are very high in the district, which means the farmers are subsistence level farmer producing mainly food crops to maintain their family, they never think for crop diversification, which ultimately reflects in low productivity in agriculture. The consolidation of land holding is a very important measure of land reforms policy, but the government has not given serious attention for its implementation. Therefore, the proposed Hypothesis

III that the size of land holding and their fragmentation retards efficiency of cultivation in the district is proved to be correct.

7.3. MAJOR FINDINGS OF THE STUDY

- Demographic characteristics of the district reveals that 50.5 percent of total farm population lies between age group of 15-50 years, 31.4 percent less than 15 years age and 18.1% is more than 50years age. It implies that more than half of the population of the district is productive.
- Around 74.7% of farm populations of the district are literate and literacy among medium class farm population is highest i.e., 77.6%.
- Average cultivable land holding in the district of small, medium and large farmers are 1.74, 3.70 and 6.28 hectare respectively.
- Distribution of livestock in the district was not so high. Average number of cow, bullock and buffalo per household was 1.3, 1.22 and 0.42 respectively.
- Farm mechanization and implements are not satisfactory at all. Average number of power tiller, pump set and sprayer per household are 0.09, 0.36 and 0.90 respectively.
- The average number of plough per family of all groups in the district was 3.02 but average number of duster and weeder in the district was only 0.07 and 0.28 respectively.
- Food grains mainly cereals production dominates the cropping pattern of the district. The cropping intensity of the district in 2009-10 was 165.7 percent.
- Use of HYV seeds, fertilizers and pesticides in the district is quite insignificant. In average 75.67kg/hect seeds, 13.8 cart load/hect of FYM,

21.85kg/hect fertilizers and 0.81liter/hect pesticides are used which are quite insignificant in comparison to State and National level.

- In the district 24.67, 61.67 and 49.3 percent area was affected by flood, drought and pest and diseases. In the district 93.0 percent farmers are not getting adequate credit facility, 64.3% deprived of getting agricultural inputs, 67.33% are suffering from inadequate mechanization and 93.0 percent are not getting any type of training till date.
- In the district 54.0% of farm families are affected by inadequate transport facility, 70.0% due to absence of domestic market, 66.33% due to presence of middlemen, 94.0 % due to inadequate storage facility and 70.33% was affected by Lack of market knowledge.
- In the district, 55.67 percent farmers in average are suffering from low marketable surplus in agricultural produce and around 92.67 percent are suffered from price uncertainty of their product in the market.
- Farmers are also not getting the facilities of sales promoting agencies in the district. Around 78.0 percent are directly affected by the absence of sales promoting agencies in the district.
- In the district, around 50.0 percent of farmers in average are suffering from high marketing charge.

7.4. RECOMMENDATIONS AND SUGGESTIONS

In the context of foregoing discussion, it is felt that there is urgent need of improving the present agricultural situation in Assam by raising the crop intensity through multiple or relay cropping and substantially raising the productivity of crops per unit of area. For this purpose the following policy measures have been suggested:

7.4.1. LAND REFORM MEASURES

It is very unfortunate that the various land reform measures undertaken in Assam have not been implemented properly to assist the farmers in their endeavours to raise agricultural production. Therefore, the following steps should be taken to implement these measures properly and if necessary by changing the existing policies.

- a) For this purpose, a drastic land distribution policy should be taken, which will break the monopoly of big farmers and help equal distribution of rural income.
- b) The agricultural land distribution policy of the Government should be such that each farmer gets sufficient land for remunerative production.
- c) State should also make laws to prohibit subdivision of land into uneconomic sizes. For this purpose, if necessary the 'law of inheritance' should be amended. Besides, new laws should be enacted to debar the non-cultivating members of a family employed in other occupation from inheriting the agricultural land and purchasing such lands from the peasants. Adoption of improved technology is not possible unless the farm size is raised to an economically feasible unit.
- d) In Assam the average size of land holdings is very small (1.11 hectares according to agricultural census 2005-06). Besides, there are marginal farmers with skill and vigour with or without little holdings of land. In such cases, the co-operative farming systems will be the best policy. But it is necessary for small neighbouring farmers to form such co-operatives for more production. For this

purpose proper guidance and help should be given to these co-operatives to achieve the purposes by the Agricultural Department of Government.

- e) In order to reduce the pressure of population on agricultural land, Government should undertake programmes for the development of rural based industry and other projects such as transport, irrigation projects, rural electrification etc. Such programmes will absorb a large labour force and thus will release the excess surplus labour force from agriculture.

7.4.2. DEVELOPMENT OF AGRICULTURAL RESEARCH, EDUCATION, TRAINING AND EXTENSION SERVICES

For the development of agriculture, the research and extension services of Assam will have to be strengthened to provide solutions of problems faced by the farmers. For this purpose, agricultural research institution should be revitalized. The various research conducted by the Agricultural University should be based on local level problems and production oriented so that it can suit the specific needs of the state. The agro-climatic and other situations of Assam are different from other parts of the country. Assam has fertile soil for different crop cultivation, but the soil of certain area need special treatment to raise the yield of crops. Therefore, agricultural research work in the state should be directed to evolve such seeds and technology that will be most suitable for the different types of soils and climatic conditions of the state and farming technology appropriate for small and marginal farmers. Further, there must be wide publicity about the seeds and technology developed by such research work among the farmers through establishment of experimental farm and by holding field demonstrations.

The Indian Council of Agricultural Research (ICAR) has innovated programmes to impart training and education to the farmers to spread knowledge of technology among the farmers. The state should avail all these facilities imparted by ICAR for agricultural development of the states. Further, the training programmes for the farmers should be need-based. Therefore, while preparing the course contents for training programmes, necessary advice should be taken from the local agricultural officers as they are more aware of the local needs of the farmers.

The illiterate farmers may not be enthusiastic to adopt the new seeds and technology until they see the changes very vividly. So the Department of extension services should make practical demonstration of new seeds and technology to the farmers. When they are satisfied that the new methods give much more yield, this demonstration can be held in some individual farmers. Gradually the neighbouring farmers will adopt these new seeds and technology and gradually this will spread to cover the whole state.

The role of agricultural extension officers will be very crucial for the success in adoption and extension of the new technology and improved seeds; they will have to hold block level training programmes to some literate and selected farmers of the block; then such training programmes to be extended to the village level; this will require greater number of field officers if the programme is held simultaneously all over the state; as, so many officers may not be available, the change can be done gradually by first starting with one district and then to another and so on. This will take up some time of a year or two or more; but when the whole of the state is covered, the result will be very satisfactory both to the state and to the farmers. Farmers will find their production of crops as increased manifolds.

The success of this programme mostly depends on the sincerity and devotion of the agricultural Extension Officers. If they sincerely work for this purpose, they can bring about the change. For this purpose, the service of the Gram Sevak can also be utilized; if the block level extension officers give training to the Gram Sevak about the new technology, they in turn will give training to the farmers falling under his area under the supervision of the extension officer. Thus the whole of the state can be covered within a year or two. The main requirement is the sincerity and devotion of the field officers, both the block level and village level.

7.4.3 USE OF HYV SEEDS

Seed is the basic, vital and central input in agriculture and all farming system. It is the timely availability of quality seeds of right variety in adequate quantity that decides the strength and health of an agricultural economy. But in Assam as well as in the district the supply of quality seed is very poor in Assam. Therefore, farmers are compelled to use the farm saved seeds which do not have any quality standard. Many times non-descript varieties are also used as seeds by the resource poor farmers which result in low productivity. Therefore, there is an urgent need to increase the supply of seeds in order to meet the growing demand for seeds.

Production and supply of hybrid seeds of the crops require highly technical know-how, trained personnel and resources. The following suggestions are given in order to increase the production and supply of seeds in the district and in the state:

- a) Government should encourage seed production in the private sector along with public sector.

- b) Proper co-ordination must be maintained between various seed producing organizations so that they can meet the seed demand of the state.
- c) Necessary financial support should be given to the seed producers. For this purpose, a good budgetary provision must be committed for the development of new varieties, hybrid and seed research.
- d) To maintain the purity of seed, necessary programmes must be organized to train the seed producers. The number of seed testing laboratories must be increased in the state.
- e) Steps should be taken to supply the seeds to the farmers in proper time and at reasonable price.
- f) Extensive publicity should be given among the farmers about the beneficial effects of hybrid seeds by farmers training programme and field demonstration.

7.4.4. PEST MANAGEMENT

As the HYV seeds are easily susceptible to pest and diseases, necessary steps should be taken to protect the crop from the ravages of pest by adopting appropriate pest management practices. During the early years of Green Revolution, use of chemical pesticides was popular as a plant protection measure. But it is observed that over use of chemical pesticides led to poisoning people and animals and as well as polluting the environment. The other problem associated with over use of pesticides is the contamination of soil and water resources including the aquatic system. Continued use of harmful pesticides poses greater danger to the soil fauna and flora. Chemical pesticides and their residues have often been detected in food grains, vegetables, fruits, oils etc. in most part of the country. Due to harmful effects of these chemical pesticides the use of non-chemical methods of pest

management has become popular in different parts of the country. Such pest management methods include botanical and biological pest control tactics. In the district and the state 'Bio-basis' method of pest management becomes popular in the recent years. In order to develop and popularize this method of pest management in every corner of the state, the following suggestions are made:

- a) Farmers of the district and the state should be given necessary training under the FFS (Farmers Field School) approach of integrated pest management programme in order to let them know about the eco-friendly crop production programme. Such programme should be extended to each corner of the state so that each farmer gains knowledge as how to grow healthy crops and manage crops.
- b) The presently available biological control agents and botanical pesticides should be made available to the farmers of Assam and all the needed infrastructure should be developed with a view to enable the farmers to adopt these non- chemical method of IPM (Integrated Pest Management)
- c) Research work should be encouraged and more importance should be given in innovate new pest management method suitable for the state of Assam under the IPM-Eco-friendly approach in agricultural production activities.

It can be expected that proper use of eco-friendly approach in agriculture in the state will protect the crops from the ravages of pest and raise crop productivity and production of quality crops.

7.4.5. USE OF FERTILIZER

Fertilizer is one of the important inputs to increase the agricultural production to meet the growing demand. Though fertilizer consumption has been rising over the years, per hectare consumption is still very low, even when compared to our neighbouring states. Therefore, there is need to undertake some measures by the Government to increase the supply of fertilizer within the state and the district. For the use of fertilizer following suggestions are made:

- a) Fertilizers should be made available to the farmers at the time of need through well-organized distributive agencies at reasonable rate.
- b) Periodical soil testing based on fertilizer application for specific crops should be made.
- c) Organic materials of plants and animals have a unique role to play in soil fertility. Therefore, farmers should be encouraged to use the Organic materials derived from plant residue and agricultural waste.

Optimum productivity level can be attained if fertilizers are applied according the requirement of the soil.

7.4.6. IRRIGATION AND WATER MANAGEMENT

Agricultural development depends a great deal on the availability of adequate and assured irrigation facilities. Assured irrigation especially during winter months is an imperative need for the optimum utilization of chemical fertilizers and HYV seeds. Irrigation also enables diversification of cropping pattern from the traditional mono-cropping to multiple cropping vis a vis increase in productivity. Unfortunately, development of irrigation is extremely tardy in the district and in the state. A good proportion of agricultural lands have been out of use on account of water-logging and

salinization caused by seepage from unlined canals and distributaries. So, required steps should be taken in time to develop the irrigation facilities and water management system in the state. For this purpose the following measures have been suggested:

- a) Detail soil surveys should be carried out in the areas where irrigation facilities are available to find out the optimum requirements and over application of water. Incentive should be given to those farmers who save water and the motto for the farmers should be 'more crop per drop of water'
- b) Govt. should identify areas suitable for setting up Lift Irrigation schemes and provide adequate funds for completion of schemes.
- c) To minimize wastage of water and water logging and salinity proper drainage facilities should be developed.
- d) Financial assistance should be provided to farmers for purchasing and repairing of machines, pump sets etc in time.
- e) The micro irrigation system such as drip irrigation not only saves each drop of water most efficiently, but also save the soil from getting water logged or saline. Steps should be taken to adopt and develop such schemes in the district and in the state.
- f) Water management requires substantial skill which depends upon technical knowledge of the persons involved in irrigation. So, proper training should be given to farmers and irrigation workers.
- g) High priority should be given on rural electrification.
- h) In Assam there is a wide gap between irrigation potential created and utilized. Govt. should take steps to reduce the gap.

- i) There should be proper coordination between the agriculture and irrigation departments and between farmers and the departments for getting maximum benefit.

It should be noted that the irrigation scenario in the state after 2000-01 show a different picture because of large scale installation of shallow tube wells in the state under the major irrigation project launched in the state through NABARD funding.

7.4.7. FARM MECHANIZATION

Mechanization of agriculture is very important to increase the total production and sustaining the tempo of agricultural growth in the district and in the state. It reduces the cost of cultivation and helps in reclaiming barren lands. Use of fertilizer and pesticides also require suitable machinery. In Assam, huge manpower in rural areas and fragmented land holding mostly prevent mechanization. Hence, there is little scope for full mechanization of agriculture in Assam. The cost of mechanization is very high and most of the farmers cannot think of buying all the necessary machines and tools themselves. So, the following suggestions are made for mechanization in agriculture:

- a) Proper land policy for consolidation of land holdings should be adopted by the Govt.
- b) Financial assistance should be made available to farmers for purchasing farm implements and tools.
- c) Iron plough should be made available to the farmers at reasonable price. Tractors can be installed by co-operative farms on co-operative basis.

- d) Vital agricultural implements should be manufactured within the state and these should be provided to the farmers at a lowest possible price and on hire basis through the co-operatives basis.

7.4.8. AGRICULTURAL MARKETING

Agriculture in Assam has been at a subsistence level with a very small surplus for sale. The growth and diversification of agriculture mostly depends upon efficient marketing system. So, the following necessary steps have been suggested for the improvement of present marketing system in the state.

- a) All the markets of the state should be brought under the purview of the Agricultural Produce Market Act and regulated according to the time bound programme. Till now 24 markets in Assam are under regulated market but none of the markets has shown the expected result.
- b) Modified storage and cold storage facilities must be made available in rural areas to increase the longevity, retention of freshness, texture and reduction of post harvest loses of different types of food grains, horticultural crops and other perishables including seeds etc.
- c) Market information should be made available to farmers all over the state and country by interlinking important markets and mandis.
- d) A necessary pre-condition for an efficient marketing system is developed transport system. But the existing transport systems in the rural areas of Assam are in very poor condition. Therefore, Govt. should take urgent step to develop existing transport and communication system of the state.

7.4.9. AGRICULTURAL CREDIT

As mentioned in chapter VI, nearly 84 percent of the operational holdings are below the minimum economic size of holdings and the economic

condition of the farmers are very poor. These subsistence level farmers are unable to invest in agriculture for its modernization. Therefore, major thrust of the existing credit policy should be to provide farmers through institutional agencies. The following suggestions are made regarding credit in agriculture in the district and in the state:

- a) To reduce the exploitation of farmers, the role of indigenous bankers should be minimized and institutional facilities should be improved.
- b) The financial institution should provide agricultural credit on priority basis and sanction of loan should be time bound.
- c) As the repayment capacity of the small and marginal farmers is relatively lower as compared to rich farmers, banks and other financial institutions should provide adequate repayment period so that loan prepayment does not become difficult for the farmers.
- d) The micro finance facilities through SHGs (Self Help Groups) should be implemented properly in Assam so that small farmers operating on a micro scale get benefit from such scheme.

7.4.10. NATURAL HAZARDS

Flood in Assam is main natural and regular hazard which causes much damage to crops every year in all the localities of the state; as a result, control of flood is the urgent necessary for increasing production. Actually, the flood problem of Assam is caused by the mighty river Brahmaputra and its tributaries. The problem is so severe and costly that it is not possible to tackle it by the state Govt. alone. Some part of the state is sometimes suffered from drought situation due to irregular rainfall. The following suggestions have

been made to minimize the damage due to flood and drought in the district and the state:

- a) To minimize the damage early variety of paddy and short duration crops should be cultivated before the probable flood period
- b) There are some flood resistant paddy and other crops, which should be cultivated during the flood period. Proper selection of crop rotation also help the flood affected farmers to a great extent.
- c) Flood can be controlled scientific way by constructing dams and reservoir in flood prone area.
- d) Proper irrigation facilities can minimize the effect of drought in drought prone areas.
- e) The flood problem in Assam should be recognizing as a National Problem and Government both a State and Union should think for permanent solution.
- f) For all these, research is essential and Govt. should install such research centre under the guidance of reputed scholars in the line.

7.4.11. LIBERALIZATION AND MARKET ECONOMY

The world scenario in recent time has been rapidly changing because of liberalization through economic reforms and also due to globalization on account of creation of WTO. Market economy is now going to play a large role in various economic activities including agriculture.

With increasing globalization of world agriculture, India has an opportunity to participate in the world agriculture market through increasing its competitiveness of various crops. In order to enjoy the benefit from trade liberalization and globalization of agriculture, India should continue to carry

out domestic reforms through streamlining its domestic markets, institutions and infrastructure policies that reduce high transaction costs and make agricultural commodities competitive in international market. Being a part of India and having high potentiality of increasing agricultural productivity with suitable soil and climatic conditions for agriculture, Assam should also introduce all necessary reforms to increase its competitiveness in the production of various food grains and other crops particularly the horticultural crops and vegetables.

7.5. CONCLUSIONS

Agriculture is the mainstay of Assam economy because of its high share in employment and livelihood creation notwithstanding its reduced contribution to the state domestic product. But the year-wise production and productivity of main agricultural products are not consistent. This is due to natural, technical and socio-economic factors which are responsible for dismal growth in the sector. But since the sector provides livelihood to major portion of population in Assam, it is very necessary to attain a sustainable growth in productivity. It is observed that agricultural development is the basic precondition of sectoral diversification and development of the states' economy. An increasing marketable surplus of agricultural output is much essential in a poor state like Assam for increasing supply of food and raw materials at non-inflationary prices, widening domestic market for industrial products through higher purchasing capacities in the rural sector, facilitating inter-sectoral transfers of capital needed for industrial development along with infrastructural development and increasing foreign exchange earnings through increasing volume of agricultural exports. But agriculture in Assam is frequently affected by natural factors like flood,

drought etc. It is necessary to develop different agricultural strategies should be developed for flood affected and unaffected areas. In the hill regions tree farming (settled cultivation) should be given top priority. In the context of the rapid growth of population and meager growth of extension of cultivation to new areas, the future strategy for agricultural development in Assam should be concentrated on increasing cropping intensity and greater emphasis on increase per hectare yield of crops like rice, wheat, pulses, mustard, potato sugarcane etc. This will reduce the dependence of the state on outside sources. There is also need to improve research on crop husbandry to evolve technology suitable to our soil and climatic conditions. In executing such a programme, farmers must be properly trained and motivated through improvement in extension service. For increasing cropping intensity there must be adequate and assured irrigation facility. So, required steps should be taken in time to develop irrigation facilities and water management system in the state. In all such efforts, State Govt. and Agricultural Institutions will have to co-operate with one another in order to assist the farmers in their endeavours to increase agricultural production. As an agricultural state, Assam can attain higher economic growth rate only after attaining a reasonable and sustainable growth in agriculture sector. Therefore, extension of irrigation facilities, extension of land under organic farming, diversification of agriculture and sustainable agriculture should receive priority.

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SCHEDULE

Schedule for inventory of data of the sample Respondents

1. General Information of the Sample Respondents:

- a) Sample No:
- b) Household No:
- c) Gaon/Village:
- d) Gaon Panchayat:
- e) Block:
- f) Name of the Respondent:

2. Principal Livelihood/Occupation:

3. Demographic Characteristics of the Household:

Sl. No	Name of the member	Age	M/F	Education level	Full time/ part time/ non worker
1.					
2.					
3.					
4.					
5.					

4. Land Holding Status of the Sample Respondent

Sl. No.	Types of land holding	Area in hectare
1.	Own land	
2.	Lease in land	
3.	Lease out land	
4.	Fallow land	
5.	Land under homestead	
6.	Land for kitchen garden	
7.	Land for fishery	
8.	Land for grazing land	
9.	Land under forest	
10.	Land for horticulture	
11.	Land for plantation	
12.	Land for others	
13.	TOTAL	

5. Major Food-Crops grown by the Sample Respondent

Sl. No	Name of crop	Area in hectare	Production in tonnes	Yield rate (tonne/hectare)
1.	Autumn rice			
2.	Winter rice			

3.	Summer rice			
4.	Wheat			
5.	Maize			
6.	Pulses			

6. Major Non-Food crops grown by Sample Respondent

Sl. No.	Name of crop	Area in hectare	Production in tonnes	Yield rate (tonne/hectare)
1.	Rape seed and mustard			
2.	Jute			
3.	Potato			
4.	Sugarcane			

7. Other Crops grown by Respondent

Sl. No.	Name of crop	Area in hectare	Production in tonnes	Yield rate (tonne/hectare)
1.				
2.				
3.				
4.				
5.				

8. Loss of Crops due to Natural Hazards

Sl. No.	Natural hazards	Area affected (in hectare)	Estimated loss of crops (in tonne)	Estimated loss of crops (in Rs.)
1.	Flood			
2.	Drought			
3.	Pest attack			
4.	Other			

9. Farm Resource used by the Sample Respondent in Major Food Crops

Sl. No	Input resource	Unit/hectare			
		Rice	Wheat	Maize	Pulses
1.	HYV Seeds				
2.	Local seeds				
3.	FYM (Farm Yard Manure)				
4.	Phosphetic fertilizers				
5.	Urea				
6.	MOP				
7.	Bullock labour				
8.	Human labour				
9.	Chemicals				
10.	Other costs				

10. Farm Resource used by the Sample Respondent in Major Non-Food Crops

Sl. No	Input resource	Unit/hectare			
		Rape seeds & mustard	Jute	Potato	Sugarcane
1.	HYV Seeds				
2.	Local seeds				
3.	FYM				
4.	Phosphetic fertilizers				
5.	Urea				
6.	MOP				
7.	Bullock labour				
8.	Human labour				
9.	Chemicals				
10.	Other costs				

11. Labour used per hectare in Production of Food Crops and Non-Food Crops by the Respondent

Sl. No.	Item of work	Labour/hectare	
		Food crop	Non-food crop
1.	Land preparation		
2.	Sowing/planting		
3.	Weeding/hoeing		
4.	Fertilizer application		
5.	Irrigation		
6.	Harvesting		
7.	Threshing		
8.	Cleaning		
9.	Bagging		
10	Others		

12. Animals and Birds with the Respondents

Sl. No.	Name of the animals/bird	Nos.
1.	Bullock	
2.	Milk cow	
3.	Buffalo	
4.	Piggery	
5.	Goat	
6.	Duckery	
7.	Poultry	
8.	Other birds	

13. Farm Implements used by the Respondents

Sl. No.	Name of farm assets	Nos.
1.	Tractor	
2.	Power tiller	
3.	Power pump	
4.	Plough	
5.	Leveler	
6.	Sprayer and dusters	
7.	Weeder	
8.	Speed driller	
9.	Other farm implements	

14. Irrigation facility available to the Respondent

Sl. No.	Types of facility	Area in hectare
1.	Rain fed	
2.	Flow irrigation (FIS)	
3.	Lift irrigation (LIS)	
4.	Deep tube well (DTWS)	
5.	Shallow tube well (STWS)	
6.	Others	

15. Availability of Agro- Infrastructural facility:

Sl. No.	Facilities	Available/not available	If not, distance from the nearest source
1.	Selling outlets of seeds		
2.	Selling outlets of fertilizers/pesticides		
3.	Fair price shop		
4.	Market for selling farm products		
5.	Financial institutions		
6.	Others		

16. Production and disposal of Food and Non-Food Crops by the Respondent

Sl. No.	Particulars	Quantity (quintals)	
		Food crops	Non-food crops
1.	Total production		
2.	For seed purpose		
3.	For family needs		
4.	Presented to relatives		
5.	Paid for labour		
6.	Paid to function/festivals		

7.	Loss during handling		
8.	For sale		
9.	others		

17. Difficulties faced by the Respondent in Production of Crops

- a)
- b)
- c)
- d)
- e)

18. Difficulties faced by the Respondent after Harvesting of Crops

- a)
- b)
- c)
- d)
- e)

19. Chronic problems faced by the Respondents in entire activity

- a)
- b)
- c)
- d)
- e)

20. Opinions/suggestions of the Respondents in handling of the problems

- a)
- b)
- c)
- d)
- e)

XXX

