PATTERN OF AGRICULTURAL DEVELOPMENT AND THE EMERGING CHALLENGES IN BARPETA DISTRICT, ASSAM: A GEOGRAPHICAL ANALYSIS

Thesis Submitted

To Nagaland University, Lumami

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BY

MD. ANJAR ALI

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Dr. WANGSHIMENLA

DEPARTMENT OF GEOGRAPHY

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HQRS.: LUMAMI -798627

NAGALAND

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Nagaland University

(A Central University Estd. By the Act of Parliament No. 35 of 1989)

Lumami 798627, Nagaland, India

DECLARATION

I, Md. Anjar Ali, hereby declare that the subject matter of this thesis entitled, “Pattern of Agricultural Development and the Emerging Challenges in Barpeta District, Assam: A Geographical Analysis” is the record of original work done by me and that the contents of this thesis did not form the basis for award of any degree to me or to anybody else to the best of my knowledge. This thesis has not been submitted by me for any Research Degree in any other University/Institute.

This thesis is being submitted to the Nagaland University for the degree of Doctor of Philosophy in Geography.

(Md. Anjar Ali)

(Prof. Dr. M. S. Rawat)
Head of Department

(Dr. Wangshimenla)
Supervisor

Nagaland University

(A Central University Estd. By the Act of Parliament No. 35 of 1989)
Lumami 798627, Nagaland, India

Dr. Wangshimenla Jamir
Assistant Professor,
Department of Geography

Date:

CERTIFICATE

The thesis presented by Md. Anjar Ali, M.A., B.Ed., bearing Registration No. 531/2013 (23rd November, 2012) embodies the results of investigations carried out by him under my supervision and guidance.

I certify that this work has not been presented for any degree elsewhere and that the candidate has fulfill all conditions laid down by the university.

(Prof. Dr. M. S. Rawat)
Head of Department

(Dr. Wangshimenla)
Supervisor

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CHAPTER I

INTRODUCTION

1.1. Introduction

Agriculture is one of the oldest primary form of economic activity of human being from the time immemorial. It is indispensable for getting food, without which survival is not possible. The recent investigation shows that agriculture began around 8000 BC during the Sumerian times in South West Asia. Agriculture occurred transformation from hunting gathering gradually after a long period of time. Went (editors of Life, 1963) explained the early development of agriculture it may have involved first with the management of wild grains and other useful plants by removing adjacent weeds. It includes not only cultivation but also livestock ranching, diary, forestry, lumbering, fishing and host of other activities. The word agriculture is derived from two Latin words ‘agree’ referring to the soil and ‘cultural’ to cultivation. According to Zimmerman, agriculture covers those productive efforts by which man settle on land, seek to make use of, and if possible, accelerate and improve upon the natural genetic or growth processes of plant and animal life, to the end that these processes will yield the vegetable and animal product needed or wanted by man. On the other hand, according to Oxford dictionary agriculture means, the science and arts of cultivating the soils, including the allied pursuits of gathering in crops and rearing livestock, tillage husbandry, farming etc.

Agricultural growth is a key to expansion of an entire economy of developing countries of the world. Agricultural development gives us the opportunity to work with suitable development in developing countries by means of economic growth food supplies and nature preservation. Agricultural developments means changes in agricultural production techniques and the structure of the agricultural enterprises towards a more desirable situation. Usually a situation in which a farmer use more agricultural research findings and where is less subsistence and more market oriented agriculture (Van den Ban & Hawkins, 1988).

Agriculture is an integral part of world food system, having the fundamental links between crops and animal production system. According to the World Bank data source agricultural sector employed 20% world populations and 51% Indian populations in 2010.The share of agriculture in GDP is 17.4% in India and 3.9% in world in 2014 (World Bank). It constitutes 10.59% of the total value of India's export in 2009-10. The development of agriculture depends on many factors such as physical and socio-economic factors. The relative importance of agriculture in the least developed countries is greater, where 76% workforce was engaged in agriculture in 1990 and it was 85% in 1970. The percentage of work force engage in agriculture of the developed countries is very low. It is as low as 2% in United Kingdom and 5% in USA.

Table 1.1: Changing share of Agriculture in GDP, 1960-2014 (In %)

Country	1960	1970	1980	1990	2000	2010	2014
England	NA	NA	NA	1.48	0.92	0.74	0.69
Japan	NA	5.14	3.08	2.12	1.59	1.18	1.17
USA	NA	NA	NA	NA	1.19	1.17	1.33
China	23.38	35.22	29.87	26.72	14.75	9.62	9.17
Bangladesh	57.47	54.56	31.55	32.75	23.77	17.81	16.11
India	42.56	41.95	35.39	29.02	23.02	18.21	17.39
World	NA	NA	NA	NA	5.2	3.9	3.9

Source: World Bank, 2016

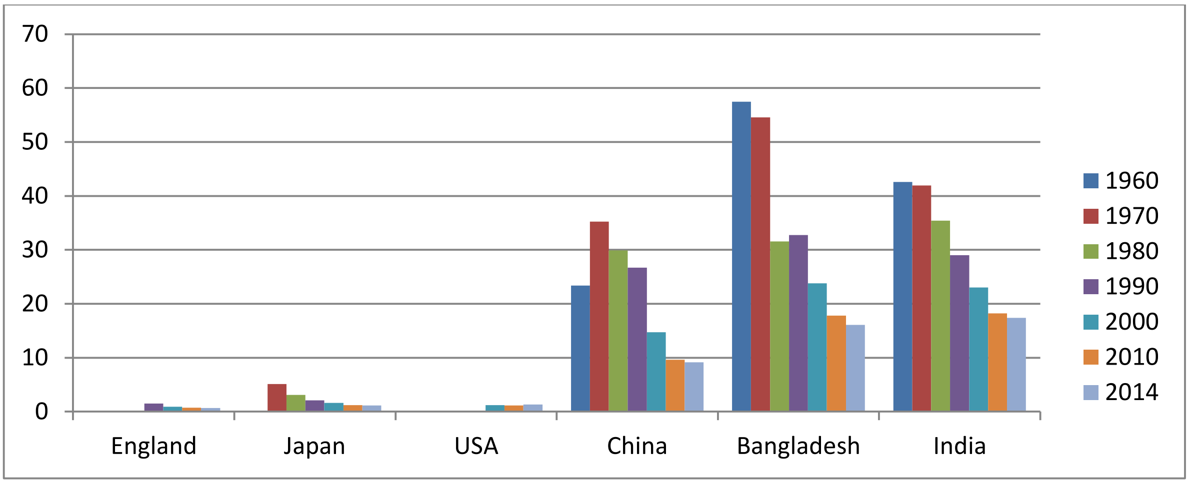


Fig 1.1: Showing changing share of Agriculture in GDP, 1960-2014

Table1.1. shows share of agriculture in GDP has been declined worldwide. The share of agriculture in GDP is 5.2% in 2000, which has been declined to 3.9% in 2014 in world. The contribution of agriculture in developing countries is more than developed countries of the world. The contribution of agriculture in GDP was 42.56% in 1960 and it steadily declined to 17.39% in 2014 in India. Further contribution of agriculture in GDP is 0.69% in England, 1.17% in Japan, 1.33% in USA, 9.17% in China and 16.11% in Bangladesh.

Agricultural growth is urgently required to support the food security of growing population in developing countries of the world. FAO has estimated that agriculture production needs to increase 70% globally to meet a projected population of more than 9 billion by 2050 and that the largest increase in demand will be in developing countries. However, the adverse impacts of climate change will increase the difficulty of obtaining needed agricultural growth. Agricultural productivity of farm is most important for all over development of a region and competitiveness on the agricultural market, income distribution, saving, labour mitigation and moreover providing foods. Agricultural productivity is becoming increasingly importance as the world population continues to grow. The techniques to increase agricultural productivities are uses of mechanization, HYV, fertilizer, liming of acid soils, irrigation, herbicides, pesticides etc. in the agricultural firms.

India is a global agricultural powerhouse. It is world largest producer of milk, pulses and spices, and world largest cattle herd, as well as the largest area under wheat, rice and cotton. It is the second largest producer of rice, wheat, cotton, sugarcane, sheep and goat meat, fruit, vegetable and tea. The country has 195 million hectares under cultivation of which 63 percent are rainfed (roughly 125 million hectares) while 37 percent are irrigated (70 million hectares). In addition, forests cover lands are65millionhectors in India. India is second larger producer of agriculture product and accounts for 7.68 percent of total global agricultural output. According to CIA Fackbook contribution of Agriculture sector in Indian GDP is 17.9%, Industry (24.2%) and Services (57.9%) in 2014. Agriculture sector total production is $366.92 billion. And industry sector GDP is $495.62 billion which world rank is 12. In Services sector, India’s world rank is 11 and GDP is $1185.79 billion. Contribution of Agriculture sector in Indian economy is much higher than world average (6.1%). India exported $39 billion worth of agricultural products in 2013, making seventh largest agricultural exporter in worldwide and the sixth largest net exporter.

According to World Bank, India Country Overview 2011, "With a population of just over 1.2 billion, India is the world’s largest democracy. In the past decade, the country has witnessed accelerated economic growth, emerged as a global player with the world’s fourth largest economy in purchasing power parity terms, and made progress towards achieving most of the Millennium Development Goals. India’s integration into the global economy has been accompanied by impressive economic growth that has brought significant economic and social benefits to the country.

Nevertheless, disparities in income and human development is on the rise. Preliminary estimates suggest that in 2009-10 the combined all India poverty rate was 32 % compared to 37% in 2004-05. Going forward, it will be essential for India to build a productive, competitive, and diversified agricultural sector and facilitate rural, nonfarm entrepreneurship and employment. Encouraging policies that promote competition in agricultural marketing will ensure that farmers receive better prices".

In 1950-51, the contribution of Agriculture and allied, Industry and Services sectors were 51.81%, 14.16%, and 33.25%, respectively at current prices. The share of Agriculture and allied sector has declined to 18.20% in 2013-14. And share of Services sector has grew up to 57.03% and Industry sector has increased to 24.77%.

Indian total net sown area is141 million hectare against 328.7 million hectare of total geographical area in 2015 out of this 195 million hectare is gross cropped area. Among the different crops, food grain constitutes largest share within the net sown area. In 1996-97, food grain cultivation was 68.8% and it was 76.7% in 1950-51. The production of food grain in India increased from 55.6 million tons in 1950-51 to 180 million tons in 1992-93. There was also considerable increase in the productivity of the crops. Per hectare average yield of rice in India was only 668 kg in 1950-51 and it grew up to 1425 kg in 1984-85. Similarly the per hectare average yield of wheat for India as a whole grew up from 663 kg in 1950-51 to 1873 kg in 1984-85. Agriculture is the backbone of the state economy of Assam and is the highest employer of labour. It engages more than 65% working force. The share of the sector in the SDP 37.6% of Assam was constant in 1980-81 and 1991-92 and it decreased to 21.3 percent in 2013-14(ESA, 1997-2013). The 43% land area of the total geographical area of the state is under cultivation and is much lower than potentialities. The multi cropping area is 39.86% of the total cultivable land area of Barpeta in 2012-13.

Agriculture is the dominant economic activity in Assam as the main source of earning livelihood. But the development of agriculture is very slow in Assam, as it is elsewhere in the world. In the development of agriculture structural change is most important. It faces many difficulties like high growth rate of population, over pressure of population on land, poverty, lack of modern technology, erratic climatic condition, lack of skill labour etc. in Assam. Moreover, the physical factors like physiographic, soil, climate etc. are also highly affecting the development of agriculture.

1.1.1. History of Agriculture in India

Indian agriculture is dates back to the Indus Valley Civilization era and before that agriculture was started in some parts of southern India. India's rankis second worldwide in farm output in 2011. A Rigveda hymn describes plowing, fallowing, irrigation, fruit and vegetable cultivation. Other historical evidence suggests rice and cotton were cultivated in the Indus Valley and plowing patterns from the Bronze Age have been excavated at Kalibangan in Rajasthan. Bhumivargaha an Indian Sanskrit text, suggested to be 2500 years old, classifies agricultural land into 12 categories: urvara (fertile), ushara (barren), maru (desert), aprahata (fallow), shadvala (grassy), pankikala (muddy), jalaprayah (watery), kachchaha (contiguous to water), sharkara (full of pebbles and pieces of limestone), sharkaravati (sandy), nadimatruka (watered from a river), and devamatruka (rainfed). Some archaeologists believe that rice was a domesticated crop along the banks of the river Ganges in the sixth millennium BC. Winter cereals were barley, oats, wheat, legumes, lentil and chickpea grown in northwest India was cultivated before the sixth millennium BC. Other cultivated crops likes sesame, linseed, field pea, grass pea, cotton, jackfruit, mango, mulberry were cultivated in India 3000 to 6000 years ago. Indian peasants has also domesticated cattles, buffaloes, sheeps, goats, pigs and horses thousands of years ago.

Some scientists claim that agriculture has widespread in the Indian peninsula from 3000–5000 years in the fertile plains of the north and other claim that Indian agriculture was began during 9000 BC as a result of early cultivation of plants and domestication of crops and animals. Settled life soon followed with implements and techniques being developed for agriculture. Double monsoons led to two harvests being reaped in one year. Indian products soon reached trading networks and foreign crops were introduced. In Middle Ages irrigation channels were reached in a new level of sophistication, and Indian crops affected the economies of other regions of the world under Islamic patronage. Before the 18th century, cultivation of sugarcane was largely confined to India. A few merchants began to trade of sugar as a luxury and an expensive spice in Europe and sugar became widely popular in 18thcentury. These led to influenced, in part colonialism, slavery and Slavery like indentured labor practices in the new world, Caribbean wars and world history in 18th and 19th centuries.

After independence Indian agriculture has made immense progress towards food security. Indian population has tripled and food grain production more than quadrupled. In the mid1960s, Green Revolution was started in India with an aims to adopt superior yielding, disease resistant wheat varieties in combination with better farming knowledge to improve productivity. Punjab led India’s green revolution and earned the distinction of being the country's bread basket. The initial increase in production was centered on the irrigated areas of the states of Punjab, Haryana and western Uttar Pradesh. A hectare of Indian wheat farm that produced an average of 0.8 tons in 1948,which increased to 4.7 tons in 1975 from the same land. Such rapid growth in farm productivity enabled India to become self-sufficient by the 1970s.

With agricultural policy success in wheat, India's Green Revolution technology spread to rice. However, since irrigation infrastructure was very poor, Indian farmer innovated with tube wells, to harvest ground water. When gains from the new technology reached their limits in the states of initial adoption, the technology spread in the 1970s and 1980s to the states of eastern India — Bihar, Odisha and West Bengal. The lasting benefits of the improved seeds and new technology extended principally to the irrigated areas which account for about one third of the harvested crop area. In the 1980s, Indian agriculture policy shifted to "evolution of a production pattern in line with the demand pattern" leading to a shift in emphasis to other agricultural commodities like oilseed, fruit and vegetables. Farmers began adopting improved methods and technologies in dairying, fisheries and livestock, and meeting the diversified food needs of a growing population.

Indian agriculture is diverse, ranging from impoverished farm villages to developed farms using modern agricultural technologies. This shows farming community in a more prosperous part of India. India's agricultural economy is undergoing structural changes. Between 1970 and 2011, the GDP share of agriculture has fallen from 43% to 16%. This is not because of reduced importance of agriculture or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and nonagricultural sectors in India between 2000 and 2010.Agricultural scientist MS Swaminathan has played a vital role in the green revolution. In the year 2013 NDTV has awarded him as 25 living legend of India for outstanding contribution to agriculture and making India a food sovereign country.

1.2. Statement of the problem

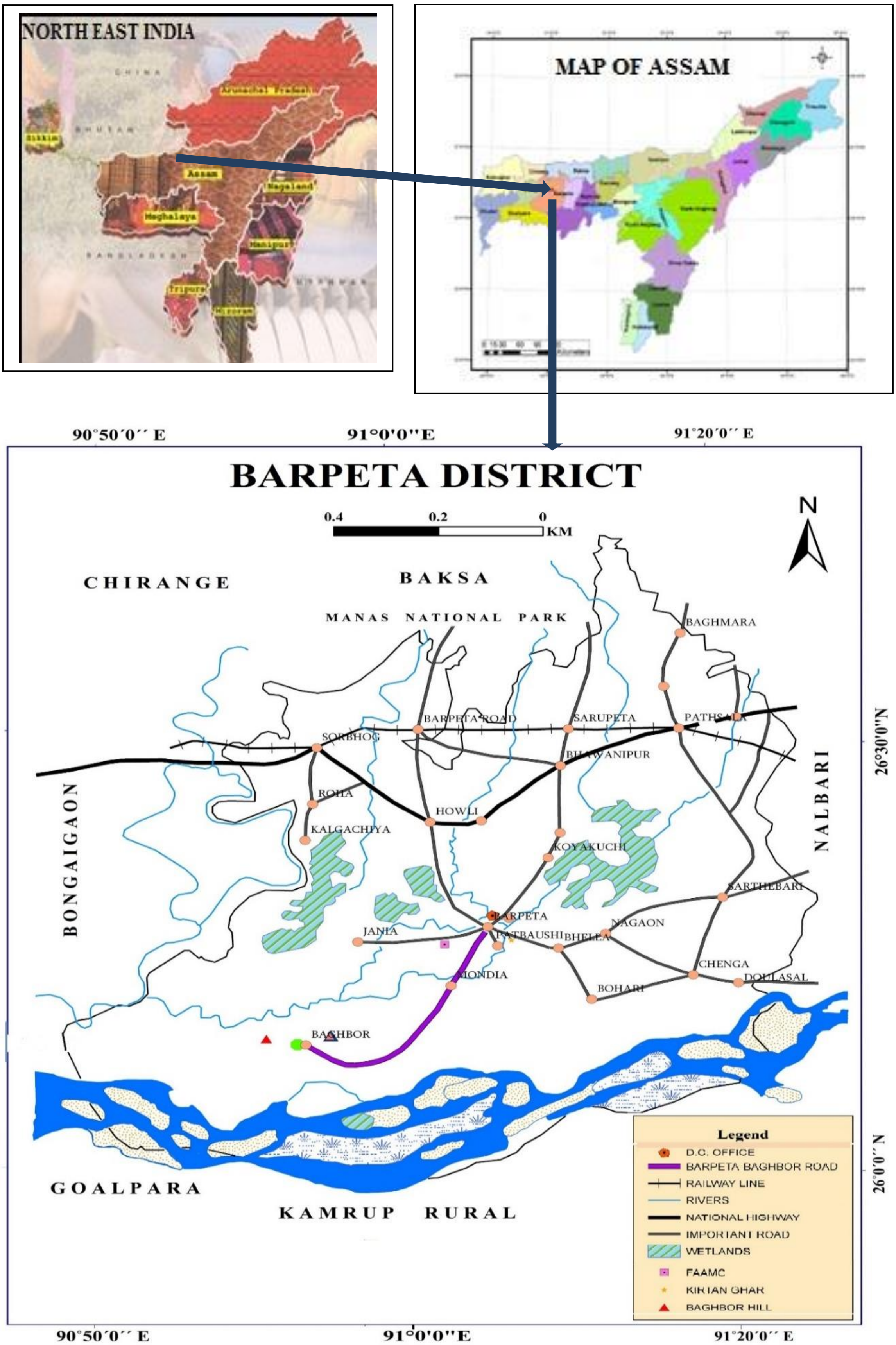
Agricultural development represent the increase of agricultural productivities, cultivable land, irrigation facilities, HYV seeds, fertilizer consumption, pesticides and insecticides use, modern technologies and a host of other sectors. According to Van de Ban and Hawking (1988), Change in agricultural production, technique and in the structure of the agricultural enterprises towards a more desirable situation. Usually a situation in which farmers uses more agricultural research findings and there is less subsistence and market oriented agriculture. Today, India ranks second worldwide in farm output in 2009-10. Agriculture and allied sectors like forestry and fisheries accounted for 13.7% of the GDP in 2013 and about 50% of the workforce. The economic contribution of agriculture to Indian GDP is steadily declining with the countries broad based economic growth. India's agricultural economy is undergoing structural change. Between 1970 and 2013, the GDP share of agriculture has fallen from 43% to 13.7%. This is not because of reduced importance of agriculture or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial outputs and nonagricultural sectors in India between 2000 and 2010. But agriculture is demographically the broadest economic sector and play a significant role in the overall socioeconomic fabric of India.

The geo-climatic condition of Assam is conducive for the cultivation of varieties of agricultural crops. But agriculture is yet to be develop, despite having most fertile soil, suitable topography, climate, plentiful water, etc. in the state. Land under cultivation remains extremely limited compared to land potential for farming. The cultivable land in Assam is around 43% of the total geographical area of the state. The method of agriculture is mainly mono-cropping and per hectare returns are very low. The consumption of fertilizer in the state is 18 kg per hectare against the national average of 75 kg. per hectare. The productivity, irrigation facilities, HYV seeds, machineries, etc. are very inadequate and insufficient. Barpeta district is great historically significant and it is one of the important district of Assam in agricultural production. The cultivable land in the district is 62.42% of the total land area of the district. In cropping intensity and multiple cropping Barpeta is highest in Assam, 75% of the area is under the multiple cropping against the state 42% area in 1997 (Statistical Hand Book of Assam, 1997). And paddy is the principal crop, which is grown in 1.35 lakh hectares in 2013-14. According to 2013-14, the coverage of autumn, winter and summer paddy is reported to 14.24%, 50.20% and 35.50%, respectively of the total Paddy cultivated area of the district (Barpeta District Inventory of Agriculture 2015, ICAR). In addition to rice, mustard, pulses, wheat and jute are other important field crops either cultivated in commercial scale or for domestic consumption. It may be mentioned that oilseed and pulses occupy 6970 hectares and 13758 hectares respectively in the district. The average productivity of the district is reported to be marginally higher as compared to state level productivity. However, the productivity of individual crops is lower than that of national average and far below the potential productivity of crops. It has 41.26% of HYV area under paddy cultivation whereas the state has 45.05% against the net sown area. In recent times, chemical fertilizers are used for the increase of agricultural productivity and it's consumption of fertilizer is 14.60 kg. per hectare of the total cropped area against the state of 17.98 kg. per hectare. Moreover, the food productivity of the district was 801.40 kg. per hectare as compare to that of the state i.e. 897.40 kg. per hectare in 1997-98. Thus the agricultural development in Barpeta district is not satisfactory.

1.3. Study area

Barpeta district lies between 26º05´ to 26º49´ north latitude and between 90º39´ to 91º17´ east longitude. Barpeta district lies in the north bank of mighty Brahmaputra River and is located in the mid-western part of lower Assam. It is bounded by Bhutan and Baska district in north, Nalbari district in east, Kamrup Rural and Goalpara districts in south and Bongaigaon and Chirang district in the west. It has rich bio-diversity and natural scenic beauty with heterogeneous colorful population representing distinct culture. The district covers an area of 2282 square km (Rural: 2245.62 Sq. Km. and Urban: 36.38 Sq. Km) and occupies 3 percent out of the state total area i.e. 78438 square km. The district administration is divided into two sub-divisions and each sub-division is divided into 9 revenue circles and each revenue circle comprises with Mouzas and revenue villages. It has 6 statutory towns and 3 census town. The district geographical area is divided into11 Community Development Blocks. It comprises of 835 villages including 10 uninhabited villages. The general topography of Barpeta district varies from low lying plain in the north to small hillocks in the south and the district enjoys tropical monsoon climate with two prominent seasons, namely summer and winter. The main river of the region is Brahmaputra River that flows from east to west across the southern part of the district and is joined by tributaries like Manah, Beki, Pahumara, Kaldia, Palla, Nakhanda, Mara Chaulkhowa and Bhelengi flowing from north to south. The soil of the district is very fertile and can be grouped as fertile alluvial soil, sandy soil, sandy-loamy and forest soil. The total population of the district is 1693622 persons with a density of 742 per. Sq. km. in 2011 with decadal growth rate 21.40 during

Fig 1.2: Location Map of Barpeta District



2001-11. The literacy rate of the district is 63.81% which is far below the state and national rate.

1.2. Objectives

1. To examine the pattern of agricultural development.
2. To ascertain the new adaptations to the agriculture in the study area.
3. To study the agricultural output in the district.
4. To examine the constraints faced by the agricultural development.
5. To identify the prospects for the agricultural development.
6. To critically examine the role of various factors that affects the agricultural development.

1.4. Hypothesis

1. Agricultural development is growing at a faster rate with the input and use of modern technologies.
2. The increase inputs increase the output.
3. Lack of modern infrastructural facilities is the main cause of low productivity of agriculture.
4. Overdependence on traditional methods hampers the yields of land.
5. Population pressure on agricultural land is increasing, adversely affecting the productivity.

1.5. Significance of the Study

The proposed study is an attempt to analyze and understand the rate of agricultural development, taking into account the input, output and modern infrastructural facilities in the study area. The emerging challenges that faces in terms of problems and prospects of agriculture are studied giving due importance to the backdrop of the agricultural system in vogue. While doing so, efforts has been made in this study to bring out the implications of the agricultural development and their bearing on the socio-economic life of the district. Nonetheless, the significance of the proposed study stems out from the fact that despite a number of publication and articles on various aspects of the area under study, none has so far done an in-depth study of the district touching upon its agriculture, agricultural development and the challenges before the agricultural development in the district. The present study is a comprehensive one which will be helpful as reference for scholars. Furthermore, it will be helpful for the administrators, planners, policy makers etc. while translating their decisions in to action for the overall development of the district. The study will be helpful for other districts of Assam having the same physical, socio-economic and infrastructural problems and bottleneck.

1.6. Methodology

Present study is mainly based on both primary and secondary sources of information. The methods to be followed for the study are

1. **Primary data:** Primary data are collected based on observation and interview through the prepared questionnaire from the field. According to 2011 census, the number of village records in Barpeta district is 835 villages including 10 uninhabited villages. Primary data are collected through purposive sampling method and accordingly sample villages are selected from side to side by considering the religion, cast, pattern of agriculture, location and characteristic of the area. Pre-survey field trips are conducted in some selected villages to get some insights relation to the study and accordingly structured questionnaires are prepared for acquiring data. The despondence for the interviews are included at least

one village from each 11 Developmental blocks considering the agricultural families of Barpeta district.

2. **Secondary data:** The research undertaken is also depends on the secondary data obtain from various sources. The secondary sources of information are collected from the relevant literature, articles of research journals, Government publications, official documents, magazine, newspaper, research report, survey conducted by the various organizations, census report, GIS, toposheet, etc. and various websites related to the study are also accessed for obtaining information.
3. **Data process, analysis and presentation:** The process of data interpretation has started from the data collected. The collected data are processed, tabulated and analyzed. The processed and tabulated data are initiated for explanation with cartographic presentation.

1.7. Review of Literature

Review of relevant works made by various scholars in line of present proposed study makes a major component of the study. Any study without referring to the kind of work having the same parameters, and aspects but not to the area under consideration cannot be adequately done in the absence of a sound grounding, be it theoretical, conceptual and practical. Earlier works done by others throw light on the approach to the study and on the formulation of the thesis. With this in mind review of relevant literature has been attempted.

Singh, (2013), 'Agricultural Economy' highlighted the productivity of farm is most important for all over development of a region and competitiveness on the agricultural market, income distribution, saving, labour mitigation and moreover providing foods. Agricultural productivity is becoming increasingly importance as the world population continues to grow. The techniques to increase agricultural productivities are uses of mechanization, HYV, fertilizer, liming of acid soils, irrigation, herbicides, pesticides etc. in the agricultural firms. Phukan, (1978), ‘Agricultural Development in Assam’, sheds light on the cropping pattern of nearly 13 crops of Assam. The major crop of Assam is rice and productivity of rice is very low in Assam. He also opines 40% area of rice in Assam is occupied by new varieties of seeds and the adaptation packages of practices have not been equally matched. There is an indication that the early Ahu crops with HYV seeds and irrigation have potentialities of rice productivity in Assam. But the use of HYV seeds and irrigation system need further development. The HYV seed in 1969-70 was 5.1% and in 1983-84 was 39.42% of the total cultivation. It is also indicated that the consumption of fertilizer is very low. In 1969-70, per hectare fertilizer consumption was 3.28 kg. per hectare of land and the average fertilizer use in agriculture was 3.94 kg. from 1969-70 to 1975-76. Goswami and Phukan, (1982) ‘Social Science Research in North East India’ the studies on agro economy in Assam is limited in number. Further most of the existing studies are partial and deal with micro level problems. Nevertheless, these studies will provide valuable information for the understanding of the problem in the rural areas. The studies also help in comprehending the agro economic problems of the region.

In ‘Agricultural Economy of Himalayan Region’, Swarup, (1993), says that crop production is a biological process involving several types of physical operations. He also points out that the livestock ranching, fruit production and wheat production are increasing and the rice production is decreasing in the Himalayan region of Uttarkhand.

In the opinion to Husain, (2004), ‘Systematic Agricultural Geography’, the land holding size influences the use of technology and equipment of an area in agriculture. If the land holding size is very small than use of modern inputs is very difficult. The availability of labour also influences the land use and cropping pattern of a region. Capital is one of the most important factors in shaping cropping pattern of a region. All agricultural inputs like the livestock, irrigation, seeds, fertilizer, insecticides, pesticides, feeding staff, labour, purchase of land, agricultural equipment etc. require capital. He further states that the land use and pattern of agriculture is also determined by the use of technology and influences the productivity of the agriculture.

In ‘Agro-climatic Regional Planning in India’, Basu and Kashyap (1996), pointed out that the agricultural population per capita land resources in India is very low at 0.33% hector, much lower than that of China which has 1.4 time than the Indian agricultural population. On the other hand per capita land available in Japan is 0.76 hector. India shares 19% of irrigated area of the world. It is stated that the share of net sown area increased from 41.8% in 1950-51 to 46% in 1980-81 in India. They also mention that the cropping pattern of a region is by and large, the reflection of land topography, soil type, rainfall, temperature and socio-economic condition of the region. Bhatia, (1998), ‘Indian Agriculture’, highlights the agricultural development, Green Revolution, current problems and challenges, agricultural based development etc. in India. Indian agriculture has recorded substantial growth during the 1951-52 to 1983-84. In 1951-52 agricultural production was 58.5 and it rose to 138 in 1978-79 and 155.8 in 1983-84. Thus the growth rate of total agricultural production in the period 1967-68 to 1983-84 was 2.5%, and the cereal production was 2.87%. He also indicates that there are regional variations in the food production in the period 1960-

61 to 1980-81. In food grain production in Northern India was 184.7%, central India 52.75%, eastern India 45.64%, southern India 39.57% and western India 48.95%. Apart from the several regional disparities, there was also wide disparity in case of input. In India total irrigated land was 26.56% of total cultivated land in 1978-79. Among irrigated land Punjab was highest 78.09% irrigated land and Assam was 21.35% and Madhya Pradesh was lowest 13.66% in 1978-79.

Nath, (2009) 'The Growth of Indian Agriculture', in 'Regional Development and Planning in India', the growth rate, agricultural production (3.42% per year) during the period 1952-53 to 1964-65 was higher than the growth rate of total population (2.15% per year) and male agricultural workers (2.46%) in India. But before the independence the agricultural growth rate was 12.6% and the population growth rate was 38% in the period 1900-1901 to 1944-45. It is also pointed out that the growth rate of productivity was 2.55% per year and output 4.30% per year during the agriculture period from 1957-58 to 1964-65. There was also an increase in the food grain and non-food grain crops. The growth rate of agricultural output differs from 5.56% in Punjab, 1.25% in Assam whereas all Indian average was 3.42%.

Agarwala and Hazarica, (2004) 'Developmental Disparities: A quantitative Insight', highlight that about 70% of total working force are being engaged in agriculture and allied sectors in Assam. The share of agriculture in SDP of Assam was 37.6% in 1980-81 and it decrease to 35.3% in 1991-92. The cultivable land is 43% of total land area of Assam and it is much lower than its potentialities. The multi cropping area is 43% of the cultivable land area of Assam. However, the consumption of fertilizer is very low 18 kg. per hectare against national average 75 kg. per hectare. The major crops grown in the state are rice, wheat, pulses, oilseeds, jute and mesta and horticulture crop like fruit, vegetable and spices. The rice occupies 80% area of annual cropped area of the state. In 1991-92 total production of rice was 31.97 lakh tonne, which increase to 33.83 lakh tonne in 1997-98. In Barpeta district 62.424% of cultivable land to total land area of the district and 89.32% of area sown to total cultivable land area and in Assam 82.108% of area sown total cultivable land area (computed from Statistical Hand Book of Assam, 1997). In Barpeta district 30.166% of irrigation potential created to net sown area (rank 3) against Assam 17.281% (computed from Statistical Hand Book of Assam, 1997). The cropping intensity, multiple cropping is highest in Barpeta district 75% against Assam 42% (computed from Statistical Hand Book of Assam, 1997). In Barpeta district 41.26% of HYV area under paddy to net sown area (Rank 10) against Assam state 45.05%. in modern times, chemical fertilizer are used for the increase agricultural productivity. In the Barpeta district 14.60 kg. (Rank 15) consumption of fertilizer per hectare of total cropped area against state 17.98 kg.

Saikia, (1995) 'Level of Agricultural Development in Assam', in 'Regional Development in North East India, analyzed that agriculture occupies a predominant place in Assam economy accounting for over 65% of the state labour force and contributing 40.7% SDP at current prices during 1986-87. He mentions that the agricultural production is far from satisfactory, the major constraint being low productivity, poor power and irrigation facilities, lack of development of institutional facilities and instability caused by annual flood or drought. Saikia, (1993), 'Problem and prospects of oilseeds and pulses production in Assam' in 'Agricultural Development in North East India', analyzed oilseed is the second most important crop of Assam which occupies 8% of the total geographical area. In 1969-70 the area under rape and mustard oil was 139.1 thousand hectare and it increased to 337.5 thousand hectare in 1987-88 in Assam. The yield of rape and mustard oil was 377 kg. per hectare in 1969-70 and it rose to 496 kg. per hectare in 1987-88. The area under total pulses was 84.8 thousand hectare in 1970-71 which increased to 138.1 thousand hectare in 1984-85. The yield of pulses was 391 kg per hectare in 1969-70 and it rose to 461 kg per hectare. The major constraints for the oilseeds and pulses are institutional, technological, management, sociological and lack of support price and marketing.

Sumit, (1990), 'Agriculture and Technology in Developing Countries', focused on the technological strategies and supporting policies being adopted in various countries. He looks at the production of the modern technological use through a case study of fertilizer, production and imports in India. Further he discusses that the chemical fertilizers is a major technology for increasing food production in India and Nigeria.

Hooda and Turan, (1995), New Farm Technology and Agricultural Indebtedness, the new farm technology encompassing assured means of irrigation, mechanization of the farm operations and the intensive use new farm inputs etc. are solely responsible for the present agricultural scenario in the country. Financing of these three factors of new farm technology by the organized sector and supplemented by unorganized rural credit channel has reduced agricultural leading to agricultural indebtedness which is viewed as a problem rather than a panacea for development.

Haque, (1996) 'Sustainability of Small Holder Agriculture', reviews the economics of crop production, horticulture, sericulture, livestock enterprises and fish cultivation etc. It also focuses on the viability and sustainability of marginal and small farmer, impact of technological change, impact of farm size on productivity and employment, impact of land tenure on farm productivity. Small and marginal land holdings are accounted for nearly 78% of the total operational holding in the country and are operating over 32% of the total area. Crop production accounts for nearly 28% of India net national product, engaging about 78% of the total rural work force in the country.

North East Council, (2008) pointed out in “North Eastern Vision 2020”, that the share of agriculture in GSDP is 28.4% in Assam and 20.2% in India during the period from 2000-01 to 2004-05. The growth rate of agriculture is 1.6% in 1993-94 to 1997-98 and 2.5% in 1998-99 to 2002-03 of Assam. The agricultural sector share in NSDP is declining from 42.07% in 1993-04 to 37.37% in 2002-03 of Assam**.**

Hazarica, (2006), explains in ‘Status of Agricultural Sector in North East India’, that the economy of North Eastern States is rural and agrarian. But the region is diversity in agricultural development due to the topography, soil, altitude and climatic condition. He stated that the per capita availability of foodgrains is slowly increasing in Assam that is 150.76 kg/annum in 1991-92 to 157.58% kg/annum in 1996-97.

Sachdeva, (Year Book, 2012), ‘Competition Success Review’, explains that agriculture is the backbone of Indian economy and nearly 60% population of India depends on the agriculture. Agriculture provides employment to 58% working people of India and it contributes 15.7% GDP and 10.59% (2009-10) export value of total Indian export. It is the basis of many premier industries of India including the cotton textile, jute and sugar industries. It also highlights that food crops are 73% of the total gross shown area and 56% area shown is dependent on monsoon rainfall in India. He also explains about various schemes like Kishan Credit Card Scheme, SHG Bank Linkage Programme, On Farm Water Management, National Agricultural

Insurance Scheme and including new scheme Kishan Call Centre, Micro Irrigation, National Bamboo Mission and Varsha Bima.

Swarup, (1993) ‘Agricultural Economy of Himalayan Region’, says that crop production is a biological process involving several types of physical operations. He also points out that the livestock ranching, fruit production and wheat production are increasing and the rice production is decreasing in the Himalayan region of Uttarkhand.

In “Principles of Agricultural Economics” Sundar, (2009), stated that the word agriculture comes from the Latin words agree, referring to the soil and cultural, to its cultivation. Agriculture is the integral part of the world food system having the foundation link between crops and animal production system. Agriculture is the integral part of world food system. The knowledge regarding the problem in agricultural production, finance, marketing, government policies and their impact on production and distribution is very essential to find out suitable solution for the farm problems. Agricultural development is close related with agriculture farming, input supply, processing, distribution, advisory services and marketing of agriculture food products. The agricultural sector continued to change rapidly during the early 1950’s as new technology moved form. Agriculture contribute major share of national income of India.

In “Rural and Agricultural Development”, Rajeev, (2008), mention that the agricultural goods are two types- i.e., industrial goods and consumer goods. He also mentions that some goods are both industrial and consumer goods. He pointed out the major problems of agriculture are market yard problem, lack of storage facilities, market intelligence, grading and standardization of agricultural product, government regulated market.

"Agriculture and Sustainable Development: A case study of Assam", Sahu, (2006), explained North East Region with natural endowment of forest, orchards and wide range of field crops and other flora, offers immense potential for the growth and development of agriculture. But Assam lie low productivity and high potential zone and here the production is very low, despite abundant water availability and good soil.

In "State of Indian Agriculture 2011-12", Government of India; examined the overall GDP share of agriculture fallen from 30% in 1990-91 to 14.5% in 2011-12, but yet agriculture is backbone of Indian economy. The average land holding size of India has demise progressively from 2.28 hectors in 1970-71 to 1.55 hectors in 1990-91 to 1.23 hectors in 2005-06.In "Agriculture in Assam", Goswami, (1989), pointed out 34.3% geographical area of Assam is occupied by agriculture, 25% forest cover and 14.4% non-agricultural land use. The rice cultivation classified as autumn rice, winter rice and summer rice.

"Emerging Crisis in Indian Agriculture" Prakash, (2006), examined adequate infrastructure support is prerequisite for accelerate economic development. Infrastructure comprises all those activities and facilities which help to sustain in growth of production. The major item of infrastructure includes; i.e., village electricity, percentage of power use in agriculture, percentage of irrigated area, intensity of tube wells, density of rural road, intensity of vehicle, fertilizer sale depot, rural credit, rural health centre, infant mortality rate, storage facilities, agricultural research agricultural worker, intensity of market etc. He also mentions major problem of agriculture are land degradation, environmental pollution, water resources depletion and degradation.

Vasu, (2009), "Agricultural Modernization and Agricultural Development in India", explained agricultural sector in India recently faces serious challenges and constraint because of liberalization and globalization policy followed by Indian government. He also find out rising production cost, lack of food processing industries, lack of external inputs, etc. are the main problem of Indian agriculture.

'Developmental Disparities: A quantitative Insight', Agarwala, and Hazarica, (2004), point out that agriculture and allied sectors engaged 70% workforce of Assam. The share of agriculture in SDP was 37.6% in 1980-81 and it decrease to 35.3% in 1991-92 in Assam. The cultivable land is 43% of total land area of Assam and it is much lower than its potentialities. The multi cropping area is 43% of the cultivable land area of Assam. The cropping intensity, multiple cropping is highest in Barpeta district 75% against Assam 42% (computed from Statistical Hand Book of Assam, 1997). In Barpeta district 41.26% of HYV area under paddy to net sown area against Assam state 45.05%.

"Perspectives of Indian Agricultural Development", Banerjee and Banerjee, (2010), pointed out that the contribution of agriculture in our GDP was 38% in 1975 which has come down to only 19%. Agriculture engaged 69% of Indian workforce is engaged in agriculture but contribute only 19% G.D.P and our food grain production is 200 million metric ton at the lowest in recent decades.

In "Preparation of Action Plan for Agricultural Development of selected Char Areas of Barpeta and Nalbari Districts", IIE, Guwahati, (2005), find out some strength for agricultural development in char area of Barpeta and Nalbari district are the geo-climatic situation, soil texture for the growth of different crops and vegetation, supportive climate and rainfall. They also identify some weakness of the area for agricultural development are cultivable period is small, land has left fallow during monsoons, damage of crops and wastage is high, transport and communication network to the areas are not well developed, continuing the traditional crops with no variations, illiteracy of the people, less awareness of the people, marketing network and market intelligence is weak etc. And they recommended for agricultural development by creating development of consciousness on health and hygiene, connectivity, market infrastructure and storage facilities, offering financial assistance and periodic monitoring and counseling to ensure proper development in the area.

“Agricultural Productivity in India: A Spatial Analysis”, Dayal, (2004), examined the regional variations in land, labour, and aggregate agriculture productivity in India. There is a good deal of spatial accord among these three measures of productivity. The analysis also indicates that there is substantial scope for increasing agricultural production in some regions of India. High productivity of agriculture takes place under two different situations. In the north- west Gujarat, and southern Karnataka it occurs in association with good irrigation, a high level of purchased inputs, relatively larger holdings, and a medium density of population. In Tamil Nadu, coastal Andhara and some districts of West Bengal it occurs in association with somewhat different conditions: good irrigation, a high level of labor inputs and varying levels of purchased inputs, small holdings, and a high density of population. In both cases the physical environments are good, but the man-made environments are more favorable.

Fan and Zhang, (2002), explained in “Production and Productivity Growth in Chinese Agriculture: New National and Regional Measures” of Chicago Journals that the agricultural output grew at a rate of 6.5% per annum during the period 1979 –1997. This long term growth rate was one of the highest worldwide during the same period. Chinese Agriculture using the gross value of agricultural output to measure growth in agricultural output. The crops are divided in to grain and cash crops.

In “Agricultural Research and Extension in India: Changing Ideologies and Practice”, Rao, (26th March 2005 in Economic and Political Weekly), analyze that the land and agriculture is an integral part of people’s lives and identities, a reflection of their status, wealth and labour. One of the major strategies for agricultural development is intensification of agriculture through double cropping. It also emphasized on the farmer motivation on the one hand and the skills required as being either managerial or technology on the other.

Sidhu and Bhullar, (December 31, 2005), “Pattern and Determinants of Agricultural Growth in the Two Punjabs”, reviews that the Indian Punjab is seriously facing the problem of declining diversity in its crop patterns and wheat and rice are the most predominant crops of the state covering more than 70% of the cropped area and other are almost vanish from the state. The area is facing the environmentally adverse effect on monoculture like higher incidence of diseases and pests, depletion of ground water resources and declining fertile status of soil. There is also stress for the easy, cheap and adequate credit availability to promote the adoption of new technology. In the Indian Punjab agricultural output growth rate is about 42% to 52% during the difference period from 1967-68 to 1990-91. The growth is a continuous process and influence by technology, institutional and infrastructural development and agrarian structure.

Mukhopadhyay, and Sudhin, (1976), “Sources of Variation in Agricultural Productivity”, focus aggregate crop output has been measured by the Divisia method that does not assumes constant relative price and ignore difference in cropping pattern. In the book analyze production function, temporal variation of crop output and efficiency. In “ Socio-economic Development of Rural India: A Case Study”, Deka and Long kumaer, (2009), stated that there has been decline in the share of both employment and national income yet it has employed 57% workforce compare to USA 2% and U.K. 2.6%.

Lal, (2009), pointed out in “Organic Farming”, the concept, scope and technique of organic farming. The organic farming is eco-friendly farming with more food vale. He explains various methods of organic farming are crop rotation, crop residues, animal manures, cover cropping, application of compost, mulching, crop diversity etc. In “Agricultural Labour Problems in Barpeta of Assam”, Khan, (2012), pointed out the causes of the poor economic condition of farm labour are unorganized, illiterate, seasonal unemployment, absence of alternative occupation, growing indebtedness, etc. He also mention that the cause of increasing agricultural labour problem are due to high birth rate and decreasing agricultural land, on account of river erosion and sends cover of char areas, increasing landless labour and no implemented wage policy at all. Norton, Alwang and Masters (2015), ‘Economics of Agricultural Development’, explained most urgent need in the world is to reduce the persistence of hunger and poverty in developing countries.

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CHAPTER II

GENERAL STRUCTURE OF THE STUDY AREA

Introduction

Barpeta is a place of great historical and religious importance. The word Barpeta is derived from "Bar" means big and "Peta" means pond. Thus Barpeta means "land of big ponds", at pre-modern times Barpeta was full of large ponds. In ancient period Barpeta was a part of Kamapitha division of Kamarupa and Medieval invaders called western Assam as Kamrup. Barpeta was an integral part of Kamrup district and was curved out in colonial and post-colonial times and created as Barpeta district in 1983. The history of Barpeta is inseparable from the history of Kamrup. Many non-Aryan princes were ruled a thousand years before Christ in Barpeta as a part of ancient kingdom of Kamrupa. After Pala dynasty, the Koch dynasty started ruled in Assam. Barnagar was the capital of Koch kings of Barpeta district. Where Nara Narayan met great saint Shrimanta Sankardeva and his renowned disciple Madhab Dev and subsequently accepted Vaishnavism. During the time of king Naranarayan regime at Barnagar great saint Srimanta Sankardeva established a Satra at Patbaushi to spread his Socio religious faith. Ahoms were earlier defeated by the Muslims and were driven out of Barpeta by Joydhwaj Singh in 1658. In 1662, the new Subedar of Bengal, Mir Jumla drove away the Ahoms from Barpeta and took the possession of Guwahati. Mohemmadan Fouzdar was posted at Guwahati. Guwahati was captured by Gadadhar Singh in 1681 A.D. after the departure of the Muslims. From this time onward Barpeta became a part of the Ahom territories.

Under the treaty of Yandaboo, 1826 Assam came under the East India Company and accordingly Barpeta district was also ceded to the Company. In 1841 Barpeta became a Civil Sub Division and John Batlor became the first administrator.

During the struggle of independence large numbers of people were participated and were jailed from Barpeta district. Madan Chandra Barman and Rauta Koch were first martyrs during Quit India Movement of 1942. Congress leaders who lead the Freedom-struggle were Umesh Chandra Brahmachari, Dhaniram Talukdar, Ganesh Lal Choudhury, Debendra Nath Uzir, Akshay Kumar Das, Bongshidhar Choudhury, Nanamohan Mazumdar, Golak Pathak, Sonaram Choudhury, Dr. Jinaram Das, Biswanath Das, Praneswar Das, Ambikagiri Raichoudhury, Mahendra Mohan Choudhury, Madhusudan Das, Upendra Chandra Das, Debendra Sharma, Naranarayan Goswami, Kabiraj Ghanashyam Das and Chandraprava Saikiani. Mahatma Gandhi visited in 1934 and Jawaharlal Nehru visited in 1937 at Barpeta.

2.1.1. **Administrative Structure**

The entire Barpeta district administration is divided into two sub-divisions viz., Barpeta and Bajali. Barpeta district is divided into 9 revenue circles and each revenue circles comprise mouzas and revenue villages. The district has 6 statutory towns and 3 census town in the district. The name of Revenue Circles are Barnagar (Pt), Kalgachia, Baghbar, Barpeta, Chenga, Sarthebari, Bajali (Pt), Sarupeta (Pt) and Jalah (Pt) as per 2011 census. The district geographical area is divided into 11 Community Development Blocks. The Community Development Blocks are Barpeta, Mandia, Chenga, Ruposhi, Gumafulbari, Sarukhetri, Chakchaka, Bajali, Bhawanipur, Pakabetbari and Gobardhana. In connection with law and order, Barpeta district is divided to 10 Police Stations. The names of Police Stations are Barpeta P.S, Baghbar P.S, Alopati Char P.S, Kachumara P.S, Jarabari P.S, Sarthebari P.S, Sorbhag P.S, Barpeta Road P.S, Kalgachia P.S, Patacharkuchi P.S. The district comprises 835 villages including 10 uninhabited villages.

The Deputy Commissioner of this district is the overall in-charge of the administration of the entire district. Deputy Commissioner also acts as a collector in case of revenue matters, District Magistrate in case of maintenance of law and order and general administration as a District Election Officer in case of conduct of election and as a Principal Census Officer while conducting census etc. Officers like District Development Commissioner, Additional Deputy Commissioners, Sub-divisional Officers, Extra-Assistant Commissioners, Circle Officer and other assist the Deputy Commissioner to look after the administration of the district.

2.2. Physical framework

The physical frameworks comprises physiography, geology, soil type, climate, drainage and other physical determinants which determine the pattern of crops, production and productivity. The physiography includes topographies like plain, mountains, hills, plateaus, flood plains, etc. The climate consist many natural phenomena like rainfall, temperature, humidity, drought, flood, dew, storms, etc.

2.2.1. Geology

Geological structure of a place determines formation, composition and quality of soil. The geological formation of Assam belongs to the Archaean, Pre-cambrian, Tertiary and Quaternary period. The Archaean rocks are composed the metamorphic rock’s type of gneisses and S. Chists are intruded by younger acidic and basic intrusive. These rocks are found in the northern and central parts of the Karbi plateau along the Assam-Meghalaya border. The isolated monad nocks like remains consisting of gneisses and granites scattered along the north and south bank of the Brahmaputra River in Goalpara, Barpeta, Nalbari, Kamrup, Darrang, Sonitpur and Nagaon districts belong to the Archaen group of rocks. The geological formation of Barpeta district is almost similar to that of other parts of Brahmaputra valley. It consists of,

(i) Recent and sub-recent alluvial deposits and

(ii) A thin strip of upper tertiary sand stone.

Recent and sub-recent deposits can be divided into older alluvium and newer alluvium. The older or high level alluvium deposited during or at the end of the Pleistocene period consists of reddish to brownish impure sands and irregularly distributed pockets of unasserted rocks pebbles covering a considerable area in the northern part of the district. The newer alluvium consists of sands, silts and clays, covering the alluvial plains along the Brahmaputra valley. The thin strip of upper tertiary sand stone is found in the northern part of Barpeta district belonging to the Siwalik group associated with clay alternations, which occur all along the Bhutan foothills. The sand stones are light grey to whitish grey, medium grained mica with pebbles at the top.

2.2.2. Physiography

Physiography of Barpeta district is not homogeneous. The physiographic elements are flood plain, Char (delta), foot hills and hillocks in Barpeta district. The topography of the district is very favorable for agriculture and allied activities. The general topography of Barpeta district varies from low lying flood plain to small hillocks. The district is characterized by almost plain topography with the highest elevation of 180 m above MSL at Baghbar hillocks at northern bank of river Brahmaputra and second highest point of the Barpeta district is 150 m above MSL which is situated at southern bank of the Brahmaputra River and bounded by the 100 m contour line. The topography of Barpeta district can be classify in to four categories, i.e.,

(i) The northern high plain

(ii) The middle built up plain

(iii) Hillocks and

(iv) The newly buildup plain (Char area)

The natural demarcations of these four regions are not distinct as each of the four regions changes its characteristics gradually to be merged with the next region. They are almost parallel in east-west direction to the Brahmaputra River, although the middle portion of the built-up area is extending towards south to river Brahmaputra. These regions are not homogeneous in physical characteristics. There are micro-regional variations within a region. The low-lying region is extending further north of Barpeta town which looks like an island surrounded by water during flood. There are innumerable undulations inside each of the four regions at the micro-level which can be observed distinctly in toposheets, but becomes obscure on small scale maps.

i) The Northern high flood plain

This region lies between the Manas National Park and foothills of Bhutan hills at north and is demarcated by 49.00 meters contour line at south forming northern boundary of the middle built-up plain. The high plain comprises Gobardhana Development Block and northern part of Bajali and Bhawanipur Development Block. The northern part of this region is mostly inhabited by indigenous tribal people and a small number of Nepali immigrants, whereas the southern part is the mixed habitat of both the tribal and the non-tribal people. Though the elevation of this plain is relatively higher than that of the southern low-lying plain, there are small number of low lying swampy lands. The alluvial soil is generally fertile and crop yields are higher provided water supply is assured.

iii) The Middle Built-up plain

The middle buildup plain is extending from the high plain region to newly buildup flood (riverian delta) plain of the Brahmaputra River. This region is intersected by numerous tributaries and many tributaries merges in river Chaulkhowa. This plain is made up of alluvium and attains fluvial maturity in comparison to the low-lying areas at south. The buildup mid-plain with extensive paddy fields is most densely populated. The main arteries of communication of the region are National Highway No. 31 and N.F. Railway is running through this built-up region in east-west direction. Some important state roads also cross the region in different directions. Most of the present urban centers of the study region namely, Pathsala, Sorbhog, Barpeta Road and Howly are located in this region. Due to the construction of roads and embankments for flood control, it has been possible to bring extensive areas of this region under cultivation leaving insignificant wasteland.

iv) The Newly Build up plain (Char area) region

The newly build up plain is locally known as Char (riverine delta) which is situated in the middle or bank side of a river. It is a build up by sand deposition of river. Between built-up mid plain and river Brahmaputra, there is an extensive low-lying plain subjected to recurrent floods. The 'Char' (river sand bar) lands amidst the river courses are also included in this region. This region is swampy and contains beels (wetland). These region is formed due to tremendous volume of detritus carried and deposited by the tributaries and the river Brahmaputra. Such a huge deposition of detritus gives rise to a natural levee which obstructs the north bank tributaries from directly meeting with the Brahmaputra. Another reason is that tremendous loads of sediments are deposited on the beds of the north bank tributaries giving rise to the sluggishness of the water current as a result of which water from the tributaries remains logged in the saucer-shaped depression of this plain. Numerous char lands are formed in this region as a result the Brahmaputra river becomes very wide. The monotony of homogeneous character of the newly buildup plain has been broken by the presence of scattered erosional hillocks viz-, Baghbar, Phulara and Chatala. The southern part of Ruposhi, Mandia, Gumafulbari and Chenga Development Blocks are lying in this plain. This region is very famous for agricultural products like jute, mesta, vegetables, paddy etc. Famous agricultural markets of Assam like Baghbar, Bahari and Mandia markets are situated on the northern Bank of Brahmaputra river. The main occupation of people is agriculture including fishing and dairy farming in this region.

iv) Hillocks

Hillocks are scattering on northern bank of Brahmaputra River. These hillocks are distributed in the south west corner of the district and originated in Pre-cambrian age, namely Baghbar, Fulora and Chatala hillocks overlooking the natural gorgeousness. These hillocks are small in size and eroded. These are geologically detached parts of the Meghalaya plateau. Hillocks are very beautiful due to natural scenery and location. These looks like a floating land on the Brahmaputra River and sun set in the hillocks. These are mainly occupied by the Muslim, Hindu and Bodo community and highly density of population. People are mainly engaged on primitive agriculture and fishing. It has very poor road connectivity. Now these hillocks are occupied by the human settlement, market and jhum cultivation.

The Baghbar hillock is situated 20 km away from Barpeta town. The highest point of the Baghbar hillock is 180 m above MSL and bounded by the 100 m contour line and is the highest point of the district. The main attraction at Baghbar Hill is a Satra built by Shri Madhabdeva. Hardira Chowk a battleground is yet another tourist spot as here was the last battle fought between Ahom army and Burmese soldiers in 1822. The hill offers stunning view of Brahmaputra River, which flows from southwest direction in Barpeta. The Flura and Chotala hillocks are sounded by the water of river Brahmaputra to enhance scenic beauty of these hills.

2.2.3. Drainage system

The drainage has been an integral part of our life since time immemorial. The main river of Assam is Brahmaputra river and its tributaries. The Brahmaputra River originates at an elevation of about 5,000 m above MSL in Tibet. The Brahmaputra River is known as Tsang Po in Tibet and southward course of river flowing through Arunachal Pradesh is known as Siang River. It passes through across the mountains of Arunachal Pradesh and emerges to the plains of Assam and downstream is met by the Dihang, which is known as the largest tributary of the Brahmaputra. The northern bank of Brahmaputra River is joined by various tributaries like Subansiri, Ranga Nadi, Dikrong, Gabharu, North Dhansiri, Pagladiya, Manas, Aie, Beki, Champamati, Gangadhar and Raidak. The south bank tributaries like Benhi-Dihing, Disang, Dikhau and South Dhansiri are originated from Naga- Patkai Hills, Kopili River is originated from North Cachar Hills and Digaru, Bharalu, Kulsi, Singra, Dudnai and Krisnai river are originated from Meghalaya Plateau.

The main river of Barpeta district is mighty Brahmaputra and its tributaries. The Brahmaputra flows from east to west across the southern part of the district with covering a distance of about 65 Km and its tributaries flow from north to south and these tributaries are originated from the Great Himalaya Mountain. It has tremendous socio-cultural and economic significance in our society. The Brahmaputra has a profound influence on Assamese culture and ethos and has been the assimilation point of Assamese culture in the annals of history.

The tributaries of the Brahmaputra River are Beki, Manah, Pohumara, Kaldia, Palla, Nakhanda, Marachaulkhowa, Bholkadoba, Chowlkhowa and Bhelengi flowing from North to South in Barpeta district. River Pohumara and Kaldia have joined near Barpeta town to form river Nokhanda whereas Palla and Beki join with Nakhanda to form Chaulkhowa**.** All of these tributaries are Perennial and are collecting water from the Bhutan Himalaya Mountain region from melting ice and rainy water. These tributaries become over flow in the rainy season.

2.2.4. Wetlands

Wetlands are the most common and integral features of the fluvial landscape and plays a very significant important role for agricultural development in Barpeta district. These lands are either temporarily or permanently covered by water and are one of the most productive ecosystems and play crucial role in hydrological cycle. Wetlands are covering 18.19% area of Barpeta district which are 7.7% areas of total wetlands of Assam.

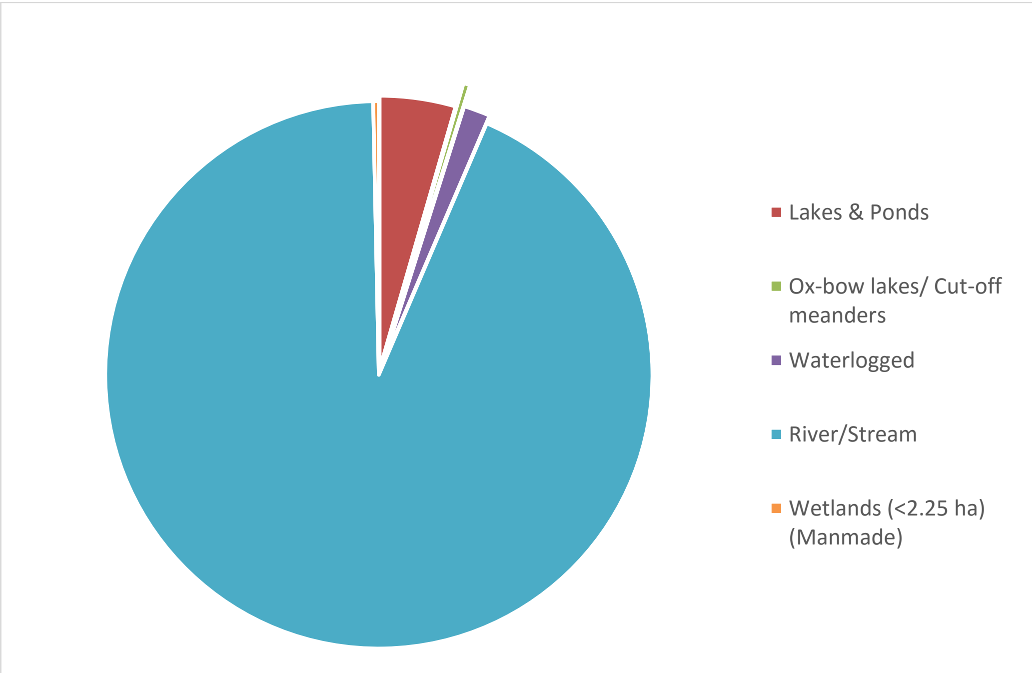


Fig 2.1: Category wise distribution of wetland in Barpeta district

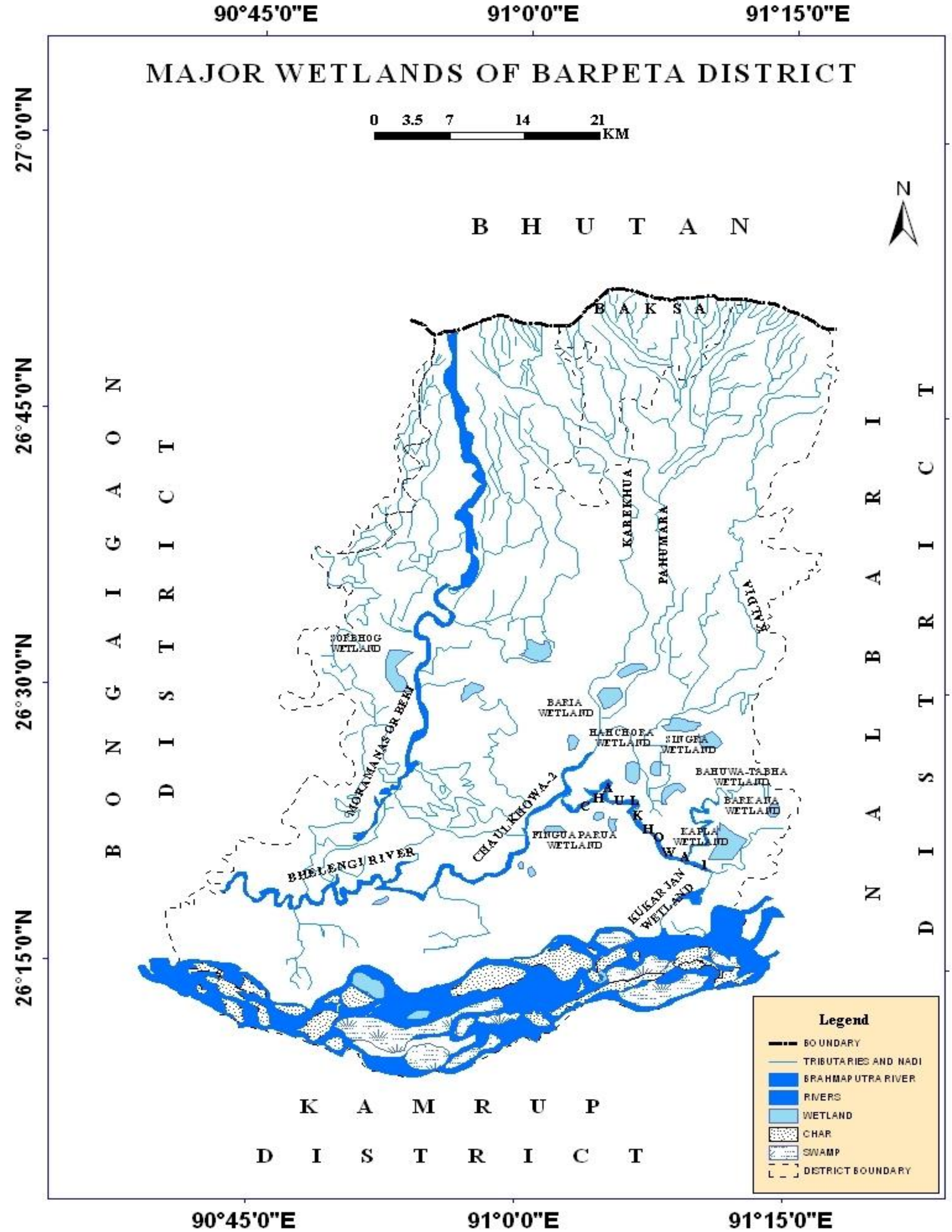


Fig. 2.2: Major wetlands of Barpeta District

Table 2.1.: Estimates area of wetlands in Barpeta district (Area in hectares)

Sl. No.	Wetland Category	No. of Wetlands	Total Wetland Area	% of wetland area	Open Water	
					Post-monsoon Area	Pre-monsoon Area
1	Lakes & Ponds	37	2644	4.48	1730	589
2	Ox-bow lakes/ Cut-off meanders	14	235	0.40	214	67
3	Waterlogged	62	927	1.57	676	209
4	River/Stream	44	55037	93.22	28542	28542
5	Wetlands (<2.25 ha) (Manmade)	195	195	0.33	-------	-------
Total		352	59038	100.00	31162	29407

Source: National Wetland Atlas: Assam, 2010

Table 2.1, shows total wetland area is 59038 hectares which includes 195 small wetlands (<2.25 ha) in Barpeta district. River and tributaries are occupying 93.22% of total wetlands area. Other major wetlands are lakes and ponds (4.48%) and waterlogged (1.57%). There are 37 lakes and ponds (locally called as Beels) with 2644 ha area. Ox-bow lakes occupied 235 ha area (0.4%). These wetlands are full of aquatic vegetation and fishes. The area under aquatic vegetation is slightly more in pre monsoon season (2967 hectors) than that of post monsoon (1187 hectors).The main Beels of Barpeta district are namely Chilashi, Borkana, Garlijer, Singr, Bhera, barbila, Betia, Tona, Baman, Katani, Akra, Kakjan, Borghopa, Gomura, Rowmari and Kapla Beels.

2.2.5. Soil

The soil is prime component of agriculture and is imperative for the agricultural development. Soil refers to the loose top most surface of the earth as distinguished from solid rock. Goff described soil is a natural body of minerals and organic constituents, usually unconsolidated, differentiated into horizons, of variable depth, which differs from the parent material bellow in morphology, physical properties and constitution, chemical properties and composition and biological characteristics.

Crop production under rain fed condition depends on rainfall pattern and stored moisture in the soil. Due to variation of rainfall amounts and its distribution and available water holding capacity in different soils, the water availability period in a given location varies from year to year and from soil to soil and influences the crop production differently (Khan and Chatterjee, 1987). The water holding capacity of soil are estimated considering the layer wise soil textural classes up to one meter soil depth. Major component of soils are as follows-

a. **Nitrogen**: Nitrogen is a major soil nutrient elements that influence plant productivity. The nitrogen used by plants on dump materials comes from organic matter, fertilizer application and legumes plants (Maiti et al., 2002). Soils fertility exhibits the status of different soils with regard to the amount and availability of nutrients essential for plant growth. It has been observed that nitrogen content was found to be maximum in surface horizons and decreased regularly with depth which is due to decreasing trend of organic carbon with depth and because cultivation of crops is mainly confined to the surface horizon only at regular intervals the depleted nitrogen content is supplemented by the external addition of fertilizers during crop cultivation (Prasuna rani et al., 1992). Nitrogen is highly consumed to increase crop productivity in Barpeta district.

b. **Soil Mineral:** The soil minerals play a vital role for soil fertility and mineral surfaces serve as potential sites for nutrient storage. Soil contains different types of minerals hold and retain differing amounts of nutrients. Organic carbon is an index of dump materials productivity and the amount of carbon broken down from plants and animals that stored in soil (Dekka et al., 2008). Organic carbon levels greater than 0.8% is rated as good quality of soil or dump and less than 0.4% is rated as low quality of dump (Ghosh et al., 1983).

c. **Phosphorus:** The word phosphorus is derived from the Greek word 'phos' meaning 'light' and 'phorus' meaning "bringing". Phosphorus (P) is essential to all known life forms because it is a key element in many physiological and biochemical processes. Phosphorus is indispensable and cannot be replaced by any other element that contains in every cell of all living organisms. It is an essential component of the energy transport system in all cells and a primary structural components of membranes that surround plant cells. It is involved in the synthesis of proteins and vitamins and occurs in important enzymes. Phosphorus is taken up by plant roots from the water in the soil, the soil solution. On a daily basis, a rapidly growing crop may take up the equivalent of about 2.5 kg, P_2O_5 per hectare. A deficiency of phosphorus affects not only plant growth, development and crop yield, but also the quality of the fruit and the formation of seeds. Deficiency can also delay the ripening of crops which can set back the harvest, risking the quality of the produce. The chemistry of phosphorus in the soil is complex because the phosphorus is associated with many different compounds to which is bound with a range of bonding energies or strengths. When phosphoric fertilizers are added to soil, only a fraction of the phosphorus is taken up immediately by the plant root and remainder are adsorbed by soil particles.

Table 2.2: Phosphorus requirement in crop production

(in grams P_2O_5 per kg fresh weight**)**

Sl. No.	Name of Crop	Requirement of Phosphorus
1	Wheat	7.8
2	Rice	6.0
3	Sprouts (buttons)	2.6
4	Peas (vining)	1.7
5	Cauliflower	1.4
6	Beans (French)	1.0
7	Potatoes	1.0
8	Carrots	0.7

Source: Understanding Phosphorus and use in Agriculture

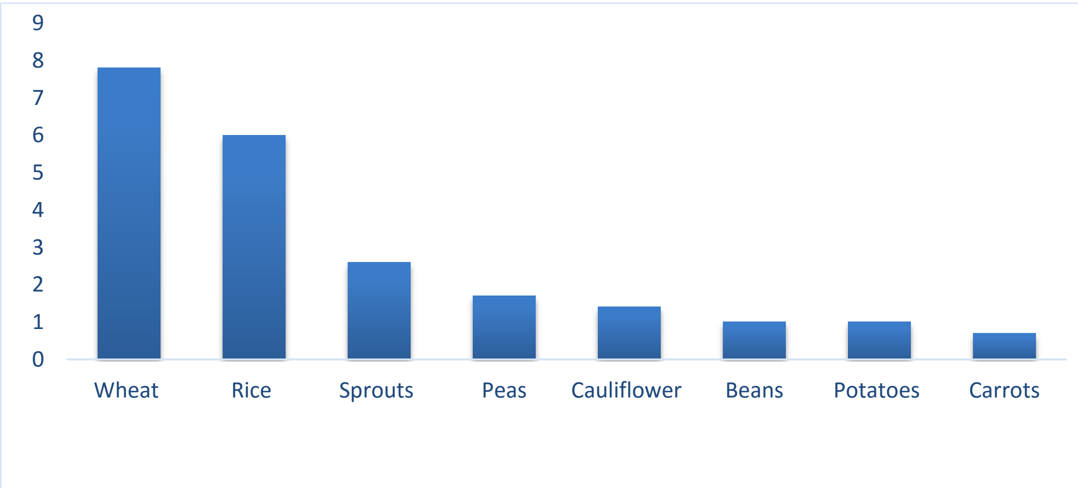


Fig 2.3: Showing requirement of Phosphorus

Table 2.2, shows requirement of phosphorus are varies among crops. The wheat requires highest phosphorus (7.8 grams P_2O_5 per kg fresh weight) followed by rice (6.0 grams P_2O_5 per kg fresh weight). Sprouts, peas, cauliflower, beans, potatoes and carrot require 2.6, 1.7, 1.4, 1.0, 1.0 and 0.70 grams P_2O_5 per kg fresh weight respectively.

The general characteristic of soil in Barpeta district is acidity and the acid soluble portion does not exceed more than 20%. And the general pH value of the soils varies from 4.5 to 7.3 i.e. acidic to neutral in the district. The soil phosphorous value varies from 4.5 to 6.0. The percentage of total (acid soluble) magnesium is relatively greater than that of calcium.

Table 2.3: Soil types of Barpeta District

Sl. No.	Soil Type	In percentage
1	Alluvial soil	63.92
2	Sandy loam soil	24.83
3	Sandy soil	11.25

Source: Agricultural Contingency Plan, Barpeta District, 2012

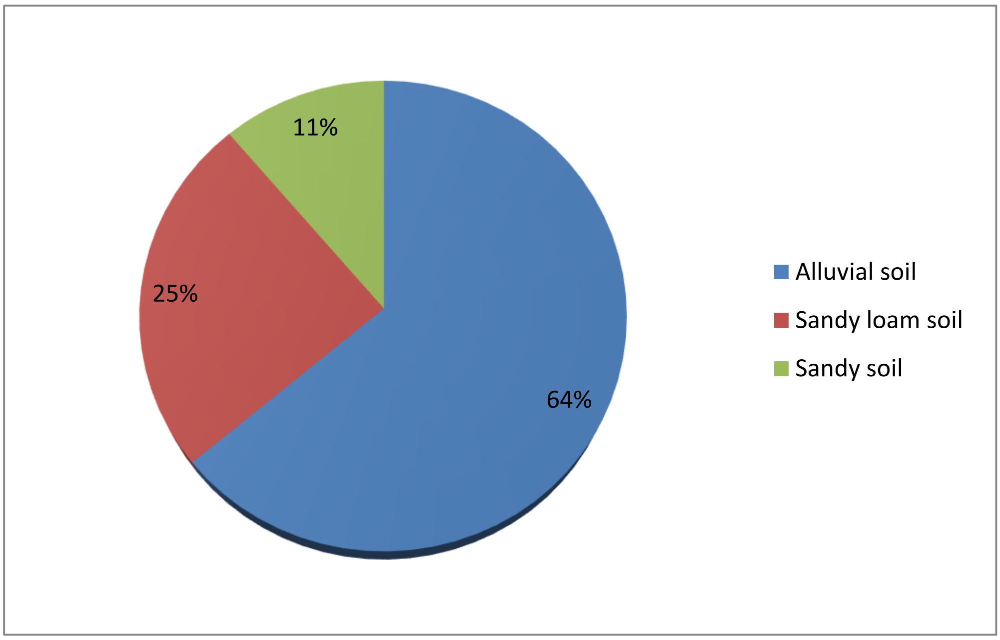


Fig 2.4: Showing type of soil in Barpeta district, 2012

The soil of Barpeta district can be classify into three major categories as Alluvial soil, Sandy loam soil and Sandy soil. Table 2.3, shows the alluvial soil is

63.92%, sandy loam soil 24.83% and sandy soil 11.25% in Barpeta district. The alluvial soil is very fertile and productive. It is famous for production of paddy, jute, vegetables etc. Sandy soil is good for the production of wheat, vegetables, sugarcane etc. And sandy loamy soil is less fertile and cannot absorb water for long time. These soil are found in newly buildup plain deposited by river sediments.

Hydro-geologically the entire area of the District is occupied by alluvial sediments of Quaternary age. The soil of Barpeta district is mainly new alluvium and partly old alluvium. Piedmont deposits comprising of course elastic sediments like boulder, pebble, gravel associated with sand and silt from the ground water bearing formation in the northern part of the district.

2.2.6. Flora and fauna

Barpeta district was one of the richest biodiversity zone in the world before separation of Manas National Park with Baska and Chirang district in 2003. The Manas National Park is World Heritage Sites and is famous for tiger project. The vegetation cover plays an important role for the productivity and stability of the natural environment. The natural vegetation belongs to semi-evergreen and mixed deciduous varieties. The most wide spread semi-evergreen forest includes important species like holong (dipterocarpusmacrocapus), Maki (shoreaassamica), Titasopa (michaliachampaca), Bonsum (phoebe goalparensis), Sal (shorearobusta), Amari (amoorawallichi), Nahar (mesuaferrea) and Gomari (gmelinaarborea).

The mixed deciduous riverine forests are found along the alluvial tracts. The common species of this area are simul (bombaxmalabaricum), khair (acacia catechu), sisoo (dalbegiasisoo), kadam (anthocephaluscadamba) and udal (starculiavillosa). Bamboos (bambusa) species are very common species in entire district. Minor forest products of the region are medical plants, aromatic plants, gums, resins and elcoresins, oil seeds, tans and dyes and fiber. Barpeta region along with other parts of Assam can be proud of the rich variety of endemic fauna. A good numbers of noteworthy fauna of this region are buffalo, cat, cow, dog, deer, horse, etc. The state has the highest diversity of birds in India with around 820 species and including sub species the numbers are 946. These birds are wild geese, teal, black and marsh partridge, wild fowl, pea fowl, wood cock, snipe and varieties of peasant are found. Varieties of snakes including python, king cobra and vipers are abundant at places. In the rivers many varieties of fishes and minor aquatic animals are found.

2.2.7. Climate

Agriculture is most climate sensitive sector and outputs is directly affected by climatic variability. Frequent and intense extreme climatic events effects on agriculture at the time of south west monsoon seasons. Slight onset changes in temperatures and precipitation are expected to affect seriously food and livelihood security in the absence of adequate adaptation and mitigation efforts. Increasing the resilience of agricultural and aquatic systems to climate change is imperative for their adaptation to climate change.

Assam experiences the predominant influence of the southwest tropical monsoon which is normally active from April to October with occasional winter showers. The approach of the monsoon is usually marked by strong winds, overcast skies accompanied by occasional thunder showers, hailstorms and cyclones between April and May and heavy rainfall starts from June. The annual average rainfall of the state varies between 160 cm and 430 cm from place to place. The average rainfall for the state as a whole is about 290 cm with maximum precipitation during June and July. The average temperature in the state varies from 4°C to 19°C during the winter and 26°C to 37°C during the summer accompanied by high humidity.

The climate of Barpeta district is tropical monsoon climate. The air is highly humid throughout the year and during rainy season the relative humidity is about 90 percent. It comes under Lower Brahmaputra Agro-climatic zone. The seasonal variation of rainfall and temperature is very high in the area. Barpeta district can be classify into four major climatic seasons on the basis of wide variation of climatic characteristics, i.e.;

(i) Summer Season

(ii) Monsoon season

(iii) Retreating Monsoon and

(iv) Winter season

i) Summer Season:

The pre-monsoon begins in the early part of March and continues up to the end of May and temperature starts rising gradually from the beginning of the season onward. Pleasant morning, hot and dry afternoons and occasional thundershowers are some of the important characteristics of the season. In this season marked atmospheric instability develops and severe thunderstorms occur, sometimes preceded by dust raising squalls. Rainfall increase both in amount and frequency as the season advances which greatly favours the cultivation of jute and ahu rice (a species of paddy).

ii) Monsoon season

The monsoon sets from the last week of May or early in June to the September or the first part of October. It is the rainy season when the state receives spells of continuous and moderate to heavy rains. June, July and August are the rainiest months where more than 70 percent of the total annual rainfall occurs and the principal crops are cultivated in these area and the tributaries of Brahmaputra starts rising causing extensive floods.

iii) Retreating Monsoon season

The south west monsoon withdraws in between the last part of September and first part of October. Consequently, the intensity of rainfall and number of rainy days goes on decreasing. The season continues up to the middle of November and fogs occur regularly. This season with a stable surface wind, clear sky and mild temperature is the most pleasant period of the year.

iv) Winter season

The winter season begins in the middle of November and continues up to the end of February. This season is characterized by cool weather, absence of rainfall and regular morning fogs and very little amount of rainfall. December and January are the driest months and January is the coldest month. The winter season is a seasonal drought prone months of the year. During the winter season north east monsoon prevail in the whole region which come from continents and mountains with a scanty water vapor as a result this region received very less rainfall.

2.2.7.1. Temperature

Agriculture are highly dependent on the temperature. Increases in temperature effects on nutrient levels, soil moisture, water availability etc. and determines the cropping pattern of a region. The temperature is mild and pleasant throughout the year in Barpeta district. The temperature of summer season ranges between 20°C to 25°C and rarely exceed 35°C. The heat is not unbearable throughout the year and the hottest month of the year is May. Otherwise temperature of winter season ranges between 12°C to 15°C and rarely comedown to 5°C.

Table 2.4: Monthly average temperature of Barpeta district (in °C)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Record high	28.8	32.2	38.4	39.0	37.0	38.3	36.5	36.2	35.8	34.3	31.0	28.1
Average high	23.6	26.2	30.0	31.2	31.2	31.7	31.9	32.2	31.7	30.3	27.6	24.7
Average low	10.3	12.0	15.9	20.0	22.7	24.9	25.6	25.6	24.7	21.9	16.7	11.8
Record low	-2.7	-0.5	6.1	11.1	16.2	20.4	21.4	22.1	17.7	10.6	5.5	-0.7

Source: Barpeta District Inventory of Agriculture, 2015

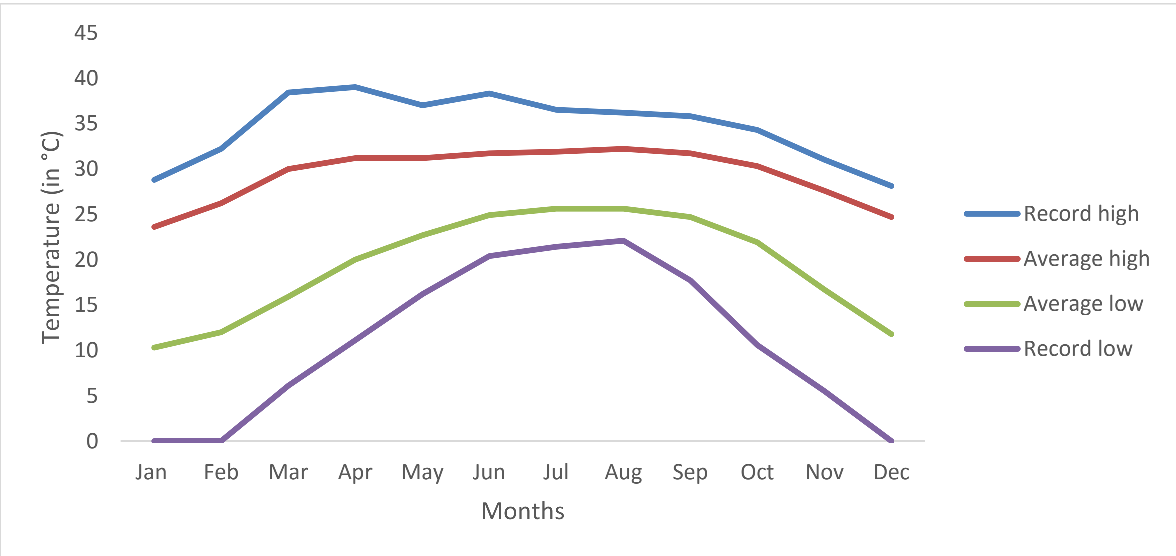


Fig 2.5: Trend of monthly average temperature in Barpeta district

Table 2.4, shows Barpeta district received highest temperature during the month from March to September (38˚ to 35˚ C). The average maximum temperature ranges from 32.2˚ C to 23.6˚ C (in August and January) and minimum temperature varies from 10.30˚ C to 25.60˚ C (in January and August). However, the recorded temperature drops to as low as -2.7˚ C while maximum shoots up to 39.0˚ C in some years.

2.2.7.2. Rainfall

Rainfall is the most important determinant for crop production under rain fed condition. Pattern of agriculture and choice of crops are depending on the availability of rainfall. Normally Barpeta district received 2287 mm rainfall annually. But the distribution of rainfall is not even throughout the year in the study area. The south west monsoon come during the period from June to September and receives 1792 mm rainfall, north east monsoon come during the period from October to December and receive 15 mm rainfall, winter season from January to March and receive 6 mm rainfall, summer season from April to May and receive 474 mm rainfall in Barpeta district. This area receives heavy rainfall 60% to 65 % every year during June to September from south west monsoon. The normal rainfall is 2127 mm for the district and actual rainfall received 2119 mm, 2239 mm and 2074 mm in 2011, 2012 and 2013 respectively and the variation of rainfall from normal rainfalls are 8 mm, 112 mm and -53 mm respectively.

Table 2.5: Season wise rainfall in Barpeta District (In percentage)

Sl. No.	Major Season	Rainfall
1	Winter season	11.6 mm
2	Summer season	509 mm
3	Monsoon season	1,456.4 mm
4	Post monsoon season	17.2 mm

Source: Statistical Hand Book of Assam, 2011

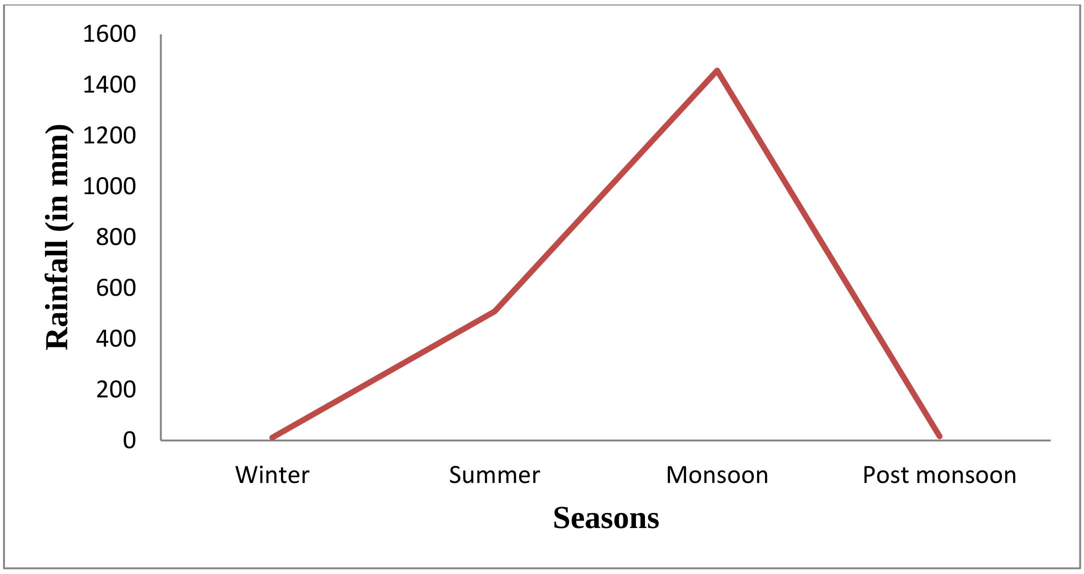


Fig 2.6: Showing seasonal variation of rainfall in Barpeta, 2011

Rainfall distribution follows a typical monsoon pattern with peak precipitation during monsoon and scanty rainfall in winter. The distribution of rainfall is not equal among the year in the region. The state average received 1566.6 mm rainfall instead of the normal rainfall (2296.3 mm) in 2011 and Barpeta district received 1994.2 mm rainfall instead of the normal rainfall (3274.3 mm) in 2011. The highest rainfall occurs during June, July and August month during a year, Barpeta district receive respectively 316.4, 345.4and 264.3 mm of rainfall respectively. Monsoon is withdrawn normally around 20th October and during post-monsoon season the region receives the least rainfall. Winter is the driest season. Local circulations and western disturbances bring some precipitation. During pre-monsoon season thunder storms and local convectional currents produce cumulus clouds. Hailstorms are common feature during the season.

The region received highest rainfall at the time of monsoon season with 1456.40 mm and receives least rainfall at the time of winter and post monsoon season with 11.6 mm and 17.2 mm respectively. In summer season the region received minimum rainfall with 509 mm. The chronically flood affected during monsoon and summer season and other season is drought affected in this district.

2.2.7.3. Humidity

Humidity plays a vital role in weather and climate. Water vapor is a key greenhouse gas, which helps to block harmful ultra violate rays from the sun as well as traps heat on Earth that makes life possible. Humidity is the amount of water vapor in the air. Water vapor is a gaseous state of water and is invisible in atmosphere. Humidity determines the precipitation, dew or fog. Higher humidity reduces the effectiveness of sweating in cooling the body by reducing the rate of evaporation of moisture from the skin and can make hot temperatures even more unbearable. Humidity is an important thing to understand climate because it affects weather and climate as well as global climate change. As temperature decreases, the amount of water vapor needed to reach saturation and temperature of a parcel of air becomes lower and will eventually reach the point of saturation without adding or losing water mass.

Humidity can be classified as absolute, relative and specific. Absolute humidity is the water content of air at a given temperature expressed in gram per cubic metre. Relative humidity is the ratio of the partial pressure of water vapor to the equilibrium vapor pressure of water at a given temperature. Relative humidity depends on temperature and the pressure of the system of interest. It requires less water vapour to attain high relative humidity at low temperatures; more water vapour is required to attain high relative humidity in warm or hot air.

On an average, the relative humidity is more than 80% in almost all the locations of Assam throughout the year. Even during dry winter months, the average relative humidity is never below 75% in the region. The state receives 4 hours sunshine per day during kharif and 6 hours in rabi season. Average solar radiation indicates that the radiation interception is only 36-38% of the sunshine hours during June to August due to overcast sky while during November to February is 70-74%. During winter months the radiation interception is low due to foggy weather.

Table 2.6: Showing monthly average humidity of Barpeta district (In percentage)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Average relative humidity	79	65	57	68	75	81	83	82	83	82	82	82	76.6
Average rainy days	1.8	2.9	5.8	13.1	17.0	19.6	22.3	18.5	15.2	7.4	2.8	1.3	127.7
Mean monthly sunshine hours	226.3	214.7	220.1	201.0	192.2	132.0	124.0	161.2	138.0	204.6	231.0	232.5	2,277.6

Source: Barpeta District Inventory of Agriculture, 2015

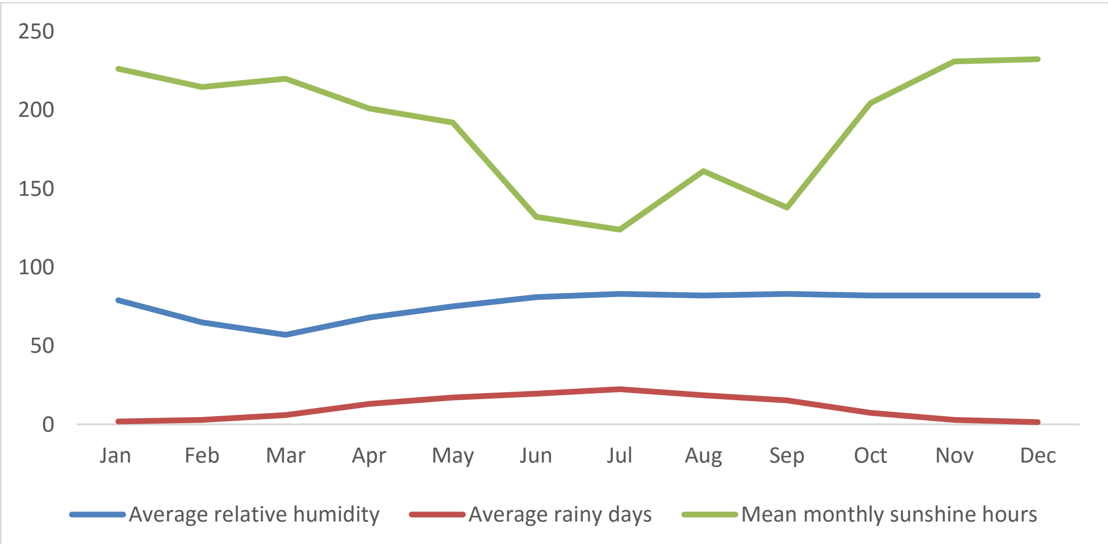


Fig 2.7: Showing monthly average humidity of Barpeta district

Table 2.6, shows the average relative humidity of the district is 76.6% and relative humidity ranges from 57% to 83%. On an average, the relative humidity is more than 80% from June to December. Even during dry in winter months, the average relative humidity is never below 57% in the district. The Mean yearly sunshine is 2,277.6 hours in the district. The district recorded lowest 124.0 hours mean monthly sunshine during July month and highest mean monthly sunshine is 232.5 hours in the month of December, table 2.6.

2.2.7.4. Dew Point

Dew is water condenses at ground level because of the air saturated. The temperature at which saturation occurs is called the dew point. Commonly see dew in the morning because air temperature goes down overnight because the cold air can't hold as much water. Condensation process occurs in the sky and clouds are created. Clouds are water condensation above ground level due to air saturation. The condensation of water vapor that falls in the morning is dew. During the winter months dew is falling and rabi crops like vegetables, wheat, mustard are highly cultivated in Barpeta district.

2.2.8. Land use pattern

Land use is characterized by the arrangements, activities and inputs of people undertake in a certain land cover type to produce, change or maintain it (FAO/UNEP, 1999). Any given area of land is usually used to satisfy multiple objectives or purposes. Albert Guttenberg (1959) explained land use is a key term in the language of city planning, commonly, political jurisdictions will undertake land use planning and regulate the use of land in an attempt to avoid land use conflicts. Land use involves the management and modification of natural environment or wilderness into built environment such as settlements and semi natural habitats such as arable fields, pastures, and managed woods. Land use and land management practices have a major impact on natural resources including water, soil, nutrients, plants and animals. The knowledge of current land use and land resources is needed for formulating changes leading to sustainable use of the resources.

The physical, economic and institutional framework taken together determines the pattern of land use of a country at any particular time. Land use is most important for the development of a region.

Table 2.7: Land use pattern of Barpeta district, 2012

Sl. No.	Land use pattern	Area ('000 ha)	Area (in %)
1	Cultivable area	180.5	55.62
2	Forest area	86.735	26.72
3	Land under nonagricultural use	19.994	6.16
4	Permanent pasture and grazing land	12.939	3.98
5	Cultivable waste land	1.608	0.49
6	Land under misc. Tree crops and groves	3.530	1.08
7	Barren and un-cultivable land	14.151	4.36
8	Current fallow	8.033	2.47
9	Other fallow	2.275	0.70
10	Geographical area	324.5	100

Source: Calculated from 'Agricultural Contingency Plan for Barpeta District'.

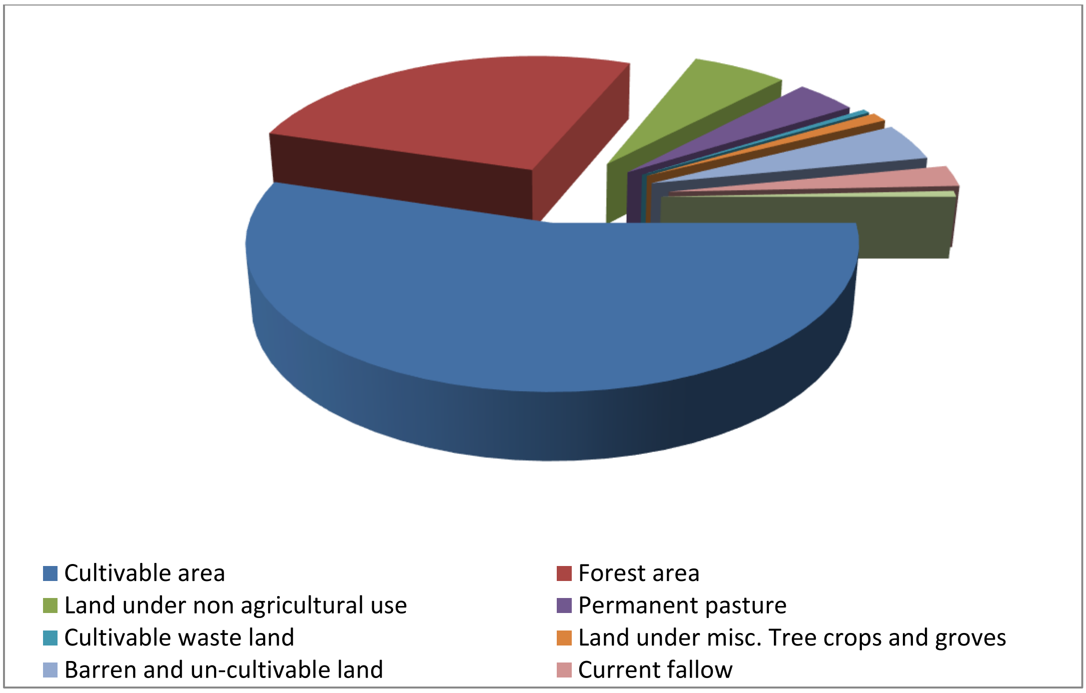


Fig 2.8: Land use pattern in Barpeta District

In the study area cultivable area is 55.62%, forest cover 26.72%, land under nonagricultural use 6.16%, permanent pasture 3.98%, cultivable waste land 0.49%, land under misc. tree crops and groves 1.08%, barren and un-cultivable land 4.36%, current fallow 2.47% and other fallow 0.47%, table 2.7.

It is shown that most of the land is under the agriculture but it is yet to be increase for the agricultural use. It has 8.06% of land under the cultivable waste land, barren and un-cultivable land, current fallow and other fallow. The development of agriculture also depends on the proper utilization of land.

Table 2.8, shows the disparities of land use in Barpeta district among the revenue circle. Forest is the most important for landcover maintaining environmental balance but in Barpeta district, there is no virgin forest land which is an alarming for future generation. The total area under nonagricultural uses are 45207 hectares, other uncultivated land has 26240 hectares and total fallow lands are 14148 hectares in this district. Total cultivated areas are 200394 hectares including net area sown as 14260

Table 2.8: Revenue circle wise land use pattern in Barpeta district

Revenue Circle	Forest	Area under non-agricultural uses						
		Water logged land	Social Forestry	Land under still water	Other land	Total (3 to 6)	Barren & uncultivable land	Total (7+8)
1	2	3	4	5	6	7	8	9
Barpeta	0	2056	2	266	1725	4049	3958	8007
Baghbar	0	3021	0	2542	2508	8071	6706	14777
Chenga	0	587	0	271	1346	2204	123	2327
Kalgachia	0	432	0	1286	1861	3579	2613	6192
Barnagar	0	215	101	411	2830	3557	505	4062
Sarthebari	0	172	6	313	2281	2772	1859	4631
Bajali	0	319	0	18	1770	2107	201	2308
Jalah	0	35	0	150	258	443	102	545
Sarupeta	0	419	0	155	1491	2065	293	2358
Total	0	7256	109	5412	16070	28847	16360	45207

(Table cont.)

Name of Revenue Circle	Other uncultivated land				Fallow land			Net area sown	Total cropped area	Area sown more than one
	Permanent Pastures & other grazing land	Land under miscellanies tree groves etc. (not included in net	Cultivable waste land	Total	Fallow land other than current fallow	Current fallow	Total			
1	10	11	12	13	14	15	16	17	18	19
Barpeta	1363	1365	633	3361	762	929	1691	18503	24806	6303
Baghbar	402	1445	1266	3113	1115	4275	5390	27347	41554	14207
Chenga	345	943	3693	4981	826	891	1717	23608	30405	6797
Kalgachia	2483	489	270	3242	595	306	901	13969	18242	4273
Barnagar	2801	181	275	3257	302	312	614	14996	22006	7010
Sarthebari	1459	1728	1043	4230	522	411	933	17144	18512	1368
Bajali	539	797	216	1552	221	728	949	11673	17991	6318
Jalah	213	329	25	567	25	29	54	3169	4808	1639
Sarupeta	691	956	290	1937	498	1401	1899	12196	22070	9874
Total	10296	8233	7711	26240	4866	9282	14148	142605	200394	57789

Source: District Statistical Hand Book, 2012-13, Barpeta District

hectares and area sown more than one is 57789 hectares in Barpeta district, table 2.8. To meet the demand of increasing population the area under cultivation should increase by transforming the fallow lands and uncultivable lands to cultivable lands.

2.3. SOCIO-ECONOMIC STATUS

2.3.1. Population growth and density

Human resource is most important resource of a country. Utilization of resource depends on the skill of human resource. Population growth is a challenge in worldwide due to no extension of land resources. The population growth rate of both India and world is 1.2% per annum in 2015 (World Bank).

According to 2011 census total population of Barpeta district is 1693190 persons and among them 867891 is male and 825299 female populations. Rural population is 1545901 and urban population is 147289. The population density is 632 per sq. km. The decadal growth rate of population is 21.40% in the period of 2001 to 2011compare to average growth rate 16.93% of the Assam. In the district total registered birth 34761 persons and registered death 4071 persons during the year 2011.

Table 2.9 shows the total population in Mandia development block is highest in Barpeta district followed by Bhawanipur development block. The population of Mandia development block is 349328 including 179275 males and 170053 females. Gobardhana development block has least population, populations are 64089 including 33095 males and 30994 females' population. Total population of Bajali, Chakchaka, Ruposhi, Barpeta, Sarukhetri, Pakabetbari, Chenga and Gumafulbari development blocks are 112721, 101192, 163765, 120521, 87259, 139766, 104236 and

Table 2.9: Block wise population in Barpeta District, 2011

(In Sq. Km, female in 1000 male)

Sl. No	Name of Block	Area	No. of household	Population			Sex Ratio	Density
				Total	Male	Female		
1	Bajali	209.48	24926	112721	56191	56530	1006	538.10
2	Gobardhana	64.94	12873	64089	33095	30994	937	986.90
3	Chakchaka	146.32	21623	101192	51172	50020	977	691.58
4	Ruposhi	174.65	31249	163765	84549	79216	937	937.68
5	Mandia	596.76	63704	349328	179275	170053	949	585.37
6	Barpeta	161.45	22368	120521	61618	58903	956	746.49
7	Gumafulbari	205.45	16358	81078	41658	39420	946	394.64
8	Sarukhetri	117.54	17774	87259	44782	42477	949	742.38
9	Chenga	172.43	20645	104236	53398	50838	952	604.51
10	Pakabetbari	132.95	27373	139766	72126	67640	938	1051.27
11	Bhawanipur	265.97	44159	222314	113925	108389	591	835.86

Source: District Statistical Hand Book, 2012-13, Barpeta District

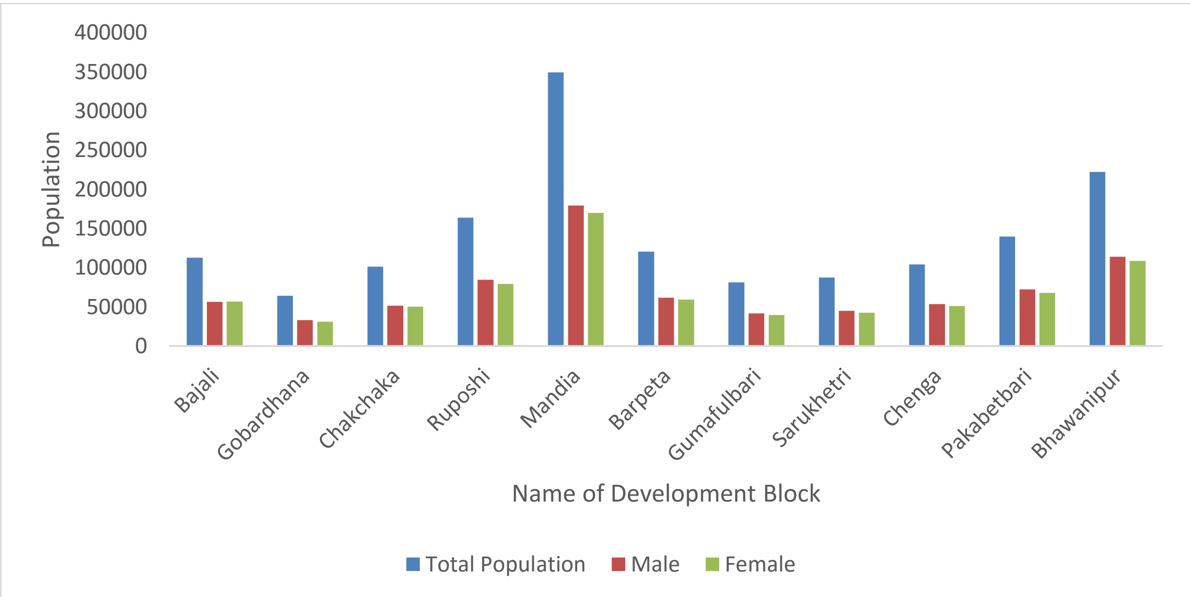


Fig 2.9: Block wise population in Barpeta district, 2011

81078 respectively in 2011. The population growth rate is highest among the uneducated population of char (riverine delta) due low educational rate.

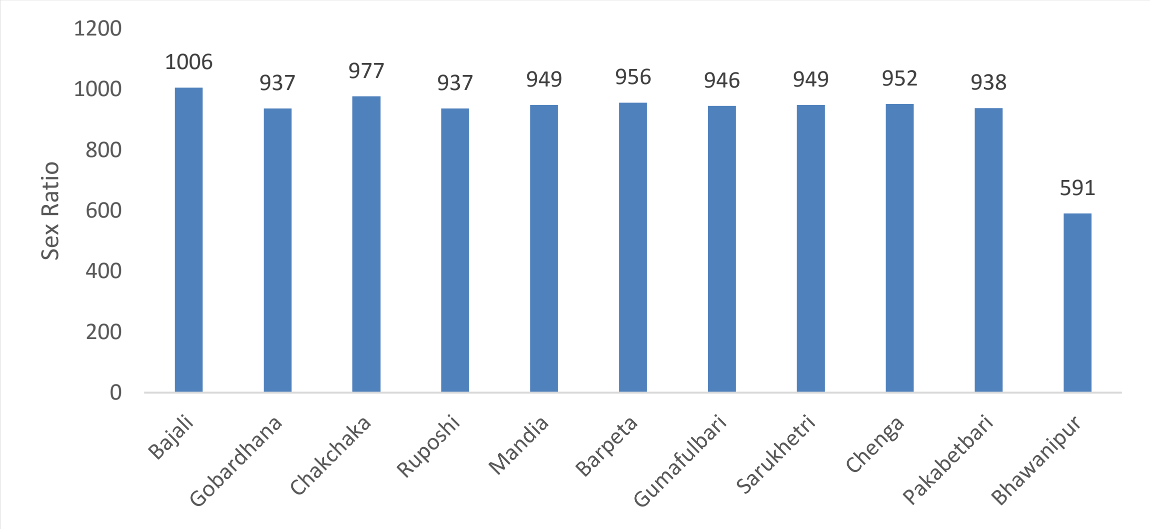
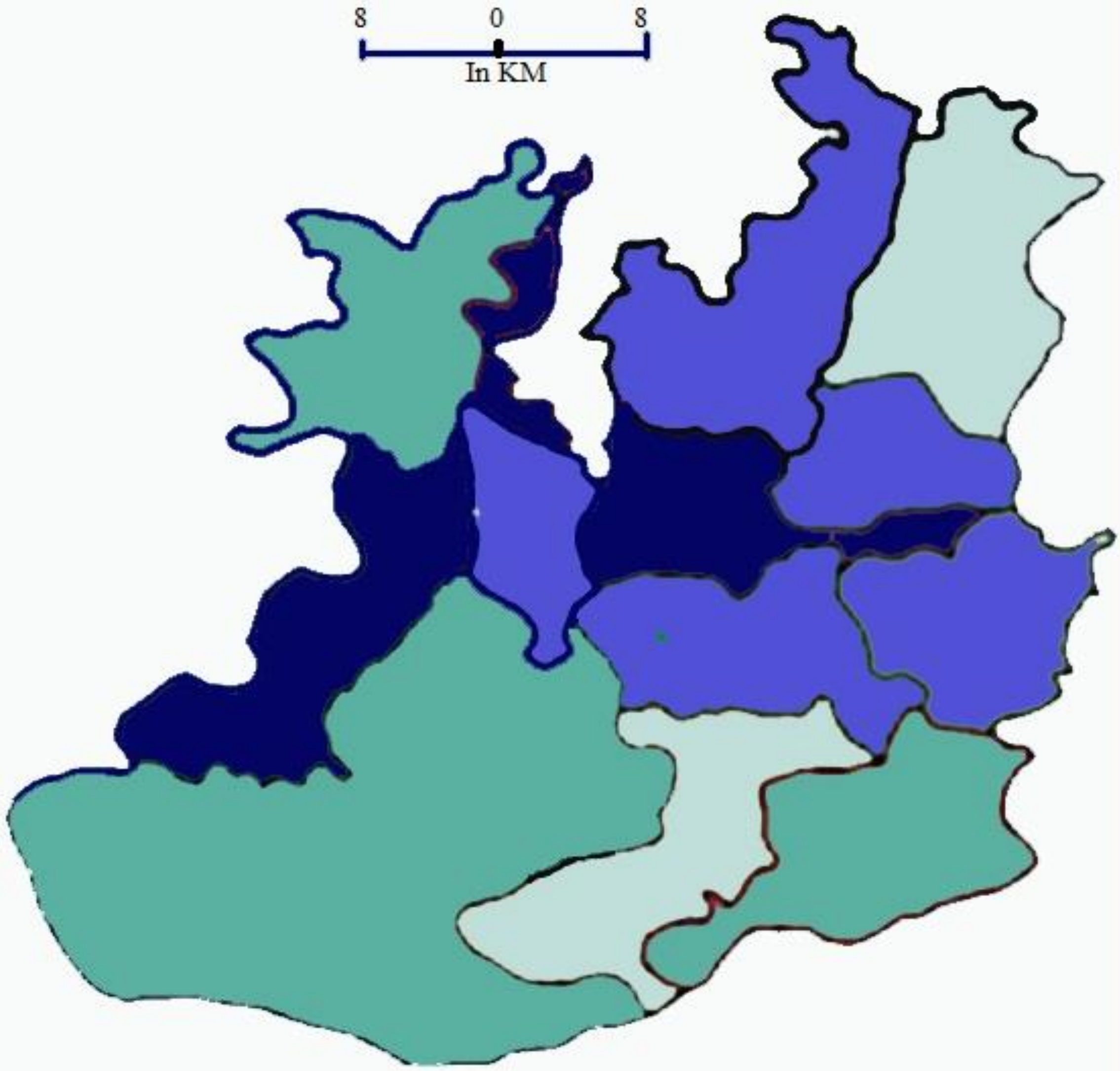


Fig 2.10: Block wise sex ratio in Barpeta district

Table 2.9, shows the sex ratio is not equally distributed among the blocks. The sex ration of Bajali development block is satisfactory which is 1006 female per 1000 male and Bhawanipur development block has least sex ratio which is 591 almost half of male. Chakchaka development block is occupying second position for sex ratio with 977 followed by Barpeta development block with 952 sex ratio, table 2.9. The literacy rate has highly influenced on the sex ratio. The literacy rate is highest in Bajali development block and the sex ratio is also highest in Barpeta district. Moreover sex ratio is less among minority majority blocks due to less literacy rate.

Table 2.9, shows population is not equally distributed in all development block in Barpeta. The density of population is highest in Pakabetbari Development Block and lowest in Gumafulbari Development Block with 1051.27 and 394.64 persons per sq. km. Next to Pakabetbari Development Block population density is highest in Gobardhana and Ruposhi Development Blocks with 986.90

Fig 2.11: Population Density Map of Barpeta District



LEGEND

Level	Range	Name of Dev. Block	Index
High	Above 887.11	Pakabetbari, Gobardhana, Ruposhi	
Medium	722.95-887.11	Barpeta, Sarukhetri, Bhawanipur	
Low	558.79-722.95	Chakchaka, Mandia, Chenga	
Very Low	Bellow 558.79	Gumafulbari, Bajali	

and 937.68 per sq. km. Medium densely populated development blocks are Barpeta, Bhawanipur and Sarukhetri density of population ranges from 722.95 to 887.11 per sq. km. Population density is low in Chakchaka, Mandia and Chenga Development Block and population density are between 558.79 to 722.95 per sq. km. The density of population in Bajali development is 538.10 per sq. km. next to Gumafulbari development block, table 2.9. The density of Gumafulbari development block is lowest due to maximum area of Gumafulbari Development Block is under Brahmaputra river and in Bajali development Block population density is low due to low population growth in the Development Block and maximum population of Bajali is literate.

Table 2.10: Decadal growth of population in 1901-2011 (in %)

Sl. No.	Year	Barpeta	Assam
1	1901-1911*	18.65	16.99
2	1911-1921*	34.49	20.48
3	1921-1931*	72.29	19.91
4	1931-1941*	47.64	20.4
5	1941-1951*	16.62	19.93
6	1951-1961*	34.39	34.98
7	1961-1971*	33.91	34.95
8	1971-1991#	40.97	53.26
9	1991-2001#	19.62	18.92
10	2001-2011	21.4	16.93

Source: District Statistical Hand Book, 2012-13, Barpeta District

* Due to non creation of the district the rates have been affected.

Due to creation of 2 new districts the rates have been affected in this district.

Fig 2.12: Decadal variation of population in 1901-2011

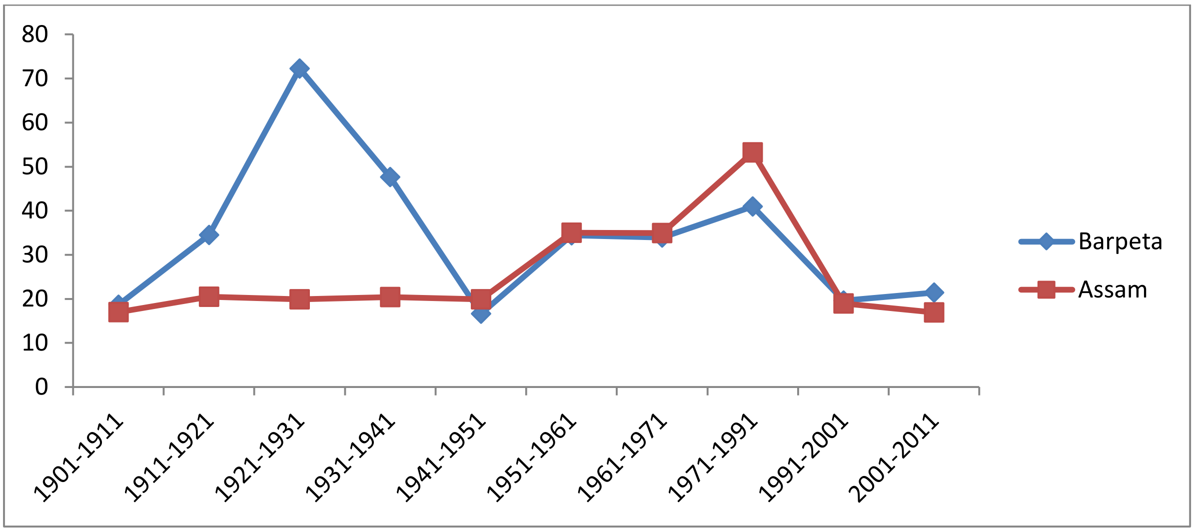


Table 2.10, shows decadal population growth rate varies among decades from 1901 to 2011 in Barpeta district and Assam. The population growth rate was highest during 1921-1931 with 72.29% in Barpeta against Assam 19.91% population growth rate. The growth rate was lowest during 1941-1951 with 16.62% against state 19.93% growth rate. During 1901-11 population growth rate was 18.65% and it increased to 72.29% during 1921-1931. During 2001-2011 population growth rate was 21.4% in Barpeta against state 16.93% growth rate. The population growth rate is decreasing due to increase of literacy rate and adoption of family planning in this district.

Table 2.11, shows government has adopted various type of program for family planning in the district, like I.U.D., Sterilization, Conventional and contraceptive distributed, Oral Pill etc. for controlling the population growth and better human resource. The use of I.U.D. was 218 in 2008-09 which steadily increased to 1737 in 2012-13. The use of oral pill records 37712 in 2008-09 which steadily decreased to 8964 in 2012-13 for popularization of I.U.D. and sterilization.

Table 2.11: Family Planning in Barpeta District

Category of Patient	**2008-09**	**2009-10**	**2010-11**	**2011-12**	**2012-13**
I.U.D.	218	929	2671	2255	1737
Sterilization (Vasectomy & Tubectomy)	87	1022	422	2077	627
Conventional & Contraceptive distributed	191	3595	2456	306	456
Oral Pill	37712	64698	100894	9464	8964

Source: District Statistical Hand Book, 2012-13, Barpeta District

2.3.2. Religion and Caste

Barpeta district has a great significance of religion. With the advent of Shrimanta Sankardeva, this region turned into a religious place spread with numerous satras and Barpeta town to be called 'Boikumthapuri Dham'. As a part of providing patronage to various religious places irrespective of religions, the Ahom rulers provided a large number of land grants to Satras. Dr. Maheswar Neog in his edited work "Prasya Sasanawali" has mentioned a large number of land-grants during the region of Shiva Singha, Rajeswar Singha, Lakshmi Singha, Gaurinath Singha and Chandra Kanta Singha. Land grants were made to Muslim-Darghas of Shah Madar at Baushi, Shah Fakir at Barnagar, Panch Peer at Khetri, Syed Shahnur Dewan Fakir at Bhella, where

Chandra Kanta Singha granted 100 bighas khiraj land. Moreover land grants were made to Devalaya in Assam.

Barpeta district has a great Hindu religious history but has more diversity in religion and cast. There are many groups of people having various religion and cast. Though Muslims are minority in Assam as well as in India but in Barpeta district Muslims are majority and Hindus are minority.

Table 2.12: Religion wise population in Barpeta (in percentage)

Sl. No.	Religion	2001	2011	
			In Number	In percentage
1	Hindu	40.01	492,966	29.11
2	Muslim	59.37	1,198,036	70.74
3	Christians	0.32	1,020	0.06
4	Sikhs	0.02	112	0.01
5	Buddhists	0.01	49	0.00
6	Jain	0.04	399	0.02
7	Other	--------	14	0.00
8	Not stated		1,026	0.06

Source: Census of India, 2001 & 2011

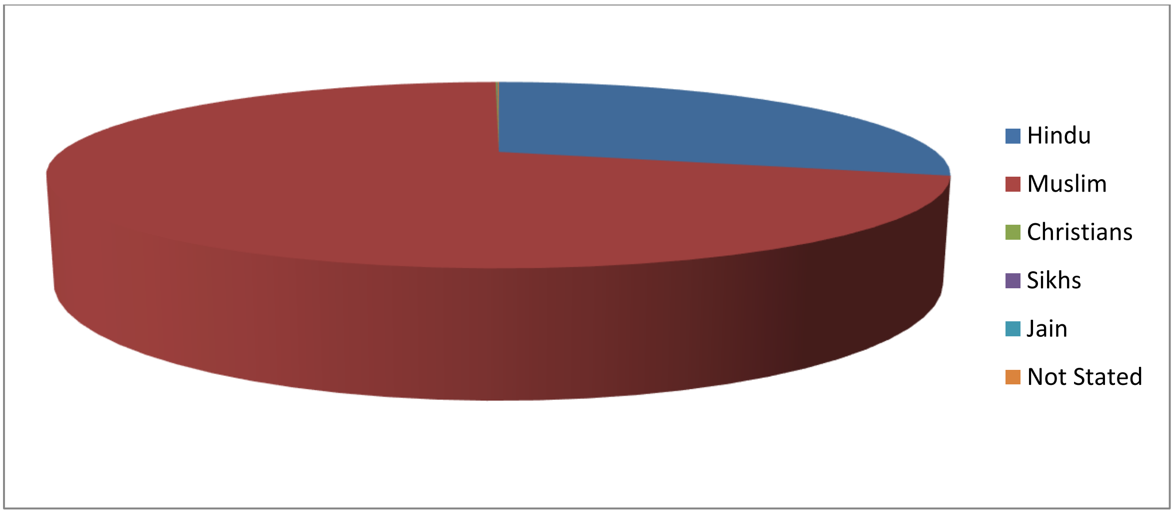


Fig 2.13: Showing religion wise population in Barpeta District, 2011

Table 2.12, shows as per census of Assam 2001, the share of various religious population in Barpeta district are Hindu 40.01%, Muslim 59.37%, Christians 0.32%, Sikh 0.02%, Buddhist 0.01% and Jain 0.04%. The percentage of Schedule cast and Schedule tribe population are 5.70 and 7.48 respectably as per 2001 census. In 2011, Hindu population are 29.11 person which is decreased by 10.9% and Muslim populations are 70.74% which is increased to 11.37%, table 2.12. The major cause of decrease of Hindu population is separation of Hindu majority villages with Chirang and Baska district in 2003 and high Muslim birth rate in this district.

Table 2.13: Schedule cast and schedule tribe population in Barpeta, 2011

District/ State	In number		In percentage to total population		
	SC	ST	SC	ST	Other population
Barpeta	95320	27344	5.63	1.61	92.76
Assam	2231321	3884371	7.15	12.45	80.4

Source: District Statistical Hand Book, 2012-13, Barpeta District

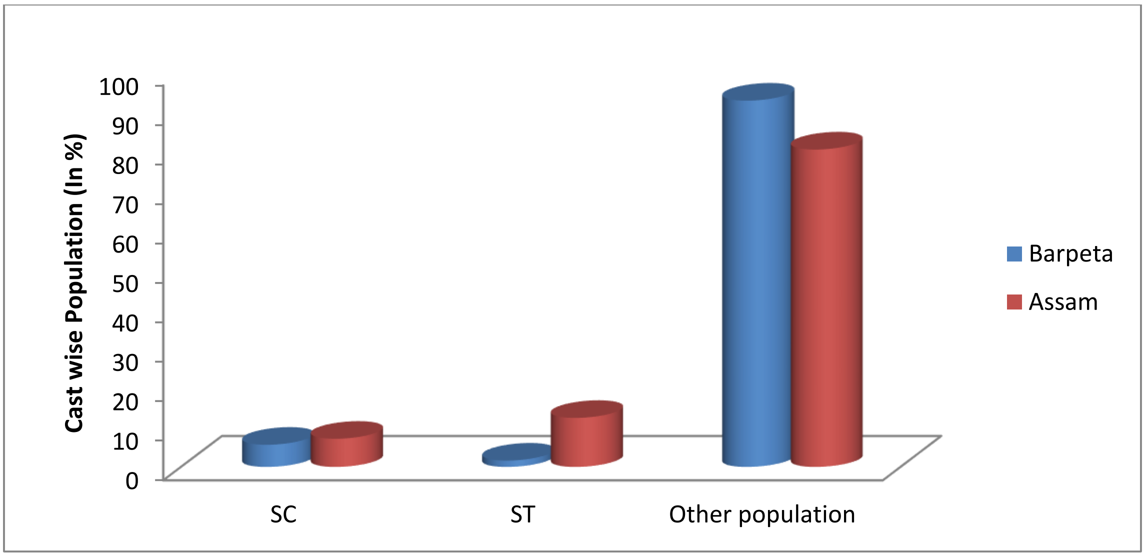


Fig 2.14: Schedule cast and Schedule tribe population in Barpeta district, 2011

Table 2.13, shows Barpeta district has a number of casts of populations. There is 5.63 % Schedule cast population against 7.15% Schedule cast population of Assam. And there are 1.61% Schedule tribe population against 12.45% Schedule tribe population of Assam in 2011. The schedule tribe population is less due to plain physiography of Barpeta district.

2.3.3. **Education**

Education is one of the fundamental factor of development in every sense. No country can achieve sustainable economic development without substantial investment in human capital. Education enriches people's understanding of themselves and world. It improves the quality of lives and leads to broad social benefits to individuals and society. Education raises people's productivity and creativity and promotes entrepreneurship and technological advances. In addition it plays a very crucial role in securing economic and social progress and improving income distribution.

Education is the backbone for the development of a country without which a country can't develop. But rate of education in Barpeta district is not satisfactory with a growth rate of 16.10%. Literacy rate is 56.00% and 65.03% respectably in

2001 and 2011 of Barpeta district against Assam literacy rate 63.25% and 73.18% respectably.

Table 2.14, shows as per 2001 census, Barpeta district has 1841 Primary (LP) schools, 225 Middle schools, 131 M.E. Madrassa, 40 M.V. schools, 160 high schools, 41 higher secondary schools, 18 government aided colleges and one each of Jawahar Navodaya Vidyalay, Kendriya Vidyalay, Vocational (ITI) and Law College.

Table 2.14: Educational Institution in Barpeta district (in number)

Institution	2008-09	2009-10	2010-11	2011-12	2012-13
Preprimary & primary (Govt.)	1518	1518	1663	1663	1663
Private Primary	469	469	469	527	527
Middle School (Govt.)	299	298	297	340	340
Private UP	356	356	356	367	367
High School	303	303	303	303	303
Higher Secondary	40	40	40	40	40
Junior & Senior College	NA	NA	NA	NA	38
Training Institute	4	4	4	4	4

Source: District Statistical Hand Book, 2012-13, Barpeta District

Table 2.15, shows literacy rate is highest in Bajali Development Block (90.79%) and lowest in Mandia development Block (47.66%). Chakchaka development block is second highest literacy rate followed by Satrukhetri development block. The variation of literacy rate between highest and lowest is 43.13% among Development Block in Barpeta. The male female literacy gap is 11.68% in 2011.

Table 2.15: Literacy Rate of Barpeta District, 2011

Name of Block	Literate Persons			P.C. of literacy		
	Total	Male	Female	Total	Male	Female
Bajali	91320	48341	42979	90.79	96.61	85.03
Gobardhana	30670	17127	13543	58.26	62.81	53.37
Chakchaka	61935	33577	28358	71.59	76.99	66.1
Ruposhi	74967	42148	32819	57.36	62.31	52.05
Mandia	132060	75865	56195	47.66	53.26	41.74
Barpeta	66752	37698	29054	65.97	72.76	58.84
Gumafulbari	34372	19463	14909	52.99	58.28	47.38
Sarukhetri	51579	28973	22606	69.67	76.01	62.94
Chenga	47239	26608	20631	55.8	61.24	50.06
Pakabetbari	66233	38212	28021	57.88	64.66	50.64
Bhawanipur	125335	69690	55645	67.28	72.95	61.3
Total	782462	437702	344760	63.06	68.90	57.22

Source: District Statistical Hand Book, 2012-13, Barpeta District

Table 2.16: Literacy rate of Barpeta district, Assam and India in 2011

Name of Block	Literate Persons			P.C. of literacy		
	Total	Male	Female	Total	Male	Female
Barpeta	897058	499038	398020	63.81	69.29	58.06
Assam	19177977	10568639	8609338	72.19	77.85	66.27
India	778454120	444203762	334250358	74.04	82.14	65.46

Source: District Statistical Hand Book, 2012-13, Barpeta District

Table 2.16, shows literacy rate is very low in Barpeta district compare to Assam and India. The literacy rate is 63.18% in Barpeta, 72.19% in Assam and 74.04% in India in 2011. The male literacy rate is 69.29% and female literacy rate is 58.06% in Barpeta. The male literacy rate is 77.85% and female literacy rate is 66.27% in Assam. The gap between male and female literacy rate is less in Barpeta district compare to Assam and India.

2.3.4. Employment and Economic status:

Employment status is most important for the development of a region. Most of the populations are engage in agriculture and allied sectors. In Barpeta district, 33.17% population is engage in various activities and 66.83% population is non workers. The number of total workers are 11,969,690 persons and main workers are 8,687,123 persons, marginal workers are 3,282,567 persons, non-workers are 19,235,886 persons, cultivators are 4,061,627 persons, agricultural laborers are 1,845,346 persons, household industries workers are 491,321 persons and other workers 5,571,396 in Assam as per 2011 census. As well as the total workers is 561,824 persons and main worker 439,453 persons, marginal workers 122,371 persons, non-workers 1,131,798 persons, cultivator 205,259 persons, agricultural laborers 98,946 persons, household industries workers 30,342 persons and other workers 227,277 in Barpeta district as per 2011 census.

Table 2.17: Worker engages in various activities in 2011

Sl. No.	Category of workers	Barpeta District		Assam	
		In number	In %	In number	In %
1	Cultivator	205,259	36.53	4,061,627	33.93
2	Agricultural laborer	98,946	17.61	1,845,346	15.42
3	Household industries worker	30,342	5.40	491,321	4.10
4	Other workers	227,277	40.45	5,571,396	46.55

Source 2.14: Census of India, 2011

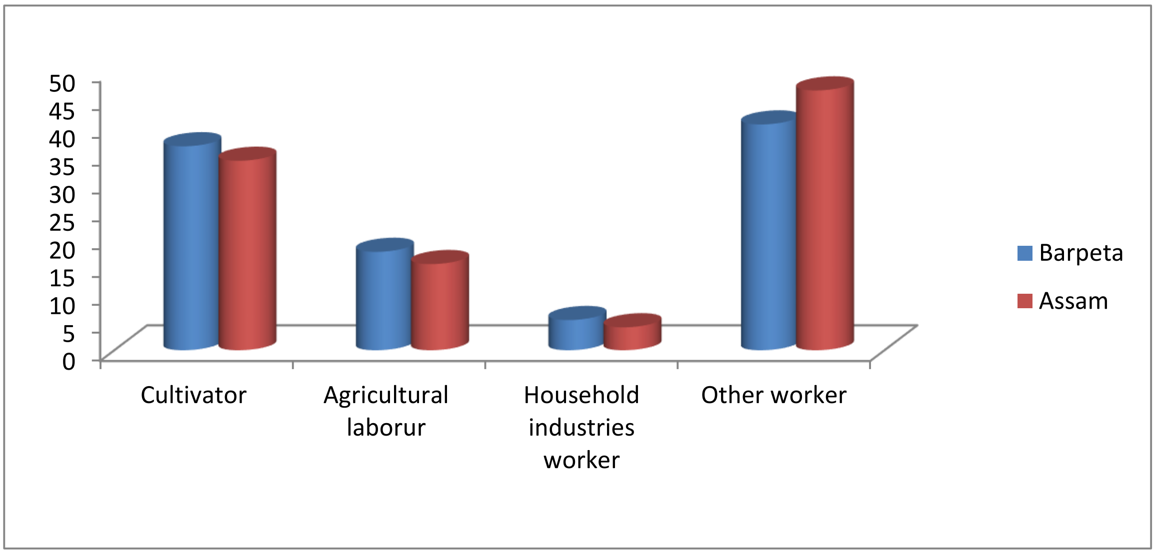


Fig 2.15: Worker engages in various activities in 2011

Table 2.17 shows agriculture and allied sector is highest employer among all sectors and employed 54.14% worker of Barpeta district in 2011. Alone cultivators are 36.53% and agricultural labour is 17.61%. The number of cultivators are 205,259 and agricultural laborers are 98,946 of total 561,824 workers in Barpeta district. And number of cultivator is 4,061,627 and agricultural laborer is 1,845,346 of total 11,969,690 workers in Assam in 2011. The share of workers in household industry is 5.40% and Other Workers is 40.45% in Barpeta district as per 2011 census.

Table 2.18: Distribution of Main Workers and Marginal Workers in 2011

Main Category	Sub Category of worker	Barpeta		Assam	
		In number	In percentage	In number	In percentage
Main Workers	Total	439453	78.21898	8687123	72.58
	Cultivators	184770	32.88752	3138554	26.22
	Agricultural laborers	56932	10.13342	903294	7.55
	Household industry	16499	2.936685	242071	2.02
	Other	181252	32.26135	4403204	36.79
Marginal Workers	Total	122371	21.78102	3282567	27.42
	Cultivators	20489	3.646872	8687123	7.71
	Agricultural laborers	42014	7.478143	942052	7.87
	Household industry	13843	2.463939	249250	2.08
	Other	46025	8.192067	1168192	9.76
Total workers		561824	100	11969690	100

Source: Infrastructure Statistics of Assam, 2014-15

Table 2.18, shows total workers of the Barpeta district is 561824 and total workers of Assam are 11969690. The numbers of main and marginal workers are

439453 and 122371 respectably and the percentage of main workers are 78.22 and marginal workers are 21.78 in Barpeta district. In Assam, 72.58% people is main worker and 27.42% people are marginal worker in 2011.

Table 2.19: Number of Households Employment in Rural, 2011 (in %)

Region	Total Salaried Job	Government Job	Salaried in Public Sector Job	Salaried in Private Sector Job	Income Tax Payer
All India	9.65%	5.00%	1.12%	3.57%	4.57%
North Eastern India	13.42%	9.20%	0.85%	3.39%	7.50%
Assam	12.27%	7.61%	0.88%	3.81%	7.12%
Barpeta	8.37%	7.17%	0.28%	0.94%	5.14%

Source: Socio-economic Census of India, 2011

Table 2.19, shows the numbers of household employed represent the economic condition of an area. The percentage of total salaried job in Barpeta district is not satisfactory in compare to Assam and North Eastern States. In Barpeta 8.37% people are engaged in salaried job and 12.27% people of Assam and 13.42% people are engaged in salaried job. The income tax payers are 5.14% in Barpeta district in 2011.

In Barpeta, maximum populations are living in a very poor economic condition compare to state and national monthly income. As shown table 2.20, the 80.06% household has less than 5000 monthly income against the state 76.89% population in 2011.

Table 2.20: Showing monthly income of household, 2011

Name	Less than Rs. 5,000		Rs. 5,000 -10,000		Rs. 10,000 or above	
	In number	In %	In number	In %	In number	In %
Barpeta	258498	80.06	39429	12.21	24903	7.71
Assam	4416524	76.89	834420	14.53	492736	8.58
North Eastern India	6121734	75.94	1183955	14.69	754967	9.37
All India	133985080	74.52	30894594	17.18	14828456	8.25

Source: Socio-economic Census of India, 2011

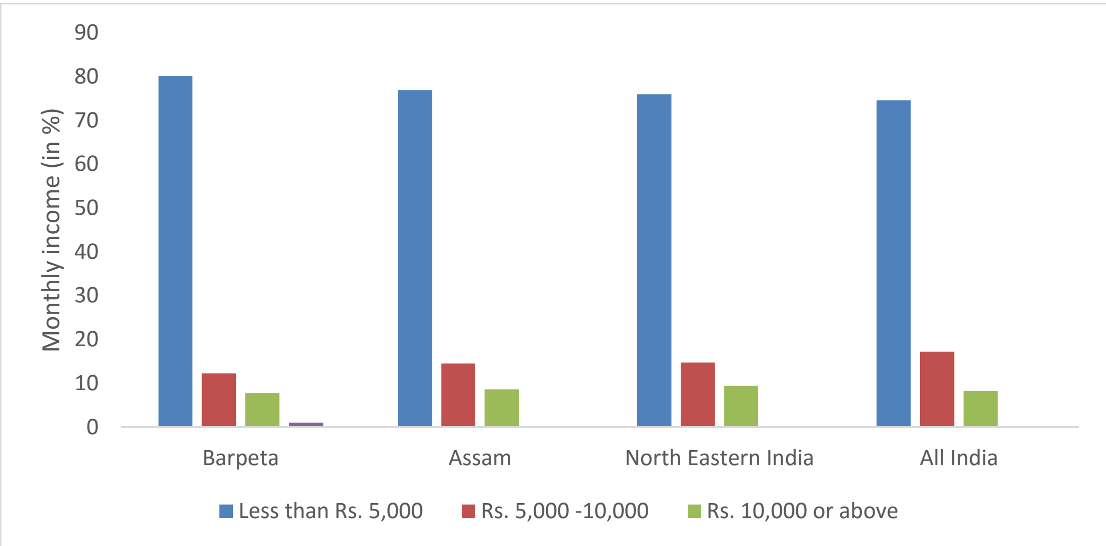


Fig 2.16: Showing monthly income of household, 2011

On the other hand 12.21% household has 5000-10000 monthly income and 7.71% household has 10000 or more than that in 2011.

2.3.5. Transport and Communication

The transportation and communication plays a crucial role for development of a country like the arterial system of the human body. The proper development of transport and communication reduces the cost of transportation, in terms of money and travel time and provide comfortable and safe journey. The transport and communication sector contribute for the economic development of a region by bringing direct benefits in all sectors such as tourism, agriculture, industry, commerce, employment and facilitated in communication. Barpeta district is well connected by roads, railways and inland water.

Barpeta district is Road transport is one of the most promising and potent means for rapid industrialization and agricultural advancement. The road transport has assumed greater importance with the growing demands for supply of inputs like fertilizers; seeds etc. as well as the transport of agricultural produce to markets have to be met largely by road transport in rural India. National highways which are the

Table 2.21: Development of Road Network in Barpeta in 2012-13 (in km)

Year	Surfaced Road	Un-surfaced Road		Total	Share (in percentage)
		Graveled	Earthen		
National Highway	72	-	-	72	2.40
State Highway	158	-	-	158	5.27
Major District Road	14	-	-	14	0.47
Other Road	933.5	458.36	1306.66	2698.52	89.94
Urban Road	45.838	9.621	2.50	57.96	1.93
Total	1223.34	467.981	1309.16	3000.48	100.00

Source: District Statistical Hand Book, 2013-14, Barpeta District

prime arterial routes span about 58112 km throughout the country and fulfill about 45% of the total road transport demand.

In Barpeta, total road length is 3000.48 Km against the state 52099.22 Km, with consisting of National Highways 72 Km, State Highways 158 Km, Major District roads 14 Km, Urban roads 57.96 Km, Rural and other Roads 2698.52 Km. Among the total road length, the share of rural roads is highest 89.94% and state high way occupies second position with 5.27%. On the other hand, share of National Highways, Major District Road and Urban roads are 2.40%, 0.47%, 1.93%, 4.689% respectably, table 2.21.

Table 2.22: Length and density of P.W.D. Roads in 2001-2012

(per Lakh of Population and density per 100 Sq. Km.)

Barpeta /Assam	Road Length Per Lakh of Population						Road Length per `00 Sq. Km.					
	2001	2003	2005	2008	2010	2012	2001	2003	2005	2008	2010	2012
Barpeta	93	90	80	80	88	107.73	39.7	45.4	40.7	41	46	68.13
Assam	149	129	130	141	141	145.98	42.5	43.9	44.3	45	48	58.01

Source: Infrastructure Statistics of Assam, 2014-15

Table 2.22, shows India's road density is 1.48 km/sq. km., as on 31st March 2012 and Assam's road density per 100 Square Km is 58.01 in 2013 of Assam. On the other hand, the share of road length is 145.98 kilometer per 1000 population in Assam and number of registered motor vehicle per lakh population is 198 in 2000-01 and it has increased to 729 in 2012-13.

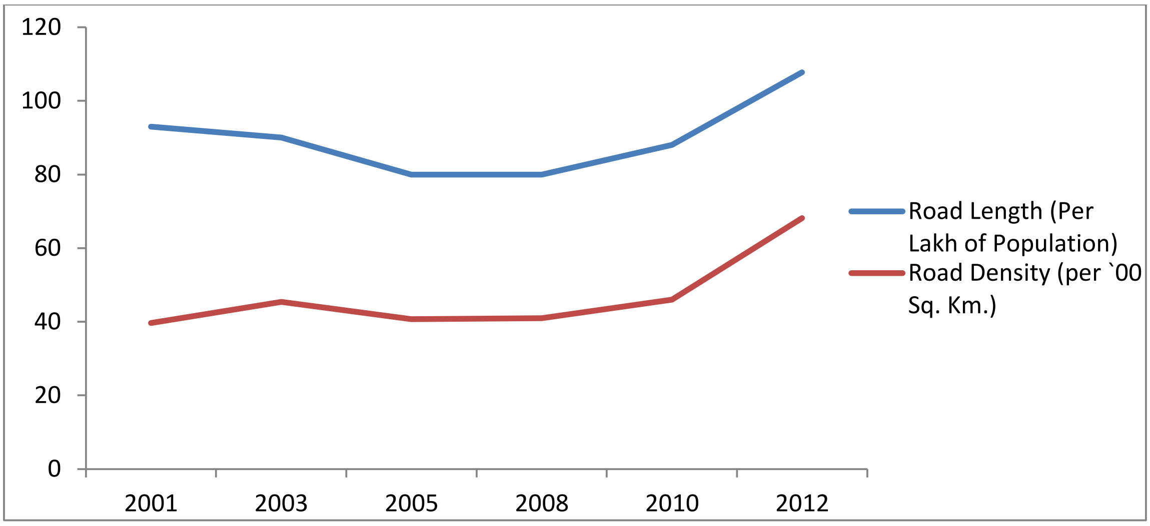


Fig 2.17: Showing length and density of P.W.D. Roads in 2001-2012

Barpeta district has 93 km road length for per lakh population in 2001 and has decreased to 80 km in 2005 and increased to 107.73 km road length per lakh population in 2012. The density of road per 100 sq. km. was 39.7 km in against the state density 42.50 km in 2001. And it has increased with a linear rate 68.13 km against the state 58.01 km per 100 sq. km area in 2012. In 2001 the density of district road was lower than the state density but density of road has increased to more than state density with 68.13 km and 58 km per 100 sq. km. in 2012.

Table 2.23: Number of Motor Vehicle in Barpeta District, 2012-13

Vehicle	Bus	Public Carrier	Motor Cars	Jeep	Taxi Cars	Two wheeler	Auto Rickshaw	Tractor	Others	Total
Register	15	228	669	0	106	6595	193	247	64	8117
On Road	296	1858	3011	21	482	45722	1090	1349	805	54634

Source: District Statistical Hand Book, 2013-14, Barpeta District

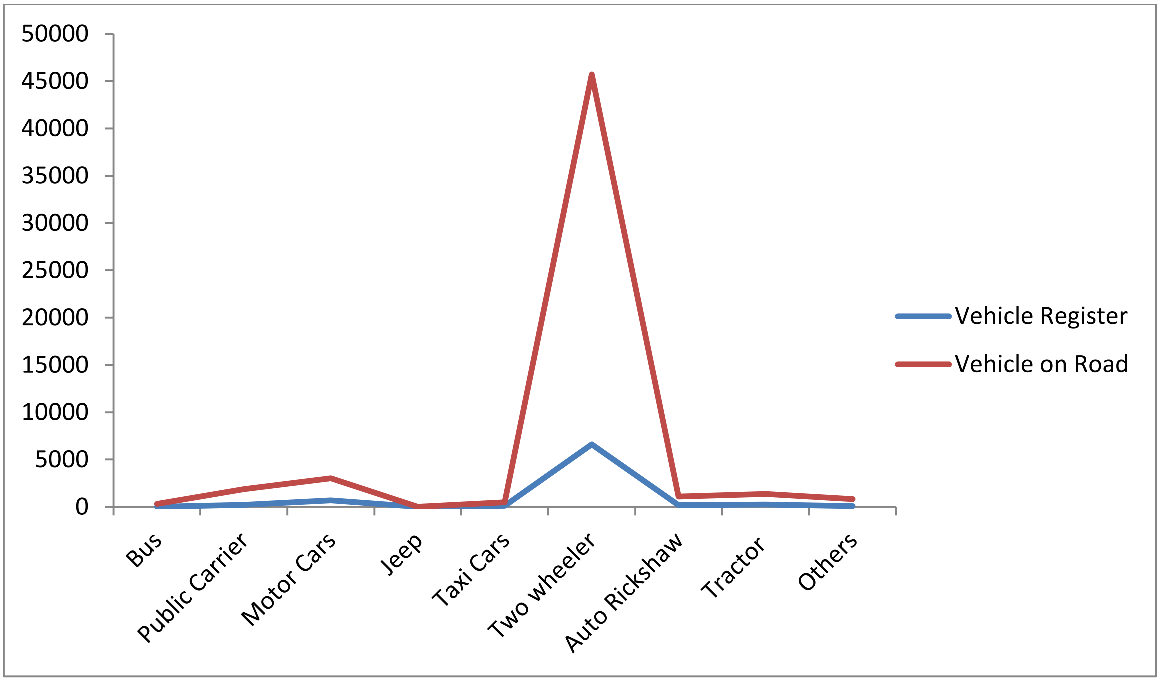


Fig 2.18: Motor Vehicles in Barpeta district, 2012-13

The number of vehicle on road is an indicator of road transport development of an area. The number of vehicle is rapidly increasing in last few decades in Barpeta district as well as Assam. The density of motor vehicles in Assam has also calculated at 22.0 per sq.km during the year 2012-13 as against 6.8 per sq. km. during 2000-01. The number of registered motor vehicle was 8117 against the state227367 vehicles in 2012-13. On the other hand, number of motor vehicle on road was 54634 against the state 1725222 vehicle in 2012-13. The number of Motor vehicles on road in the State have recorded about 61.0 percent growth during the last six years period from 2007-08 to 2012-13, table 2.23.

2.3.5.1. Inland Water Transport

Water transport is the world cheapest transport system and is very suitable for carrying heavy and bulky materials. Inland water transport plays a very important role next to road transport in Barpeta district. A large numbers of river delta (Char) are scattered in Brahmaputra River and its tributaries for these deltas water transport is only means of transportation. The larger agricultural market of Assam are situated on the bank of Brahmaputra River like Baghbar, Mandia and Bahari weekly market and many other small markets are situated in Barpeta district. These water ways are frequently used by the tourists and interstates and international trade. The railway network should increase in the district for better development of transport and communication because a small portion of Barpeta is covered by the rail network.

2.3.5.2. Railway

Railway is most popular transport system for the interstate transportation of passengers, goods and tourists. The total length of railways are 47 km and main rail stations are Barpeta Road, Pathsala, Sorbhog, Sarupeta, etc. in Barpeta district. People of all income groups can travel by train with General, Sleeper and AC chair car coaches. This railways has been covered the northern part of Barpeta district.

2.3.5.3. Communication

Internet is the fastest, effective, secured and advance mode of communication. People are using mobile phone, e-mail, computer, tablet etc. to access information, e-commerce and carrying out money transactions in Barpeta district. People of urban to rural areas are using internet, mobile, radio, television (T.V.) etc. in this district. The companies like BSNL, Airtel, Aircel, Reliance, Reliance Jio, Vodafone, etc. are providing services. But due to network problems entire district cannot properly access communication.

Conclusion

Agricultural development is mainly depends on the physiographic framework and the socioeconomic status of a region. The physical frameworks comprises physiography, geology, soil, climate, drainage and other physical determinants which determine the pattern of crops, production and productivity. The physical framework of Barpeta district is very favorable for the development of agriculture and these elements are flood plain, char (riverine delta) and foothills. Rivers and wetlands are the most common and integral features of the fluvial landscape and plays a very significant important role for agricultural development in Barpeta district. These rivers are depositing fertile alluvium soil at the time of floods. The alluvial soil is 63.92%, sandy loam soil 24.83% and sandy soil 11.25% in Barpeta district. The alluvial soil is very fertile and productive. Pattern of agriculture and choice of crops are depending on the availability of rainfall, normally Barpeta district received 2287 mm rainfall annually.

Utilization of resource depend on the skill of human resource. According to 2011 census total population of Barpeta district is 1693190 persons and among them male is 867891and female 825299 in 2011. In Barpeta, population growth rate is 21.4% against state growth rate 16.93% during 2001-2011. The literacy rate is 56.00% in 2011 of Barpeta district. The male literacy rate is 69.29% and female literacy rate is 58.06% in Barpeta. In Barpeta district, 33.17% population is engaged in various activities and 66.83% population is non workers. Barpeta district had 93 km road length for per lakh population in 2001 which has increased to 107.73 km road length per lakh population in 2012. The density of road per 100 sq. km. is 39.7 km in against the state density 42.50 km in 2001. The number of vehicle is rapidly increasing in last few decades in Barpeta district as well as Assam. The density of motor vehicles in Assam has also calculated at 22.0 per sq.km during the year 2012-13 as against 6.8 per sq. km. during 2000-01.

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CHAPTER III

AGRICULTURAL DEVELOPMENT: PATTERN AND CHARACTERISTICS

Introduction

The term development means changes over time, involving growth and expansion. It is an effort giving process with many economic and social dimensions. Economic development implicates changes in people standard of living. Successful agricultural development requires to intensification output per hectare and per worker to develop standard of living. Agriculture has been an integral part of our life since time immemorial. Agricultural development is multidimensional in nature and includes a variety of aspects like agricultural land utilization, intensity of cropping, crop productivity, crop diversification, crop combination, and commercialization of agriculture etc. It indicates input development and output development of agriculture. Agricultural development depends on modernization of agriculture. Agriculture plays a vital role in the process of economic development in less developed countries of world like India. Agriculture is a composite term and agricultural development is a difficult process.

India exported $39 billion worth of agricultural products in 2013 and it is seventh largest agricultural exporter in worldwide and sixth largest net exporter. These represents explosive growths, as in 2003 net export were about $5 billion. India is the fastest growing exporter of agricultural products over a 10 years period, its $39 billion of net exports is more than double the combined exports of the European Union (EU28). It has become one of the world's largest suppliers of rice, cotton, sugar and wheat. India exported around 2 million metric tons of wheat and

2.1 million metric tons of rice in 2011 to Africa, Nepal, Bangladesh and other regions around the world.

The development of agricultural system has focused on increase of agricultural productivity by extensively use of high yielding varieties, fertilizer, promoting diversification and farm mechanization.

Importance of Agriculture for Economic Development

Agricultural development is essential to provide food, employment and capital support to increased population. Agriculture occupies a very important place in economic development in our country. Agriculture continues to play a predominant role in Indian economy both in terms of share in national income as well as economic condition for a majority of rural population. Agricultural sector contribution is 12.7 percent in India's Gross Domestic Product during 2012-13 (at Current Prices 2011-12). It employed around 70 percent of total workforce and accounts around 13.6 percent of the total value of the country's exports. Transition towards faster and more inclusive growth calls for significant thrust on Agriculture Sector.

Agricultural development is most important in overall economic development of Barpeta district**.** About 54.14% of total working forces are being engaged in agriculture and allied sectors in rural areas of Assam. The shares of main and marginal workers are cultivators 36.53% and agricultural laborers 17.61% in Barpeta district in 2011. The importance of agriculture can be explained by considering the role of agriculture under the following points:

a) Source of livelihood

Main source of livelihood is agricultural product of human in the world. All kinds of food can get from agriculture may be direct or indirectly. But staple foods are not same all over the world. Some countries of the world are eating rice as staple food and some countries are using wheat, maize, barley etc. as staple food. Food requires to maintain normal physical and mental growth. Nearly three-quarters of India’s families depend on rural incomes and majority of India’s (about 70 percent) are found in rural areas. India’s food security is depended on production of cereal crops, fruits, vegetables and milk to meet the demands of growing population and rising incomes.

b) Provider of Employment

Agricultural and allied sector creates highest employment and engaged majority of people of the country. In village area more 70% people are engage in agriculture and allied activities. Agriculture and allied sector is highest employer among all sectors and employed 54.14% worker of Barpeta district and 49.35% of Assam in 2011. Alone cultivators are 36.53% and agricultural laborers are 17.61% in 2011.

c) Industrial development

Agriculture provides raw material to the industries. Most of industries are agro-based industry in Barpeta district. The major small scale and cottage industries are handloom weaving, rice husking, coir, pickle, khadi, etc.

d) Contribution to national income

Agriculture contributes a major share to national income in India. Earlier contribution of agriculture was higher than present time. Due to development of industries and service sectors, the contribution of agriculture is decreasing to the national income. During 1950-51 to 1979-80, share of agriculture and allied sectors were more than 40% and it stood at about 25% during 2002-03 to national income.

e) Trade and commerce

Agriculture plays an important role in the international trade of India. Agriculture contributes to sizeable part of export and it is an important segment of imports of the economy. It is a net earner of foreign exchange. The main export agricultural commodities are tea, oil cakes, fruits and vegetable, spices, tobacco, cotton, coffee, sugar, raw wool and vegetable oils.

f) Capital formation

In rural area of Barpeta district, more than 70% people directly engaged on agriculture and agriculture is the main source of capital formation. This capital helps to full fill daily life requirement like dresses, houses, child education cost, foods etc. These capitals again invest for input of agriculture. Cultivators are selling surplus crops and cash crops for capital formation in the rural area.

Agricultural Systems

Agricultural system is an assemblage of components which are united by some form of interaction and interdependence and which operate within a prescribed boundary to achieve a specified agricultural objective on behalf of the beneficiaries of the system. On the basis of terrain, climate, soil, location, socio-culture, ecopolitical condition etc. the agriculture systems are differ from place to place. In the study area, agricultural system can be classify as follows- (i) Intensive subsistence tillage with paddy dominance, (ii) Intensive subsistence tillage without paddy dominance, (iii) Commercial grain farming, (iv) Subsistence crop farming and (v) Shifting cultivation

Intensive subsistence agriculture is extensively practiced in the monsoon area of Barpeta district. Some geographers term it as 'oriental agriculture'. The characteristic of intensive subsistence agriculture are prominent features include an intensive use of land, manual labor, low use of farm machinery, use of a variety of manures, dependence on rain water and fertilizers.

Shifting cultivation is mainly practiced by tribes of hilly areas in the slope of hill. Farmer practices this cultivation for themselves and their families. The cultivated patches are usually very small and primitive tools are used by cutting and burning of forest. As the practice leads to soil erosion and deforestation.

Plantation agriculture involves specialized commercial cultivation of cash crops on estates of plantations. The main plantation crops are tea, fruits like pineapples and bananas, as well as sugarcane, hemp, oilseed and jute.

Cultivation practice in Barpeta district

1. **Broadcasting method**

Dry or pre-germinated seeds are sown in prepared field by hand in broad casting method. This method is practiced in those areas which are comparatively dry and less fertile soil and minimum labor to work in the fields. It is the easiest method requiring minimum inputs and yields are also minimum. The main crops under broadcasting method are ahu paddy, mustard, pulses, jute, wheat, etc. in rabi season when rainfalls are very limited in Barpeta.

2. **Transplantation method**

Transplanting is more popular cultivating method in Barpeta district. This method is practiced in areas of fertile soil, abundant rainfall and plentiful supply of labor. Transplanting occurs when pre-germinated seeds are transferred from a seedbed to a wet field. Prior to transplanting, seeds are germinated in a separate nursery area. These seedling grow between 20 to 80 days and transplanted in the field. Seeds can be transplanted by either machine or hand. But due to lack of technological development in Barpeta seeding are transplanted by hand. It requires heavy inputs, labors and gives the highest yields. And consumes less seed and is an effective method for controlling weeds. The main crops under Transplantation method are irri, sali and HYV paddies etc. in kharif season when rainfall are plentiful in Barpeta.

3. **Shifting cultivation**

Shifting cultivation is very rarely practiced in Barpeta district due to lack of hilly areas. This method is practiced in the hills of Baghbar, Fulora and Chatala. The crops are paddy, wheat, planation, fruits and vegetables in the district.

Major crops of Barpeta District

Barpeta district is an important district for agricultural production in Assam. It has various types of crops in the district. The major crops of Barpeta can be divided into four sub categories viz. Food grains (Rice, Wheat, Maize and Pulses), Cash Crops (Jute, Sugarcane, Tobacco, and Oilseeds), Plantation Crops (Tea & Coconut) and Horticulture crops such as Fruits and Vegetables. On the basis of seasons, the crops have been divided into Rabi and Kharif crop.

Kharif crop is known as summer crop or monsoon crop in Barpeta district. Kharif crops are usually sown at beginning of first rains of June or July, during the south-west monsoon season. Major Kharif crops are sugarcane, turmeric, paddy, jute, mesta, maize, brinjal, green and Red Chilies, etc. in Barpeta district. Rabi crop is spring or winter harvest crop in Barpeta. It is sown in the last of October month and harvested in March-April month every year. Major Rabi crops are wheat, barley, mustard, sesame, peas, pulses, onion, potato etc. in Barpeta.

Main crops of the study area

Rice

Rice is a staple food of India and is second largest producer of the world after China. Rice is predominantly a Kharif crop. It covers one third of total cultivated area of India. It provides food to more than half of the Indian population. Rice is produced in almost all states of India. Top three producer of rice are West Bengal, Punjab and Uttar Pradesh. In fiscal year ending June 2011, with a normal monsoon season, rice output hit a new record at 95.3 million tons and a 7% increase from the year earlier in India. Thus about 80 kilograms rice is for every member of Indian population in 2011. The per capita supply of rice is higher in India than per capita consumption of rice in Japan in every year. The most suitable soil for rice production is alluvial soil and ideal temperature for rice cultivation is above 25˚ C and rainfall is above 100 cm and can grow in areas of less rainfall with the help of irrigation.

Rice is most important crops in the district. The climatic and physiographic feature is very favorable for rice cultivation in Barpeta district and more than 80%

land is under rice cultivation. Wide variation of physiographic features and climatic characteristics has resulted three distinct growing seasons of rice viz., ahu (Feb/March - June /July), Sali (June/July - Nov /December) and boro (Nov /December -May /June) in Barpeta. To match with diverse land situations encountered with varying growing season, diverse varieties are traditionally grown in the state since unknown past. Ahu or autumn rice is grown during February/March to June/July and it covers 4 lakh hectares (16 percent of gross rice area) and contributes 11 percent of rice production. This class of varieties is photo period insensitive and can be grown as early ahu as pre-flood crop in flood affected areas where as normal ahu is grown in the areas where risk of flood is minimum.

Table 3.1: Area, production and productivity of autumn paddy during 2003-13

(Area in hectares, production in tons and Productivity in tons/ hectares)

Year	Barpeta			Assam		
	Area	Production	Productivity	Area	Production	Productivity
2003-04	58500	72400	1.24	441142	742198	1.68
2004-05	60760	13098	0.22	436244	493667	1.13
2005-06	51500	68821	1.34	398316	686341	1.72
2006-07	46504	51678	1.11	379441	578807	1.53
2007-08	33564	31383	0.94	354115	599986	1.69
2008-09	48880	74369	1.52	350649	644847	1.84
2009-10	50877	69786	1.37	346369	576992	1.67
2010-11	40403	58284	1.44	312995	613490	1.96
2011-12	27987	23736	0.85	276486	582784	2.11
2012-13	6346	1853	0.29	238178	532318	2.23

Source: State / District Wise Ten Major Crops in Assam, 2003-04 to 2012-13.

Autumn rice is one of the important paddy crops after summer and winter paddy in Barpeta district. The area under autumn paddy has recorded 5th position among the crops and it has been observed that during 2012-13, the area under autumn paddy is 6346 hectares. It occupies 3.1 percent area of total cropped area in the district. The area under autumn rice was up and down with a decreasing trend during 2003-04 to 2012-13 in Barpeta district. In 2003-04 area under autumn rice was 58500 (20.70%) hectors and increased to 60760 hectors (25.30%) in 2005-06, but has decreased from 2006-07 to 2012-13 with 46504 hectares (22.86%) to 6346 hectors (3.17%) in Barpeta. Moreover area under autumn rice has also decreased during the period from 441142 hectors in 2003-04 to 238178 hectors in 2012-13 in the state, table 3.1.

The production and productivity of autumn paddy is not satisfactory during the period from 2003-04 to 2012-13 and the productivity was lowest among the paddy crops in this district. The production and productivity of crops is increasing in the world wide, but the production and productivity of autumn paddy has been decreasing during the period in the district. The production decreased from 72400 tons in 2003-04 to 1853 tons in 2012-13. The productivity decreased from 1.24 tons per hectares in 2003-04 to 0.29 tons per hectares in 2012-13. The production and productivity was highest in 2008-09 with 74369 tons and 1.52 tons per hectors and lowest in 2004-05 with 13098 tons and 0.22 tons per hectors in the district. On the other hand the production and productivity of crops was increasing in the state during the period. Contrary production and productivity of 742198 tons and 1.68 tons per hectors in 2003-04 has goes up to the 532318 tons and 2.23 tons per hectares in 2012-13.

Table 3.2: Area production and Productivity of winter paddy during 2003-13

(Area in hectares, production in tons and Productivity in tons/ hectares)

Year	Barpeta			Assam		
	Area	Production	Productivity	Area	Production	Productivity
2003-04	99750	197908	1.98	1769203	4426729	2.50
2004-05	62225	114603	1.84	1636050	3960437	2.42
2005-06	52755	115906	2.20	1707340	3991372	2.34
2006-07	50173	79008	1.57	1498335	3000223	2.00
2007-08	53821	98325	1.83	1646992	3444254	2.09
2008-09	72524	142712	1.97	1773211	4408989	2.49
2009-10	74812	160206	2.14	1789161	4944582	2.76
2010-11	75539	229171	3.03	1858559	5614046	3.02
2011-12	78281	169909	2.17	1875601	5073216	2.70
2012-13	66597	164649	2.47	1857410	5623738	3.03

Source: State / District Wise Ten Major Crops in Assam (2003-04 to 2012-13)

The table 3.2 shows area under winter paddy was occupied 1st position among the crops in this district. It has been observed that during 2012-13, the highest area was covered by Winter Paddy (i.e. 66597 hectares) followed by summer paddy (52921 hectares) and Autumn Paddy (6346 hectares). The area under winter paddy has declined from 99750 hectares in 2003-04 to 66597 hectares in 2012-13. Accordingly, production of winter paddy is the second highest with 164649 tones after summer paddy with 261400 tons in 2012-13. The production of winter paddy had declined from 197908 tons in 2003-04 to 169909 tons in 2012-13 and was lowest 79008 tons in 2006-07.

The productivity of winter paddy shows second highest with 2.47 tons per hectare after summer paddy 4.94 tons per hectare in Barpeta district, which is less than the state average 3.03 tons per hectare in 2012-13. The productivity of winter paddy is recorded highest 2.20 tons per hectare in 2005-06 and recorded lowest 1.57 tones per hector in 2006-07 during the period in this district.

Table 3.3: Area, production and productivity of summer paddy during 2003-13

(Area in hectares, production in tons and Productivity in tons/ hectares)

Year	Barpeta			Assam		
	Area	Production	Productivity	Area	Production	Productivity
2003-04	17400	60621	3.48	319480	917102	2.87
2004-05	19645	53642	2.73	311437	976217	3.13
2005-06	13897	32606	2.35	314671	895949	2.85
2006-07	15213	52741	3.47	312471	1008261	3.23
2007-08	16829	59939	3.56	322889	1170962	3.63
2008-09	42937	136998	3.19	360266	1229732	3.41
2009-10	48309	195096	4.04	394442	1375665	3.49
2010-11	51581	210344	4.08	398785	1644119	4.12
2011-12	51708	278909	5.39	393620	1728115	4.39
2012-13	52921	261400	4.94	392640	1862934	4.74

Source: State / District Wise Ten Major Crops in Assam, (2003-04 to 2012-13)

Area under Summer Paddy occupied most important position among the paddy crops in Barpeta district. It had been observed that during 2012-13, second highest area was covered by Summer Paddy with 52921 hectares after Winter Paddy with 66597 hectares and followed by Autumn Paddy with 6346 hectares. The area under summer paddy has steady out stretched from 17400 hectares in 2003-04 to 52921 hectares in 2012-13. Summer paddy is replacing the area of winter paddy and autumn paddy. However summer paddy occupies second largest area among the crops, but production of summer paddy is the highest with 261400 tones followed by winter paddy (164649 tones) and Autumn Paddy (1853 tones) in 2012-13. The production of summer paddy has increased from 60621 tons in 2003-04 to 261400 tons in 2012-13 and was lowest 32606 tons in 2005-06.

The productivity of Summer Paddy is highest with 4.94 tons per hectare followed by Winter Paddy 2.47 tones and Autumn Paddy 0.29 tons per hectare in Barpeta district during the period. The summer paddy has more productivity (4.94 tons per hectare) than state average 4.74 tons per hectare in 2012-13. The productivity of winter paddy recorded highest 5.39 tons per hectare in 2011-12 and recorded lowest 2.35 tones per hector in 2005-06 during the period in the district, table 3.3.

Wheat

Wheat is second most important crop of India after rice and most important crop of Rabi season. It is a staple food of north and north western India. In fiscal year ending June 2011 with a normal monsoon season, Indian agriculture accomplished an all-time record in production of wheat by producing 85.9 million tons and 6.4% increase than last year. Indian farmers thus produced about 71 kilograms of wheat for every member of Indian population in 2011. It is a winter crop and needs low temperature. Ideal temperature for wheat cultivation is between 10-15° C at the time of sowing and 21-26° C at the time of harvesting. Wheat thrives well in less than 100 cm and more than 75 cm rainfall. The most suitable soil for cultivation of wheat is well drained plain fertile loamy soil and clayey soil. Wheat is highly mechanized oriented and may need less labour.

Table 3.4: Area, production and productivity of wheat in Barpeta and Assam

(Area in hectares, production in tons and Productivity in tons/ hectares)

Year	Barpeta			Assam		
	Area	Production	Productivity	Area	Production	Productivity
2003-04	10125	9267	0.92	69954	73186	1.05
2004-05	10305	11773	1.14	63854	68083	1.07
2005-06	6051	6264	1.04	49961	53735	1.08
2006-07	8788	9497	1.08	59573	67413	1.13
2007-08	7356	9480	1.29	56069	70797	1.26
2008-09	6249	5226	0.84	50053	54551	1.09
2009-10	7400	6216	0.84	60067	65301	1.09
2010-11	6654	10038	1.51	44772	56216	1.26
2011-12	6924	7634	1.10	40194	48592	1.21
2012-13	6318	8969	1.42	33984	44190	1.30

Source: State / District Wise Ten Major Crops in Assam (2003-04 to 2012-13)

Table 3.4, shows wheat has occupied an important position among the crops in this district. It has been observed that during 2012-13, wheat records for an area of 3.15 percentage area from 4.32 percentage in 2006-07 of total cropped area of this district. The area under wheat has shown a declining trend, i.e., 10125 hectares in

2003-04 and with lowest as 6051 hectares in 2005-06, but increased to 6318 hectares during 2012-13.

The production of wheat was highest in 2005-06 with 11773 tones followed by 10038 tons in 2010-11 and the lowest as 6318 tons in 2012-13 in Barpeta district during the period. The wheat has more productivity (1.42 tons per hectare) than state average 1.30 tons per hectare in 2012-13. The productivity of wheat recorded highest 5.39 tones per hector in 2011-12 and recorded lowest 0.84 tones per hector in 2008-09 during the period from 2003-04 to 2012-13 in this district.

Jute

Jute is kwon as the golden fiber. During 2015-16, Assam produced almost 767 thousand bale (1 bale= 150 kg) jute and was occupying second position in the country. The demand for Jute-based factory products has also increased in manifold during the last few years since they are eco-friendly, bio-degradable and environmentally protective. Traditionally jute is used to make hessian cloths and sacks, but now jute has been diversified to make various products like all kind of bags, sacks, carry bags, door-mates, carpets, file- covers, sofa- backs and covers, decorates, shoes and sandals, curtails etc. Jute is getting replaced by synthetic fibers due to low cost and durability of these artificial fibers. Alluvial soil is most suitable for jute cultivation and ideal temperature is above 27˚ C and rainfall is 170 cm to 250 cm. Barpeta is a major jute producing district of Assam. River bank, flood plain and char (delta) are famous for jute production and can sustain up to two meters of flood.

Table 3.5: Production and productivity of jute in Barpeta and Assam

(Area in hectares, production in tons and Productivity in tons/ hectares)

Year	Barpeta			Assam		
	Area	Production	Productivity	Area	Production	Productivity
2003-04	7775	77543	9.97	64033	665068	10.39
2004-05	7580	5615	0.74	57981	410409	7.08
2005-06	7006	65703	9.38	56757	578858	10.20
2006-07	6294	63576	10.10	57663	558564	9.69
2007-08	3774	39205	10.39	59842	656821	10.98
2008-09	5667	46004	8.12	60111	647455	10.77
2009-10	7182	61035	8.50	65270	713294	10.93
2010-11	6469	50524	7.81	62267	625575	10.05
2011-12	6151	61441	9.99	65560	608023	9.27
2012-13	1294	5823	4.50	65092	557990	8.57

Source: State / District Wise Ten Major Crops in Assam (2003-04 to 2012-13)

Table 3.5 shows, Barpeta has occupied 7775 hectares of Assam 64033 hectares of total jute sowing area in 2003-04 but shows decline as 1294 hectares in Barpeta, of 65092 hectares in Assam during 2012-13. Barpeta produced 5823 tons against the state 557990 tons jute production in 2012-13. The production of jute was highly declined to 5823 tons, 4.50 tons per hectare, in 2012-13 from 77543 tons, 9.97 tons per hectare in 2003-04, against 557990 tons in 2012-13 from 665068 tons, 10.39 tons per hectares in 2003-04. The productivity of jute is very low (4.50 tons per hectare) in Barpeta district against the state (8.57 tons per hectares) productivity in 2012-13. The productivity of jute being recorded highest as 10.39 tones per hectares in 2007-08 and with lowest 0.74 tons per hectare in 2004-05 in the district during the period from 2003-04 to 2012-13. The production of jute has declining a lot within the span of 10 years, i.e. 2003-2013, declining from 9.97 tons per hectare in 2003 to 4.50 ton per hectare in 2013.

Rape and Mustard

Subtropical climate is most suitable for rape and mustard. India occupies number one position in production of mustard oil. Mustard mostly grown in Rabi season and thrives well in dry and cool climate. Mustard crop requires the temperatures between 10°C to 25°C. Mustard is grown in the areas receiving 625-1000 mm rainfall yearly. This crop does not tolerate frost and requires clear sky with frost free conditions. Mustard can be grown in wide varieties of soils that range from light to heavy loamy soils. Medium to deep soil with good drainage is best suitable for mustard cultivation. Soil ideal pH range for mustard is 6.0 to 7.5.

Mustards are usually sown in the month of September and October. The pure mustards are sown by drilling method and mixed mustard crop seeds are sown by broadcasting or drilling method and seeds are mixed with the sand for uniform spacing. For better germination, seeds are sown at maximum 6 cm depth in the soil and requires enough moisture in the soil when seeds are sown. It requires seeds about 4 to 6 kg per hectare with about 45 cm and 20 cm spacing while planting. The major commercial hybrid varieties of mustard in India are Pusa Agrani (SEJ-2), Kranti, Pusa Vijay (NPJ-93), Pusa Mustard 27 (EJ-17), Pusa Karishma (LES-39), Sita, Pusa Mahak (JD-6), Pusa Mustard 21 (LES 1 27), Pusa Mustard 22 (LET - 17),NPJ-112 (Pusa Mustard 25), Varuna, Krishna,Pusa Mustard-24 (LET-18), PusaTarak (EJ-13), Pusa Mustard 26 (NPJ-113), Pusa Mustard 28 (NPJ-124), Punjab bold etc.

Table 3.6: Area, production and productivity of rape and mustard during 2003-13 (Area in hectares, production in tons and Productivity in tons/ hectares)

Year	Barpeta			Assam		
	Area	Production	Productivity	Area	Production	Productivity
2003-04	28740	17948	0.62	264103	138286	0.52
2004-05	20740	11522	0.56	244948	129395	0.53
2005-06	14768	4279	0.29	212471	96992	0.46
2006-07	18508	8561	0.46	238426	115874	0.49
2007-08	18766	9931	0.53	234804	122897	0.52
2008-09	12607	7265	0.58	226385	124688	0.55
2009-10	14241	7359	0.52	248700	131493	0.53
2010-11	16740	7385	0.44	243815	142661	0.59
2011-12	16500	10794	0.65	247949	138647	0.56
2012-13	18005	14813	0.82	279496	170382	0.61

Source: State / District Wise Ten Major Crops in Assam (2003-04 to 2012-13)

Rape and mustard is an important cash crop of Assam. It has been observed that Rape and Mustard occupied 4^{th} position with a coverage of area 2,64,003 hectares in 2003-04 to 2,79,496 hectare in 2012-13 and has occupied 7^{th} position among the ten major crops in respect of the value addition to GSDP (which increased from Rs.24,069 lakh to Rs.43,097 lakh during the period of 2003-04 to 2012-13).

Barpeta is an important rape and mustard producing district of Assam. The sandy soil and fertile flood plain and char (delta) are famous for the rape and mustard production. The area under rape and mustard is 8.98 percent in 2012-13 and has recorded highest as the 10.14 percent in 2003-04 of total cropped area during the period from 2004-05 to 2012-13 in the study area. Rape and mustard covers 18005 hectares in Barpeta and 170382 hectares in Assam in 2012-13. The area under rape and mustard is 28740 hectares in 2003-04 which has declined to 18005 hectares in 2012-13.

Table 3.6, shows the production of rape and mustard has highly declined to 14813 tons in 2012-13 from 28740 tons in 2003-04 in Barpeta. Whereas it has increased in Assam during the periods, from 138286 tons in 2003-04 to 170382 tons in 2012-13. The production of rape and mustard is higher (0.82 tons per hectare) than the state average production (0.61 tons per hectare) in 2012-13. The productivity of rape and mustard increased from 0.62 tons per hectares in 2003-04 to 0.82 tons per hectares in 2012-13 in Barpeta district.

3.1. Input development

Application of modern inputs in agricultural is very essential for speedy development of agriculture in the region. Each farmer uses inputs to produce higher outputs. Inputs are the things that go for production, i.e. use of land, farm and family labour, seeds, fertilizers, insecticides, herbicides and implements and modern machineries.

In Barpeta district, innovative agricultural practices has been observed to be implemented during the recent period. Due to adoption of such innovative farming practices, like mechanization, irrigation, chemical fertilizer, HYV seeds, pesticides, insecticides etc. the traditional method of agriculture has been gradually getting replaced. This change has been bringing remarkable change in the crop productivity in this district.

Table 3.7: Showing input and output of various crops in sample villages (in Rs.)

Sl. No.	Crop	Total Input Cost	Output
1	Irri paddy	5406	8100
2	Sali	1644.5	3275.8
3	Ahu	2641	3050
4	Wheat	1933	2833
5	Oilseeds	1333	1833.3
6	Jute	1736	4900

Source: Primary data, 2014-16

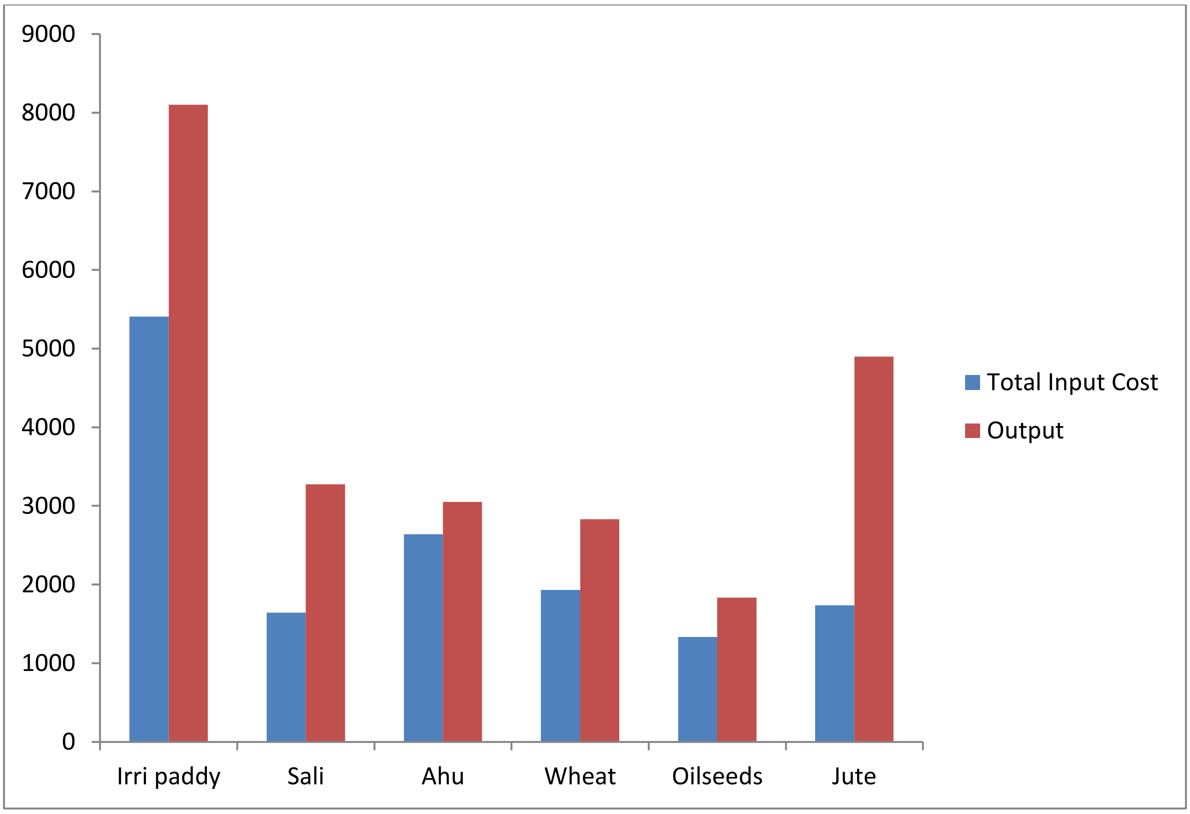


Fig 3.1: Showing input and output of various crops in sample villages

More input represent more output and high input costs represent high number of input. Irri paddy has recorded highest input cost due to use of irrigation, HYV, fertilizer and mechanization of crops and output is also highest. Irri paddy has Rs.

5406.00 input cost and the output is Rs. 8100.00. Oilseeds has lowest input cost (Rs. 1333.00) and the output is also very low (Rs. 1833.30), as shown table 3.7.

3.1.1. Land Holding Size

Land holding size of cultivators are highly impact on cropping pattern and modernization of agriculture and impact on production and productivity of field. The small land holding size hampers on use of modern inputs.

The unequal distribution of land holding size has badly influence in cropping pattern and use of modern technology in agricultural field. The unequal distribution of land holding can be analysis by the Lorenz Curve. And unequal distribution of land holding is analyzed through the Lorenz Curve in the study area. In Lorenz curve cumulative percentage of one variable is up to certain points plotted on a graph against the cumulative percentage of other variables up to the some points.

Table 3.8: Number and Size of Operational Holding in Barpeta District, 2010-11 (In hectares)

Class	Range	Operational Holding		Size of Operational Holding	
		In nos.	In %	In hect.	In %
Marginal	0-1.0	72558	57.09	37896	23.39
Small	1.0-2.0	29507	23.22	43105	26.61
Semi Medium	2.0-4.0	20359	16.02	56964	35.16
Medium	4.0-10.0	4620	3.64	23109	14.26
Large	10.0 & Above	49	0.04	926	0.57
All Classes		127093	100	162000	100

Source: Director of Economics & Statistics, Assam, Guwahati-28

Table 3.9: Number of holding and area of holding in Barpeta district, 2010-11

Sl. No.	Number of holding (in ascending order)	Corresponding area of holding	No. of holding (in %)	Area of holding (in %)	Cumulative frequency of No. of holding	Cumulative frequency of Area of holding
1	49	926	0.04	0.57	0.04	0.57
2	4620	23109	3.64	14.26	3.67	14.84
3	20359	56964	16.02	35.16	19.69	50.00
4	29507	43105	23.22	26.61	42.91	76.61
5	72558	37896	57.09	23.39	100.00	100.00

Source: Calculated from table no. 3.8.

The table 3.9, shows distribution of land holding size is not equal among farmer in Barpeta district. On the basis of land holding size cultivators are classified as marginal (0-1.0), small (1.0-2.0), semi medium (2.0-4.0), medium (4.0-10.0) and large land holding size (10.0 and above). The number of marginal operational land holder is 72558 numbers and is occupying 37896 hectares land followed by small, semi medium, medium and large land holder.

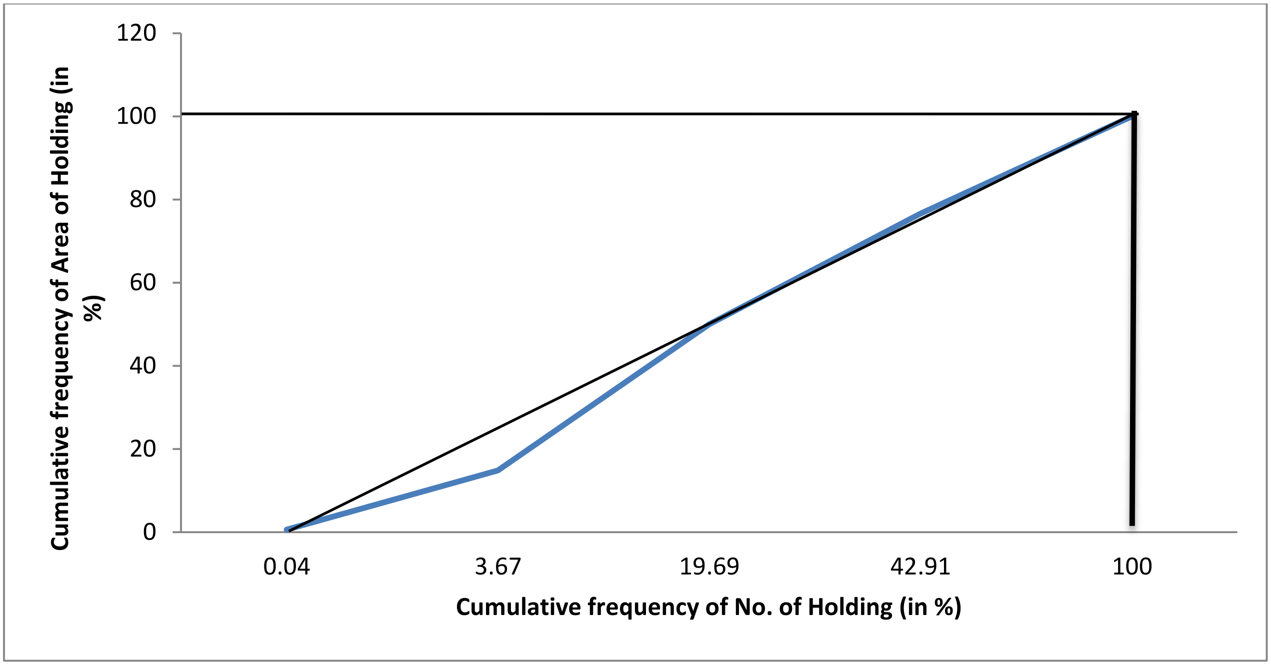


Fig 3.2: Pattern of land holding using Lorenz Curve

Marginal land holder is 57.09 percent and is occupying 23.39 percentage of land. Though marginal land holder is highest but semi medium land holder has holding highest land (35.16%) followed by small land holder (26.61%) and medium land holder (14.26%) of total land holder in Barpeta district. The percentage of large land holder is lowest (0.04%) and is holding 0.57% land. The number of small, semi medium, medium and large numbers of operational holders are 29507, 20359, 4620 and 49 respectively and lands are occupying 43105, 56964, 23109 and 926 hectares respectively in this district.

3.1.2. Land ownership pattern

Land is prerequisite for agricultural practices and land ownership pattern highly influence on the pattern of agricultural development. The selection of crops and modern inputs depends on land ownership pattern.

Table 3.10: Household Land ownership pattern (rural), 2011

Region	Total Households	Total Land (In hectare)	No. of Households with Own Land		No. of Households with No Land	
			In hectare	In %	In hectare	In %
India	179787342	1058785984	78355331	43.58	101422485	56.41
N. E. India	8061458	116958378	3312635	41.09	4748710	58.91
Assam	5743835	99949483	2488717	43.33	3255083	56.67
Barpeta	322866	994859.3	116712	36.15	206154	63.85

Source: Socio-economic Census, India, 2011

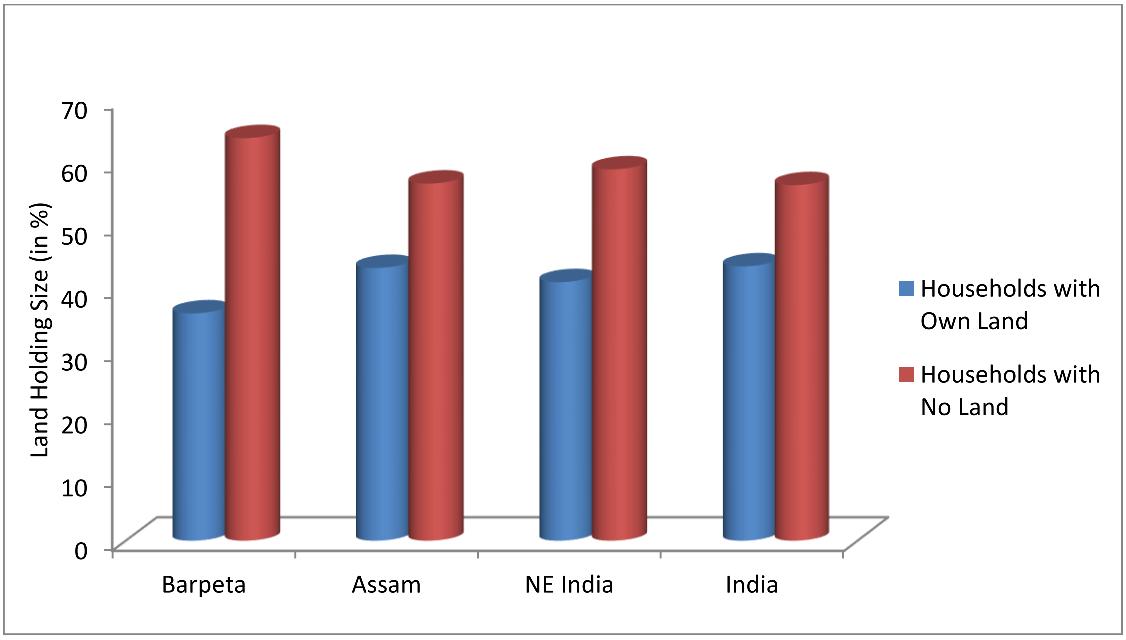


Fig 3.3: Showing household land ownership pattern (rural), 2011

Table 3.10 shows total numbers of householders in rural area are 322866 and are occupying 994859.3 hectares land in Barpeta district in 2011. The number of household with own lands are 116712 and number of household without lands are 206154, which is 36.15% household has own land and 63.85% household has no land in Barpeta district. The number of household occupying own lands are very low in Barpeta compare to India, North East India and Assam which are 43.58%, 41.09% and 43.33% respectively. However household without lands are highest in Barpeta (63.85%) than Assam (56.67%), North East India (58.91%) and India (56.41%). It has greatly influence on agricultural pattern and development of agriculture.

3.1.3. Fertilizer

Fertilizers are food for crops and use of fertilizer is most important to increase agricultural productivity. According to R. A. Olson (1990), the introduction of fertilizers has transformed many regions of naturally low productivity into agriculturally effective regions. Fertilizer provides the advantage of divisibility because they can be used according to the size of the farms. Fertilizer has shown very remarkable results on productivity in past few years. Lack of fertilizers greatly impacts on productivity and due to their less use output may be very low.

In India, fertilizer accounts for second largest fiscal subsidies after food with about Rs. 73,000 crore and 0.5 percent of GDP in 2015-16. Nearly 70 per cent of this amount (about Rs 50,300 crore) is allocated to urea, the most commonly used fertilizer. It is estimated that 17,500 crores of the urea fertilizer subsidies about 35 per cent go to small farmers. Fertilizer subsidies suffer from 3 types of leakages (i) leakages to the black market, (ii) leakages to inefficient fertilizer manufacturers and (iii) leakages that prevent small farmers from deriving full benefits from the subsidy. 51 per cent of farmers were forced to buy urea in the black market at prices above the Maximum Retail Price (MRP), according to 2012-13 Cost of Cultivation Survey. Moreover, small farmers buy urea in black market than large farmers. Urea leakages to the black market are driven by a violation of the One Product One Price principle.

Controlling of fertilizer import is another important feature of agriculture. Currently 3 firms are allowed to import urea into India and import timings and quantities are also controlled of these firms. This restricts the ability of supply to respond to unexpected changes in fertilizer demand due to climatic and other market conditions. Decimalizing urea imports would allow fertilizer supply to respond more flexibly to changes in demand. This would reduce the likelihood of shortages, decrease black marketing and consequently benefit the small farmer. Leakages can be further reduced by bringing the JAM agenda of delivering subsidies via DBT to fertilizer.

Table 3.11: Fertilizer consumption, 2011-12 (In tons)

District/ State	Nitrogen (N)	Phosphorous (P)	Murate of Potash (K)	Total	Per hectare
Barpeta	13717	4007	7777	25501	104.36
Assam	151055	49084	75527	275666	74.58

Source: Statistical Handbook, Assam, 2012

Barpeta district used 9.25 percentage fertilizer of the state in 2011-12. Per hectare consumption of fertilizer is higher in the district than state average, i.e. 104.36 kg per hectares in Barpeta and 74.58 kg per hectares in Assam, table 3.11.

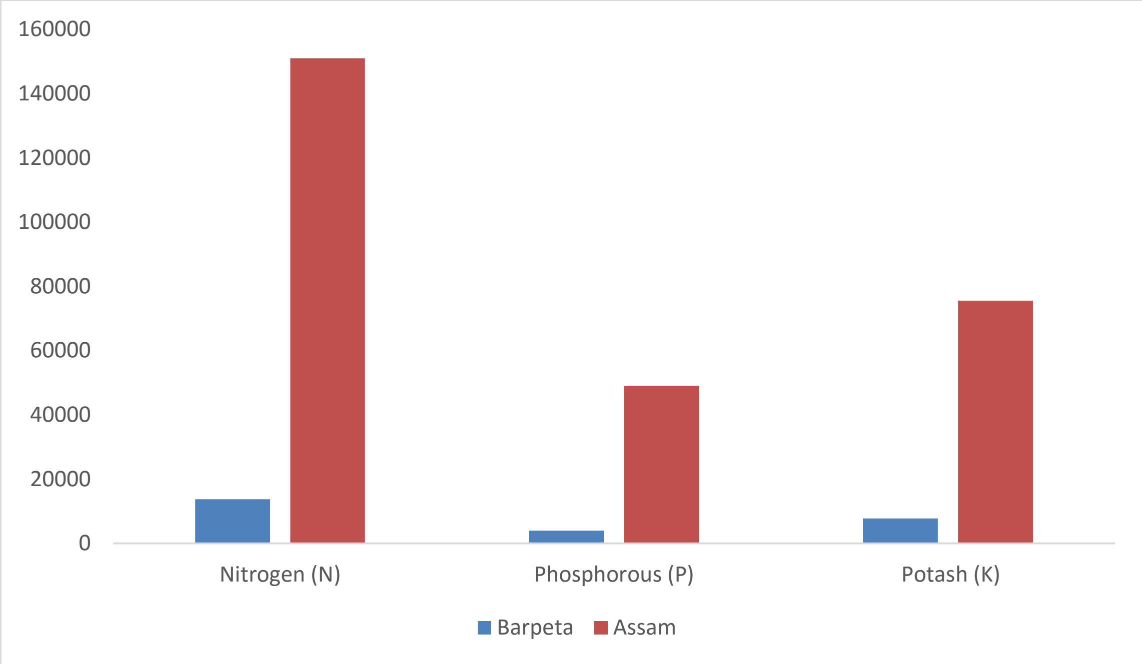


Fig 3.4: Fertilizer consumption, 2011-12

Barpeta consumed 25501 tons fertilizer of the state total 275666 tons fertilizer in 2011-12. Barpeta district consumed highest number of nitrogen (13717 tones) followed by potash (7777 tons) and phosphorous (4007 tones) respectively. The share of nitrogen, potash and phosphorous are 53.79%, 30.50% and 15.71% respectively in the district, correspondingly state consumed nitrogen, potash and phosphorous are 54.80%, 17.81% and 27.40% respectively.

Table 3.12, shows Rabi crop consumes highest number of fertilizer than Kharif crops in Barpeta district. Rabi crops consumes 56.44% fertilizer in Barpeta and 57.31% fertilizer in Assam followed by Kharif crops 43.56% fertilizer in Barpeta and 42.69% fertilizer in Assam. Kharif crop consumes 52.44% nitrogen followed by potash (33.47%) and phosphorous (14.09%) of the season in the district. Rabi crop consumes 54.83% nitrogen followed by potash (28.20%) and phosphorous (16.97%) in this district.

Table 3.12: Season wise Fertilizer consumption, 2011-12 (In M. Tones)

Season	Fertilizer	Barpeta			Assam		
		In M. Tones	Season wise in %	Year wise in %	In M. Tones	Season wise in %	Year wise in %
Kharif	Nitrogen (N)	5826	52.44	22.85	65191	55.40	23.65
	Phosphorous (P)	1565	14.09	6.14	18124	15.40	6.57
	Murate of Potash (K)	3718	33.47	14.58	34355	29.20	12.46
	Total	11109	100	43.56	117670	100	42.69
Rabi	Nitrogen (N)	7891	54.83	30.94	85864	54.35	31.15
	Phosphorous (P)	2442	16.97	9.58	30960	19.60	11.23
	Potash (K)	4059	28.20	15.92	40072	25.36	14.54
	Total	14392	100	56.44	157996	100	57.31

Source: Computed from Statistical Handbook, Assam, 2012

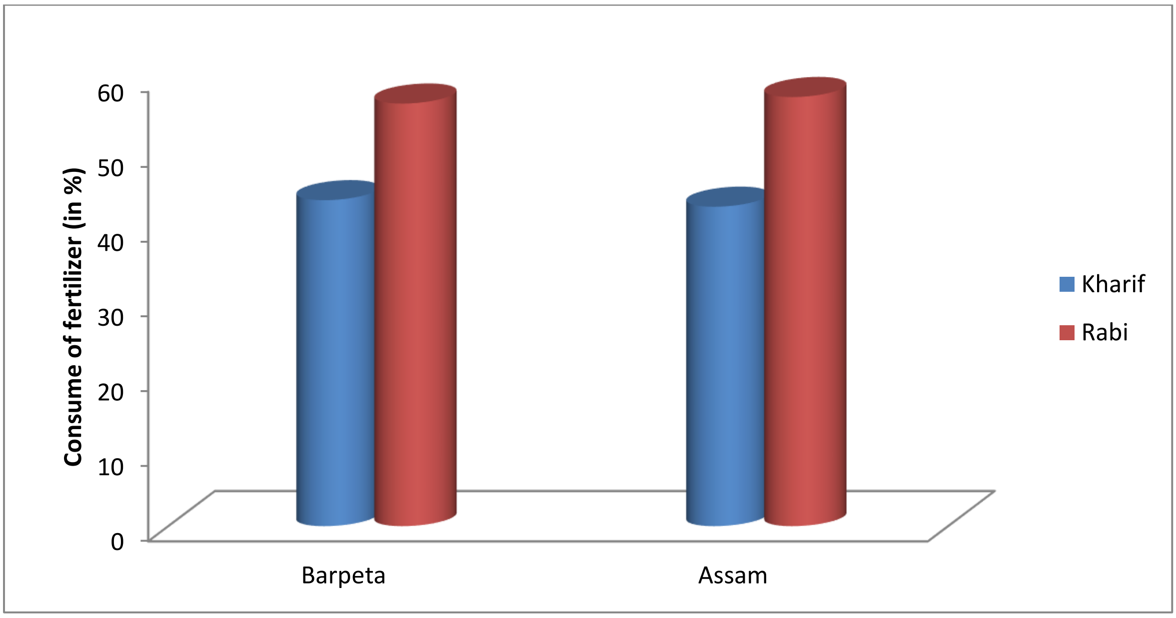


Fig 3.5: Season wise fertilizer consumption in Barpeta district, 2011-12

Table 3.13: Showing fertilizer use in the sample villages (in Kg. per Bigha)

Sl. No.	Name of Crops	Fertilizer
1	Irri/ HYV paddy	51.25
2	Sali paddy	10
3	Ahu paddy	12
4	Oil Seeds	23.22
5	Jute	15

Source: Primary data, 2014-16

Table 3.13, shows in the study area chemical fertilizer is mostly consumed by irri paddy i.e. 51.25 kg followed by oil seeds 23.22 kg per bigha. And fertilizer consumes by sali, ahu and jute crops are 10 kg, 12 kg and 15 kg per bigha respectively. In the study area, some Hindu dominated villages of Sarukhetri and Bajali Development Blocks is not using any kind of chemical fertilizer in the field and consequently the productivity of crop is very low and muslim dominated villages are highly mechanized.

3.1.4. Irrigation facilities

Irrigation is the most important inputs for agriculture practice. It is prime essential to coping with growing problem of weather condition, uncertainty of rainfall, seasonal drought, natural calamities, multiple cropping and modernization of agricultural practices. Thus importance of irrigation development bears special significance in the context of efforts towards economic development of the State. Irrigated cropland is defined as a lands designated for the purposes of growing crops that require irrigation for crop cultivation or increase. India has gross irrigated cropped area of 82.6 million hectares (215.6 million acres) is the largest in the world as on 2011. The irrigation has a great potentiality in Assam. In Barpeta district 30.17% of irrigation potential created to net sown area (rank 3) against 17.281% irrigation potentiality of Assam (computed from Statistical Hand Book of Assam, 1997).

The irrigation equipment includes pump set of diesel or electric, sprinkler or drip irrigation system, etc. The irrigation schemes are categories as minor and major scheme.

Table 3.14: Showing households having own irrigation equipment, 2011

Sl. No.	Country/ State/ District	Number of Households owning Irrigation equipment	% of Households owning Irrigation equipment
1	India	17669298	9.83%
2	N. E. India	249098	3.09%
3	Assam	213700	3.72%
4	Barpeta	12777	3.96%

Source: Socio-economic census India, 2011

Irrigation schemes using either ground water or surface water and having a cultivable area up to 2000 hectare individually is categorized as Minor Irrigation schemes. The minor schemes has been categorized into five major types; (1) Dug well, (2) Shallow tube well, (3) Deep tube well, (4) Surface flow and (5) Surface lift. Barpeta district has very less number of household having the own irrigation equipment (3.96%) than the national average (9.83%) in 2011. But Barpeta district has more household having own pump set followed by Assam (3.72%) and North East India (3.09%).

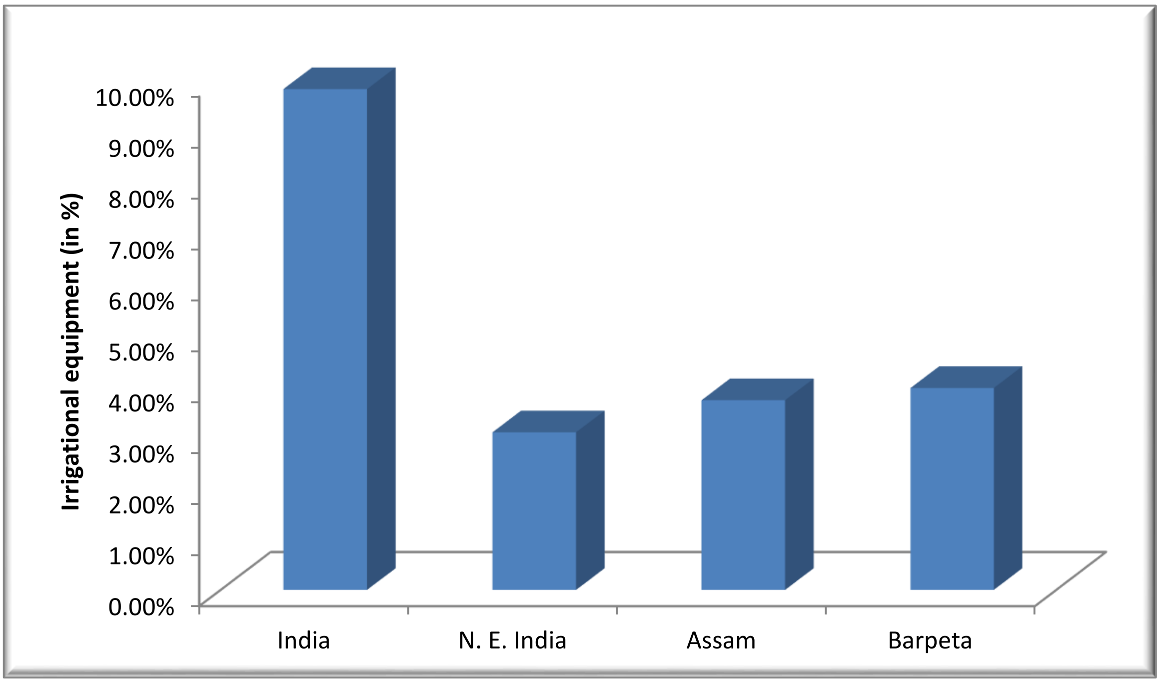


Fig 3.6: Households having own irrigational equipment, 2011

In this district, 3.96% household has own irrigational equipment contrary more than 65% population are engaged on agriculture, table 3.14. For overall development of irrigational facilities and agriculture, number of household must be more own equipment than present position.

Table 3.15: Number of Power pump in Barpeta District from 2008-09 to 2012-13

Sl. No.	Equipment	2008-09	2009-10	2010-11	2011-12	2012-13
1	Power Pump	2023	2172	2670	2789	2956

Source: District Statistical Hand Book 2012-13, Barpeta district

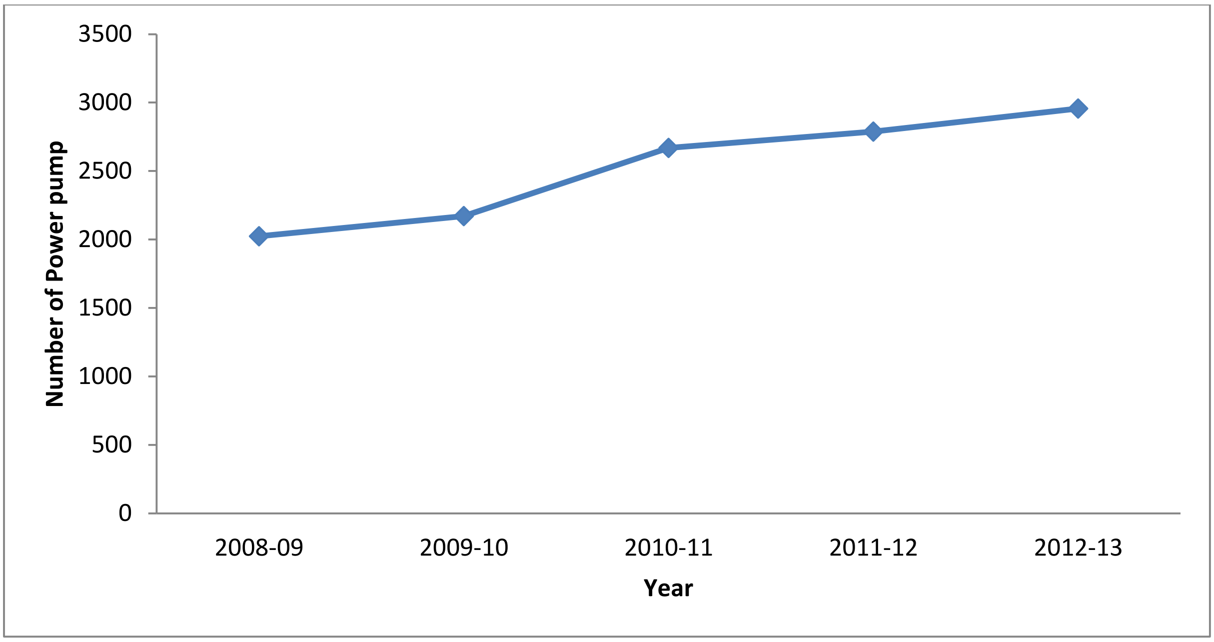


Fig 3.7: Showing Number of Power pump in Barpeta District

Power pumps are the main equipment for irrigation due to absence of canal, tank and well in Barpeta. The number of power pumps are increasing gradually from 2023 in 2008-09 to 2956 in 2012-13 in the study area. And number of power pumps were 2172 in 2009-10 which has increased to 2670 in 2010-11 and 2789 in 2011-12, table 3.15. The number of power pumps should increase to adequate the irrigation facilities. Large numbers of perennial rivers are available in the district to introduce cannel and tank irrigation.

Table 3.16: Sources of irrigation in Barpeta district, 2005-06 (area in hectares)

District/ State	Canal	Tanks	Wells	Tube wells	Other sources	Total Area
Barpeta	0	0	0	151.9	9.4	161.3
Assam	23120.2	31413.3	330.8	16696.0	102413.9	145702.2

Source: Statistical Handbook, Assam, 2012

Table 3.16, shows total irrigated areas are 161.3 hectares in Barpeta district in 2005-06. Tube wells supplies water for 151.9 hectares land and other sources supplies water for 9.4 hectares in 2005-06. Canal, tank and well are fully absent as a source of irrigation in this district. In Assam, canals supplies water for 23120.2 hectares, tanks supplies water for 31413.3, wells supplies water for 330.8, tube wells supplies water for 16696.0 hectares and other sources supplies water for 102413.9 hectares in 2005-06.

Table 3.17: Season wise irrigated area, 2011-12 (in hectare)

Season	Crops	Barpeta	Assam
Kharif	Sali Paddy	325	90407
	Jute	0	54
	Other	0	17879
	Total	325	108340
Rabi	Early Ahu	543	11766
	Boro Paddy	0	4410
	Wheat	0	437
	Oilseeds	0	516
	Others	0	4748
	Total	543	21877
Grand Total		1066	130217

Source: Statistical Handbook, Assam, 2012

Table 3.17, shows total irrigated area were 1066 hectares in Barpeta and 130217 hectares in Assam. The Rabi crops occupied more area than the Kharif crops in Barpeta district and Assam in 2011-12. Karif crops occupies 325 hectares irrigated land and rabi crops occupied 543 hectares land in Barpeta district. Sali paddy and early ahu are irrigated in Barpeta district and other crops are rain fed.

3.1.5. Pesticide and insecticide

Diseases, pests and herbs are major problem that creates hamper in the production of crops. Productivity can be low because of different types of pests and diseases. As a result crops will be damage and production will be very low. Pesticides should use at proper time and amount otherwise crops will be damage and will lead to low agricultural productivity and health hazards.

Table 3.18: Number of sprayer machine in Barpeta, 2008-09 to 2012-13

Equipment	2008-09	2009-10	2010-11	2011-12	2012-13
Sprayer (H.C. & D.P.)	300	550	400	453	467

Source: District Statistical Hand Book 2012-13, Barpeta district

For properly use of pesticides and insecticides, various equipment are essential. In Barpeta district, number of sprayer machines were 300 in 2008-09 and has increased to 467 spray machines in 2012-13. The number of spray machine was highest 550 in 2009-10 and again decreased to 400 in 2010-11 during the period in this district as shown table 3.18.

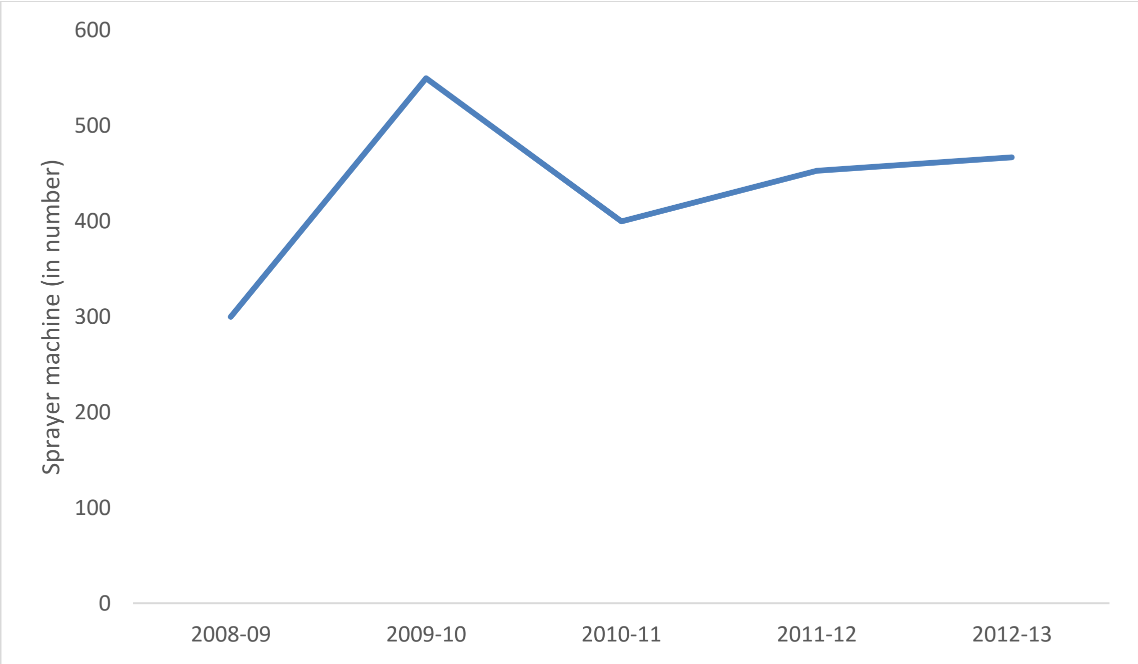


Fig 3.8: Number of sprayer machine in Barpeta, 2008-09 to 2012-13

3.1.6. Area under HYV crops

Implementation of HYV (High Yielding Varieties) is an important steps initiated for agricultural development in the region. A HYV seed breeding technology is considered as a revolutionary change from the traditional method to contemporary innovation in the practice of agriculture. It helps to use a plot of land for double cropping and multiple cropping for stimulating high productivity. The Government of Assam tried to introduce improved varieties of rabi crops in different districts of the state. The HYV seeds are not available for all crops in Assam.

In the study area, some cultivators are using HYV seeds in agriculture, but most of the areas are under traditional method of agriculture. Mainly HYV seeds of rice are used and rape and mustard oils, wheat and jute are rarely practices in this district. The area under HYV seeds are not equally distributed all over the Barpeta district. The main causes of unequally distribution of area under HYV seeds are lack of irrigation facilities, floods, capital etc.

Table 3.19: Bock wise area under HYV crops in Barpeta District, 2012-13

Name of Block	Autumn Paddy	Winter Paddy	Summer Paddy	Wheat	Jute	Rape & Mustard	Total	HYV crop (in %)
Bajali	468	9188	3026	181	76	2066	15005	12.99
Gobardhana	352	5999	2558	545	102	1610	11166	9.67
Chakchaka	271	4334	1766	464	93	1258	8186	7.09
Ruposhi	337	3528	3370	503	734	1361	9833	8.51
Mandia	915	3881	10540	1815	291	4028	21470	18.59
Barpeta	295	3213	4486	456	85	1176	9711	8.41
Gumafulbari	183	1659	2750	305	66	738	5701	4.94
Sarukhetri	187	2489	2035	337	61	959	6068	5.25
Chenga	283	4068	4852	115	103	1477	10898	9.44
Pakabetbari	267	3427	3394	442	96	1232	8858	7.67
Bhawanipur	246	3247	3494	125	86	1387	8585	7.43
District	3804	45033	42271	5288	1793	17292	115481	100

Source: District Statistical Hand Book 2012-13, Barpeta district

Table 3.19, shows the total area under HYV is 115481 hectares in Barpeta district in 2012-13. Mandia Development Block occupies highest area with 21470 hectares (i.e. 18.59%) for HYV crops followed by Bajali Development Block with 15005 hectares (12.99%) in 2012-13. Gumafulbari Development Block has least area (i.e. 4.94% / 5701 hectares) under HYV seeds among the Blocks in Barpeta district. Total area of HYV seeds in Gobardhana, Chakchaka, Ruposhi, Barpeta, Sarukhetri, Chenga, Pakabetbari and Bhawanipur development block are 11166, 8186, 9833, 9711, 6068, 10898, 8858 and 8585 hectares respectively in 2012-13.

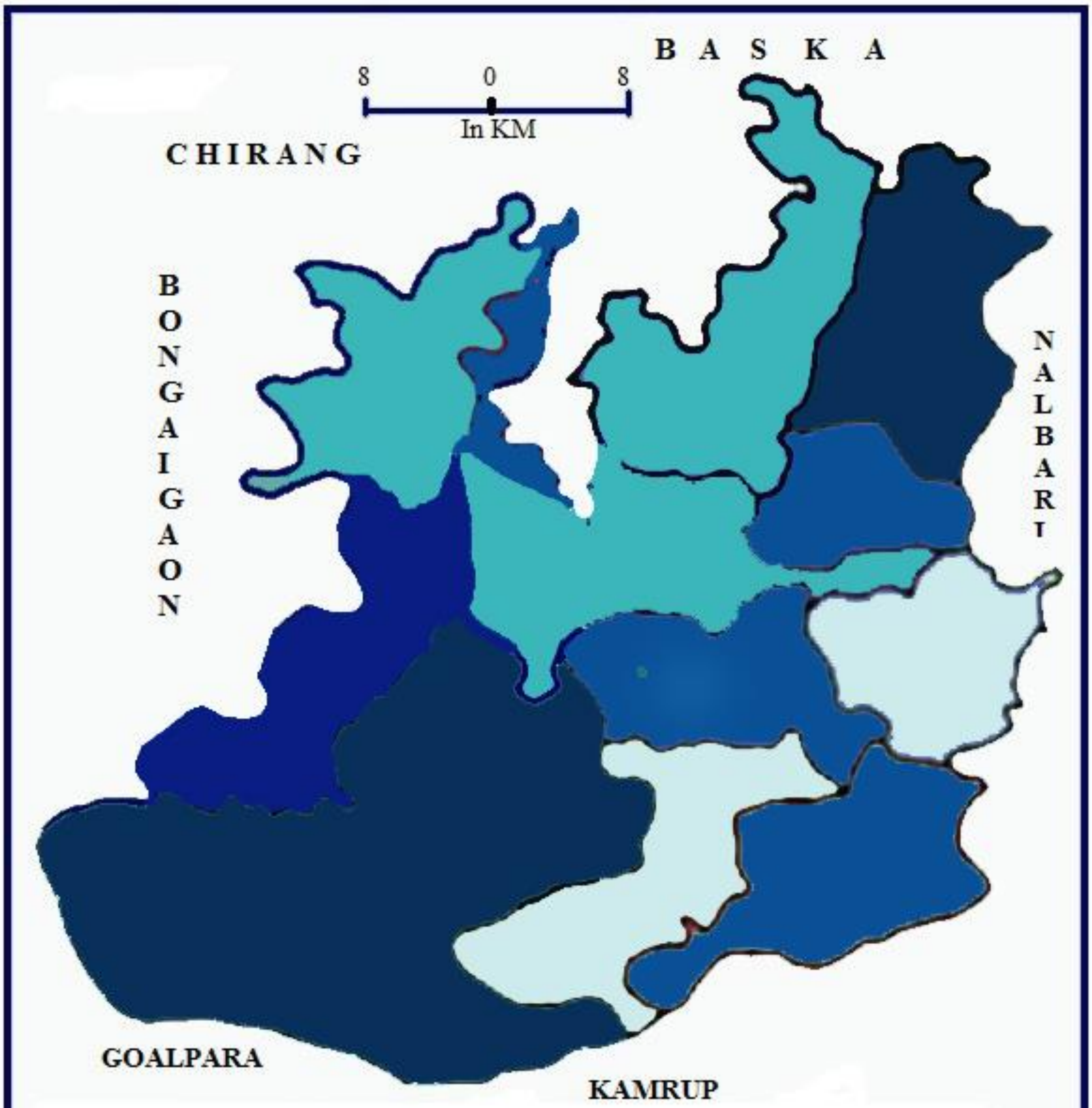
Table 3.20: Crop wise area under HYV in Barpeta District, 2012-13

Sl. No.	Crop	Area (in hectare)	Area (In %)
1	Autumn Paddy	3804	3.29
2	Winter Paddy	45033	39
3	Summer Paddy	42271	36.6
	Total Paddy	91108	78.89
4	Wheat	5288	4.58
5	Jute	1793	1.55
6	Rape & Mustard	17292	14.97
	Total	115481	100

Source: Calculated from District Statistical Hand Book 2012-13, Barpeta district

Table 3.20, shows that the area under HYV are not equally scattered among the crops in Barpeta district. Paddy alone occupied 91108 hectares (i.e. 78.89 percentages) of the total cropped area followed by rape and mustard 14.97% in this district in 2012-13. Winter paddy occupied an area of 39% (45033 hectares) followed by summer paddy 36.6% (42271 hectare) and 3.29% area among the HYV in the study area. Rape and mustard has occupied third position with 17292 hectares (14.97%) next to winter paddy and summer paddy in HYV. The jute and wheat

Fig 3.9: Map of Barpeta district showing Bock wise area under HYV, 2012-13



LEGEND			
Level	Range	Name of Dev. Block	Index
High	Above 9.99	Mandia, Bajali	
Medium	8.00-9.99	Gobardhana, Chenga, Barpeta, Ruposhi	
Low	6.00-7.99	Chakchaka, Pakabetbari, Bhawanipur,	
Very Low	Bellow 5.99	Sarukhetri, Gumafulbari	

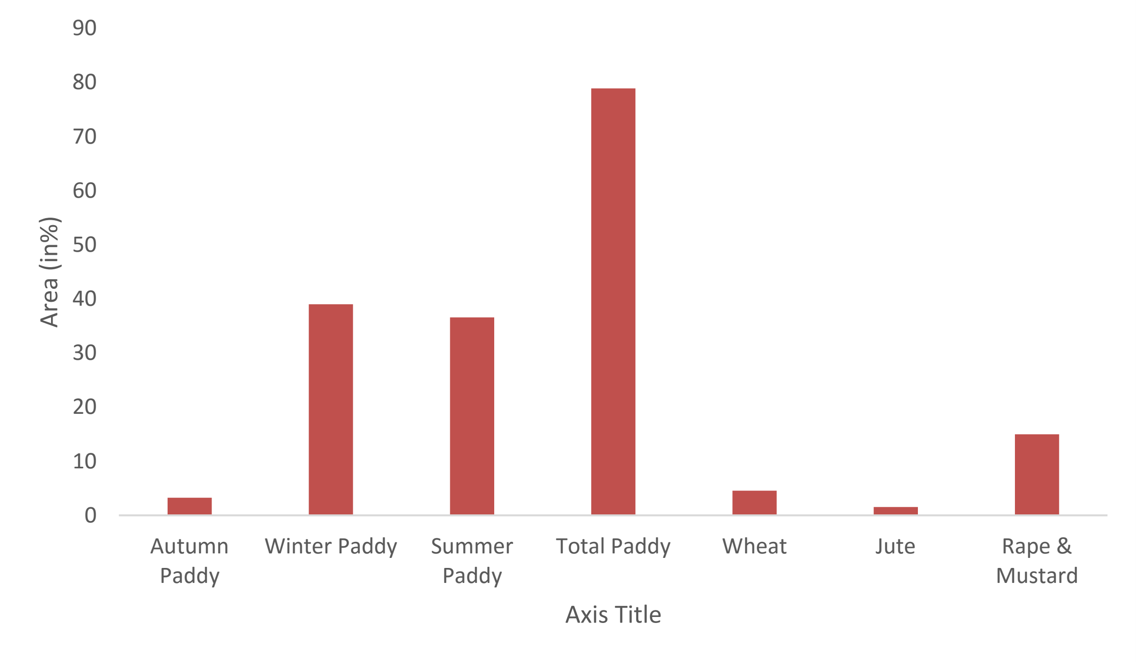


Fig 3.10: Crop wise area under HYV in Barpeta District, 2012-13

occupies least area 1.55% and 4.58% respectively in this district in 2012-13. Due to paddy dominance, over dependence on rain water and subsistence type of agriculture most of the areas are under traditional paddy.

3.1.7. Traditional Plough and Tractor

The plough is an instrument for digging lands. Traditional method of plough is very laborious and time consuming process. Tractor is a very suitable instrument for plough in agricultural field. Tractor can plough large areas within a days with low cost.

Table 3.21, shows the number of tractor was highest as 93 in 2008-09 and has decreased to 27 tractors in 2009-10. Further it increased to 67 numbers of tractors in 2012-13. There are 67 nos. tractors, power tillers 194, steel plough 54 and weeder 52 in Barpeta district in 2012-13, table 3.21. For development of agriculture, intensive use of modern technology is most essential.

Table 3.21: Field plough tools in Barpeta district

Equipment	2008-09	2009-10	2010-11	2011-12	2012-13
Tractor	93	27	41	54	67
Power Tiller	154	448	184	198	194
Steel Plough	NA	NA	20	34	54
Wooden Plough	NA	NA	NA	NA	NA
Harrow	NA	NA	NA	NA	NA

Source: District Statistical Hand Book 2012-13, Barpeta district

Table 3.22, shows number of households having own mechanized 3 and 4 wheelers for agriculture are 7369945, 111149, 88258 and 5184 in India, North East India, Assam and Barpeta district respectively in 2011. In North East India, Assam

Table 3.22: Households with three and four wheeler for Agricultural, 2011

Sl. No.	Region	No. of Households with Mechanized devices	% of Households with Mechanized devices
1	All India	7369945	4.10%
2	North Eastern India	111149	1.38%
3	Assam	88258	1.54%
4	Barpeta	5184	1.61%

Source: Socio-economic census India, 2011

and Barpeta district percentage of household having own three or four wheeler vehicles for agriculture is very less than the national average. The percentages of household having own three or four wheeler devices are 4.10, 1.38, 1.54 and 1.61 in India, North East India, Assam and Barpeta district respectively in 2011, table 3.16.

Though Barpeta district has less percentage of agricultural three or four wheeler own machineries but it has more household own devices in North East India and Assam during the year. Consequently the modernization of agriculture is very poor in the region and agricultural productivity is very low.

3.1.8. Crops harvesting device

Crop harvesting devices are most important for minimize post harvesting losses and to reduce crop harvesting cost in agriculture. At the time of flood and extreme season for harvesting paddy and jute deficiency of labor is faced by the farmer in Barpeta district. But there is not development of crop harvesting devices. There is not any kind of crops cutter and dryer devices in the district and made a big problem due to lack of labour, uncertainty weather and storage facilities. Barpeta district is famous for the production of vegetables and fishes and due to underdevelopment of food processing industries and storage facilities these perishable products are damaged regularly.

3.1.9. Other Important agricultural tools in Barpeta District

Mechanization of agriculture can increase the agricultural production and productivity and meet the needs of growing population of the world. The mechanization of agriculture is lack behind in the district. Essential equipment for agriculture like wheel hoe, garden rake and weeder are very limited and seed driller, ford implement and crop cutter are absent in the district. Some equipment like wheel hoe, garden rake and weeder etc. are introduced recently in 2010-11.

Table 3.23: Important agricultural tools use in Barpeta District, 2008-09 to 2012-13

Sl. No.	Name of Equipment	2009-10	2010-11	2011-12	2012-13
1	Wheel Hoe	NA	20	34	43
2	Garden Rake	NA	20	37	53
3	Weeder	NA	20	34	52
4	Seed Drill	NA	NA	NA	NA
5	Ford Implements	NA	NA	NA	NA
6	Crops cutter	NA	NA	NA	NA

Source: District Statistical Hand Book 2012-13, Barpeta district

Table 3.17 shows number of wheel hoes were absent in 2009-10 but in 2010-11, 20 numbers has been used. Followed by an increased to 43 in 2012-13 and garden rake 20 number in 2010-11 and increased to 53 in 2012-13. The weeder has increased from 20 in 2010-11 to 52 in 2012-13. But the seed drill, ford implements, crops cutter, etc. are not introduced in the district.

3.1.10. Credit facilities

Credit is most important for agricultural mechanization. As a result government has given Kishan Credit Card (KCC) to cultivator with a low interest rate.

The numbers of households having KCC are 6484623, 73684, 54973 and 1958 in India, North East India, Assam and Barpeta district respectively in 2011. And percentage of households having KCC are 3.61, 0.91, 0.96 and 0.61 in India, North East India, Assam and Barpeta district respectively. The percentage of households

Table 3.24: Households having Kisan Credit Card (KCC), 2011

Sl. No.	Region	No. of Households having KCC with credit limit of Rs 50,000 or above	% of Households having KCC with credit limit of Rs 50,000 or above
1	All India	6484623	3.61%
2	North Eastern India	73684	0.91%
3	Assam	54973	0.96%
4	Barpeta	1958	0.61%

Source: Socio-economic Census India, 2011

having KCC is very limited compare to national average in Barpeta, N. E. India and Assam. Barpeta district has the lowest percentage of households compare to the whole region in 2011. As a result Government should issue more KKC in Barpeta district for modernization of agriculture.

3.2. Output development

Outputs are crops production and productivity. The output of agriculture depends on quantities of inputs applied. The relationship between inputs and outputs determines that the farm produces. Economists call this relationship as production function. India had a large and diverse agricultural sector, accounting about 16% of GDP and 10% of export earnings. Indian arable land area is 159.7 million hectares (394.6 million acres) and is the second largest area in the world, after the United States in 2011. It gross irrigated crop area is 82.6 million hectares (215.6 million acres) and is the largest in world. India is among the top three global producers of many crops like wheat, rice, pulses, cotton, peanuts, fruits and vegetables. The outputs of crop can be determine by production, productivity and marketability.

3.2.1. Production and Productivity

Agricultural productivity is measured as a ratio of agricultural outputs to agricultural inputs. India has attained self-sufficiency in food staples but productivity of farms is below to the Brazil, United States, France and other nations. Indian wheat farms produces about one third of wheat production per hectare per year compared to farms production in France. Rice productivity in India was less than half of China and other staples productivity in India is similarly low. Indian total factor productivity growth remains below 2% per annum as compare to China's total factor productivity growths is about 6% per annum, though China has many smallholding farmers. Several studies suggest that India will eradicate hunger and malnutrition and be a major source of food for the world by achieving productivity compare with other countries. India’s farm produces best yield, for sugarcane, cassava and tea in the world.

Table 3.25, shows the productivity of rice and wheat is very low in India with compare to other countries of the world. The productivity of paddy is 3.99 tons per hectare in India and productivity of Australia is 12.03 tons per hectare in 2010.

Table 3.25: Productivity of crops in India and world, 2010 (tons per hectare)

Sl. No.	Commodity	Average yield	Most productive country	
1	Rice	3.99	12.03	Australia
2	Wheat	2.8	8.9	Netherlands

Source: FAO, 2010

Australia is the world most productive country for paddy production and productivity of paddy is more than three times compare to India. The productivity of wheat is 2.8 tons per hectare in India and is three times less than the world most productive country. World most productive country is Netherland for wheat production and productivity is 8.9 tons per hectare in 2010. It focus that productivity of crops are very low in India and is a more potentiality for improvement of crops productivity through modernization of agriculture in India.

Importance of Agricultural Productivity

The productivity of farm is most important for all over development of a region and competitiveness of agricultural market, income distribution, saving, labour mitigation and moreover livelihood depends on agriculture.

The higher productivity means the produces are lower opportunity of cost than other regions. Therefore the region becomes more competitive on the world market due to attract more consumes since they are able to buy more of the products offered for the same amount of money.

Agricultural productivity leads to meet the problem of poverty alleviation in poor and developing countries of the world and offer to employ largest portion of population. Agricultural productivity is becoming increasingly importance as the world population continues to grow. India is world second highest populous country of the world and has taken step for more agricultural productivity in last decades.

Table 3.26: Production and productivity of crops in Barpeta district, 2010-11

(Area in hect, Av. Yield in Kg/Hect & Production in Tones)

Sl. No.	Crops	Area	Production	Productivity
1	Jute	6469	50524	1406
2	Rape & Mustard	16740	7385	441
3	Wheat	6654	10038	1508
4	Summer Paddy	51581	131465	2549
5	Winter Paddy	75539	148961	2002
6	Autumn Paddy	40403	33805	850

Source: Director of Economics & Statistics, Govt. of Assam.

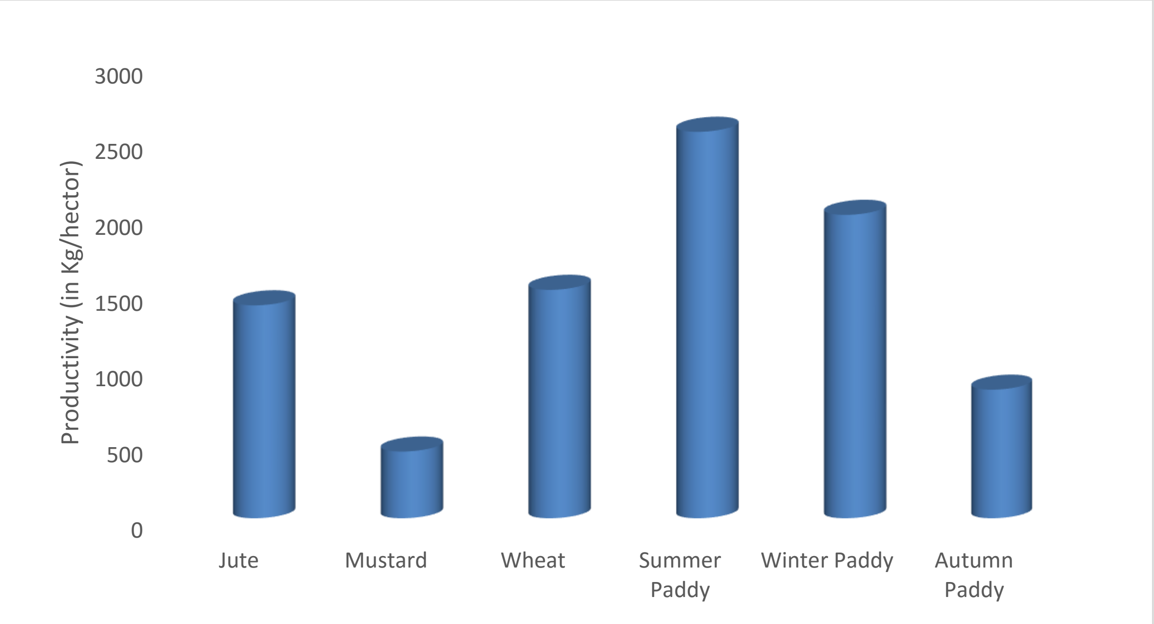


Fig 3.11: Showing productivity of crop in Barpeta, 2010-11

Production and productivity of crop varies from crop to crop. Paddy is dominant crop of the study area and winter paddy occupies highest area among the crops. The paddy occupies 167523 hectors and winter paddy, summer paddy and autumn paddy occupies 75539 hectares, 51581 hectares and 40403 hectares respectively. Rape and mustard occupies second position by occupying 16740 hectares area next to paddy. The wheat and jute occupies 6654 hectares and 6469 hectares respectively next to paddy, rape and mustard, table 3.26.

The average yield of paddy is 1800.33 kg per hectare. The winter paddy occupies highest area but the productivity of winter paddy occupies second position next to summer paddy. The productivity of summer paddy is highest among winter and autumn paddy, which are summer paddy 2549 kg, winter paddy 2002 and autumn paddy 850 kg per hectare. The productivity of autumn paddy is lowest (i.e. 850 kg per hectare) among the paddy crops due to fully based on the traditional method of agriculture and uncertainty of flood. The productivity of wheat, jute and rape and mustard are 1508 kg, 1406 kg and 441 kg per respectively hectares, as shown in table 3.27.

The production of particular crops has increased in the study area and several traditional crops has decreased in the district during the period from 1984-85 to 2013-14, table 3.27. The average production of total paddy has unevenly increased in the district from 102622 tons in 1984-85 to 298014 tons in 2013-14. The increasing trend of total paddy was lowest in 2004-05 with 115615 tons and was highest in 2013-14 with 298014 tons during this period. The main cause of low production of crops in 2004-05 was high flood in summer paddy season. The production of autumn paddy has increased from 34245 tons in 1984-85 to 59762 tons in 1999-00 and lowest 7597 tons in 2004-05 and 16796 tons in 2013-14. The production of

Table 3.27: Production of major crops in Barpeta district, 1984-2014 (in tons)

Crops	1984-85	1989-90	1994-95	1999-00	2004-05	2009-10	2013-14
Autumn Rice	34245	54907	59061	59762	7597	40476	16796
Winter Rice	67681	102902	96309	121735	74492	104134	123146
Summer Rice	696	14875	12112	57626	33526	121935	158072
Total Rice	102622	172684	167482	239123	115615	266545	298014
Wheat	21300	12905	14217	10954	11773	6216	8731
Rape &Mustard	3942	6527	10632	13599	11522	7359	10054
Jute	95840	109783	69422	51600	5615	61035	50564

Source: Nine Principal Crops in Assam, 2013-14

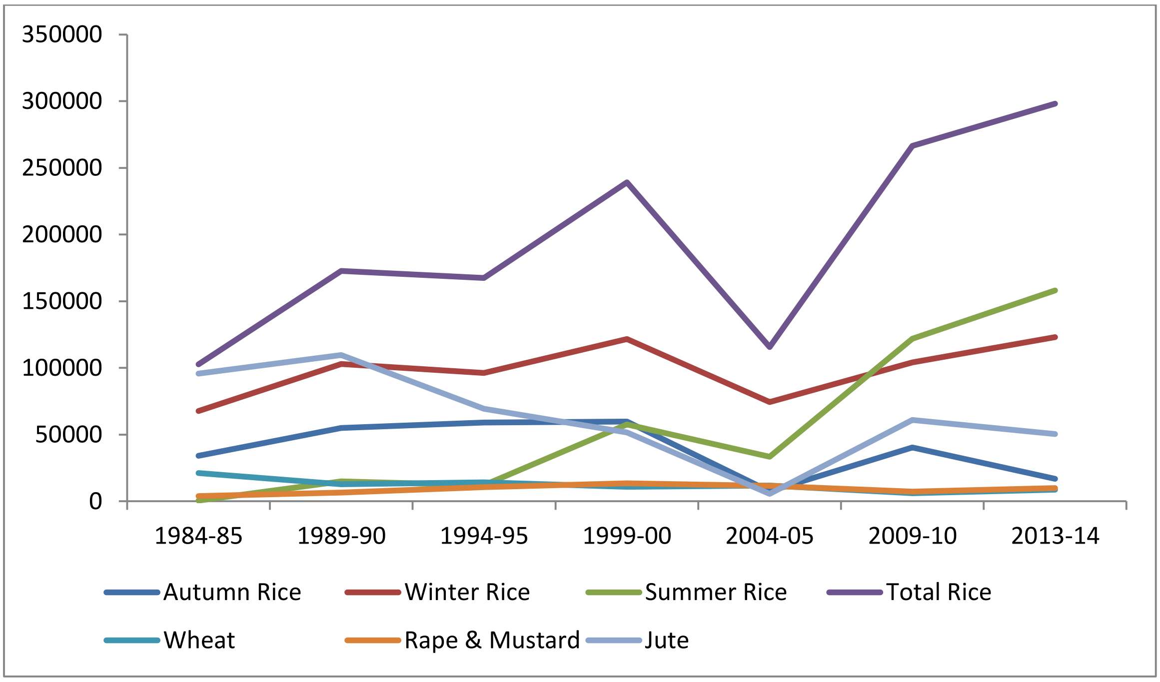


Fig 3.12: Production of major crops in Barpeta district, 1984-2014

winter paddy has unevenly increased from 67681 tons in 1984-85 to 123146 tons in 2013-14 and is lowest 74492 tons in 2004-05. The production of summer paddy has exceptionally increased among the paddy from 696 tons in 1984-85 to 158072 tons in 2013-14.

The production of wheat is highly decreasing trend from 21300 tons in 1984-85 to 8731 tons in 2013-14 and production was lowest 6216 tons in 2004-05. Uneven production of rape and mustard has increased from 3942 tons in 1984-85 to 10054 tons in 20013-14. Production of wheat was highest in 1999-00 with 13599 tons and lowest in 2009-10 with 7359 tons. Jute is one important cash crop in the district. The production of jute was gradually decreasing from 95840 tons in 1984-85 to 50564 tons in 2013-14 and the production was lowest 5615 tons in 2004-05.

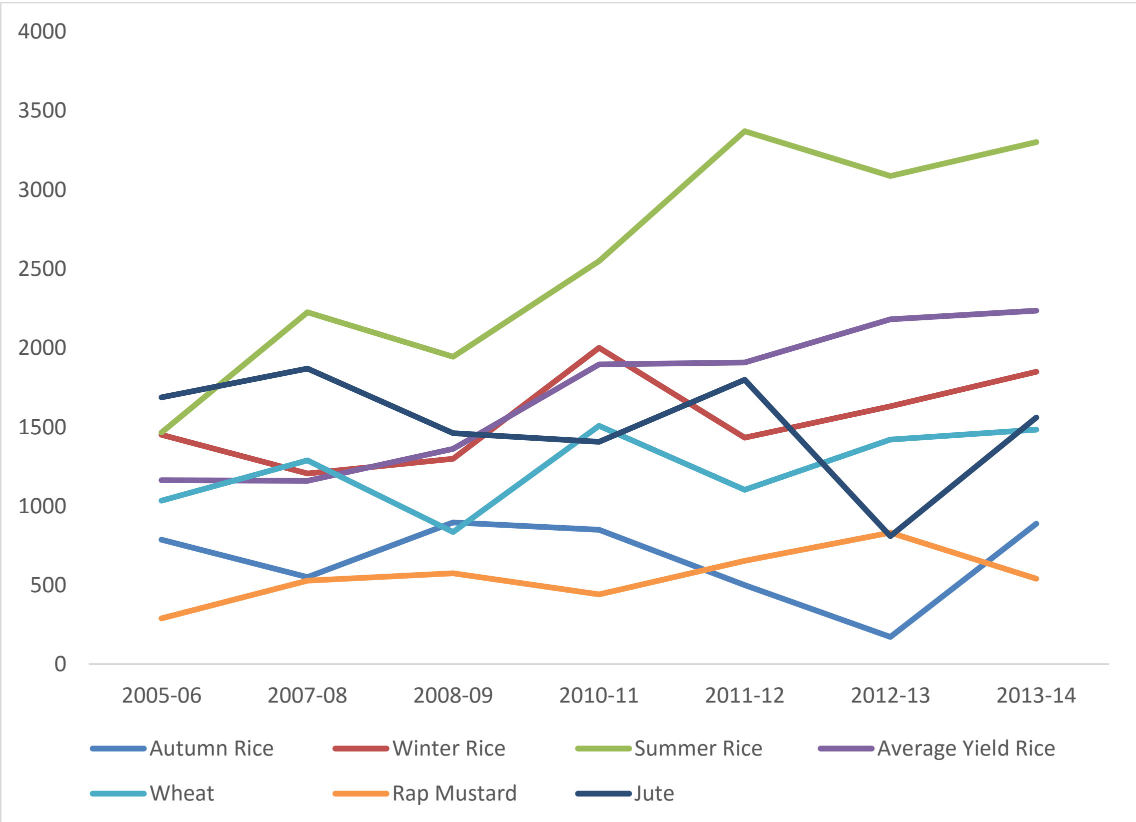


Fig 3.13: Trend of crops productivity in Barpeta district

Table 3.28: Productivity of Crops in Barpeta district

(in Kg. per hectare)

Major Crop	2005-06	2007-08	2008-09	2010-11	2011-12	2012-13	2013-14
Autumn Rice	788	551	897	850	500	172	889
Winter Rice	1450	1206	1299	2002	1432	1631	1849
Summer Rice	1466	2226	1944	2549	3371	3087	3302
Average Yield Rice	1163	1160	1361	1896	1909	2181	2235
Wheat	1035	1289	836	1508	1103	1420	1483
Rap Mustard	290	529	576	441	654	832	541
Jute	1688	1870	1461	1406	1798	810	1561

Source: District Statistical Hand Book 2012-13, Barpeta district

Table 3.28, shows the productivity of some crops has increased in Barpeta and several traditional crops has decreased in the district during the period from 2005-06 to 2013-14. The average productivity of entire paddy has increased to two times in the district from 1163 kg per hectare in 2005-06 to 2235 kg per hectare in 2013-14. The increasing trend of total paddy was lowest in the 2006-07 with 1160 kg per hectare and was highest in 2013-14 with 2235 kg per hectares during the period. The productivity of summer paddy is highest and has increased from 1466 kg per hectare in 2005-06 to 3302 kg per hectare in 2013-14 and increased to more than two times during the period. The productivity of winter paddy has occupied second position next to summer paddy and increased from 1450 kg per hectare in 2005-06 to 2002 kg per hectare in 2010-11 and decreased to 1849 kg per hectare in 2013-14. The productivity of autumn paddy has unevenly increased from 788 kg per hectare in 2005-06 to 889 kg per hectare in 2013-14. The productivity of autumn paddy is exceptionally lowest 172 kg per hectare in 2012-13 during this period in Barpeta district.

The productivity of wheat occupies fourth position next to summer paddy, winter paddy and jute among the major crops of Barpeta district in 2013-14. The productivity of wheat is unevenly increased from 1035 kg per hectare in 2005-06 to 1508 kg per hectare in 2010-11 and again decreased to 1483 kg per hectare in 2013-14. Unevenly productivity of rape and mustard has increased from 290 kg per hectare in 2005-06 to 541 kg per hectare in 20013-14. Productivity of rape and mustard was highest in 2011-12 with 654 kg per hectare. Jute is one important cash crop in this district. The productivity of jute was uneven, i.e. 1688 kg per hectare in 2005-06 and was highest 1798 kg per hectare in 2011-12 and 1561 kg per hectare in 2013-14 and productivity was lowest 810 kg per hectare in 2012-13 during this period. The techniques to increase agricultural productivities are uses of mechanization, HYV, fertilizer, liming of acid soils, irrigation, herbicides, pesticides etc. in the agricultural firms.

The Causes of low productivity in Barpeta district

According to the World Bank, Indian branch's Priorities for Agriculture and Rural Development, India's large agricultural subsidies are hampering productivity enhancing investment. Over regulation of agriculture has increased costs, price risks and uncertainty. Government intervenes in labour, land, and credit markets. India has inadequate infrastructure and services. The World Bank also says that the allocation of water is inefficient, unsustainable and inequitable. The irrigation infrastructure is deteriorating. The over use of water is being covered by over pumping aquifers but as these are falling by one foot of groundwater each year, this is a limited resource. The Intergovernmental Panel on Climate Change released a report that food security may be a big problem in the region post 2030.

Average land holding size is very small (less than 2 hectares) and is subject to fragmentation due to land ceiling acts and family disputes in India. Such small holdings are often over manned resulting in disguised unemployment and low productivity of labour. Farmers are not able to adopt the modern adaptation due to fragmentation of land holding size and poor economic condition. Adoption of modern agricultural practices and use of technology is inadequate among small land holder. It hampered on production and lead to high costs and low output in small land holdings. Irrigation facilities are inadequate in Barpeta district and 52.6% land was irrigated in 2003–04, which result to dependent on rainfall, specifically the monsoon season. A good monsoon results in smooth growth for production, while a poor monsoon leads to a slug is growth. These leads to low agricultural productivity in Barpeta district.

Moreover inconsistent government policy, Agricultural subsidies and taxes are often changed without notice for short term political ends. Which hamper on small land holder for poor economic condition of farmer.

Illiteracy, socioeconomic backwardness, slow progress in implementing land reforms, inadequate or inefficient finance and marketing services for farm produce are main factors of agriculture.

3.2.2. Agricultural market Infrastructure

Agricultural Marketing infrastructure plays a vital role in fostering and sustaining the tempo of rural economic development. It includes godown, correct weighment, cold storages, drying yards, market sheds, price information centre, rest sheds, drinking water facility, cattle sheds, free medical aid to farmers, input shops, phone and fax facilities. The poor market infrastructure and facilities in the markets calls for addressing the problem of planning designs of the market.

Table 3.29: Market infrastructure in Barpeta District, 2011

Sl. No.	Infrastructure	Barpeta		Assam	
		Number	Capacity (in MT)	Number	Capacity (in MT)
1	Cold Storage	3	5500	51	153316
2	Market Godown	3	2000	15	13495
3	Rural Godown	1	500	23	15000
4	Drying Platform	2	NA	NA	NA

Source: Agricultural Marketing Board, Assam

Table 3.29, shows Barpeta district has 3 cold storage, market godown 3, rural godown 1, drying platform 2 and some market yards which are distributed in various places of the district among 2 Primary Market Yard (PMY) and 4 Small Market Yard

(SMY). Thus the infrastructural development is not satisfactory and post crop harvesting lose is very high in Barpeta district.

2.1. Cold storage: Cold storages are most important parameter for agricultural development. Cold storage is prerequisite to minimize losses of post crop harvesting and sale of commodity in reasonable price. It can preserve perishable goods for a long time.

Table 3.30: Cold storage in Barpeta district, 2009-10

Sl. No.	Name of cold storage	Sponsor Organization	Capacity (in MT)
1	Co-opeartive Cold Storage, Barpeta	Co-operative	3000
2	Sorbhog Cold Storage, Barpeta Sorbhog Road, Barpeta	Central Bank of India	2500
3	Howly Cold Storage, Howly	Public	0

Source: Agricultural Marketing Board, Assam

Table 3.30, Barpeta district has 3 cold storages out of 51 cold storages in Assam. These cold storages are concentrated in northern side of Barpeta district. This area is famous for the production of vegetables and fishes in Assam. The biggest cold storage of Barpeta district is Co-opeartive Cold Storage, Barpeta with 3000 MT storage capacity. Sorbhog Cold Storage, Sorbhog has 2500 MT storage capacity and Howly Cold Storage, Howly has not started for storage.

2.2. Godown: Godown is most important to store commodities and reduce post-harvest losses. Godown can be classified as Market Godown and Rural Godown. Barpeta district has 3 Market Godown and one Rural Godown with storing capacity 2000 MT and 500 MT in Barpeta district. Moreover, there are 15 Market Godown and 23 Rural Godown with storage capacity 13495 MT and 15000 MT respectively in Assam.

2.3. Drying Yards: To avoid wastage losses, construction of drying yards in every villages is most essential. Marginal poor farmer cannot construct Drying Yards for lack of capital and place. And Barpeta district is chronically flood affected area and facilities of drying yard are most essential. There are 2 drying yards in Barpeta district.

3.2.3. Development of Agro-industry

Food processing industries eliminates wastage of agricultural produce to a greater extent. Food processing industries ensure steady and better price to farming community as well as availability of the commodities in processed form to consumer throughout the year. Cultivation of good quality process able agricultural produce the farmers stand to gain better returns and employment opportunity. It ensures to reduce wastage of agricultural commodities. Perusable goods can store for long time and export to other places through food processing industries. The main agro-industries are Atta Chaki, Rice Mill, Bakery, Mustard Oil, Spice and grinding industry in Barpeta district.

Table 3.31: Registered Agro-industry in Barpeta district

Year	No. of Unit		Employment	
	Temporary	Permanent	Temporary	Permanent
2010-11	53	1	162	4
2011-12	65	3	182	14
2012-13	55	2	143	5

Source: District Statistical Hand Book, Barpeta District, 2012-13

The number of temporary agro industries were 53 in 2010-11 and were increased to 65 in 2011-12 and again 10 numbers of temporary industries decreased in 2011-12 and reached to 55 in 2012-13. The temporary agro industries employed was 162 person in 2010-11, 182 persons in 2011-12 and 55 persons in 2012-13. The number of permanent agro industry is single and employed 4 person in 2010-11, it reached to 3 permanent units and employed 14 person in 2011-12 and decreased to 2 and 5 during 2012-13, table 3.31.

3.2.4. Sustainable agriculture

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. For a sustained development in the agricultural sector availability of assured irrigation facility is undoubtedly the most important prerequisite. The organic manures like burning of firewood, use of vermicompost, ash, crop rotation etc. may be practiced in agriculture.

Barpeta district has started vermicompost unit for organic farming to avoids of toxic chemicals and fertilizers which is harmful for human consumption. Vermicompost is the product of the compost process using various species of worms to create a heterogeneous mixture of decomposable vegetable, food waste, bedding materials and vermicast. Vermicompost contains water-soluble nutrients and is an excellent nutrient-rich organic fertilizer and soil conditioner. It is used in farming and small scale sustainable, organic farming. Vermicomposting can also be applied for treatment of sewage sludge. Initiative vermicompost are started in Ruposhi block after awareness campaign and most of the women Shelf Help Groups are practicing in agricultural activities in the block by taking training at RSETI in Barpeta

3.2.5. Marketability

Agricultural marketing occupies an integral position for overall development of agriculture. It determines cropping pattern, selection of crops and farmers economic condition. Agricultural marketing comprises all activities like supply of farm inputs to the farmers and movement of agricultural products from farms to consumers. In this way farmer obtains capital to maintain agricultural practice and livelihood. So efficient agricultural market is most important to strength the agricultural development. An efficient marketing system facilitates for optimization of resource use, output management, enhance farmer incomes, widening of markets, growth of agro-based industry, value addition to national income and employment creation. Therefore market reform and marketing system improvement ought to be an integral part of policy and strategy for agricultural development. Though it is playing most important role for agricultural development and is yet to be properly develop and manage.

Conclusion

Agricultural development represents increase of agricultural productivity, cultivable land, irrigation, HYV seeds, fertilizer consumption, pesticide and insecticide use, machineries, intensity of cropping, crop diversification, crop combination, commercialization of agriculture and host of other sectors. The major crops of Barpeta can be divided into four sub categories viz. Food grains like rice, wheat, maize and pulses, Cash crops like jute, sugarcane, tobacco, and oilseeds, Plantation Crops like tea and Coconut and Horticulture crops such as fruits and vegetables. These crops are cultivated in two season, i.e. Rabi and Kharif crop.

Autumn rice has occupied 3.17 percentage of the total cropped area of Barpeta district. The area under autumn rice has decreased to 58500 (20.70%) hectors in 2003-04 to 6346 hectors (3.17%) in 2012-13 in the study area. The productivity of autumn paddy is lowest among the paddy crops due to lack of mechanization in the district. Area under winter paddy has recorded 1st position among the crops in this district which is winter Paddy 66597 hectares followed by summer paddy 52921 hectares but production of winter paddy is the second highest with 164649 tones after summer paddy with 261400 tons in 2012-13. The productivity of winter paddy has been in an increasing trend.

Wheat has occupied 4.32 percentage in 2006-07 which has decreased to 3.15 percentage during 2012-13 of total cropped area of this district. The productivity of wheat is recorded the highest 5.39 tons per hector in 2011-12 which is 0.84 tons per hector in 2008-09 in this district. The area under wheat has decreased due to less mechanization and irrigation facilities. The area under jute has declined from 7775 hectares in 2003-04 to 1294 hectares in 2012-13. The production of jute has declined a lot within the span of 10 years, i.e. 2003-2013, from 9.97 tons per hectare in 2003-04 to 4.50 ton per hectare in 2012-13. The area under rape and mustard is 8.98 percent in 2012-13 and has recorded highest as the 10.14 percent in 2003-04 of total cropped area in the study area. The productivity of rape and mustard has increased from 0.62 tons per hectares in 2003-04 to 0.82 tons per hectares in 2012-13 in Barpeta district which is more than the state average.

Through the adoption of innovative farming practices, like mechanization, irrigation, chemical fertilizer, HYV seeds, pesticides, insecticides etc. the traditional method of agriculture has been gradually getting replaced. This change has been bringing remarkable change in the crop productivity in this district. More input is more output. Irri paddy has highest input cost due to use of irrigation, HYV, fertilizer and mechanization of crops and output is also highest. Irri paddy has Rs. 5406.00 input cost and the output is Rs. 8100.00. Oilseeds has lowest input cost (Rs. 1333.00) and the output is also very low (Rs. 1833.30) in the sample villages. In 2011-12, total irrigated area was 1066 hectares in Barpeta, Rabi crops are highly irrigated than the Kharif crops in Barpeta district. The use of fertilizer has increased in Barpeta district which is 9.25 percentage of the state in 2011-12.

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CHAPTER IV

DIVERSIFICATION OF AGRICULTURE

4.1. Introduction

Diversification originated from the word “diverge”, which means to move or extend in a different direction from a common point. In this sense diversification is the opposite of concentration, thus most of the techniques of measuring diversification actually measures concentration in the system. Crop diversification means to grow several crops in their holdings in an agricultural year which refers to the raising of varieties of crops in a given area in a particular crop season. Many crops grown in an area are refers as the higher crop diversification. The level of crop diversification largely depends on the geo-climate, socio-economic and technological development in a region. In economics, diversification refers to a situation in which decrease in the dominance of an activity, alternately increase in the share of many activities in a system is depicted. Extending the same notion to agriculture means increase in the share of many commodities in agricultural income may be termed as income diversification in agriculture, whereas increase in the share of withdrawal of a resource by many crops may be termed as resource diversification in agriculture. Diversification is therefore measured with concentration ratios.

Encouraging farmers to diversify to higher value commodities will be a significant factor for higher agricultural growth, particularly in rain-fed areas where poverty is high. Moreover, considerable potential exists for expanding agro-processing and building competitive value chains from producers to consumers, urban centers and export markets. Diversification initiatives should be done by farmers and entrepreneurs and the Government has a responsibility to liberalize constraints to marketing, transport, export and processing. It can also play a small regulatory role, taking due care that this does not become an impediment.

In relation to agricultural development, “diversification” is probably one of the most frequently used terms in the recent decade. Due to the importance of crop diversification many scholars has given various techniques of crop diversification. Among them for measurement of crop diversification Gibb’s Martix propounded following formula-

$$\textbf{Gibb's Martix Index} = 1-\frac{\sum x^2}{(\sum x)^2}$$

Where, **x**= percentage of total cropped area occupied by each individual crop in hectares.

The index of diversification provides a method for generalization the relationship between the relative strength and the number of crops grown. The regional dominance of some crops in an area those have some relationship with other crops, indicating a strong bearing on the degree of crop diversification or specialization. The larger the number and closer the percentage of land occupancy of crops in a regional unit, the higher the degree of crop diversification and vice versa.

Table 4.1: Crop Diversification in Barpeta District from 2003-04 to 2012-13(in %)

Year	Autumn Rice	Winter Rice	Summer Rice	Rap& Must	Wheat	Jute	Potato	Matikalai	Sugarcane	$(\sum x)^2$	$\sum x^2$	Diversification
2003-04	20.70	35.30	6.16	10.17	3.58	2.75	3.37	1.55	0.07	6997.01	1849.78	0.74
2004-05	23.82	24.39	7.70	8.13	4.04	2.97	3.39	1.64	0.09	5800.27	1326.68	0.77
2005-06	25.30	25.91	6.83	7.25	2.97	3.44	2.55	1.56	0.15	5770.29	1440.12	0.75
2006-07	22.86	24.66	7.48	9.10	4.32	3.09	3.57	1.75	0.16	5928.67	1313.75	0.78
2007-08	17.40	27.90	8.73	9.73	3.81	1.96	3.48	1.90	0.17	5638.72	1286.42	0.77
2008-09	19.57	29.03	17.19	5.05	2.50	2.27	2.68	1.76	0.11	6422.97	1567.99	0.76
2009-10	19.29	28.36	18.31	5.40	2.81	2.72	2.32	1.80	0.12	6581.68	1564.66	0.76
2010-11	15.26	28.53	19.48	6.32	2.51	2.44	2.79	1.99	0.13	6315.63	1490.77	0.76
2011-12	10.99	30.73	20.30	6.48	2.72	2.42	3.16	2.14	0.15	6253.82	1547.29	0.75
2012-13	3.17	33.23	26.41	8.98	3.15	0.65	3.93	2.71	0.17	6790.36	1925.79	0.72

Source: Calculated from State / District Wise Ten Major Crops in Assam (2003-04 to 2012-13)

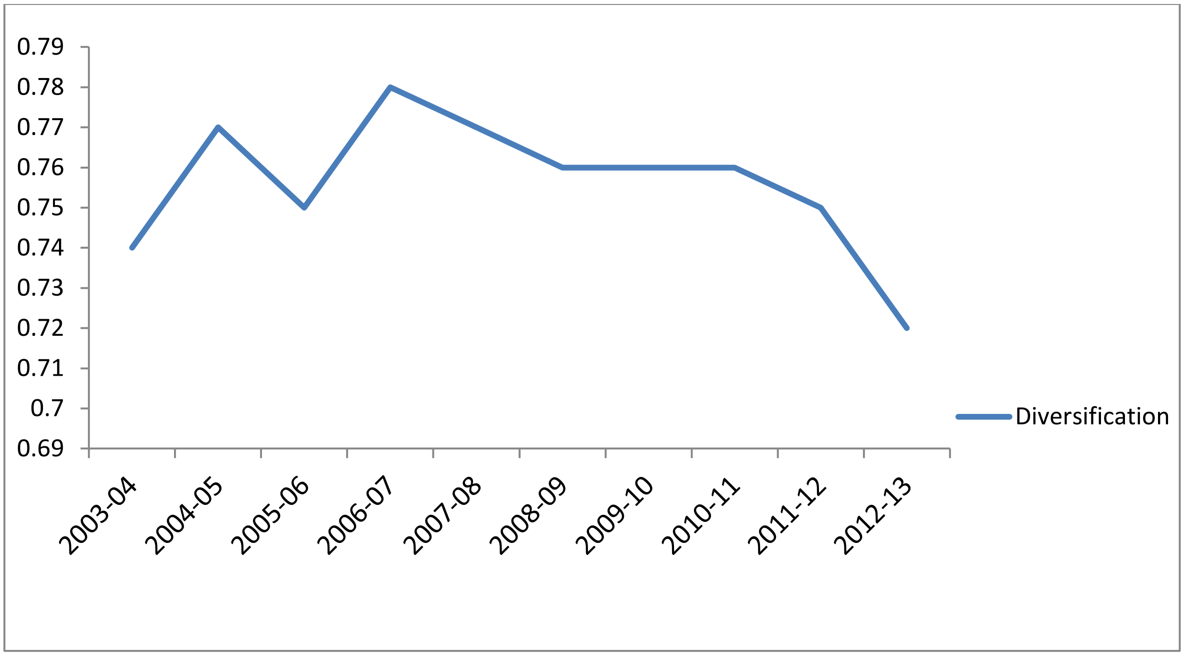


Fig 4.1: Trend of Crop Diversification in Barpeta District from 2003-04 to 2012-13

The above table 4.1, provides explanation of changing pattern of crop diversification index from the year 2003-04 to 2012-13 based on Gibb's and Martin Method. The trend of crop diversification is not favorable in the area during this period. On an average the crop diversification has negative growth in the district. In 2003-04 crop diversification was 0.74 and it has increased to 0.78 in 2006-07. Crop diversification has declined from 0.78 in 2006-07 to 0.72 in 2012-13. Crop diversification has no change during the period from 2008-09 to 2009-10 with 0.76 diversification index and it decreased to the lowest level in 2012-13 with 0.72 in Barpeta district. The main causes of decline of crop diversifications are fragmentation of landholding and shifting of occupation to other sectors due to less benefits. Over population growth and small land holding size has created the problem of less per capita production.

Table 4.2: Diversification of HYV Crops in Barpeta District, 2012-13

Sl. No	Name of Block	Autumn Paddy	Winter Paddy	Summer Paddy	Wheat	Jute	Rape & Mustard	$(\sum x)2$	$\sum x2$	Diversification
1	Bajali	3.02	59.29	19.53	1.168	0.49	13.33	9375.66	4085.14	0.56
2	Gobardhana	2.97	50.68	21.61	4.604	0.86	13.60	8897.02	3251.17	0.63
3	Chakchaka	3.12	49.89	20.33	5.341	1.07	14.48	8879.48	3151.40	0.65
4	Ruposhi	3.27	34.19	32.66	4.875	7.11	13.19	9081.14	2494.62	0.73
5	Mandia	3.94	16.73	45.44	7.824	1.25	17.36	8564.39	2724.36	0.68
6	Barpeta	2.90	31.64	44.17	4.490	0.84	11.58	9143.18	3115.45	0.66
7	Gumafulbari	3.06	27.75	46.00	5.102	1.10	12.35	9093.91	3075.19	0.66
8	Sarukhetri	2.93	38.97	31.86	5.276	0.96	15.01	9026.14	2796.36	0.69
9	Chenga	2.49	35.80	42.70	1.012	0.91	13.00	9199.11	3281.98	0.64
10	Pakabetbari	2.86	36.77	36.42	4.742	1.03	13.22	9032.98	2884.94	0.68
11	Bhawanipur	2.63	34.68	37.32	1.335	0.92	14.81	8407.97	2824.37	0.66

Source: Calculated from District Statistical Hand Book, Barpeta, 2012-13

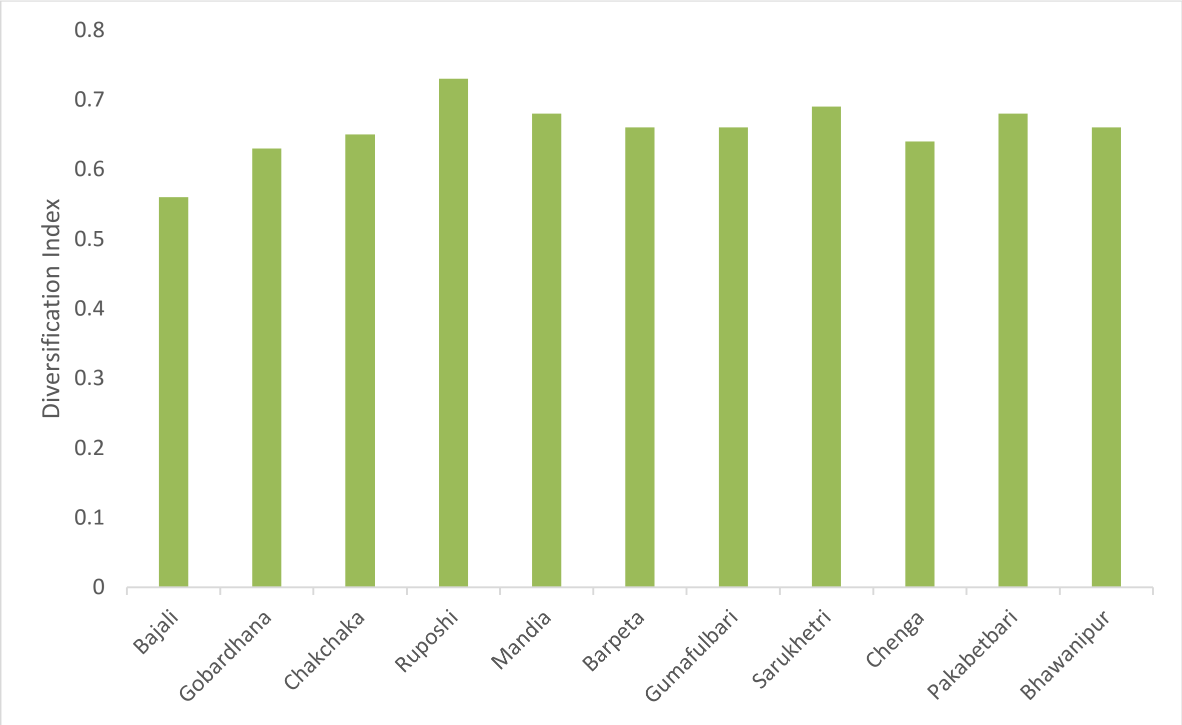


Fig 4.2: Block wise HYV crop diversification in Barpeta district

Table 4.2, shows the disparities of HYV crop diversification among the blocks. The diversification of HYV crops is highest in Ruposhi development block, 0.73 followed by Sarukhetri development block with 0.69 diversification index in 2012-13 in Barpeta district. The HYV crop diversification is lowest in Bajali development block (0.56).

The table 4.3, shows the dissimilarities of cultivation of various crops among the households in the sample villages. In an average 43.25% households practices sali paddy followed by Irri 20%, Mustards 18.05%, jute 9.70%, 7.65% ahu and 1.34% wheat cultivation among the villages. The households practices along 70.90% paddy among the crops. In some villages mono crop is practices among the six major crops of the district. The mono crop is practice in Jakua para village of Chakchaka Development Block and it is due to practices of traditional method of agriculture and non-development of irrigation facilities in the village. The double crops practices

Table 4.3: Household wise cultivation of crops in sample villages (In %)

Sl. No.	Village Name	Wheat	Mustard	Jute	Irri	Sali	Ahu
1	Jakua Para	0.00	0.00	0.00	0.00	100.00	0.00
2	Byaskuhi	0.00	0.00	0.00	3.85	96.15	0.00
3	Tetelirtol	0.00	41.86	0.00	58.14	0.00	0.00
4	Palshartal	4.26	53.19	0.00	42.55	0.00	0.00
5	Chaulia Bori	10.53	17.54	8.77	36.84	26.32	0.00
6	Kapahar Tari	0.00	37.50	0.00	62.50	0.00	0.00
7	MaripurAnandapur	0.00	24.24	0.00	0.00	75.76	0.00
8	Malipara Char	0.00	0.00	31.82	1.52	33.33	33.33
9	Khar Balli	0.00	0.00	40.00	10.00	30.00	20.00
10	Kaltali	0.00	0.00	26.15	4.62	38.46	30.77
11	Bogriguri Gaon	0.00	24.24	0.00	0.00	75.76	0.00
Average		1.34	18.05	9.70	20.00	43.25	7.65

Source: Primary data, 2014-16

among the sample villages are Byaskuchi, Tetelirtol, Kapahar Tari, Maripur Anandapur and Bogriguri Gaon with one Kharif crop and another Rabi crop. These villages are mainly depends on the traditional methods of agriculture and little

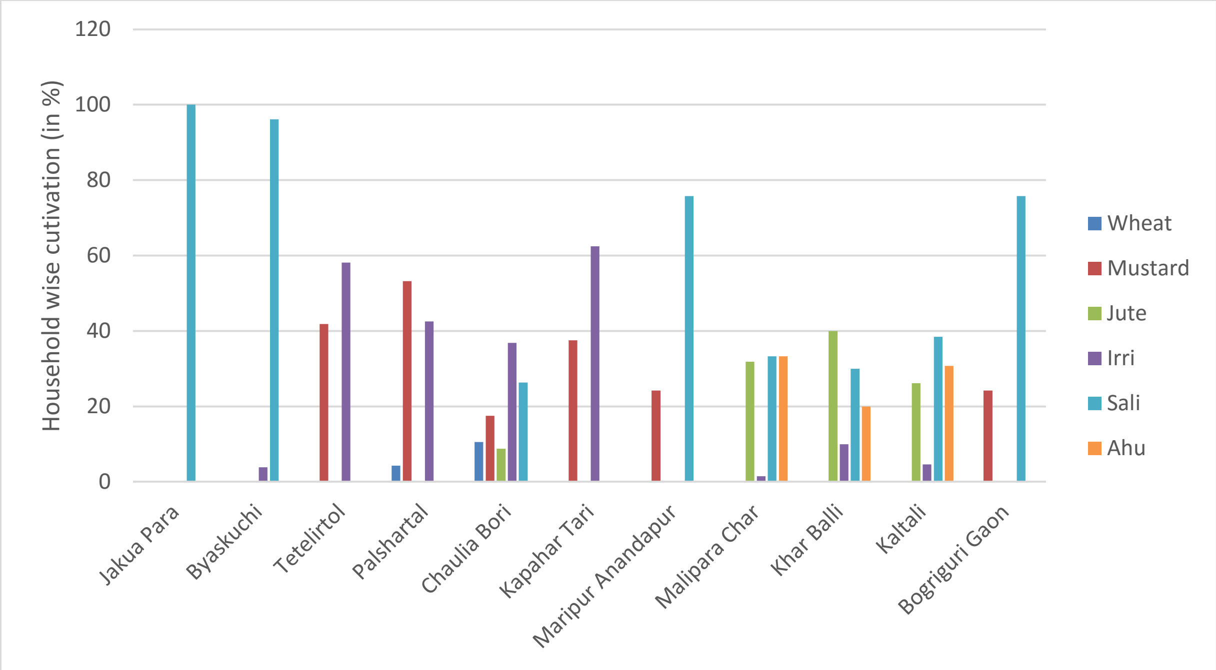


Fig 4.3: Household wise cultivation of crops in sample villages

development of irrigation facilities. There is triple crop practices in Palshartal village of Barpeta development block where the village practices modern method for irri paddy and traditional methods in mustard. Four types crop practice in villages are Malipara Char, Khar Balli and Kaltali char. These villages are situated on the Char (build up) area of the river and is chronically flood affected with seasonal drought prone villages which is very in poor economic development. Moreover these villages are practicing traditional method of agriculture and has low development on irrigation method. The fifth types crop is practice in Chaulia Bori village of Bhawanipur Development Block both using modern and traditional method of agriculture.

Soil depletion, yield stagnation, natural hazards, increase in production cost and low returns are the main causes of decreasing the crop diversification in the district. Earlier the alluvial plains of Barpeta was occupied by the traditional crop like mustards, pulses, maize, various kind of vegetables etc. but in recent times modern inputs has changed the agricultural landscape from crop diversification to crop specialization. Due to the unscientific irrigation facilities, chemical fertilizers, pesticides, insecticides etc. the soil health has depleted and the traditional crops production and productivity has highly declined. According to the farmers pulses, mustard, ahu paddy etc. are unproductive after the entry of modern inputs in the district. Crop diversification is replacing to crop specialization. The crop diversification is more in Char (delta) area of Chenga, Mandia and Ruposhi Development Blocks in Barpeta district, where modern technologies are not able to reach. On the other hand the crop diversification is very low in Sarukhetri, Bajali and Bhawanipur Development Blocks in this district.

Advantage of crop diversification

1. Crop diversification increase per capita production and productivity of farmers.
2. It enhance the per capita income and standard of living of farmers.
3. Crop diversification helps for future planning and meet the raising population.
4. The areas of high diversification of crops deserve special attention to planner for development of agriculture.
5. Comprehensive plan for the regions of high diversification will go a long way in enhancing the agricultural productivity.
6. Crop diversification facilitates to reduce regional inequalities for agricultural development.
7. The experts in agriculture sector and cultivators are more aware in maintaining of soil health to make agriculture more productive and sustainable.

8. Crop rotation and sustainable agriculture increase to facilitate soil and human health.

4.2. Crop Concentration

Crop concentration and diversification are equally important in the study of agriculture. Crop concentration is opposite to crop diversification. Crop concentration focuses on important crops like food crops or cash crops. This is mainly practiced in the developed countries of the world where agriculture is more mechanized. It is determined by the different variables like physiography, climate, soil, socio-economic factors and method of agriculture of a region. The concentration of crops is measured by using the Location Quotation Methods which is known as crop concentration index.

$$\text{Crop concentration Index (CI)} = \frac{\frac{Pij}{Pi}}{\frac{Pj}{P}}$$

Where,

CI = Concentration Index

Pij= Area under a crop in a unit area

Pi= Area of all crops in a unit area

Pj= Area of a crop in whole region

P= Area of all crops in whole region

Table 4.4, shows the HYV paddy is not equally concentrated in the entire district among the blocks. The concentration of HYV paddies are highest in Bajali and Chenga development block with 1.07 concentration index followed by Barpeta, Gobardhana, Pakabetbari and Bhawanpur Development Block. The concentrations are medium in Chakchaka and Sarukhetri Development Block with location quotation index as 0.99. Lowest HYV paddy concentrated blocks are Ruposhi and Mandia development block with location quotation index 0.91 and 0.93. The HYV paddy concentration is highest in Bajali and Chenga development block during 2012-13 due to less popularization of other HYV crops.

Table 4.4: Block wise Concentration of HYV paddy, 2012-13

Sl. No.	Name of Block	All HYV Paddy (Pij)	All HYV crops in a block (Pi)	HYV Paddy in Barpeta (Pj)	All crops in Barpeta (P)	Pij/Pi	Pj/P	$\frac{Pij/Pi}{Pj/P}$
1	Bajali	12682	15064	91108	115783	0.84	0.79	1.07
2	Gobardhana	8909	11195			0.80	0.79	1.01
3	Chakchaka	6371	8214			0.78	0.79	0.99
4	Ruposhi	7235	9845			0.73	0.79	0.93
5	Mandia	15336	21533			0.71	0.79	0.91
6	Barpeta	7994	9720			0.82	0.79	1.05
7	Gumafulbari	4592	5710			0.80	0.79	1.02
8	Sarukhetri	4711	6077			0.78	0.79	0.99
9	Chenga	9203	10913			0.84	0.79	1.07
10	Pakabetbari	7088	8898			0.80	0.79	1.01
11	Bhawanipur	6987	8614			0.81	0.79	1.03

Source: Calculated form District Statistical Hand Book 2012-13, Barpeta district

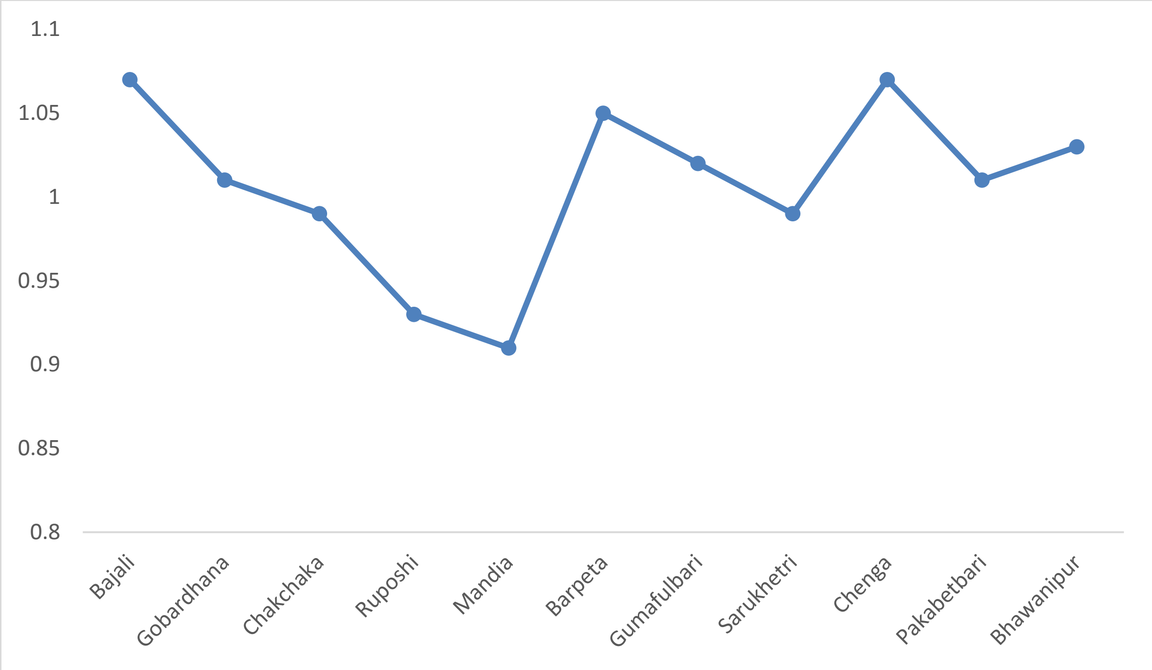


Fig 4.4: Block wise HYV paddy concentration in Barpeta district

Table 4.5, shows concentration of HYV rape and mustard are measured by the crop concentration index. HYV rape and mustard is occupying second position which is next to paddy crop in Barpeta district. These crops are not equally concentrated in the entire district among the blocks. The concentration of HYV rape and mustard is highest in Mandia development block with 1.25 concentration index followed by Chakchaka, Sarukhetri and Bhawanpur Development Block. The concentrations are medium in Bajali, Gobardhana, Ruposhi, Pakabetbari and Chenga Development Block with concentration index ranges between 0.90 to 0.99.The lowest concentrated blocks are Barpeta and Gumafulbari development block with crop concentration index 0.81 and 0.87 respectively. The concentration of HYV rape and mustard is highest in Mandia development block due to highly popularization of this crop. Rape and mustard are highly popularized in these block which are intensively affected by flood in Barpeta district.

Table 4.5: Block wise HYV Rape and Mustard concentration in Barpeta

Sl. No.	Name of Block	Rape & Mustard	All HYV crops in Block (Pi)	HYV Rape & Mustard in Barpeta district (Pj)	Area of all crops in Barpeta (P)	Pij/Pi	Pj/P	$\frac{\frac{Pij}{Pi}}{\frac{Pj}{P}}$
1	Bajali	2066	15064			0.14	0.15	0.92
2	Gobardhana	1610	11195			0.14	0.15	0.96
3	Chakchaka	1258	8214			0.15	0.15	1.03
4	Ruposhi	1361	9845			0.14	0.15	0.93
5	Mandia	4028	21533			0.19	0.15	1.25
6	Barpeta	1176	9720	17292	115783	0.12	0.15	0.81
7	Gumafulbari	738	5710			0.13	0.15	0.87
8	Sarukhetri	959	6077			0.16	0.15	1.06
9	Chenga	1477	10913			0.14	0.15	0.91
10	Pakabetbari	1232	8898			0.14	0.15	0.93
11	Bhawanipur	1387	8614			0.16	0.15	1.08

Source: Calculated form District Statistical Hand Book 2012-13, Barpeta district

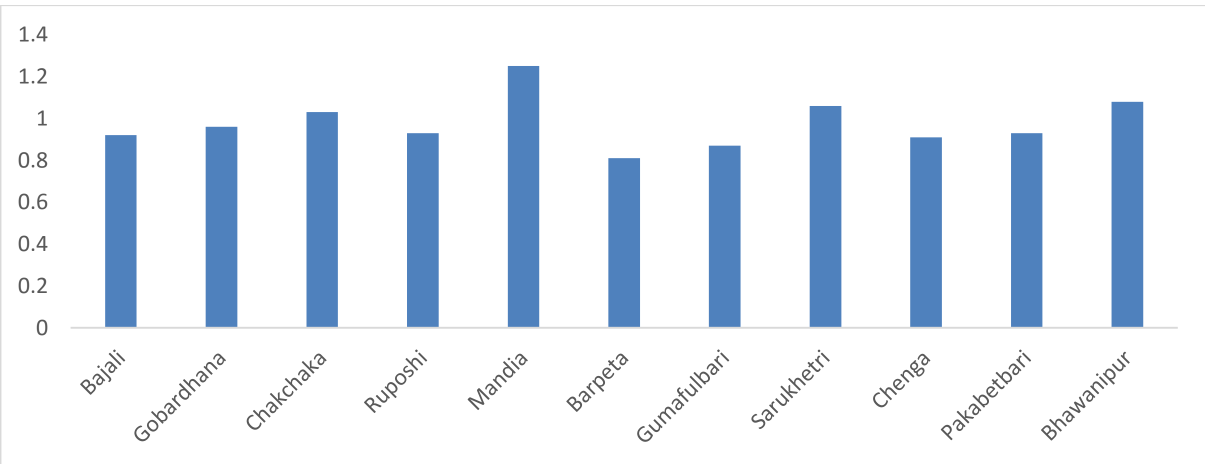


Fig 4.5: Block wise HYV rape and mustard concentration in Barpeta district

4.3. Crop Intensity

Cropping intensity means grow of several crops in their holding in one agricultural year. Higher cropping intensity means higher portion of the net area is being cropped more than once during one agricultural year. This also implies higher productivity per unit of arable land during one agricultural year. The level of cropping intensity is determined by several factors. The most important factor is availability of water from rainfall or irrigation facility. Cropping intensity is severely constrained by the seasonal distribution of rainfall in Barpeta district. Winter season is affected seasonal drought prone area and monsoon season is affected by heavy rainfall or flood. So, natural constraints can be relaxed through developing irrigation facility and agricultural technology. In general level of cropping Intensity is higher in the regions with higher percentage of net sown area irrigated and with higher intensity of land use by irrigation. Another crucial variable that determines level of cropping intensity is the availability of labour. Due to migration of agricultural labour to urban places in Barpeta district and underdevelopment of agricultural technologies that labour availability is an important determinant of cropping intensity.

In the analysis cropping intensity is measured as the ratio of grossed crop area to net cropped area multiplied by 100.

$$\text{Cropping Intensity} = \frac{\text{Gross Cropped Area}}{\text{Net Sown area}} * 100$$

Gross Cropped Area= Net Sown area + Area Sown more than once

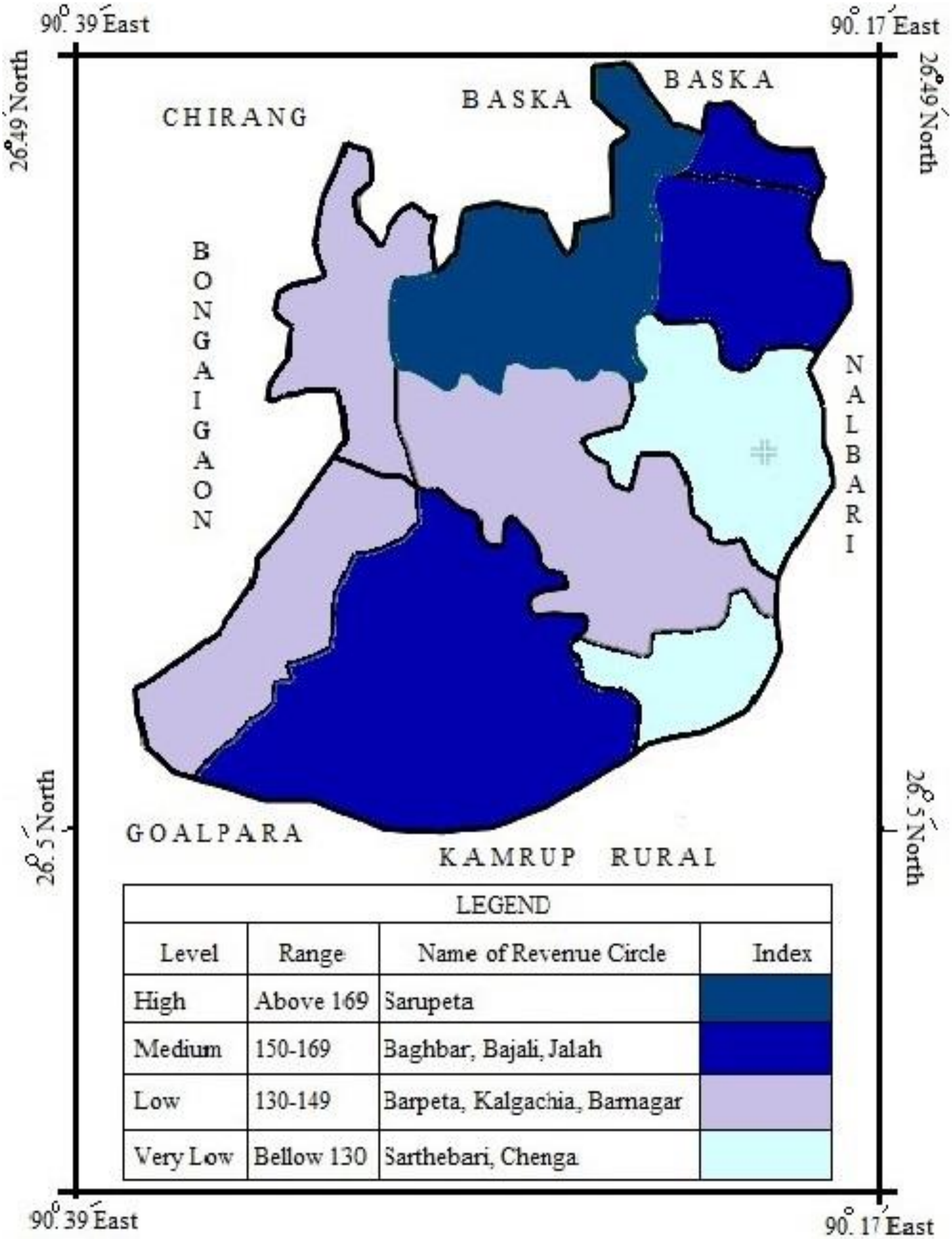
Table 4.6: Revenue Circle wise Cropping Intensity in Barpeta District, 2012-13

Sl. No.	Revenue Circle	Net Sown area	Area Sown more than once	Gross cropped area	Cropping intensity
1	Barpeta	18503	6303	24806	134.06
2	Baghbar	27347	14207	41554	151.95
3	Chenga	23608	6797	30405	128.79
4	Kalgachia	13969	4273	18242	130.59
5	Barnagar	14996	7010	22006	146.75
6	Sarthebari	17144	1368	18512	107.98
7	Bajali	11673	6318	17991	154.12
8	Jalah	3169	1639	4808	151.72
9	Sarupeta	12196	9874	22070	180.96
All District		**142605**	**57789**	**200394**	**140.52**

Source: District Statistical Hand Book, 2012-13, Barpeta District

Table 4.6, the average cropping intensity is 140.52 during 2012-13 in Barpeta district and cropping intensity is not equal among all revenue circles in Barpeta district. The cropping intensity is highest in Sarupeta Revenue Circle with 180.96 intensity and lowest in Sarthebari Revenue Circle with 107.98 intensity. The difference of cropping intensity between Sarupeta Revenue Circle (highest) and Sarthebari Revenue Circle (lowest) is 72.98. Three revenue circles has cropping intensity less than district average

Fig 4.6: Cropping intensity map of Barpeta district



Level	Range	Name of Revenue Circle	Index
High	Above 169	Sarupeta	
Medium	150-169	Baghbar, Bajali, Jalah	
Low	130-149	Barpeta, Kalgachia, Barnagar	
Very Low	Bellow 130	Sarthebari, Chenga	

cropping intensity, viz. Sarthebari, Chenga, Kalgachia and Barpeta Revenue Circle with 107.98, 128.79, 130.59 and 134.06 intensity respectively. The chronically flood affected Revenue Circles on the bank of Brahmaputra river has less cropping intensity in this district. These areas are less mechanized with modern agricultural input and less number of literacy rates and the backward economic condition of people in the district.

Conclusion

Conclusively, the level of crop diversification largely depends on the geo-climate, socio-economic and technological development in a region. Based on Gibb's and Martin Method in 2003-04 crop diversification was 0.74 and it has increased to 0.78 in 2006-07. Crop diversification decline to the lowest level in 2012-13 to 0.72 diversification index in the Barpeta district. The HYV crops diversification is highest in Ruposhi development block with 0.73 followed by Sarukhetri development block with 0.69 diversification index in 2012-13. The HYV crop diversification is lowest in Bajali development block (0.56) in 2012-13. The main causes of decrease of crop diversification is shifting of economic activity to the other sectors due to defragmentation of land holding size and less benefits. The natural calamities like foods, drought etc. has also influenced on the crop diversification. The faster development and benefits of other economic sectors has highly influenced on the less crop diversification. Encouraging farmers to diversify to higher value commodities will be a significant factor for higher agricultural growth to meet the needs of growing population.

The cropping intensity in Barpeta district is 140.52 in 2012-13 which is not equally distributed. The cropping intensity is highest in Sarupeta Revenue Circle which is 180.96 intensity and lowest in Sarthebari Revenue Circle which is 107.98

intensity. The chronically flood, seasonal drought, less development of irrigation, seeds, mechanized etc. is main cause of less cropping intensity in this district.

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CHAPTER V

AGRICULTURAL DEVELOPMENT: PROBLEM AND PROSPECT

Introduction

The economy of Assam is predominantly agrarian in nature and agricultural sector continues to support more than 75 percent population of the state directly or indirectly by producing employment avenues to more than 50 percent of total workforce of the state. The farmers and the workforce engaged in agricultural activities has to encounter with adverse weather condition such as frequent flood and draught like situations along with lack of proper inputs in time, which affects the production and growth in this sector. The agriculture sector has registered a gradual decline in its contribution on GSDP over the years towards state economy. This region has great potentialities for agricultural development due to under development of modern technologies. The adaptation of modern technologies will facilitate to increase agricultural production and productivity in Barpeta district. Agriculture of the world is facing various types of challenges. The challenges and issues of agricultural sector include costs and benefits of both current practices and proposes changes to these practices. This is a continuation of thousands of years of invention in feeding ever growing populations and challenges of agriculture are countless in Assam. The challenge of agriculture includes both the problem and prospects of agriculture.

5.1. Problem of Agricultural Development in Barpeta district

Agricultural sector is facing a lot of problems for development. World Bank (India Country Overview, 2008), pointed out slow agricultural growth is a concern for policymakers as two thirds of India's people depend on rural employment for a living. Current agricultural practices are neither economically nor environmentally sustainable and India's yields for many agricultural commodities are low. Low maintenance of irrigation systems and almost universal lack of good extension services are among the factors responsible. Farmers access to markets is hampered by poor roads, rudimentary market infrastructure and excessive regulation. An analysis of India’s agricultural growth from 1970 to 2001 by FAO (2003), identified systemic problems in Indian agriculture. For food staples, the annual growth rate in production during the six year segments 1970-76,1976–82, 1982–88, 1988–1994, 1994-2000 were found to be 2.5,2.5, 3.0, 2.6, and 1.8% per annum. Corresponding analyses for the index of total agricultural production show a similar pattern, with the growth rate for 1994-2000 attaining 1.5% per annum.

Agriculture of Barpeta district is facing various types of problems. The agricultural input and technology of agriculture have not been developed, though many changes have been taken place. So agricultural development has remained stagnant. Recently it has been made focus on some major infrastructural problem of agricultural system in Barpeta District. The problem of agriculture can be classified in to two broad categories i.e. natural factors and socio-economic factors.

5.1.1. Natural factors

Natural factors are gifts of nature and is manageable by human effort which includes land, water, rainfall, temperature, soil quality etc. These factors do not come out through the human effort. The impact of environment on agriculture varies from place to place and based on the wide variety of agricultural practices employed around the world. Ultimately, the environmental impact depends on the production practices of the system used by farmers. The major natural problems for agriculture are soil, uncertainty of rainfall, flood, drought etc.in the study area.

5.1.1.1. Soil

Soil is prerequisite for agriculture and suitable soil is the most important for agricultural development. Poor soil means lower outputs and larger inputs of fertilizers. In Barpeta district about 11.25% areas are sandy soil, 24.83% are sandy loam soils. These soils highly consume water and fertilizes, due to under development of irrigation facilities and poor inputs of fertilizer for poor economic condition of farmer and productivity of these soil are very low. The riverine Char (delta) and riverine flood plains are directly affected by chronically flood every year. The flood water carries a lot of unfertile sands and deposits on the fertile soils. These soils highly effect on the production of crops. The sands cannot absorb waters for long times and due to non-availability of irrigation facilities, the productivity is very low and sowing is not possible.

5.1.1.2. Weather

Weather is a natural phenomenon. The weather includes rainfall, temperature, humidity, fog, dew etc. It is one of important factor for agricultural development in Barpeta district. Weather change in this regard disturbs on overall agricultural activity. For instance floods and heavy rainfalls greatly affect the agricultural output. The agricultural production has been greatly affected due to change of weather. The uncertainty of rainfall is one of the major problems of Barpeta district. Most of the people cultivated by the traditional methods depending on rain water. The normal rainfall in the district is 2127 mm, each month receive177.25 mm of rainfall but from June to September it receives 1792 mm rainfall. During October to December it receive 15 mm rainfall whereas January to March receive only 6 mm, April to May receive 474 mm rainfall. And annual actual rainfall received 2119 mm, 2239 mm and 2074 mm in 2011, 2012 and 2013 respectively and variation of rainfall from the normal rainfall is 8 mm, 112 mm and -53 respectively during the years. This causes flood and drought as a regular phenomenon in the district. Changes in the frequency and severity of droughts and floods could pose challenges for farmers and ranchers and threaten food safety. The nutrient levels, soil moisture, water availability and other conditions of soil will decreases due to drought.

5.1.1.3. Flood

Flood regularly claims over 20,000 lives per year and adversely affects around 75 million people worldwide (Smith, 1996). The reason lies in the widespread geographical and geomorphological distribution of the tracks of rivers and floodplains and low-lying coasts, together with their longstanding attractions for human settlement. Death and destruction due to flooding continue to be as common phenomena throughout the world and is affecting millions of people annually. Floods cause about one third of all deaths, one third of all injuries and one third of all damage from natural disasters (Akew, 1999).

Among all natural disasters, floods are most frequent faced by India. On account of geo-climatic conditions about 60 percent of the landmass of India is prone to flood and it is the most common of all environmental hazards. As reported by Central Water Commission (CWC) under Ministry of Water Resources, government of India, the annual average area affected by floods is 7.563 million hectares. This observation was based on data for the period 1953 to 2000, with variability ranging from 1.46 million hectares in 1965 to 17.5 million hectares in 1978. On an average, floods have affected about 33 million people between 1953 and 2000. There is every possibility that this figure may increase due to population growth. The National Flood Commission (1980) has reported that the total flood prone area of India was 34 million hectares. It has also mentioned that an area of 10 million hectares has been protected, but the effective protection may be available to 6 million hectares only. Main problems in India with respect to floods are inundation, drainage congestion due to urbanization and bank erosion. The river systems, topography of the place and flow phenomenon are the different contributing factors responsible for flooding. Being a vast country, the flood problems in India may be visualized on regional basis.

Table5.1: Damages cause by flood in Assam

Item	2005	2006	2007	2008	2010	2011 & 2012	2014
No. of Village affected	1563	916	10295	3019	3630	N.A.	4,446
Area affected (in Hectares)	222410	57732	1504146	416000	N.A.	N.A.	N.A.
Population affected (in '000)	1025	555	10868	2906	2546	N.A.	42,03,609
Crop area affected (in Hectares)	98434	10406	674671	314000	147038	N.A.	3,72,178
Value of Crop lost (in lakh)	2347.26	111.04	N.A.	329.00	3678.87	N.A.	N.A.
Value of houses damaged (in lakh)	93440.01	163.06	N.A.	29335	1099.60	N.A.	N.A.
House damaged fully	9286	2270	15846	30315	4864	N.A.	54,088
House damaged partially	1503	5076	N.A.	26235	49638	N.A.	82,095
No. of Human death	29	7	134	40	17	N.A.	90

Source: Statistical Hand Book, Assam, 2012 & 2014

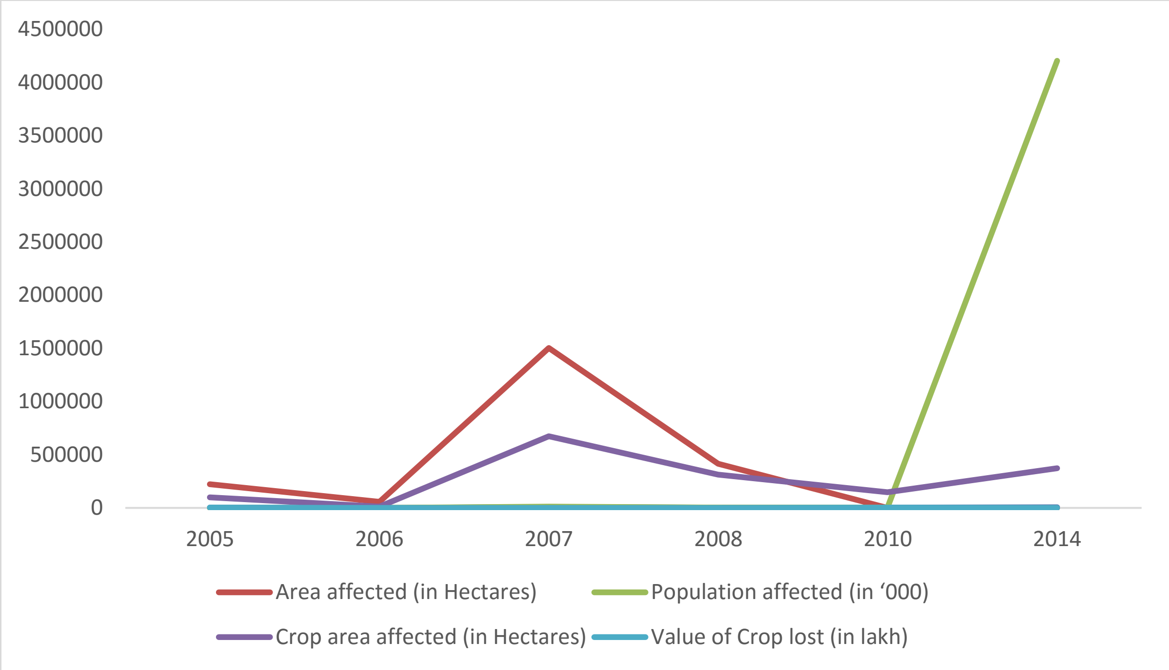

Fig 5.1: Damages cause by flood in Assam

Flood is a major problem of Barpeta district as well as Assam after the earthquake of 1950 due to upliftment of bedstead in Brahmaputra river. Assam is facing3 to 5 times every year and around 4.75 lakh hectare areas in the State is chronically flood prone.

The damages of flood were changing among the years and were highest in 2007 during the period from 2005 to 2014 in Assam. Though flood is a major problem of Assam, but sufficient and reliable data are not available on flood affected area during the year 2011 and 2012. The numbers of flood affected villages were 1563, 916, 10295, 3019, 3630 and 4446 during the year 2005, 2006, 2007, 2008, 2010 and 2014 respectively. The affected villages are 222410, 57732, 1504146 and 416000 hectares in 2005, 2006, 2007, 2008 and 2010 respectively in Assam. And number of flood affected and area affected village was highest in 2007 and lowest was in 2006. The number of population affected were 1025000, 555000, 10868000, 2906000, 2546000 and 4203609000 in 2005, 2006, 2007, 2008, 2010 and 2014 respectively in Assam. The number of population affected was highest in 2014 and was lowest in 2006 during this period. The crop areas affected were 98434, 10406, 674671, 314000, 147038 and 372178 hectares in 2005, 2006, 2007, 2008, 2010 and 2014 respectively in Assam. The value of crops were lost 2347.26, 111.04, 329.00and 3678.87 lakh in 2005, 2006, 2008 and 2010 respectively in Assam. The Value of houses damage were 93440.01, 163.06, 29335.00 and 1099.60 lakh in 2005, 2006, 2008and 2010 respectively. The value of houses damage was highest in 2005 and lowest in 2006 during the period from 2005 to 2010. The numbers of houses damaged fully were 9286, 2270, 15846, 30315, 4864 and 54088 in 2005, 2006, 2007, 2008, 2010 and 2014 respectively. The numbers of houses totally damaged as shown table 5.1 is 1503, 5076, 26235, 49638 and 82095 in 2005, 2006, 2008, 2010 and 2014 respectively. Human deaths were recorded as 29, 7, 134, 40, 17 and 90in 2005, 2006, 2007, 2008, 2010 and 2014 respectively. The number of flood effected human death was highest in 2007 and lowest in 2006 in the state.

Barpeta is regularly affected by floods due to high discharge of water to Brahmaputra River from other tributaries of the district. The main causes of flood is due to heavy rainfall in the catchment areas and inadequate capacity of the river channels. Barpeta district is one of the major flood affected district of Assam. The southern side of the district is very low with an elevation of bellow 18 m above MSL and is frequently subjected to flood. There are numbers of small streams, abandoned channels and marshy lands and is the cause of chronically floods. Brahmaputra river and its tributaries following through the district are the causes of annual floods and riverbank erosion particularly in the char areas (flood plain), leading to a considerable loss of life and property. Chronicle flood affected the area of Barpeta district is 31000 hectares (DAO, Barpeta).

Table 5.2: Damage of Embankment by flood during the flood, 2011

District /State	Type of Embankment	No. of Embankment breaches			No. of breaches in Embankment			Length of breaches (in metre)		
		2011	2012	2013	2011	2012	2013	2011	2012	2013
Barpeta	Tributary	12	1	1	12	1	1	271	15	15
	Brahmaputra	2	1	1	2	1	1	850	150	150
	Total (In no.)	14	2	2	14	2	2	1121	165	165
	Total (In %)	18.42	7.14	20	18.42	7.14	10.53	13.39	10.45	18.79
Assam	Tributaries of Brahmaputra	59	15	7	59	15	0	3844	499	648
	Tributaries Barak	1	11	2	1	11	16	50	790	80
	Brahmaputra	15	2	1	15	2	2	4404	290	150
	Barak	1		-	1		1	75		
	Total	76	28	10	76	28	19	8373	1579	878

Source: Statistical Hand Book, Assam, 2012& 2014

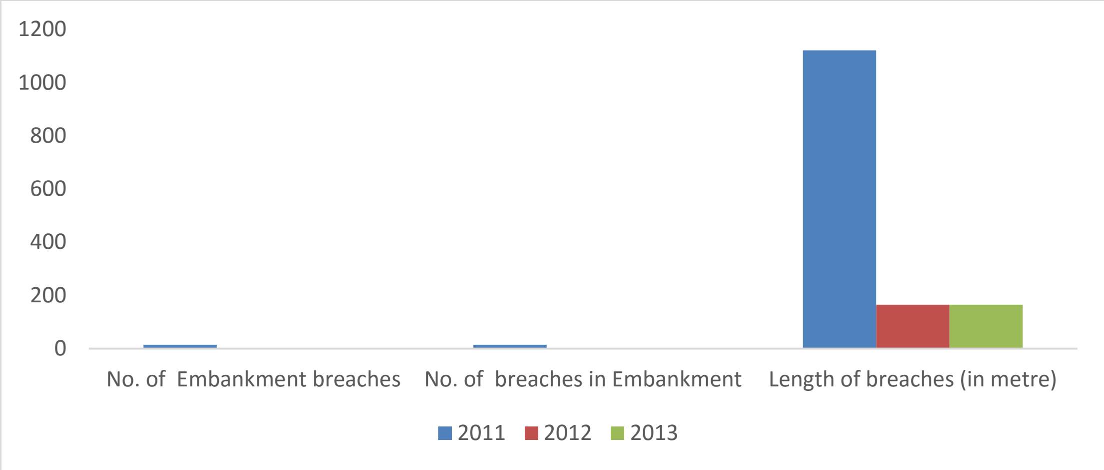

Fig 5.2: Damage of embankment by flood during the flood, 2011

Embankments are chief measures for control of chronicle flood in Assam and every year flood abolishes embankments in many places. The damages of floods are high in Barpeta district among other districts of Assam. The total number of embankment breach and number of breaches in embankment in Barpeta district is 14 in Brahmaputra river 2 and tributaries out of 72 in Assam during 2011. The damages of number of embankment breach and number of breaches in embankment in Barpeta district was 18.42 percentage and length of beaches was 13.39 percent (1121 metre) of Assam in 2011. The number of embankment breach and number of breaches in embankment in Barpeta district and Assam has decreased to 2 and 28respectively in 2012. The damages of embankment breached and breaches in embankment of Barpeta district is 7.14 percentage and length of beaches was 10.45 percent (165 metre) in Assam, 2012. Further number of embankment breached and number of breaches in embankment in Barpeta district has been recorded 2 (Brahmaputra river 1 and tributaries 1) out of 10 in Assam during 2013. The damages of number of embankment breached and number of breaches in embankment in Barpeta district was 20 and 10.53 percentage and length of beaches was 18.79 percent (1121 metre) of Assam in 2013.

5.1.1.4. Drought

Drought is a natural disaster associated with lack of precipitation for a considerable long period of time. Generally drought is the outcome of low precipitation for a long period of time or a particular season. It can happen anywhere in the world and cause harmful effect to human life and ecosystem. Drought is characterized by lack of water availability in a region (Beran and Rodier, 1985). It is different from other natural disaster because its onset, extent and end are difficult to determine. Agricultural output is greatly affected by the drought**.** Stephen Devereux, introduces an investigative outline for understanding the impacts of droughts and floods on rural livelihoods. He said that impact of drought is the results of failures of production-based entitlement.

Assam has 0.94 lakh hectares which reports draught prone area. The area covered under winter rice and the principal kharif crops of the state is declined due to serious drought like situation experienced by the State. In the study area the agricultural activities are highly affected due to drought. In seasonal drought fall occur every year.

Barpeta district is seasonal drought prone region. Barpeta district receives lowest rainfall in winter season and post monsoon season. During winter season it receives 11.6 mm and post monsoon season receives 17.2 mm rainfall which effects badly on the agricultural growth. Irrigation facilities are very poor in the study area where some crops get damaged due to insufficient of water.

5.1.1.5. Land Erosion

The highly productive and fertile soils of Barpeta is now facing the serious problem of soil erosion like other parts of the state. Heavy precipitation and humid causes loss of topsoil and surface runoff which is the most common type of soil erosion in the state. The problem of topsoil erosion is severe in the plain during the flood season. It is estimated that nearly 3.2 million hectares of land in the plain districts of the state are vulnerable to topsoil erosion with varying intensity. Terrain deformation through mass movement is another type of soil degradation. Another important type of soil erosion in the state, which assumed serious proportion in the recent time is the bank erosion by the rivers. It is observed that at some places, a few kilometers of bank along the villages, fertile agricultural lands and roads are being eroded by the rivers. The extent of loss of bank erosion varies from year to year depending on the severity of floods in the state.

Riverbank erosion is one of the main causes of destruction to the life and property of the people living in the riverside areas. Riverbank erosion is more dangerous than floods. River bank erosion during high flood period in Barpeta district is a regular annual feature. Over flood due to breaches in the embankment render the fertile cultivable land to unsuitable for crop production due to deposition of coarse sand on the surface to a variable depth. As per Assam Government Revenue Department 6116 hectares of land were affected by soil erosion in Upper Brahmaputra Valley and North Bank Plain zone during 1994.

Dr. Bhumidar Barman (Minister, Assam Revenue and Disaster Management, 2015) informed to Assam Legislative Assembly a total of 36,981 houses were eroded and nearly 37,000 families have been lost their houses due to erosion across the Assam during the last five years. The largest numbers of houses were washed away in Dhubri district, where 14,324 families lost their dwelling units followed by 12,186 houses in Jorhat and 3,137 houses in Barpeta districts (March 3, 2015). In 15th districts of Brahmaputra valley some landless people were affected by erosion and have shifted houses and are living on embankments and roadside, while some are living on leased land. Among those 15th districts, 880 villages has been eroded completely and 67 villages were eroded partially.

The records of the last century show a trend of widening of the Brahmaputra riverin Assam. The Brahmaputra occupied around 4000 sq. km in 1920s and now the Brahmaputra occupies about 6000 sq. km (WRD, 2008). Based on the satellite image estimation of area eroded in the Brahmaputra for the years of 1997 to 2007-08 (WRD, 2008), the total land loss per year (excluding avulsion) is recorded as 72.5 to 80 Sq. km. Bank erosion has been continually wiping out more than 2500 villages and 18 towns including sites of cultural heritage and tea gardens affecting lives of nearly 500,000 people.

The estimate of river bank land erosion through Brahmaputra and Barak Rivers in Assam during 1966-2002 using Satellite Remote Sensing Techniques prepared by Water Resource Division, RS and GIS Application Area National Remote Sensing Agency, Hyderabad is 28262 hectors and land deposition is 5854 hectors in Assam. The total amount of land erosion is 2098 hectors and land deposition is 146 hectors in Barpeta District during the period 1966-2002. Barpeta district is 7th highest land eroded district in Assam next to Sonitpur, Marigaon, Dhemaji, Dhubri, Golaghat and Tinisukia District.

The erosion has so far damage 71 villages, over 25,000 families and thousands of hectares of cultivable land in an around the Gomafulbari area under Gumafulbari Development Block of Barpeta district since 1951 to 2015 (Daily Pioneer, 15th June 2016). The south and south eastern part of Barpeta district is badly affected by land erosion which includes Chenga, Baghbar, Barpeta and Kalgachia revenue circle. The land erosion has been affected 22.28% village land area in

Barpeta district. The overall rate of riverbank erosion is 10.41 sq. km per year and 186 revenue villages were affected during 1960 to 2014 in this district.

Table 5.3: Revenue Circle and Mauza wise effect of river erosion in Barpeta, 1960-2014

Sl. No.	Revenue Circle	Mauza	No. of Affected Villages	Total area of land under affected villages (in hectares)	Total area of land eroded (in hectares)
1	Chenga	Chenga	6	18.28	1448.46
		Bagribari	29	17229.25	12587.85
		Total	**35**	**19057.58**	**14036.31**
2	Barpeta	Barpeta	5	956.80	679.62
		Nagaon	5	1324.03	1031.17
		Total	**10**	**2280.83**	**1710.79**
3	Baghbar	Baghbar	43	19117.66	14360.45
		Mandia	31	7105.55	5390.61
		Jania	19	5699.52	3175.88
		Total	**93**	**31922.73**	**22926.94**
4	Kalgachia	Titapani	2	803.32	476.63
		Ruposhi	15	3713.34	2971.04
		Baghbar	31	7808.89	3637.19
		Total	**48**	**12325.55**	**7084.86**
		Grand Total	**186**	**65586.69**	**45758.90**

Source: Revenue Circle Office, Chenga, Baghbar, Barpeta & Kalgachia, 2015

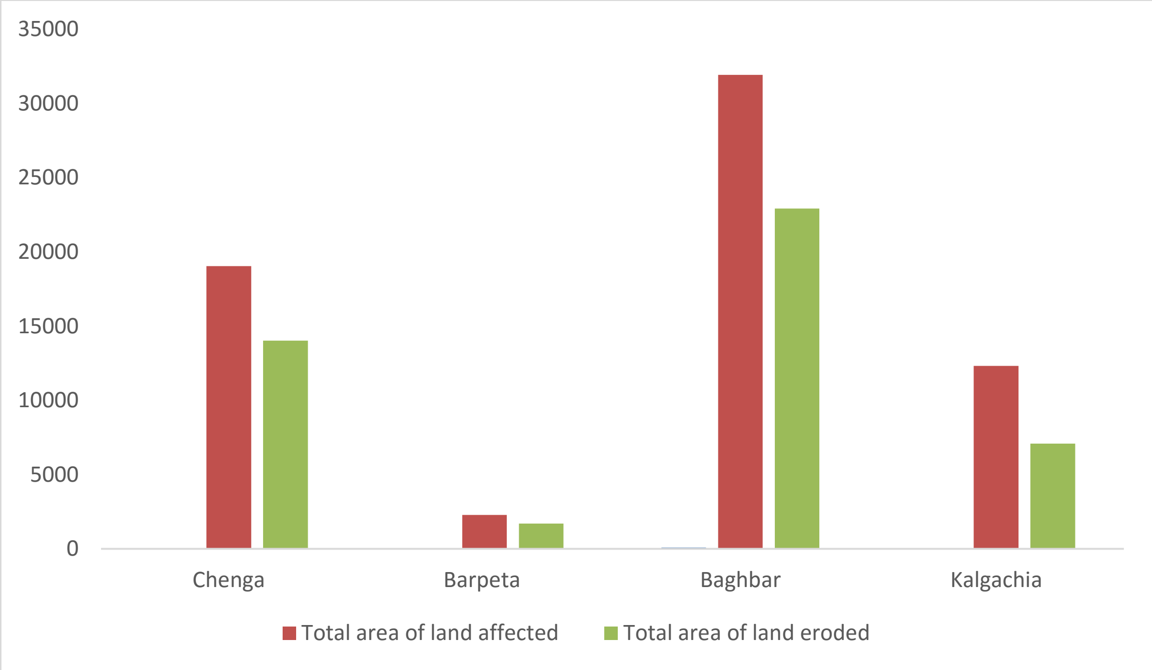

Fig 5.3: Revenue Circle wise effect of river erosion in Barpeta, 1960-2014

Out of 186 revenue villages, 91 villages were completely eroded and 95 were partially eroded by the riverbank erosion. Of these 91 completely eroded villages, 75 were eroded by the river Brahmaputra and 16 by river Beki. A total of 45758.90 hectares (457.58 Sq. km) of land from 186 villages falling in 10 Mauzas under 4 revenue circles in the southern part of Barpeta district had been washed away by the mighty river Brahmaputra and its main tributaries Beki and Manah in the post independent era (Ahmed, Seikh Faruk, 2016).

During 1960 to 2014, moreover 30 thousand families were directly affected by the riverbank erosion in Barpeta district and 41% of the affected families were displaced and shifted their first residence during 1975 to 1985 in Barpeta district. Many of them became landless and homeless. Loss of homesteads forces people have move to new places without any option and put them in disastrous situations (Rahman, 2010). Likewise, finding no other means of livelihood, they started migrating to various towns and cities of Assam as well as to different north-eastern states.

People lost valuable immoveable properties like house shed, agricultural land and house building. They also lost livestock like cows, goats, sheep, hens, cows, buffalos and ducks, etc. Moreover, many public property and institutions like school buildings, temples, masjids, market places, roads etc. and many more natural forest and wildlife were also lost in the river erosion. The extreme braided nature of river Brahmaputra coupled with silt and sand strata of its banks is the main cause of bank erosion in Brahmaputra valley (Mohile, 1998). Erosion occurs mainly through slumping and hydraulic action of the river water (Chatterjee and Mistri, 2013). After the 1950's earthquake in Assam, the erosional activity has increased as a result large number of inhabited villages, agricultural land, embankments, roads, etc. were completely washed away. The process of riverbank erosion is still continuing in a dangerous trend. Every year flood water wash away fertile topsoil by waves of water in Char and river banks agricultural field and transform to an unfertile and unproductive field. The sand deposit on fertile soil, wash away fertile soil is also a common phenomenon and a major problem in Barpeta district. The cultivator of Chenga, Ruposhi, Gumafulbari and Mandia Development Blocks are regularly affected by the sand deposition and wash away of fertile soils in flood season. Moreover flood water carries unfertile sand from upstream and spread sands on fertile soil and soil transform to unfertile barren land.

5.1.1.6. Socio-economic problem

Socio-economic problems are the major factors of agricultural development. Socio-economic problems are infrastructural development, population pressure, technological, small and fragmented landholdings, landholding system, poverty sickness, poor inputs and lack of mechanization, scarcity of capital, low consumption of chemical fertilizer, indebtedness of farmer, inadequate research, etc.

5.1.1.7. Infrastructural Development

Barpeta district has very poor road network which effects the inputs and outputs from farms to consumers. Railways facilities covers the northern part of Barpeta district with total length of 47 km only which is not sufficient for socioeconomic development of a region. The fastest mode of transportation is air ways but the study area do not have this facilities. Irrigation systems are inadequate, leading to crop failures in some parts of the country because of lack of water. Flood, poor seed quality and inefficient farming practices, lack of cold storage spoilts the harvested the harvested crops to over 30% of farmers production. Lack of organized retail and competing buyers are limiting to sell the surplus and commercial crops in India.

In Barpeta district, due to lack of infrastructural development perishable vegetables get damaged in place of production. There is no food processing industries and no sufficient storage facilities in Barpeta. Inefficient drying yards cannot dry crops during the time of rainy and flood season and crops are damaged at postharvest period. Producer can’t send their produces to the market due to poor rural road networks.

5.1.2.1. Population pressure

The most important factor responsible for agricultural development is over population pressure on land. According to 2001 census, the density of population is 521 per sq. km and increased to 632 sq. km in 2011 with a steady growth of population in Barpeta district. The decadal growth rate is 21.40% during 2001 to 2011compare to average growth rate in the state i.e. 16.93%. The population pressure has created a number of problems like fragmentation and subdivision of land holdings, supply of modern practices and services has fallen short for requirements. It has created the problem of unemployment and disguised unemployment. All these factors are responsible for low production and productivity, low inputs to farms and less use of modern technology in the agriculture.

5.1.2.2. Small and fragmented landholding

The Food and Agriculture Organization (FAO) of United Nations estimates that in forth coming decades, cropland will continue to be lost due to industrial and urban development, along with reclamation of wetlands and conversion of forest to cultivation, resulting in the loss of biodiversity and increased soil erosion. Population is increasing with demand for food and pressure on land resources which results in defragmented to land holding.

Small and fragmentation of the holdings is one of the main causes of low agricultural productivity and backward state of our agriculture. Lost of time and labour is wasted in moving seeds, manure, implements and cattle from one piece of land to another. Irrigation becomes difficult on such small and fragmented fields. Further, a lot of fertile agricultural land is wasted in providing boundaries. Under such circumstances, the farmer cannot concentrate on improvement. The average land holding size is very low in India. About 80% of lands holding size are less than 2 acres. The small size of land holdings lead to great waste of time, labour, difficult in proper utilization of irrigation facilities and other modern inputs, wastage of crops in the absence of fencing. The main reason for this sad state of affairs is our inheritance laws. The land belonging to the father is equally distributed among his sons.

In Barpeta, marginal land holders are highest with 57.09% followed by semi medium land holder 35.16% and small landholding 26.61% and medium land holder

14.26% of land in the district. The percentage of large land holder is lowest 0.04% and are holding 0.57% land table 3.8. This makes setback for adaptation of new technology in agriculture.

5.1.2.3. Landholding System

Landholding of cultivators can be classified as Madhi, Eksona, sharecropping and contractual land in Barpeta district. The Madhi lands are permanent land and land holders can use the land by paying a low rate of tax to the government. These land landholder will get full price of land, if it is occupied by the government. Eksona lands are temporary land of landholder and land holder paying low rate of tax to the government. Government can occupied Eksona land and landholder will not get any type of value for the land. Share cropping lands are not a land of cultivator, the land is cultivated by the cultivators with a 50% share of crops output between cultivator and land lord. The landlords don't give any kind of input costs for cultivation. The land lord provides land to the cultivator for one crop or a year and can return the land from cultivator any times without any prior information. Contractual lands are not a land of cultivators, this land is cultivated by the landless cultivators with an agreement of fixed amount of crops or money between cultivator and land lord for one crop or whole year. The land lord is giving land to the cultivator for one crop or a year and the land lord can return the land any times from cultivator.

Table 4.5 shows among the sample villages, farmers has 60.52% own lands, share copper 35.33% and contractual 4.15% for cultivation. The distributions of land tenure systems are not equal among the villages. The cultivators of Tetelirtol village has highest own land for cultivation which is 75% own land followed by Kapahar Tari (65.85%), ChauliaBori (61.3%), Maripur Anandapur (61.2%), Bogriguri Gaon

(61%), Malipara Char (60.5%) and lowest own land has Jakua Para village with 47% of total cultivated land. Own landholder can prepare a long term planning and can adopt new technologies for long time.

Table 5.4: Types of landholding in sample villages (In Percentage)

Sl. No.	Name of Village	Madhi	Eksona	Own (Col. 3+4)	Share cropping	Contractual
1	2	3	4	5	6	7
1	Jakua Para	47	0	47	50	3
2	Byaskuchi	52	4	56	44	0
3	Tetelirtol	75	0	75	16.5	8.5
4	Palshartal	60.48	0.82	61.3	30.6	8.1
5	ChauliaBori	61.3	0	61.3	35.4	3.3
6	KapaharTari	65.8	0	65.8	26.4	7.8
7	MaripurAnandapur	61.2	0	61.2	38.8	0
8	Malipara Char	60.5	0	60.5	36.6	2.9
9	KharBalli	52.8	4.3	57.1	36.2	6.7
10	Kaltali	59.5	0	59.5	35.1	5.4
11	Bogriguri Gaon	61	0	61	39	0
	Average	59.69	2.28	60.52	35.33	4.15

Source: Primary Data, 2014-16

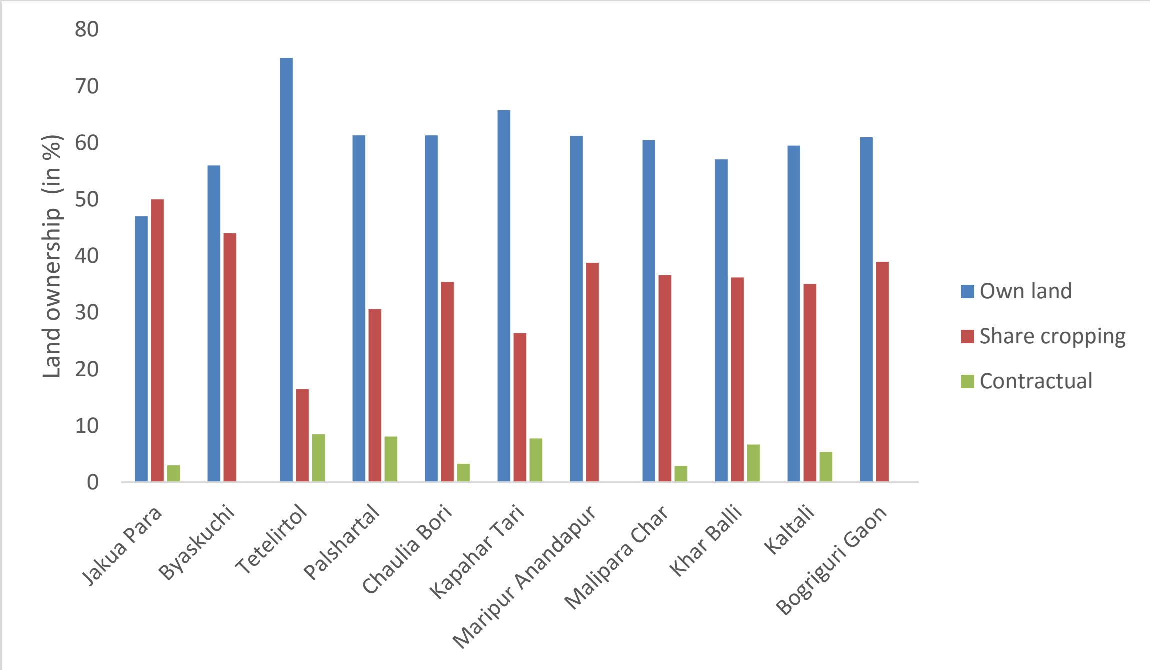

Fig 5.4: Types of landholding in sample villages

The cultivators of Jakuapara village has highest share cropping land for cultivation with 50% own land followed by Byaskuchi (44%) Bogriguri Gaon (39%), Maripur Anandapur (38.8%), Malipara Char (36.6%), KharBalli (36.2%), ChauliaBori (35.4%), Kaltali (35.1%), Palshartal (30.6%), KapaharTari (26.4%) and lowest share cropping land has Tetelirtol village with 16.5% of total cultivated land. These share cropper provides 50% of produces of cropland to the land lord. These land lord do not bear any kind of input cost or little amount of input cost is beared. As result results cultivators are highly loser and is living in a poor economic condition and cannot prepare long term plan for agriculture.

The cultivators of Tetelirtol village is highest contractual cropping land for cultivation with8.5% own land followed by Palshartal (8.1%), KapaharTari (7.8%), KharBalli (6.7%), Kaltali (5.4%), ChauliaBori (3.3%), Jakuapara (3%) and lowest contactual cropping land has Malipara Char village with 2.9% of total cultivated land. The cultivator of Byaskuchi, Bogriguri Gaon and Maripur Anandapur villages has no contractual land for cultivation. These cultivators make an agreement with the land lord to provide a satisfactory portion of produces or money (i.e. 160 kg to 200 kg paddy or Rs. 2000.00) without bearing any input cost for one crops or whole year. These farmers are living in very poor economic condition and can not increase the inputs to increase outputs. Due to the low percentage of area of own land and small landholding size, cultivators are not able to adopt the modern technologies. The contractual and share cultivator has no certainty for long term cultivation on same landholding. The benefits of these cultivators are very low as a result economic condition of these cultivation is also poor and use of modern method of cultivation is not possible.

5.1.2.4. Poverty sickness

The development of agriculture is highly affected by the poverty sickness of cultivator in India as well as Barpeta district. In 2012, as per National Crime Bureau Records of India has reported 13,754 farmer suicides in India. Farmer suicides account for 11.2% of all suicides in India. The main reasons for farmer suicides are as monsoon failure, high debt burdens, genetically modified crops, government policies, public mental health, personal issues and family problems.

Table 5.5, shows in Barpeta district 80.06% household has less than 5000 monthly income against the state 76.89% population in 2011. On the other hand 12.21% household has 5000-10000 monthly income and 7.71% household has 10000 in 2011 (Socio-economic Census, 2011).In sample villages more than 52% families has less than 5000 monthly income and 37.82% people has 5000-15000 monthly income and 10.18% household has above 15000 monthly income only. The monthly incomes among the villages are not equal. In KharBalli village of Ruposhi Development block has highest number of household bellow 5000 monthly income among the sample villages followed by Kapahartari village of Pakabetbari Development Block and these villages has no families whose monthly income is more than Rs. 15000.

Table 5.5: Income pattern of Cultivator in sample villages

Sl. No.	Name of Village	Bellow 5000	5000-15000	Above 15000
1	Jakua Para	28	56	16
2	Byaskuchi	36	56	8
3	Tetelirtol	48	40	12
4	Palshartal	52	32	16
5	ChauliaBori	52	40	8
6	KapaharTari	72	28	0
7	Maripur Anandapur	48	32	20
8	Malipara Char	64	36	0
9	KharBalli	76	24	0
10	Kaltali	56	36	8
11	Bogriguri Gaon	40	36	24
Average		52	37.82	10.18

Source: Primary data, 2014-16

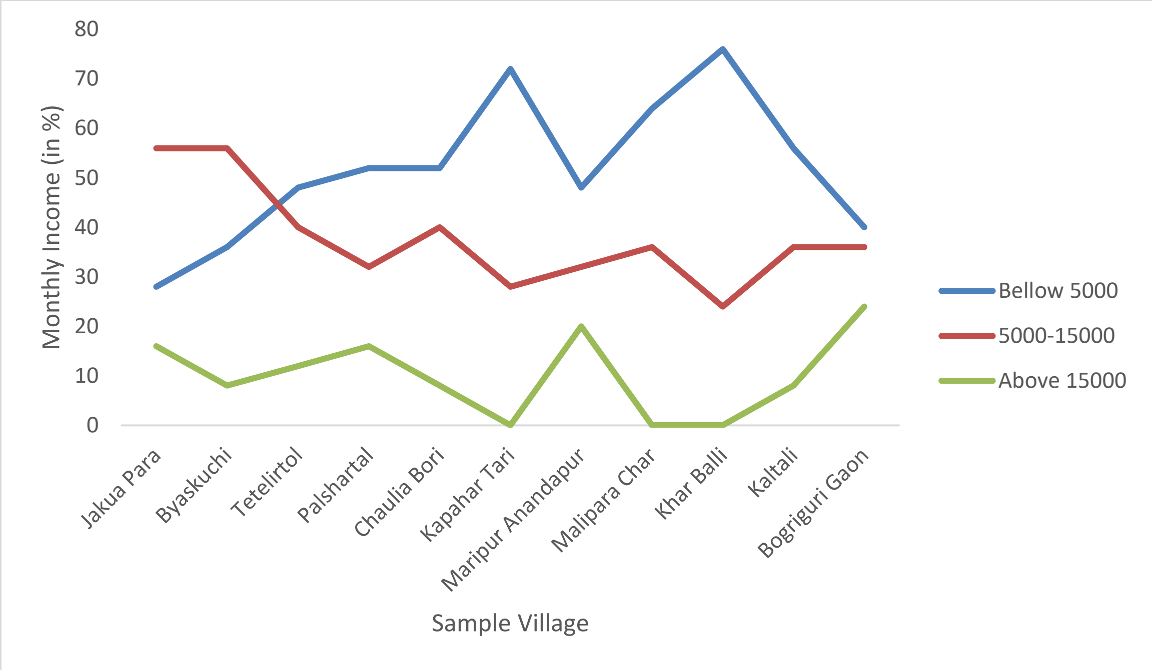

Fig 5.5: Monthly Income in sample villages

Table 5.6, shows 108151 households are living below poverty level (BPL) which is 37.79% households of Barpeta district. Gobardhana Development Block has highest BPL family with 67.47% families and Bhawanipur Development Block has lowest BPL family with 10.28% families. Bajali, Chakchaka, Ruposhi, Mandia, Barpeta, Gumafulbari, Sarukhetri, Chenga, and Pakabetbari development blocks are 20.73, 32.29, 39.73, 42.15, 38.83, 35.38, 38.04, 38.19 and 52.52 percentage people are living under below poverty line.

The main cause of poverty sickness of cultivators in Barpeta district is small size of land holding, low output of agriculture, low inputs, effect of national calamities and traditional methods of agriculture. Due to the poverty sickness cultivators are not able to increase inputs and cannot adopt modern methods for cultivation as a result output are very limited.

Table 5.6: Bellow poverty line (BPL) family in 2011(in number and percentage)

Sl. No.	Name of Dev. Block	Total Household	Total BPL family	BPL family
		In Number	In Number	In Percentage
1	Bajali	24926	5167	20.73
2	Gobardhana	12873	8685	67.47
3	Chakchaka	21623	6982	32.29
4	Ruposhi	31249	12416	39.73
5	Mandia	63704	26852	42.15
6	Barpeta	22368	8685	38.83
7	Gumafulbari	16358	5788	35.38
8	Sarukhetri	17774	6762	38.04
9	Chenga	20645	7885	38.19
10	Pakabetbari	27373	14389	52.57
11	Bhawanipur	44159	4540	10.28
Total		303052	108151	37.79

Source: Office of the Project Director, DRDA, Barpeta, 2016

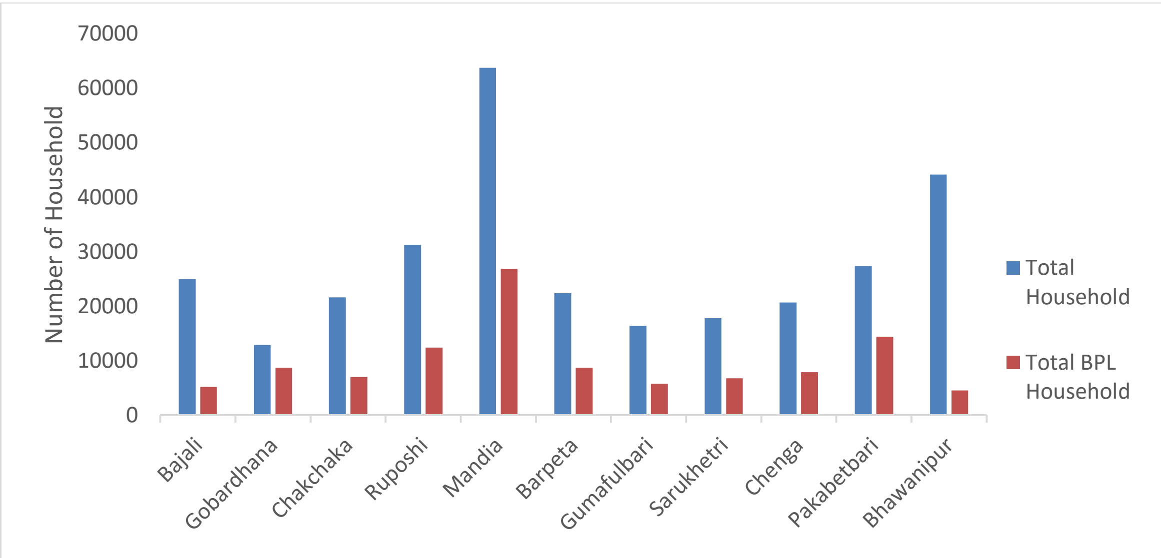

Fig 5.6: Bellow poverty line (BPL) household in 2011

5.1.2.5. Poor inputs and lack of mechanization

In spite of the large scale mechanization of agriculture in some parts of the country, most of the agricultural operations in larger part is carried out by manual work using simple and conventional tools and implements like wooden plough, sickle, etc. Little or no use of machines is made in ploughing, sowing, irrigating, thinning and pruning, weeding, harvesting threshing and transporting the crops. This is specially the case with small and marginal farmers. It results in huge wastage of human labour and in low yields per capita labour force. There is urgent need to mechanize the agricultural operations so that wastage of labour force is avoided and farming is made convenient and efficient. Agricultural implements and machinery are a crucial input for efficient and timely agricultural operations, facilitating multiple cropping and thereby increasing production. The use of inputs are very limited in some villages of Bajali, Sarukhetri and Chakchaka development blocks due to poor economic conditions and lake of awareness of modern techniques.

5.1.2.6. Scarcity of capital

Agriculture is an important industry and like all other industries it also requires capital. The role of capital is becoming more and more important with the advancement of farm technology. The main suppliers of money to the farmer are the money-lenders, traders and commission agents who charge high rate of interest and purchase the agricultural produce at very low price. All India Rural Credit Survey Committee showed that in 1950-51 the share of money lenders stood at as high as 68.6 per cent of the total rural credit and in 1975-76 their share declined to 43 per cent of the credit needs of the farmers. This shows that the money lender is losing ground but is still the single largest contributor of agricultural credit. Rural credit scenario has undergone a significant change and institutional agencies such as

Central Cooperative Banks, State Cooperative Banks, Commercial Banks, Cooperative Credit Agencies and some Government Agencies are extending loans to farmers on easy terms.

5.1.2.7. Manure and fertilizer

Indian soils has using for growing crops over thousands of years without caring much for replenishing. This has led to depletion and exhaustion of soils resulting in their low productivity. The average yields of almost all the crops are among the lowest in the world. This is a serious problem which can be solved by using more manures and fertilizers.

Cow dung provides the best manure to the soils. But it usage is limited because much of cow dung is used as kitchen fuel in the shape of dung cakes in Barpeta district. Reduction in the supply of fire wood and increasing demand for fuel in the rural areas is due to increase in population has further complicated the problem. Chemical fertilizers are costly and are often beyond the reach of the poor farmers. The fertilizer problem is, therefore, both acute and complex. It has been felt that organic manures are essential for keeping the soil in good health. The country has a potential of 650 million tons of rural and 160 lakh tons of urban compost which is not fully utilized at present. The utilization of this potential will solve the twin problem of disposal of waste and providing manure to the soil.

Fertilizer is a prime input to maintain soil nutrition for agricultural productivity. To use of land again and again nutrition of soil decreases and chemical fertilizer is most important for crop production. The main chemical fertilizers of Barpeta district are Nitrogen, Phosphorus (P) and Potash (K).

Table 5.7: Consumption of fertilizer, 2013-14 (in’000’ Tonne)

Sl. No.	Fertilizer	Assam	India
1	Nitrogen (N)	151.25	16750
2	Phosphorus (P)	41.70	5633
3	Potash (K)	80.08	2099
4	Total Consumption	273.03	24482
5	Consumption Rate (in Kg/hect)	65.41	125.4

Source: Assam at a Glance, 2014

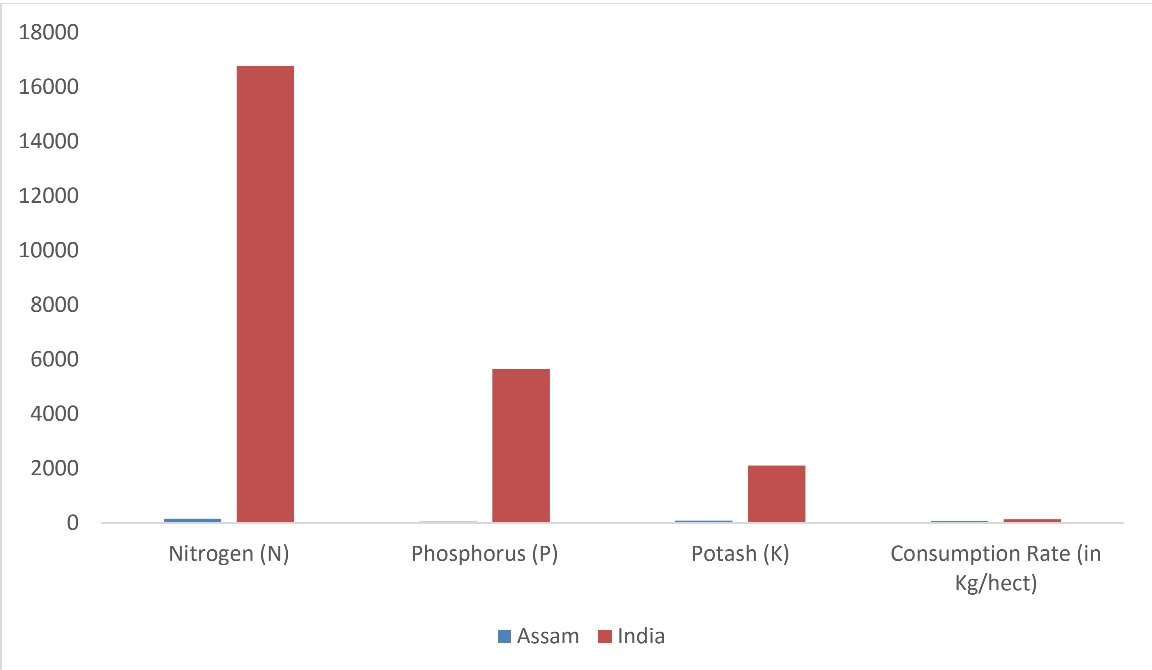

Fig 5.7: Consumption of fertilizer in 2013-14

The consumption of chemical fertilizer is very low in Assam compare to National average. Assam consumes 65.41 kg per hectare chemical fertilizer and Indian consumes 125.4 kg per hectare. It is very low 59.99 kg per hector in Assam than national average. Assam consumes total 273030 tons chemical fertilizer and

India consumes 24482000 tons chemical fertilizers in 2013-14. Among the chemical fertilizer use of nitrogen is highest 151250 tons followed by potash 80080 tones and phosphorous 41700 tons in Assam during 2013-14. The consumption of nitrogen is 16750000 tons, potash 2099000 tones and phosphorous 5633000 tons in India during 2013-14, table 5.7.

Table 5.8: Crop wise consumption of fertilizer in sample villages

Sl. No.	Name of crops	Fertilize (in kg)
1	Irri Paddy	85
2	Shali Paddy	15
3	Ahu paddy	10
4	Jute	18
5	Wheat	20
6	Rape and mustards	40

Source: Primary data, 2014-16

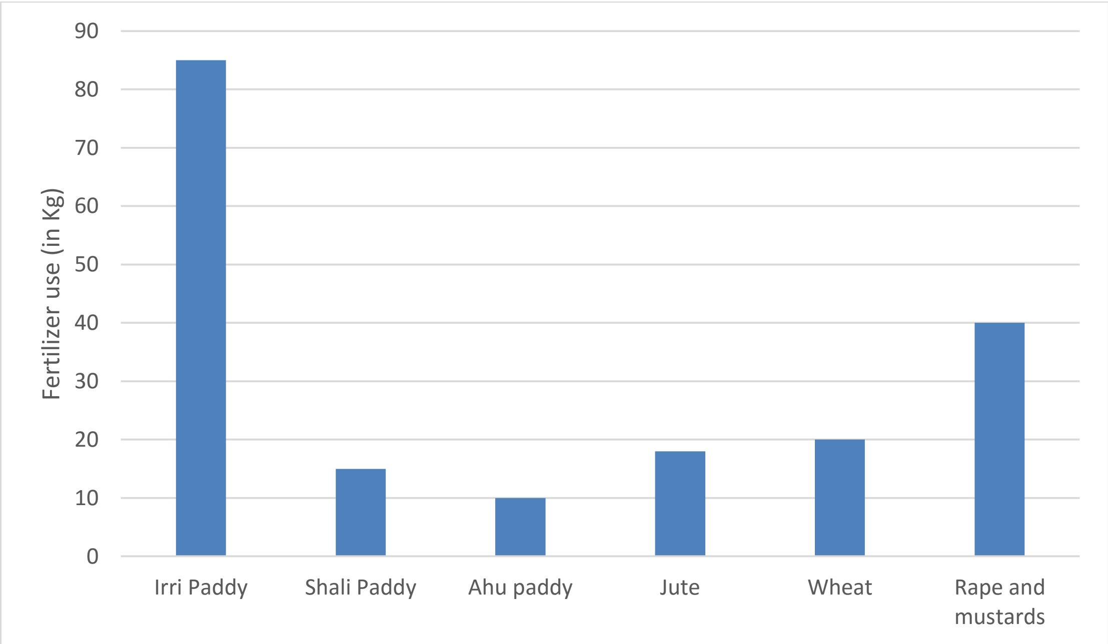

Fig 5.8: Crop wise consumption of fertilizer in sample villages

Table 5.8, shows the use of fertilizers which is very limited in sample villages. The average use of fertilizer is highest in irri paddy which is 85 kg per bigha including nitrogen, phosphorus, and potassium. The highest fertilizer consumers rape and mustard which consumes 40 kg per bigha including nitrogen, phosphorus and potassium. Wheat consumes 20 kg, jute consumes 18 kg, sali paddy 15 kg and ahu paddy 10 kg only in the sample villages. So the productivity is very limited in Barpeta district.

5.1.2.8. Indebtedness of farmer

Agricultural indebtedness has always been a major social and economic issue in India, despite the growth of institutional credit to agricultural, indebtedness among farmers persists. It is said that the farmers are born in debt, live in debt, die in debt and bequeath debt in India. According to NSSO 59th Round 48.6 per cent farmer households were estimated to be indebted and in NSSO 70th Round about 52 per cent of the households in the country were estimated to be indebted. Among the major States, Andhra Pradesh had the highest share of indebted agricultural households in the country (92.9 per cent). Assam (17.5 per cent), Jharkhand (28.9 per cent), and Chhattisgarh (37.2 per cent) were the major States with lowest share of indebted agricultural household.

Table 5.9: Estimated indebted farmer households in Assam and India

State / Country	NSSO 59th Round		State NSSO 70th Round		Increase/Decrease
	In Number	In percentage	In Number	In percentage	In percentage
Assam	4536	18.1	5995	17.5	-0.6
India	434242	48.6	468481	51.9	+3.3

Source: NSSO 59th and 70thRound

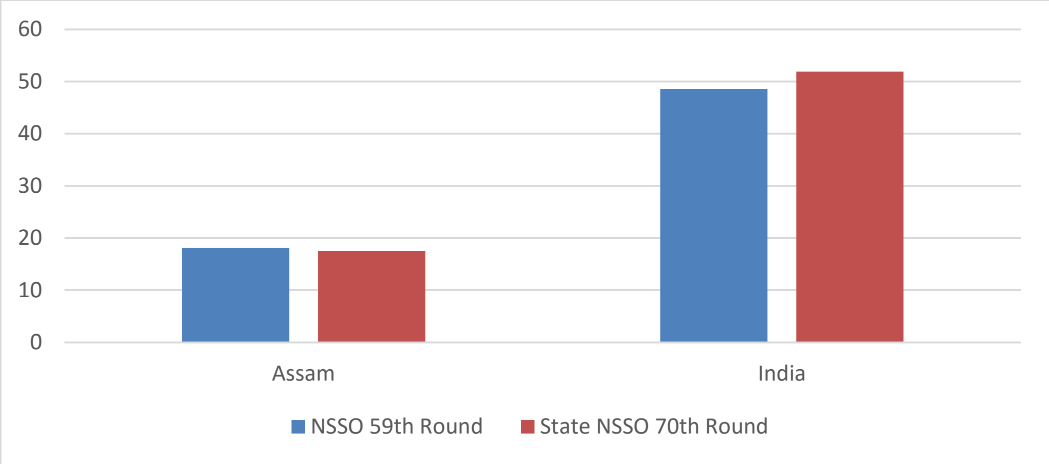

Fig 5.9: Estimated indebted farmer households in Assam and India

Table 5.9, shows percentage of indebted farmer household which is less than half of the Indian indebted farmer household in Assam. Indebted farmer household had 18.1 % in Assam and 48.6% in India as per NSSO 59th Round and it decrease to 17.5 % in Assam and increased to 51.9% in India as per NSSO 70th Round. The indebted farmer household has decreased to -0.6% in Assam and increased to 3.3% in India as per 70th state NSSO round as compare to the 59th NSSO round.

Table 5.10: Outstanding credit and loans in Commercial banks as on March 2011 (Amount in thousands)

District/ State	Bank Credit	Personal Loan	Balance
Barpeta	5244967	2929388	2315579
Assam	196638119	85984938	110653181

Source: Calculated from Statistical Hand Book Assam, 2012

Table 5.10, shows the outstanding bank credit is 5244967 thousand and personal loan is 2929388 thousand in all commercial banks, thus total bank balance is 2315579 thousand as per occupation as on March 2011 in Barpeta district. Barpeta district has 2.67% outstanding bank credit, 3.41% personal loan and 2.09% bank balance of Assam as on March 2011. An outstanding bank credit is 196638119 thousand and personal loan is 85984938 thousand in all Commercial banks, thus the bank balance is 110653181 thousand as per occupation on March 2011 in Assam.

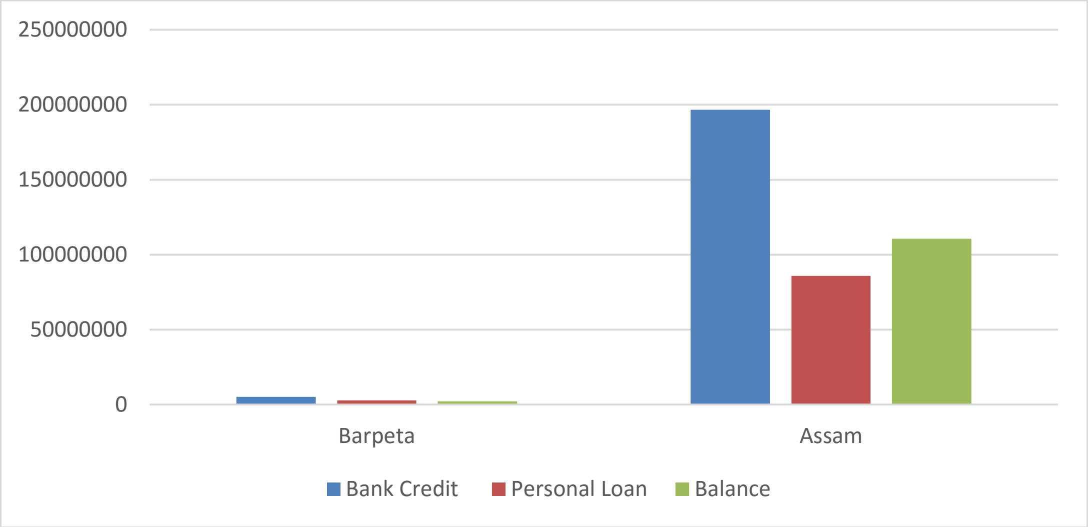

Fig 5.10: Outstanding credit and loans in commercial banks as on March 2011

Table 5.11: Sector wise credit outlay under Annual Credit Plan in Barpeta, 2015-16as on 31.03.2016 (Amount in lacs)

Sl. No.	Sector	Target	Achievement	% of Achievement
1	Crop	12225.19	3021.88	50
2	Agri.& Allied	7638.94	4057.17	38
3	MSME	4519.50	4720.53	104.45
4	Others priority Sectors	7220.71	5656.77	78.34
Total		31604.34	17456.35	55.23

Source: Annual Credit Plan, 2016-17

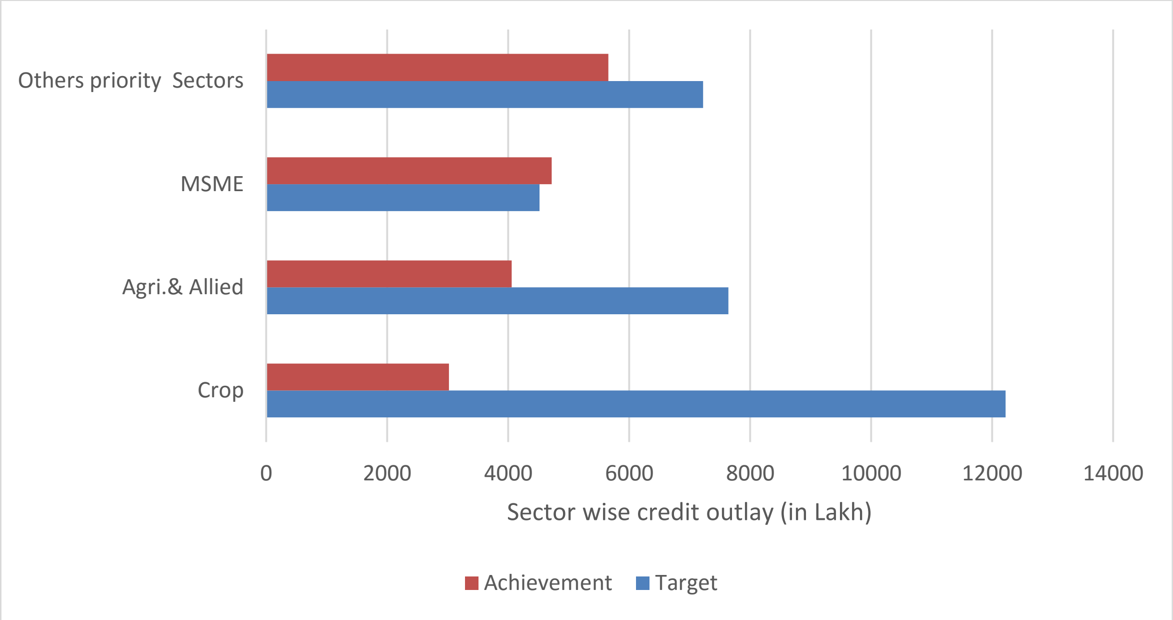

Fig 5.11: Sector wise credit outlay under Annual Credit Plan in Barpeta, 2015-16

Agricultural credit outlay under annual credit plan plays an important role for capital formation of cultivation. Total sectors wise credit outlay target is 31604.34 lakh and achievements is 17456.35 lakh (i.e. 55.23 only) under Annual Credit Plan, 2015-16 in Barpeta. The crop sector achievement for credit outlay was 50% and agriculture and allied sector credit achievement was 38% in Barpeta district in 2015-16. In MSME sector achievement accounts for 104.45% which is more than the stipulated target other sectors achievement i.e. 78.34%. Due to lack of knowledge, awareness among the cultivators and low cooperation with the officials, the achievement of credit outlay is not satisfactory.

Table 5.12, shows 43.27% people are in debt in sample villages of Barpeta district. Among them 36% cultivators are debt in non-institution (private loan). The interest rate in private institution is very high. In private intuition annual average rate of interest is 70.92% whereas bank rate of interest for agricultural loan is 8% per annum. In Chauliabori village 76% cultivators are under debt followed by

Table 5.12: Debt position in Sample Villages (In percentage)

Sl. No.	Name of Village	People in Debt			Non Debt	Rate of interest in Non-Institutional (Annual)
		Institutional	Non Institutional	Total Debt		
1	Jakua Para	8	12	20	80	60
2	Byaskuchi	4	28	32	68	84
3	Tetelirtol	12	36	48	52	60
4	Palshartal	8	60	68	32	60
5	Chauliabori	16	60	76	24	60
6	Kapahartari	12	40	52	48	96
7	MaripurAnandapur	8	28	36	64	60
8	Malipara Char	0	40	40	60	60
9	KharBalli	8	24	32	68	120
10	Kaltali	0	32	32	68	60
11	Bogriguri Gaon	4	36	40	60	60
Average		7.27	36	43.27	43.27	70.92

Source: Primary Data, 2014-15

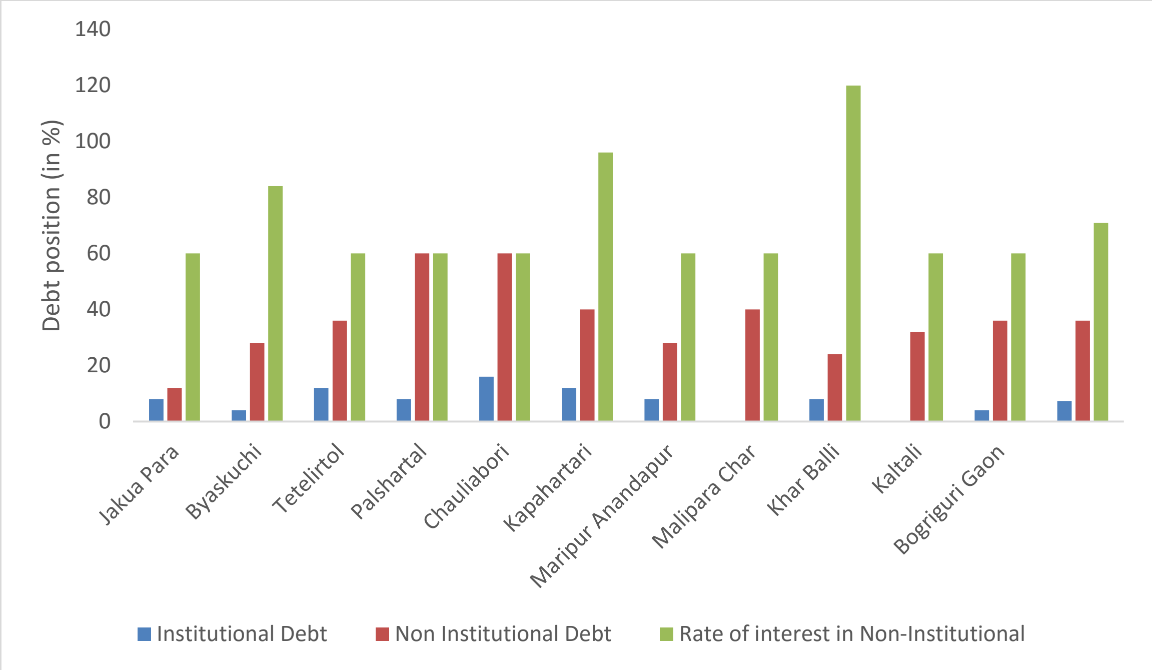

Fig 5.12: Debt position in sample villages

Kapahartari village 68%cultivators are in debt. The institutional debt in Chauliabori village is 16% and private debt is 60%. The farming community in India consists of about 121 million farmers of which only about 20 per cent avail crop loans from financial institutions and only three fourth of those are insured. The remaining 80 per cent (96 millions) are either self-financing or depend upon informal sources for their financial requirements. Most of the farmers are illiterate and do not understand the loan procedure and other requirements of formal financial institutions loan and shy away from them. Therefore, the institutional loans are insured compulsorily under the NAIS, only about 15 per cent of the non-loan farmers avail insurance cover voluntarily.

5.1.2.9.Agricultural research:

Major determinant of growth in agricultural production is the effectiveness of agricultural research and the spread of improved technologies and institution. Agricultural research and extension system is one of the most important needs for agricultural growth and strengthening. This service have declined over time due to chronic underfunding of infrastructure. There is too little connection between research and extension or between these services and the private sector. India has established the world record on rice yields. In 2011, an Indian farmer, Sumant Kumar made a world record by producing 22.4 tons rice per hectare in Bihar in a demonstration plot. This farmer claim to have employed newly developed rice breeds and system of rice intensification (SRI), a recent innovation in farming. The claimed of Chinese and Indian yields have yet to be demonstrated on 7 hectare farm lots and that these are reproducible over two consecutive years on the same farm.

In study area sufficient agricultural research is not done. There is Krishi Vikash Kendra at Howly in Barpeta district. This institution is demonstrating to increase agricultural production and are organizing various type of training programmers for farmers. Maximum cultivators of sample villages has never done soil test and do not know soil quality of field. They are using fertilizers and other inputs with a traditional knowledge and is a health hazards for soil as well as human. The productivity of crops is very low in Barpeta district due to inefficient agricultural research.

5.1.2.10. Storage facilities

The storage is the most important to store crops and reduce post crop loses. But storage facilities in the rural areas are either totally absent or grossly inadequate in Barpeta district. Under such conditions farmers are compelled to sell their produce immediately after the harvest at the prevailing market prices which are bound to be low. Such distress sale deprives the farmers from income and less inputs development. The Parse Committee estimated the post-harvest losses are 9.3 percent of which nearly 6.6 percent occurred due to poor storage conditions. Therefore scientific storage is very essential to avoid losses and to benefit the farmers and the consumers alike.

The farmers of Barpeta district are using three type of house, like Thatch house, Assam Type (A.T.) house and RCC building. Most of the people are using A.T. houses in the study area followed by Thatch and RCC building. The roof of the Assam Type house is made by the aluminous or iron sheets and walls are made by bamboo, jute or iron sheets and floor is prepared with sand. The thatch house is fully traditional house. The roof and walls are made by bamboo or jute and floor with sands. The roof of RCC building is prepared with aluminum or iron sheets and floor and walls are prepared with concrete.

Table 5.13: Storage facilities among Sample villages

Sl. No.	Name of Village	Thatch	A.T.	RCC
1	Jakua Para	0	88	12
2	Byaskuchi	0	92	8
3	Tetelirtol	0	100	0
4	Palshartal	12	88	0
5	Chauliabori	0	100	0
6	Kapahartari	0	100	0
7	Maripur Anandapur	0	100	0
8	Malipara Char	20	80	0
9	KharBalli	40	60	0
10	Kaltali	12	88	0
11	Bogriguri Gaon	0	92	8
Average		7.64	89.82	2.55

Source: Primary data, 2014-16

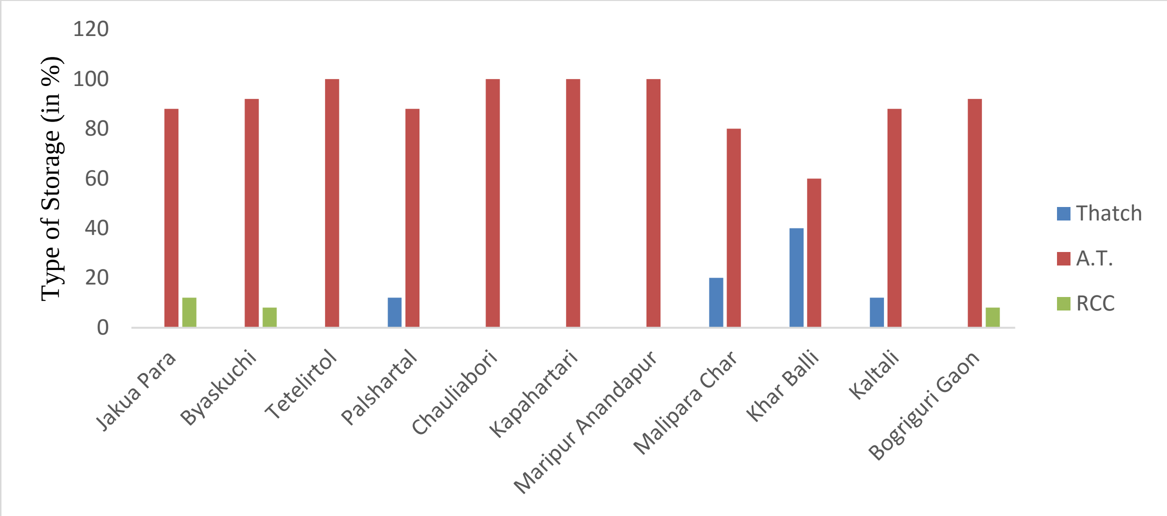

Fig 3.13: Storage facilities among Sample villages

Table 5.13, shows 89.82% people of sample villages are using Assam Type house and 7.64% people are using Thatch houses and 2.55% people are using RCC building for storage crops. The char villagers are mostly using Thatch houses. The households of KharBalli, Malipara Char, Palshartal, Kaltali are using Thatch house, i.e. 40%, 20%, 12% and 12% respectively. Most of villagers are using A.T. house. The 100% households of Tetelirtol, Chauliabori, Kapahartari and MaripurAnandapur villagers are using A.T. house. The RCC buildings are found in 3 village among the sample villages. In Jakuapara village 12% households are using RCC building followed by Bogriguri Gaon and Byaskuchi with 8% each. The thatch and A.T. house is not suitable for the storage the crops due to mud and sand floor. The store houses are submerge by flood water during flood season in Char and river bank areas.

5.1.2.11. Lack of irrigation facilities

Although India is the second largest irrigated country of the world after China, only one-third of the cropped area is under irrigation. Irrigation is the most important agricultural input in a tropical monsoon country like India where rainfall is uncertain, unreliable and erratic India cannot achieve sustained progress in agriculture unless and until more than half of the cropped area is brought under assured irrigation. Barpeta district has very less number of household having the own irrigation equipment (3.96%) than the national average (9.83%) in 2011. But Barpeta district has more household having own pump set followed by Assam (3.72%) and North East India (3.09%).In this district, 3.96% household has own irrigational equipment contrary more than 65% population are engaged on agriculture, table 3.14.

5.1.2.12. Seeds

Seed is basic input for attaining higher crop yields and sustained growth in agricultural production. Distribution of assured quality seed is not sufficient and is critical to production of such seeds. Unfortunately, good quality seeds are out of reach to the majority of farmers, especially small and marginal farmers mainly because of exorbitant prices of better seeds.

In order to solve this problem, the Government of India has established the National Seeds Corporation (NSC) in 1963 and the State Farmers Corporation of India (SFCI) in 1969. In the sample villages all farmers has used traditional seeds which productivity is very low and some farmers has started to use HYV seeds. Minimum productivity of Ahu paddy productivity is 200 to 320 kg per bigha and irri (HYV) paddy productivity is 600 to 1200 kg per bigha in the sample villages which shows to increase agricultural productivity HYV seeds is most essential. This good quality HYV seed is not available in the study area.

5.1.2.1. Market facility

In order to meet the daily requirement and to pay debt, the poor farmers are forced to sell the produce at a price which is offered to farmer. The Rural Credit Survey Report rightly remarked that the producers in general sell their produce at an unfavorable place and unfavorable time and usually they get unfavorable terms. In the absence of an organized marketing structure, private traders and middlemen dominate the marketing and trading of agricultural produce. Most of the benefit goes to the middlemen than the producer which increases the load on the consumer.

Table 5.14: Marketing of products in sample villages (in %)

Sl. No.	Name of village	Time of sale		Causes of Sale	
		Time of high price	After production	Poor economic condition	Lack of storage facilities
1	Jakua Para	20	80	76	24
2	Byaskuchi	16	84	100	0
3	Tetelirtol	24	76	96	4
4	Palshartal	16	84	80	20
5	Chauliabori	8	80	92	8
6	Kapahartari	0	100	84	16
7	Maripur Anandapur	36	76	100	0
8	Malipara Char	0	100	68	32
9	KharBalli	0	100	80	20
10	Kaltali	0	100	92	8
11	Bogriguri Gaon	28	72	72	28
Average		13.45	86.55	85.45	14.55

Source: Primary data, 2014-16

Table 5.16, shows 13.45% farmers sale their products at the time of high price and 86.55% people sale their products at a less price due to poor economic condition and storage facilities. Kapahartari, Malipara Char, KharBalli and Kaltali villages are selling produces after production due to lack of storage facilities and poor economic condition.In these sample villages 85.45% people sale their products after production with low price due to the poor economic condition and 14.55% sale their products with a low price due to lack of storage facilities of farmer. At Byaskuchi and Maripur Anandpur village 100 farmer sale their products due to poor economic condition. Maximum farmers are buying inputs by debt at the time of sowing and are selling produces after the crop harvesting at a very low price. Moreover some farmer has no facilities of storage as a result they are selling produces after the crop harvesting. Farmers of char (riverine delta) and flood affected areas has no permanent storage facilities and store house are flooded at the time of flood. In order to save the farmer from the clutches of the money lenders and middle men, the government has come out with regulated markets. These markets generally introduce a system of competitive buying, help in eradicating malpractices, ensure the use of standardized weights and measures and evolve suitable machinery for settlement of disputes thereby ensuring that the producers are not subjected to exploitation and receive remunerative prices.

3. Seasonal variation in price

Seasonal variation of price highly influence on the economic condition of poor farmer. At the peak post harvesting season the price of crops decrease to a lowest level. This time farmer come to sale their commodities due to poor economic condition and lack of storage facilities. And the price of commodity decreases by intelligent stocker and wholesaler. These commodities are stored by the wholesaler and the price of the commodity increases to double or more than double after the peak season in the district. Ultimately farmer economic conditions are badly affected and the stockers are highly benefited than the producer.

Table 5.15: Season wise price of commodities. (In Rs./per quintal)

Sl. No.	Major Crops	Peak Season	Offseason	Difference
1	Rice	875	1500	625
2	Wheat	1550	1750	200
4	Jute	1500	3000	1500
5	Rape Mustard	3000	4500	1500
6	Potato	700	2500	1800
7	Onion	1000	2000	1000

Source: Primary data, 2015-16

Table 5.15, shows, the price of rice is Rs. 875.00 in peak season and the price increased to Rs. 1500.00 per quintal in offseason. On the other hand price of wheat, jute, oilseed, mustard, potato and onion are Rs. 1550, 1500, 3000, 700 and 1000 per quintal respectively in peak season and in offseason prices are Rs. 1750, 3000, 4500, 2500 and 2000 per quintal respectively. The price of potato increased more than 3

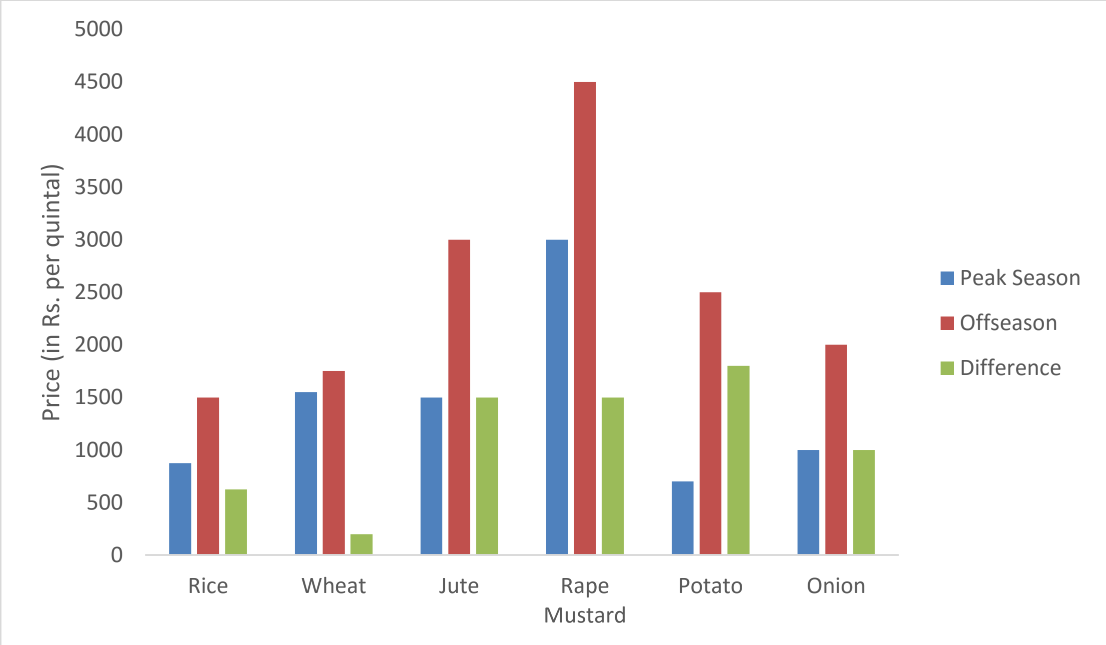

Fig 5.14: Season wise price of commodities

times and the price of onion shifted to double between peak season and offseason. The prices of rape mustard, onion, jute etc. has increased to double in 2015-16.

5.1.2.2.Inadequate transport and communication system:

One of the main handicaps of agriculture is lack of cheap and efficient means of transportation in Barpeta district. Even at present there are many villages which are not well connected with main roads or with market centers. Most roads in the rural areas are Kutcha (bullock cart roads) and become useless in the rainy season. Under these circumstances the farmers cannot carry their produce to the main market and are forced to sell it in the local market at low price. Linking each village by metalloid road is a gigantic task and it needs huge sums of money to complete this task. A small portion of Barpeta district is connected by railways which is only 47 km in northern side and there is no air transportation facilities.

5.1.2.3. Low agricultural output

Low agricultural output determines the low farm profit. It influence on the cultivator life style, agricultural pattern, poverty, inputs development etc. Profit shows the farmer gain after taking in to account the full production costs in the farm with compare to all total farm production.

Profit = Total gross productions of farm – total production cost of farm

The amount obtained is higher in value then the total production cost, it is an indicator of profit. And the amount obtained is lower in value then total production cost, it is an indicator of loss. These production costs are field preparing, fertilizer, labour, irrigation, pesticides, insecticides cost etc.

Table 5.16: Production cost, output and benefit in sample villages

(inRs./per bigha)

Sl. No.	Crop	Production Cost	Output	Profit
1	Irri paddy	5406	8100	2694
2	Sali	1644.5	3275.8	1631.3
3	Ahu	2641	3050	409
4	Wheat	1933	2833	900
5	Oilseeds	1333	1833.3	500
6	Jute	1736	4900	3164

Source: Primary data, 201-15

Table 5.16, shows the profits of all crops are not equal in the district. The profits of jute is highest followed by Irri (HYV) paddy, Sali paddy, Wheat, Oilseeds and Ahu Paddy among the crops in sample villages. The production cost of Jute is Rs. 1736.00, output value is Rs. 4900.00 and profit is Rs. 3164.00. The input cost of

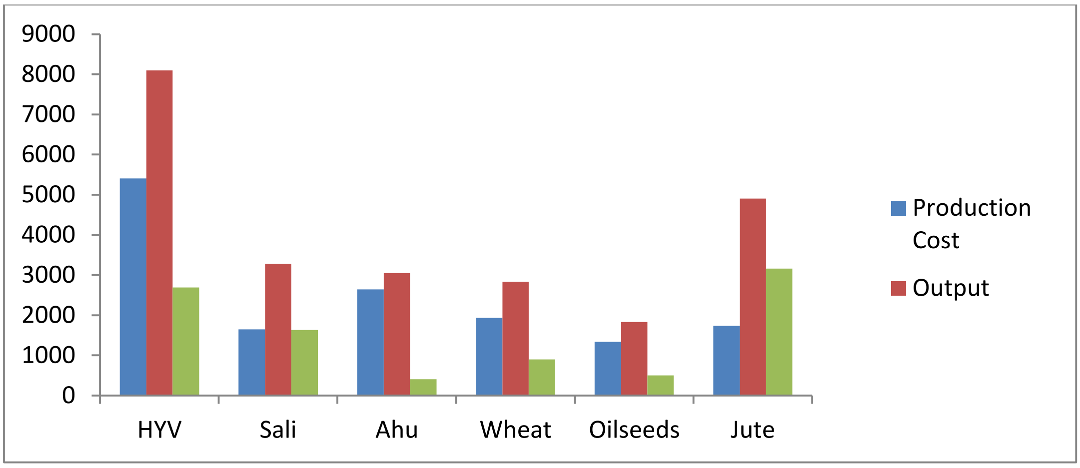

Fig 5.15: Production cost, output and benefit in sample villages

jute is low compare to Irri Paddy, but profit is more than Irri paddy. The production cost of Irri paddy is Rs. 5406.00, output value is Rs. 8100.00 and profit is Rs. 2694.00. The input cost and profit of Irri paddy is highest among the other verities of paddy in the district. The production cost of Ahu paddy is Rs. 2641.00, output value is Rs. 3050.00 and profit is Rs. 409.00 in the sample villages. The input cost, output values and profits are very low for the Ahu paddy and ahu paddy is replacing the crop by Irri and Shali paddy. The input cost, output values and profits of wheat isRs. 1933.00, 2833.00 and 900.00 respectively among the sample villages. The input cost, output values and profits of oilseeds are Rs. 1333.00, 1833.30 and 500.00 respectively. The profits of oilseeds is low but the oilseeds help to maintain the soil fertility. In a normal condition, if input is high than the output is also high, as a results profit is also high of the crops.

The input cost, output value and profit is not equal among the sample villages. The input cost and output value is highest in Tetlirtale village and lowest in Palahartal and Biyakuchi village for Irri paddy among the sample villages. The input cost is Rs. 7000.00 and output value is Rs. 9200.00 in Tetlirtale village in Irri paddy.

And input cost is Rs.2400.00 and 2750.00 and output value is Rs. 8400.00 and 6800.00 in Palahartal and Biyakuchi village respectively for Irri paddy.

Table 5.17: Crop wise production cost, output and profit in sample villages

(per bigha)

Name of village	Irri		Sali		Ahu		wheat		oilseed		Jute	
	Cost	Output	Cost	Output	Cost	Output	Cost	Output	Cost	Output	Cost	Output
Jakua Para	0	0	1284	2456	0	0	0	0	0	0	0	0
Byaskuchi	2750	6800	1596	3400	0	0	0	0	0	0	2750	6800
Tetelirtol	7000	9200	0	0	0	0	0	0	1500	2400	7000	9200
Palshartal	2400	8400	0	0	0	0	2000	2500	1100	1000	2400	8400
Chauliabori	6500	8000	3000	3200	0	0	2200	3000	2300	2400	6500	8000
Kapahartari	6000	8000	2500	4000	0	0	0	0	1600	2400	6000	8000
MaripurAnandapur	0	0	1700	4000	0	0	0	0	750	1400	0	0
Malipara Char	6500	8000	676	2600	2724	2850	1600	3000	0	0	6500	8000
KharBalli	5800	8000	0	0	3000	3500	0	0	0	0	5800	8000
Kaltali	6300	8400	700	2550	2200	2800	0	0	0	0	6300	8400
Bogriguri Gaon	0	0	1700	4000	0	0	0	0	750	1400	0	0

Source: Field survey data, 2014-16

The production cost of other villages is from 5800.00 to 6500.00 for Irri paddy. The production cost of Sali paddy is highest in Chauliabari village (Rs. 3000.00) and lowest in Malipara Char Rs. 676.00 and output values are Rs. 3200.00 and 2600.00 respectively.

5.1.2.4. Lack of public awareness

Farmers has lack of awareness about the new inputs and technologies of agriculture. Lack of awareness among the poor farmer about the available government schemes has been found to be a matter of serious concern. It prevents a sizeable section of the people from getting the necessary support. Market intelligence plays a vital role in marketing agricultural produce. If the information of commodity prices prevailing in various markets is made available, the farmers will be able to get better price to their produce by moving their produce to the market which pays higher.

Table 5.18: Public awareness and cooperation with government agencies

Sl. No.	Name of Village	VLEW	Office Visited	Training	Soil Testing
1	Jakua Para	4	0	0	0
2	Byaskuchi	12	8	0	0
3	Tetelirtol	20	0	0	0
4	Palshartal	24	0	0	0
5	Chauliabori	20	0	0	0
6	Kapahartari	16	0	0	0
7	MaripurAnandapur	20	0	0	0
8	Malipara Char	0	0	0	0
9	KharBalli	12	0	0	0
10	Kaltali	16	0	0	0
11	Bogriguri Gaon	28	0	0	0
Average		15.64	0.73	0	0

Source: Field survey data, 2014-16

Table 5.18, shows the public awareness of the agricultural program in the study area 15.64% people knows the village level extension worker. VLEW is a grass root level worker for agricultural people to information of cultivation, training and helps people. But maximum people is unable to know about VLEW. According to the farmer,0.73% official of agricultural department has visited in the field. The farmer of the sample villages do not get training and never make soil testing and do not know about the importance of soil testing.

5.1.2.5.Scarcity of labour

The National Commission explanation on agricultural labour is one who is basically unskilled and unorganized and has little for his livelihood, other than personal labour. A person, who derive major part of income as payment for work performed in the farm of other farmer and major part of year work as agricultural worker can be designed as agricultural labor. The shares of main and marginal workers are cultivators 36.53% and agricultural labor are 17.61% in Barpeta district in 2011. On the other hand, 33.93% of the populations are engaged on cultivation and 15.42% are agricultural labor in Assam.

Table 5.19: Labor availability in the sample villages (in Percentage)

Sl. No.	Name of village	Available	Seasonal	Not available
1	Jakua Para	12	48	40
2	Byaskuchi	20	72	8
3	Tetelirtol	20	80	0
4	Palshartal	20	60	20
5	Chauliabori	8	84	8
6	Kapahartari	24	64	12
7	MaripurAnandapur	16	84	0
8	Malipara Char	4	96	0
9	KharBalli	16	64	20
10	Kaltali	28	72	0
11	Bogriguri Gaon	16	60	24
Average		16.73	71.273	12

Source: Primary data, 2014-15

Table 5.19, shows that more than 71.27% people faces scarcity of labour at the time of crop sowing and post harvesting period and 12% people faces scarcity of labour for cultivation among the sample villages. The main cause of lack of agricultural labour is for the migration of labour from village to urban areas.

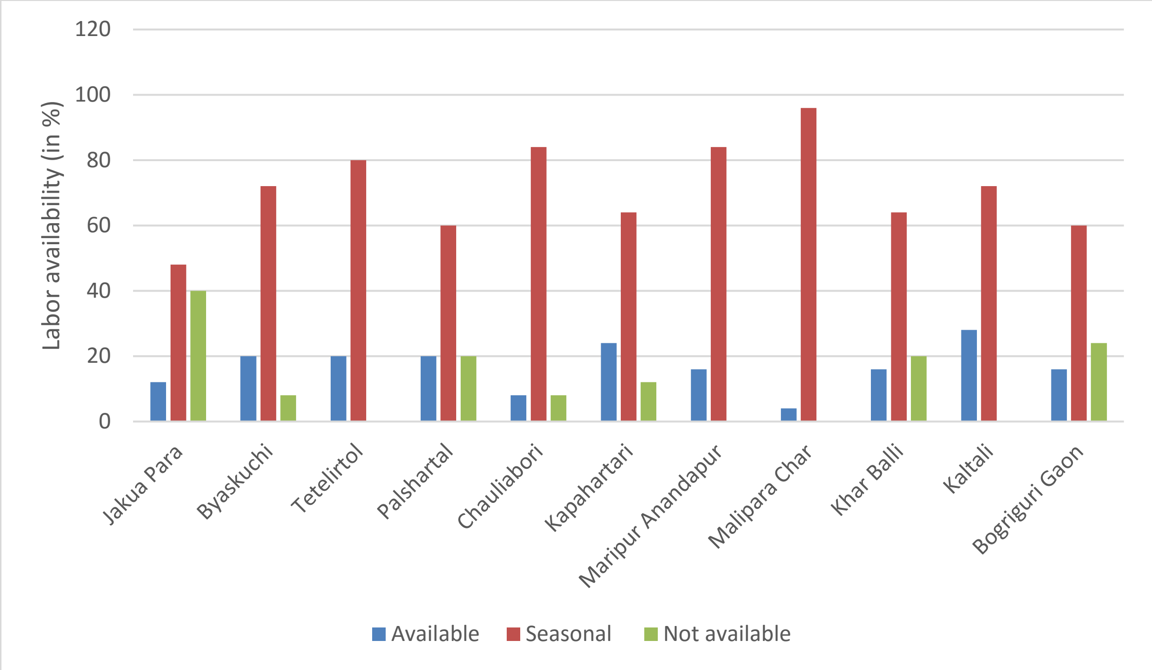

Fig 5.15: Labour availability in the sample villages

The seasonal scarcity of labour is highest in Malipara Char for chronically flood and over migration of labour to urban area and other state as a result the wages of labour is also very high at peak harvesting season. The main causes of non-availability of labour are low agricultural productivity, small land holding size, natural hazards etc. As agricultural productivity and income grow as fast as non-farm output, labour will gradually transformed to farm from non-farming activity.

5.1.2.6. Narrow religious mind

Barro and Mc. Cleary (2003) point out economic development causes individuals to become less religious, as measured by church attendance and religious beliefs. The secularization hypothesis also encompasses the idea that economic development causes organized religion to play a less important role in political decision making and in social and legal processes more generally. B. Burnham (1986) reviews several studies of IQ and religiosity and concludes that more intelligent people tend not to believe in religion. Barro and Mc Cleary (2003) investigated the effects of religiosity on aggregate economic performance and found that economic growth responds positively to the extent of religious beliefs, but negatively to church attendance. There is no variation in cultivation in the study area. The pig farming is practiced by the Bodo people and Muslim is fully absence from pig farming due to religious belief in Barpeta district. The muslim people are highly engaged in agricultural activity due to poor economic condition and lack of government and private sector jobs.

5.1.2.7.Migration

The study reveals that people are migrated to other places due to chronically natural calamities like flood, drought, small agricultural land holding and low outputs of crops etc. The river bank erosion is one of the major causes of migration due to river bank erosion a large number of people has been lost homestead and cultivated land and become shelter less. As a results people are migrated to town, other places of state, outside of state and other states of North East states in search of employment. They mostly work as security guards, rickshaw pullers, daily wager etc. in the urban areas. Most of the youth migrate to states like Kerala, Andhra Pradesh, Delhi, Uttar Pradesh, Maharashtra and Middle East countries to find employment opportunities as semi-skilled laborers in factories and as a security guards. Migration has been a major problem for the people of Barpeta district as the workforce has been gradually decreasing in this district. According to respondent migrated illiterate Muslim and Hindu Bengali people are facing a lot of problems as a name of doubtful Bangladeshi in the North Eastern States. At the time of sowing and post-harvest period large numbers of labour requires and due to migration farmers face the problem of labour.

5.2. Strategy for Agricultural Development

Agriculture faces multi type challenges during the time of operation. The modernization of agriculture results in qualitative and quantitative improvement of firm input. Agricultural production can be increased through the judicious use of land, labour and farmers involvement with improvement of seeds, fertilizers, irrigation, method of practicing and technological transformation in Barpeta District. The strategies for agricultural development can be classified as General, Pre harvest or Operational and Post harvesting strategy.

5.2.1. Operational strategy

5.2.1. Productivity

Raising productivity per unit of land will need to be the main engine of agricultural growth as fundamentally all cultivable land is farmed. The use of modern inputs in agricultural can raise productivity with reducing agricultural risk. Productivity of crops can increase by rational use of high yield varieties, fertilizers, liming, irrigation, pesticides, herbicides etc. Fertilizers are primary plant nutrients like nitrogen, phosphorus and potassium and secondary nutrients such as sulfur, zinc, copper, manganese, calcium, magnesium and molybdenum on deficient soil. Liming is most important for the acid soils to raise pH and to provide calcium and magnesium. The productivity can also increase through adopting new practices and management like diversification to higher value of crops, developing value chains to reduce marketing costs, increasing cropping intensity, crop rotation, crop combination etc.

5.2.2. Modern Technology

Matson (1997) observed that total area of cultivated land worldwide increased 466% and yields increased because of selectively bred high-yielding varieties, fertilizers, pesticides, irrigation and machinery. Matthew Scully (2002) explained global agricultural production doubled between 1820 to 1920,between 1920 to 1950,between 1950 to 1965 and between 1965 to 1975 to feed a global population that grew from one billion in 1800 to 6.5 billion in 2002. Increase of production and productivity is possible by adopting modern technologies to agricultural activities only. In the study area farmers are highly affected by seasonal variation rainfall and this problem can solve by adopting irrigation facilities. The fertility of soil is depleting for lack of crop rotation and intensity of cropping. Other problem like scarcity of labour and affect of pesticides and herbicides can be managed by adopting modern technologies. Post crop harvesting losses can be dipping through use of technology.

5.2.2. Control of flood

Control of flood is most important for agricultural and socio-economic development in Barpeta district. Every year large number of agricultural land, standing crop, fertile soils are wash away and fertile soil are submerge by the unfertile sandy soils etc. in the study area. To control the unprecedented floods in the country in 1954, the Govt. of India announced a National Policy on Floods comprising three phases viz.-

1. The immediate,
2. The short term and
3. The long term measures.

The Water Resources Department has taken up works primarily for the general development of the rural sector and for the protection of major townships in both side of Brahmaputra. The main measures for flood controls are taken up:

1. Construction of Embankments and Flood walls
2. River training and bank protection works
3. Anti-erosion and town protection works
4. River channelization with pro siltation devices
5. Drainage improvement/ Sluices`
6. Raised Platform
7. Flood forecasting and warning
8. Flood zoning

But till date, no long-term measures has been implemented to mitigate the flood and erosion problems of the state. Immediate and short-term measures are implemented by the state Water Resources Department is taken up. In the study area, length of Embankment is 188.974 km against 4473.82 Km embankment of Assam. Various programs like river bed digging, porcupine system, river channelize or any other scientific measurement to stop flood may be implemented in Barpeta district. In 2017, government of Assam is planning to dig the bed of Brahmaputra which will be a very effective measures for flood control.

5.2.3. Control of river erosion and rehabilitation of river eroded family:

Anti-erosion program like river bed digging, porcupine system, river channelize or any other scientific measurement to stop river bank erosion has to be implemented. Especially digging the bed of river Brahmaputra to allow passing huge volume of water through one major channel is most important measures of bank erosion. This deep channel can be used as national and international water ways. In the study area the Brahmaputra river and tributaries carries a huge volume of water in rainy season from the hilly state of North East India and river bank erosion take an intensification.

Rehabilitation is most essential for river eroded families. River eroded families has converted to shelter less and insecurity of livelihood. The erosion affected families of the study area can be classify as homestead and agricultural land less family, homestead less family and agricultural land less family. These families are transforming to landless labor, bagger, illiterate, robber, murderer, etc. and are taking shelter temporarily in the compact road and embankment side or government khash or reserve land, forest land, char land, religious or educational institute.

The government of Assam has taken various scheme for rehabilitation of erosion affected families. In the Chief Minister's Special Scheme for Rehabilitation of Erosion Affected Families in Assam in 2015 in order to rehabilitation of homestead and landless families are as follows:

1. Rehabilitation packages for homestead and land less families by erosion:
    a. A plot of land measuring at least 1 bigha for homestead purpose,
    b. A cash amount of Rs. 75000.00 for construction of home and
    c. 3 bighas of agricultural land subject to availability of government land or financial grant equivalent to cost of 4 bighas.
2. Rehabilitation packages for homestead less families by erosion:
    a. A plot of land measuring at least 1 bigha for homestead purpose or equivalent of cost of one bigha lands.
    b. A cash amount of Rs. 75000.00 for construction of home and

c. 1.5 kathas for bighas of land or a financial assistant of Rs, 2.00 lakhs for homestead and Rs. 75000.00 for construction of home. So that the beneficiaries can arrange for their settlement.

3. Rehabilitation packages for agricultural land less families by erosion: A plot of land measuring at least 3 bighas of agricultural land subject to availability of Govt. land or financial grant equivalent to cost of Rs. 2.00 lakh for land ceiling. So that beneficiaries can arrange for livelihood.

5.2.3. **Adaptation of flood friendly strategy**

People of the study area adopt flood friendly strategies. The adaptation processes includes people moving to raised areas during flood and generally live in stilt houses *(*changghar) during flood time. Farmer can cultivate water resistant paddy and short periodic paddy in flood affected areas or using other water resistance crops like jute, mesta etc. The choice of crop cultivation and identification of worst areas affected by flood is based on the place based tacit knowledge. Deep water or floating varieties of rice has the capacity to elongate their submerged stem internodes by 25 cm per day, at pace with a slow-rising flood in a seasonal wetland (Kende et al., 1998). These plants can reach heights of 8 m but are typically low yielding due to the high investment of energy reserves in underwater biomass. In some regions of Asia or Africa, deep water rice cultivation is extensive and can be effectively coupled with fish and oyster production. Agricultural Research Station (RARS) of Assam Agricultural University at Titabor has developed a submergence resistant gene in rice variety of Ranjit which will bring good harvest to flood-hit farmers offering great relief to them in 2010.The SUB1 locus of FR13A has been bred into 10 varieties favored by farmers in different locales of south and South East Asia. The rapid adoption of Sub1 rice by farmers is attributed to its effectiveness, high similarity to the varieties it replaces, and involvement of farmers in the varietal selection (Singh et al., 2009; Manzanilla et al., 2011). Encouragingly, wide hybridization of wheat species is the Triticumaestivum resulted in amphiploid hybrids with improved root aeration in flooded conditions (Malik et al., 2011).

Moreover drought-tolerant crops are crucial to helping ensure global food security and can reduce the impact of drought on the national economy. A 2015 Climate Council report found that the Australian GDP fell one per cent due to drought and lower agricultural production in 2002 and 2003. Drought normally hits wheat at the flowering and seed stage, which is critical in determining the size of a crop's harvest. By activating the sensor alarm faster during a dry season, the plant can activate counter-measures in its leaves to prevent unnecessary water loss and ensure that the plant survives until the next rainfall.

5.2.4. Development of new irrigation facilities

Irrigation is an important device in modern agriculture due to uncertainty of rainfall and seasonal variation of rainfall in Barpeta district. The area under irrigation is increasing continuously from time to time. It is most viable source of investment as to helps in increasing agricultural output and generates rural employment by allowing agricultural activities throughout the year. Irrigation enable farmer to take up multiple cropping and facilitates for increasing agricultural land. And due to the uncertainty of rainfall and dry in winter season in Barpeta. The development of irrigation is most important for development of agriculture. Underground water is available to lifting water for development of irrigation facilities in the study area. The high density of perennial rivers are available to generate cannel irrigation facility. In rainy season’s rainfall water are abundant which we can use for irrigational purpose by water harvesting. The rain water harvesting can also facilitate for irrigation because monsoon season receives heavy rainfall in Barpeta.

5.2.5. Farmer credit facilities

Capital is most important factor in shaping cropping pattern of a region. All agricultural inputs like seeds, fertilizer, insecticides, pesticides, feeding staff, labour, purchase of land, agricultural equipment, development of irrigation etc. are require in credit. Formation of credit facilities is most important to fulfill the firm requirement and management. Government is issuing Kishan Credit Card (KCC) to cultivator for credit formation with a limited interest. The bank disbursed 5281 numbers KCC against the target of 14120 numbers KCC in 2015-16. The achievement of KCC is 37.40% against the target of KCC in 2015-16 for Barpeta district. The causes of unsatisfactory achievement to disbursement of KCC is the lack of farmer awareness, inefficient official and difficult procedure for disbursement of KCC. Illiteracy is a major cause of lack of public awareness and farmer has less self-confidence to speak with official person. At the time of KCC disbursement lot of documents are required and farmer finds difficulties in submitting the requires document in this way many farmers lost the opportunity of KCC.

5.2.6. Promoting agricultural diversification to higher-value commodities

Encouraging farmers to diversify higher value commodities will be a significant factor for higher agricultural growth, particularly in rain-fed areas, where poverty is high. Moreover, considerable potential exists for expanding agro-processing and building competitive value chains from producers to urban centers and export markets. While diversification initiatives should be left to farmers and entrepreneurs, the Government can, first and foremost, liberalize constraints to marketing, transport, export and processing. It can also play a small regulatory role, taking due care that this does not become an impediment.

Some agricultural sub-sectors have high potential for expansion, especially fishing, dairy and vegetable in Barpeta district. Milk production is constrained by the poor genetic quality of cows, inadequate nutrients, inaccessible veterinary care and other factors. If these dairy farming are transformed to the high verities of genetics will more productive. Bajali development block is well known for dairy production. Fishing is a major sector of income generation in low laying area where waterlogging are abundant. The study area is low laying area, and sufficient rainfall receives during monsoon and is most suitable for the fishing. The income of vegetable farming is very high and people can extensively adopt vegetable farming in raised area during rainy season.

5.2.7. Pest, insect and weed management

Pest and diseases are major constraint for the agricultural development. Crops are damaged and affected to low production in agriculture every year in the world wide. The notable diseases of crops are Sheath Blight, Bacterial Blight, Rice Blast, Rice yellow, mottle virus, sheath rot, bakanae, brown spot, narrow brown spot, Bacterial Leaf Streak, Grassy stunt, etc. in study area. The pest and diseases are control by use of pesticides and sprayed through pesticides sprayer. In some villages of Sarukhetri, Bajali and Ruposhi development block are fully avoiding the use of pesticides, insecticides etc. and crops are damaged in these area by pest and insects.

In agriculture, systematic weed management is usually required to decrease agricultural loses. The weeds are generally cleaned by the labour in the study area which is more expensive. And gradually uses of herbicides are adopting and these isoften performed by liquid herbicide sprayer's machines. Herbicides kill specific targets while leaving the crop relatively unharmed. Weed control through herbicide is made more difficult when the weeds become resistant to the herbicide. Herbicides are less expensive than the labour. Through awareness generation on use of insecticides, pesticides, herbicides etc. may decrease the crops damages in Barpeta district.

5.2.8. Landholding size

Land holding size is an important factor for agricultural growth. The area under agriculture is continuously varying from time to time due to various factors. One of the important factors is rainfall fluctuations and secondly adoption of modern agricultural technology which has been influencing cropped area under cultivation. In Barpeta district, distribution of land holding size is not equal among the farmers. Marginal operation holder is 57.09% followed by small operational holder 23.22% and large operation holder is 0.04% in 2010-11, table 3.8. The small land holding size has badly influence in the cropping pattern and use of modern technology in the agricultural field. Efficient operational holdings of farmers can be economically viable and profitable. The problem can be manage through forming farmer SHG participatory approach and community action on cluster basis.

5.2.8. **Construction of Drying Yards in the Villages**

In order to minimize the post-harvest losses in grains, government has taken up construction of drying yards at village level. Out of 10% agricultural commodity wastage, 6% loss is due to lack of proper post-harvest practices. During the year 2007-08 constructions of 100 Drying Yards at the cost of Rs. 2.50 crores is under progress and this scheme has continued up to 2008-09.

Drying yards is most essential in study area. Kharif crops harvesting period is rainy or flood season at this time crops are damages due to lack of drying yards in Barpeta. Most of the places of study areas are flooded area and cultivators drying places are under water during this period. The drying yards is most essential in the study area due to more low laying area and chronicle floods. Farmer can also construct drying yard in a participatory approach and government should take some schemes for construction of drying yards extensively.

5.2.9. Agricultural awareness

Agricultural Awareness is a program to promoting agriculture and agro foods sector and provides information to all residents on the benefits of agricultural development. It provides information of funding to producers, community organizers, and agribusiness, public and private agencies to develop and implement agriculture awareness and education. Agricultural awareness provides information of new adaptation and management of agriculture. The agricultural awareness includes planning information of documents, training and education campaigns. The awareness can reach to every household through proper planning, hosting workshops and conferences, recruiting and training spokespersons. Mass media such as websites, videos, displays, publications, advertisement etc. will bring public awareness. In Barpeta district, most of cultivators are illiterate and they do not have basic knowledge of modern adaptation. So extensively village level awareness program will bring a revolutionary change of agriculture in Barpeta.

5.2.10. Population control

Population pressure is emerging challenges worldwide. It creates defragmentation of land holding size and 57.09% household has been occupied 0-1 hectors land in Barpeta in 2010-11, table 3.8. The small land holding size creates hamper in adaptation of new technology in agricultural operation. The population density is 632 per sq. km in 2011. The decadal growth rate of population is 21.40% in the period 2001-11compare to average growth rate is 16.93% in Assam, but cultivable lands are not increasing as population growth. The new cultivable land are occupying for home shed, expansion of urbanization, industrialization, road network etc. As a result population control is most important for agricultural growth in Barpeta district. Population can be control through awareness creating.

5.2.11. Crop rotation

Crop rotation is most important adaptation for soil health protection in Barpeta district. Crop rotation is a practice of growing a series of dissimilar types of crops in the same space in sequential seasons for benefits such as avoiding pathogen and pest buildup that occurs when one species of crop is continuously cultivated. Crop rotation helps to balance the nutrient demands of various crops to avoid depletion of soil nutrient. A traditional component of crop rotation is the replenishment of nitrogen through the use of legumes and green manure in sequence with cereals and other crops. Crop rotation can also improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants. In the study area Rabi crops like rape and mustards, pulses and other species of small rooted plant can help to create soil nitrogen level. This crop root is able to produce nitrogen and reduce use of fertilizer for next Kharif crops. The Kharif crops like jute, mesta etc. can also increase soil nutrition level. Through massive public awareness on crop rotation may reduce depletion of soil health in Barpeta.

5.2.12. Sustainable agriculture

Sustainable agriculture is eco-friendly farming and has been defined as an integrated system of plant and animal production practices having a site-specific application that will last over the long term. In recent decades steady increase of population has increased the practice of agricultural land conversion to meet demand for food and has increased effects on the environment. Organic farming is a multifaceted sustainable agriculture set of practices that can have a lower impact on the environment at the small scale. The principle of the organic farming is to satisfy human food and fiber needs, to enhance environmental quality and natural resource, to make most efficient use of non-renewable resources and on-farm resources and integrate, to sustain the economic viability of farm operations, to enhance the quality of life for farmers and society as a whole.

The declaration for Healthy Food and Agriculture, (November 3, 2013), "We, the undersigned, believe that a healthy food system is necessary to meet the urgent challenges of our time. Behind us stands a half-century of industrial food production, underwritten by cheap fossil fuels, abundant land and water resources, and a drive to maximize the global harvest of cheap calories. Ahead lie rising energy and food costs, a changing climate, declining water supplies, a growing population, and the paradox of widespread hunger and obesity".

Organic manures are essential for keeping the soil in good health for sustainable development. The country has a potential of 650 million tons of rural and 160 lakh tons of urban compost which is not fully utilized at present. The utilization of this potential will solve the twin problem of disposal of waste and providing manure to the soil. Extensive use of organic fertilizer like vermicompost, cow dang, burning firewood, etc. will help for the development of sustainable agriculture in the study area. Crop rotation can also increase the soil fertility which can decrease the effect of pest and disease. Vermicompost are started in Barpeta district by the women Shelf Help Group. Awareness creation on the organic farming will facilities for sustainable agriculture.

5.2.2. Strategies for Post-Harvest Stage

5.2.2.1. Development of storage facility

Adequate storage facilities are essential to save farmer from exploitation at the time of post harvesting in Barpeta district. This will enable farmers to store the produces safely, avoiding damage due to rains, floods, pilferage and spillage. At present there are number of agencies engaged for warehousing and storage activities. The Food Corporation of India (F.C.I.), the Central Warehousing Corporation (C.W.C.) and State Warehousing Corporation are among the principal agencies engaged in this task. These agencies help in building up buffer stock, which can be used in the hour of need. The Central Government is also implementing the scheme for establishment of national Grid of Rural Godowns since 1979-80. This scheme provides storage facilities to the farmers near their fields and in particular to the small and marginal farmers. In Barpeta district, cold storage are most important because at the time of post harvesting season of kharif crops heavy rain occurs and crops are damaged.

5.2.2.2.Modern technology for crop harvesting

Modern crop harvesting technology will help to reduce post crops losses. Capacity building of farmers can increase to adopt technology and centers at strategic locations to supply reasonably priced quality seeds, fertilizers, pesticides and farm equipment. These technologies will help to solve the problem of crops cutting, drying, packaging at the time of peak season and extreme weather when labours are not abundant.

5.2.2.3.Use of ultra-modern seeds

Agriculture is affected chronicle flood and seasonal drought in Barpeta in every year. Reasonably, the use of short duration high yielding varieties will reduce the flood effect by producing in short period before the flood and use high water resistance verities of crops will also helpful for production in flood time. If crops can live more days under water and become more longer with strong bodies then the crops will not damage during flood period. These seeds are most suitable for char (delta) areas of Chenga, Mandia, Gumafulbari and Ruposhi Development Block. The drought resistance crop should cultivate during drought period. These crops can live by consuming less water which will be helpful for the winter crops in Barpeta district.

5.2.3. **Food Processing Industries**

Food processing industries are most important to reduce wastage of foods at the peak time of food production and to development of economic condition of farmer. Processing of food eliminates wastage of agricultural produce to a greater extent. Food processing is gaining momentum as food processing industries ensure steady and better price to the farming community as well as availability of the commodities in processed form to the consumer throughout the year. By cultivation of good quality processable agricultural products the farmers stand to gain better returns and employment opportunity.

5.2.4. Development of transportation

Transportation is most important for agricultural development. The transport facilities are prerequisites for transportation of modern input to firms, transportation of produces to home for post harvesting, transportation of produces to market, transportation of produces from market yards to place of storage and inter market transportation. The railways has connected the northern part of Barpeta district which should further extend to the southern side of Barpeta district. The rural roads should develop to connect between main roads and markets with the fields.

5.2.5. **Crop Insurance**

Agriculture production and farm incomes in India are frequently affected by natural disasters such as droughts, floods, cyclones, storms, landslides and earthquakes. Susceptibility of agriculture to these disasters is compounded by the outbreak of epidemics and man-made disasters such as fire, sale of spurious seeds, fertilizers and pesticides, price crashes etc. All these events severely affect farmers through loss in production and farm income, and they are beyond the control of the farmers. Agricultural insurance is considered an important mechanism to effectively address the risk to output and income resulting from various natural and manmade events. Agricultural Insurance is a means of protecting the agriculturist against financial losses due to uncertainties that may arise agricultural losses arising from named or all unforeseen perils beyond their control (AIC, 2008). Unfortunately, agricultural insurance in the country has not made much headway even though the need to protect Indian farmers from agriculture variability has been a continuing concern of agriculture policy. According to the National Agriculture Policy 2000, “Despite technological and economic advancements, the condition of farmers continues to be unstable due to natural calamities and price fluctuations”. In some extreme cases, these unfavorable events become one of the factors leading to farmers‟ suicides which are now assuming serious proportions (Raju and Chand, 2007). Assam has been experiencing flood as well as localized calamities such as hailstorm, landslide, cyclone in almost every year and around 4.75 lakh hectare area is chronically flood prone and around 0.94 lakh hectares area is draught prone. Therefore, the crop insurance is an area to help farmers at the time when there is crop loss or crop damage due to recurring natural calamities, severe pest infestations and diseases in notified crops. The Government of India launched Crop Insurance programmers under the nomenclature "National Agricultural Insurance Scheme" (NAIS).

In the study area people are highly affected by floods and drought and losses large number of crops every year. People are losing capital and debts are increasing day by day. If people adopt crop insurance then loss of capital and debts will decrease of cultivators.

5.2.6. Agricultural Subsidies

A subsidy is a grant or financial assistance given by one party to support the development of another party. According to OECD definition, ''A subsidy is a measure that keeps prices for consumers bellow market levels, of keep prices for producers above market levels or that reduces costs for both producers and consumers by giving direct or indirect supports.'' The most common definition of a subsidy refers to a payment made by the government to the producer. Subsidies can be classifies as direct subsidy and indirect subsidy. Direct subsidies are cash grants, interest free loans etc. and indirect subsidies are tax breaks, insurance, low interest loans and depreciation write offers, rent rebates etc.

Agricultural subsidy is a governmental subsidy paid to farmers and agribusinesses to supplement income manage the supply of agricultural commodities and influence the cost and supply of such commodities. Farm subsidies have the direct effect of transforming income from the general tax payers to the farm owners. The European Union spent €57 billion on agricultural development and of which €39 billion was spent on direct subsidy in 2010. Agricultural and fisheries subsidies form over 40% of the EU budget. The United State currently pays around €20 billion per year to farm in direct subsidies as farm income stabilization.

Farm mechanization is most important to increase agricultural productivity. The major program components covered under the farm mechanization are as tractor, power tiller, reaper, pump Sets, power drawn implements (cultivator/leveler), animals drawn implements (cultivator), manual operated implements (Paddle Thresher), power thresher, rotavator, strip till drill, sprayer, self-propel reaper etc. These schemes are 100 percent Central Government sponsor and subsidies are given to all farmers and communities. In Barpeta district standing crops are damaged by natural calamities like flood, drought etc. and farmers are becoming economically weaker.

5.2.7. **Agricultural Policy**

Agricultural policy describes a set of laws relating to domestic agriculture and import of foreign agricultural products. The agricultural policy ensures a guaranteed supply level, price stability, product quality, product selection, land use, employment etc. Major issues of agricultural policies are marketing challenges, consumer testes, international trading environment, infrastructural development, management skill, labour supply, technological development, modernization of agriculture, sustainable agricultural development etc. As a results effective agricultural policy is required for the agricultural development in the study area. In Assam a lot of agricultural policies are available, but all these policies are not executed due to lack of public awareness and inefficiency of government agencies. In the marketing system middle man are more benefited then cultivators for the lack of public awareness in Barpeta district.

5.2.8. Agricultural Insurance

Insurance is a means of protecting the agriculturist against financial losses due to uncertainties that may arise agricultural losses arising from named or all unforeseen perils beyond their control (AIC, 2008). Unfortunately, agricultural insurance in the country has not made much headway even though the need to protect Indian farmers from agriculture variability has been a continuing concern of agriculture policy. The National Agriculture Policy 2000 pointed out despite technological and economic advancements, the condition of farmers continues to be unstable due to natural calamities and price fluctuations. In some extreme cases, these unfavorable events become one of the factors leading to farmer suicides which are now assuming serious proportions (Raju and Chand, 2007).

Agricultural insurance is a method by which farmers can stabilize on farm income and investment and guard against disastrous effect of losses due to natural hazards or low market prices. Crop insurance not only stabilizes the farm income but also helps the farmers to initiate production activity after a bad agricultural year. It helps farmers to make more investments in agriculture and forms an important component of safety-net program which is being experienced in many developed countries like USA and Canada as well as in the European Union. However, one need to keep in mind that crop insurance should be part of overall risk management strategy. Insurance comes towards the end of risk management process, redistribution of cost of losses of few among many and cannot prevent economic loss.

There are two major categories of agricultural insurance which are single and multi-peril coverage. Single peril coverage offers protection from single hazard while multiple peril provides protection from several hazards. In India, multi-peril crop insurance programme is being implemented, considering the overwhelming impact of nature on agricultural output and its disastrous consequences on the society, in general and farmers in particular. In the study area most of the people are poor and illiterate and do not know about crop insurance. Therefore, the crop insurance is necessary to help farmers at the time of crop loss or crop damage due to recurring natural calamities, severe pest infestations and diseases in notified crops.

5.2.9. Market system

Agricultural marketing occupies an integral position for overall development of agriculture. It determines the cropping pattern, selection of crops and farmer economic condition. Agricultural marketing comprises all activities like supply of farm inputs to the farmers and movement of agricultural products from the farms to the consumers. In this way farmer obtains capital to maintain agricultural practice and livelihood. So the efficient agricultural market is most important to strength the agricultural development. An efficient marketing system facilitates for optimization of resource use, output management, enhance farmer incomes, widening of markets, growth of agro-based industry, addition to national income through value addition, and employment creation. Therefore, market reform and marketing system improvement ought to be an integral part of policy and strategy for agricultural development. Though it is playing most important role for agricultural development, it is yet it is to be developed and manage properly. The main strategies for the development of Agricultural market are discussed bellow-

a. Regulated Markets: The development of agricultural market depends on the well regulated market system. Efficient regulated market is most important for the development of agriculture and farmer economic condition. The regulated market will helps to getting optimum price to the farmer, through effective marketing policy, proper infrastructural development, free grading facilities for agricultural commodities and issuing pledge loan during distress sale.

b. Undertaking Loan Facilities to Farmers: To avoid distress sales, loan facilities is necessary to the small and marginal farmers in the peak season. Most of the farmers are poor in economic condition and sale product in peak season at fewer prices.

c. AGMARK Grading: AGMARK grading is undertaken to protect the consumers from the ill effects of consuming adulterated food commodities and to ensure quality food products. It also helps to get optimum price for the commodities. AGMARK quality control programs as well as improvements in marketing practices and procedures are given wide publicity through mass media.

d. **Construction of Drying Yards in the Villages:** To avoid post wastage losses, construction of Drying Yards in the Villages is most essential. Marginal poor farmer cannot construct Drying Yards for lack of capita and space. Moreover, Barpeta district is chronically flood affected area.

e. Marketing Information Centre: Market intelligence plays a vital role in marketing of agricultural produce. If the information of prices prevailing in various markets is made available, the farmers would be able to get better price to their produce by moving their produce to the market which pays higher

f. Construction of Cold Chain: Barpeta district is well known for the production of vegetables, milk, fish and fruits in Assam. These are perishable goods and these are wasted due to non-availability of cold storage facility and farmers get very less price for their produce. To minimize post-harvest losses of agricultural produce, especially fruits and vegetables, cereals, spices and plantation crops, cold storages are most essential.

g. Construction of godown: Farmers are highly affected due to lack of proper storage facilities. And farmer get very less price of the commodity and the postharvest losses are very high. At the time of over flood many commodities damages due to lack of proper storage facilities. Thus Construction of godown is most important in the district.

h. Market intelligence: Market intelligent is most important for agricultural improvement. Poor farmers are not aware of market prices and middlemen can easily take the advantage. They are not getting proper price of produces. The regulated markets are publishing the price charts but more than 90% farmer do not know market price in the district. The regulated market should take more publicity of price chart for agricultural produces by using huge number of mass media and banner and board in various places of market. They are not aware about various facilities of regulated market. Due to lack of awareness farmers are not getting good quality of seeds, pesticides, fertilizers and other inputs on right price. So their yield and quality is inferior but entrepreneur has good analytical capacity, negotiation skills and purchasing power to buy such input on very competitive price to reduce cultivation cost.

i. Construction of Food Processing Industries: Food processing industries eliminates wastage of agricultural produce to a greater extent. Food processing industries ensure steady and better price to the farming community as well as availability of the commodities in processed form to the consumer throughout the year. By cultivation of good quality process able agricultural produce the farmers stand to gain better returns and employment opportunity. It also ensures to reduce the wastage of agricultural commodities. Perusable goods can be process and store for long time and export to the places through the food processing industries.

j. Strengthening rural road connectivity: The condition of rural roads is poor and has posed a major challenge for the transportation of products in Barpeta district. Poor road connectivity is also one of the contributory factors for low realization of value. As a consequence of poor road condition, transportation costs are higher, loading and unloading creates difficulties and high produce losses occur.

5.2.23. **Application of GIS**

Geographic Information Systems (GIS) is very effective modern tool for store, manipulate and analysis of huge data for agricultural planning and mapping. Agricultural mapping plays a vital role in monitoring and management of soil, irrigation and cropping pattern of any given farm in a region. It also helps in management and control of agricultural resources. GIS tools helps the farmer to conduct crop forecasting and to collect geo-reference samples in cultivated areas that helps farmers to make better decisions. This tool will be very effective for the prediction at the time of droughts, floods and others natural calamities in Barpeta district. After the natural calamities to speedy estimate, planning and re-habitation, use of GIS will most supportive in the study area.

5.2.24. Green house farming

Green house technology is the technique of providing favorable environment for plant growth. It is rather used to protect the plants from the adverse climatic conditions such as wind, cold, precipitation, excessive radiation, extreme temperature, insects and diseases. In green house condition yield may be 10-12 times higher than that of outdoor cultivation depending upon the type of greenhouse, type of crop and environmental control facilities. In Barpeta district it is very effective at the time of extreme weather conditions like flood, winter, drought for off-season production of vegetable, fruit, floricultural crops.

Conclusion

The agricultural scenario reflects slow rate of growth, inadequate production, lack of technological adaptation in termed of improved seeds, fertilizers, irrigation, pesticides, etc. in the study area. The factors that influence on agricultural development can be classified in to two broad categories i.e. natural and socio-economic problems in Barpeta district. Natural factors of agricultural are soil, uncertainty rainfall, flood, drought, soil erosion, etc. in the Barpeta district. In the study area about 11% area is under sandy soil and 25% is sandy loam soils. These soils are consuming more water and fertilizes, due to under development of irrigation facilities and poor inputs of fertilizer due to poor economic condition productivity of these soil are very low. The uncertainty of rainfall is one of the major problems of Barpeta district. The normal rainfall receives in the district is 2127 mm and distribution of rainfall is not equal in each month. The monsoon season has received heavy rainfall which is causes flood and winter season receives less rainfall which causes drought as a regular phenomenon in the district. Socio-economic factors are major for agricultural development which includes infrastructural development, population pressure, technological, small and fragmented landholdings, landholding system, poverty sickness, poor inputs and lack of mechanization, scarcity of capital, low consumption of chemical fertilizer, indebtedness of farmer, inadequate research, etc.

Agricultural development is possible with the judicious use of land, labour and farmer involvement with adaptation of modern inputs like seeds, fertilizers, irrigation and technological transformation in Barpeta District. An efficient marketing system facilitates for optimization of resource use, output management, enhance farmer incomes, widening of markets, growth of agro-based industry, addition to national income through value addition and employment creation. Agricultural awareness provides information of new adaptation and management of agriculture.

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CHAPTER VI

SUMMARY AND CONCLUSION

Summary

The research work on Pattern of Agricultural Development and the Emerging Challenges in Barpeta district of Assam has undertaken with the objectives to examine the pattern of agricultural development, to ascertain the new adaptations to the agriculture in the study area, to study the agricultural output in the district, to examine the constraints faced by the agricultural development, to identify the prospects for the agricultural development and lastly to critically examine the role of various factors that affects the agricultural development. The first chapter consist the introduction of the thesis and the conceptual study of the agricultural. The Agriculture has been an integral part of our life since time immemorial as the main source of earning livelihood. Agriculture is the central economic activity in India as the main source of earning livelihood which has been engaged 51% of Indian populations in 2010. Agricultural growth is urgently required to support the food security of growing populations in developing countries of the world. FAO has estimated that agriculture production needs to increase globally 70% to meet a projected population of more than 9 billion by 2050. India's agricultural economy is undergoing structural change. Between 1970 and 2011, the GDP share of agriculture has fallen from 43% to 16%. This isn't because of reduced importance of agriculture or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and nonagricultural sectors in India between 2000 and 2010.

The second chapter covers the physical frameworks and socioeconomic condition of the study area. The general topography of Barpeta district varies from low lying flood plain to small hillocks and physiographic elements are flood plain, Char (delta), foot hills and hillock in Barpeta. The highest elevation is 180 m above MSL at Baghbar hillocks and bounded by 100 m contour. The decadal growth rate of population is 21.40% during the period from 2001 to 2011compare to average growth rate of 16.93% in Assam. The population density is 632 per sq. km. in the district in 2011. Barpeta has a great significance for religious composition, the Muslims are majority with 70.74% and Hindu's are minority with 29.11% in 2011. The literacy rate of Barpeta district is not satisfactory with a growth rate of 16.10% and literacy rate 65.03% in 2011 against state literacy rate 73.18%. Agriculture and allied sector is highest employer among all sectors and it employed 54.14% worker of Barpeta district in 2011. Alone cultivators are 36.53% and agricultural labors are 17.61%.

The third chapter deal with the agricultural development, pattern and characteristics in Barpeta district. Agricultural development represent increase of agricultural productivity, cultivable land, irrigation facilities, HYV seeds, fertilizer consumption, pesticides and insecticides use, machineries, land utilization, intensity of cropping, crop productivity, crop diversification, crop intensity, commercialization of agriculture, nature of agrarian relationship and maintenance of ecological balance and host of other sectors. The major crops in Barpeta can be divided into four categories viz. Food grains (Rice, Wheat, Maize and Pulses), Cash Crops (Jute, Sugarcane, Tobacco, and Oilseeds), Plantation Crops (Tea and Coconut) and Horticulture crops such as Fruits and Vegetables. Paddy is main crop of Barpeta district and more than 80% cultivated land is under rice cultivation.

Land is prerequisite for agricultural practice and the land ownership pattern also highly influence on the pattern of agriculture. The 36.15% household has own land and 63.85% household has no land in the sample villages. In Barpeta district, the distribution of land holding size is not equal among farmer. The number of marginal land holder is 57.09 percent and occupying 23.39 percentage of land. Though marginal land holder is highest but semi medium land holder is holding highest land followed by small and medium land holder in the district. Fertilizer is most important to input to increase the agricultural productivity. Barpeta district used 9.25 percentage fertilizer of the state in 2011-12. Per hectare consumption of fertilizer is higher in the district than state average, i.e. 104.36 kg per hectares in Barpeta and 74.58 kg per hectares in Assam. In the region Rabi crop consumes highest number of fertilizer than Kharif crops. In 2011-12, total irrigated area were 1066 hectares in Barpeta and 130217 hectares in Assam. Rabi crops are highly irrigated than the Kharif crops in Barpeta district. Gross irrigated area of Barpeta district is 159700 hectares and net irrigated area is 4914 hectare. Implementation of HYV (High Yielding Varieties) is one of the important steps initiated for agricultural development. Total area under HYV is 115481 hectares in Barpeta district in 2012-13. Mandia Development Block occupies highest area and Gumafulbari Development Block has least area under HYV seeds among the Development Blocks in Barpeta district in 2012-13. The average productivity of entire paddy has increased to two times in the district from 1163 kg per hectare in 2005-06 to 2235 kg per hectare in 2013-14. The productivity of wheat occupies fourth position next to summer paddy, winter paddy and jute among the major crops of the district in 2013-14. The productivity of wheat is 1483 kg per hectare in 2013-14 in Barpeta and rape and mustard is 541 kg per hectare in 20013-14.

The fourth chapter studies the crop diversification. Crop diversification refers to the raising of varieties of crops in a given area in a crop season. Based on Gibb's and Martin method in 2003-04 crop diversification was 0.74 which has increased to 0.78 in 2006-07. Crop diversification has declined to a lowest level in 2012-13 with 0.72 in the Barpeta district. Average cropping intensity in Barpeta district is 140.52 during 2012-13 and cropping intensity is not equal among all revenue circles in Barpeta district. The cropping intensity is highest in Sarupeta Revenue Circle with 180.96 intensity and lowest in Sarthebari Revenue Circle with 107.98 intensity.

Fifth chapter covers the problem of agricultural development and strategies for agricultural development in the study area. The problem of agriculture can be classified in to two broad categories i.e. natural factors and socio-economic factors in Barpeta. The major natural factors of agricultural are soil, uncertainty rainfall, flood, drought etc in the Barpeta district. In the study area about 11% area is under sandy soil and 25% is sandy loam soils. These soils highly consume water and fertilizes, due to under development of irrigation facilities and poor inputs of fertilizer for poor economic condition of farmer and productivity of these soil are very low. The uncertainty of rainfall is one of the major problems of Barpeta district.

Socio-economic factors are infrastructural development, population pressure, technological, infrastructural development, small and fragmented landholdings, landholding system, poverty sickness, poor inputs and lack of mechanization, scarcity of capital, low consumption of chemical fertilizer, indebtedness of farmer, inadequate research, etc. that constraint for agricultural development. Agricultural production and productivity has increased through the judicious use of land, labour

and farmer involvement with adaptation of HYV seeds, fertilizers, irrigation, liming, method of practicing and technological transformation in Barpeta District. The strategies for agricultural development has been classified as General, Pre harvest or Operational and Post harvesting strategy. The modern use of inputs in agriculture has raise its productivity by reducing agricultural risk. Productivity of crop has increase by rational use of high yield varieties, fertilizers, liming, irrigation, pesticides, herbicides etc. Moreover adopting flood and drought resistant friendly crop varieties will help the farmers in the production. Agricultural Research Station (RARS) of Assam Agricultural University at Titabor has developed a submergence resistant gene in rice variety of Ranjit which has brought great relief to flood-hit farmers in 2010. Some agricultural sub-sectors have particularly high potential for expansion, especially fishing, dairy and vegetable.

Agricultural awareness provides information of new adaptation and management of agriculture. The awareness can reach to every household trough promote planning, organizing or hosting workshops and conferences, recruiting and training spokespersons. Crop rotation helps to balance the nutrient demands of various crops to avoid depletion of soil nutrient. In the study area Rabi crops like rape and mustards, pulses and other species of small rooted plant can help to create soil nitrogen level. These crops root are able to produce nitrogen and reduce use of fertilizer for next Kharif crops. The Kharif crops like jute, mesta etc. can increase soil nutrition level. Through massive public awareness on crop rotation may reduce depletion of soil health in Barpeta. An efficient marketing system facilitates for optimization of resource use, output management, enhance farmer incomes, widening of markets, growth of agro-based industry, addition to national income through value addition, and employment creation with reducing post crop harvesting losses. There are two primary regulated marketing committee with four sub market yards in Barpeta district. The agricultural policy ensures a guaranteed supply level, price stability, product quality, product selection, land use, employment etc.

6.1. Findings

The study has come out with the following revelations-

1. Agricultural sector employed 20% of world populations and 51% of Indian populations in 2010. The share of agriculture GDP is 17.4% in India and 3.9% in world during 2014.
2. India is second larger producer of agriculture product and accounts for 7.68 percent of total global agricultural output. It constitutes 10.59% of the total value of India's export in 2009-10.
3. Agricultural growth is urgently required to support the food security of growing populations in developing countries of the world. FAO has estimated that agriculture production needs to increase globally 70% to meet the projected population of more than 9 billion by 2050.
4. The decadal growth rate of population is 21.40% during the period from 2001 to 2011 as compared to average growth rate of 16.93% in

Assam. The population density is 632 per sq. km. in Barpeta during 2011.

5. The district is characterized by almost plain topography with the highest elevation of 180 m above MSL at Baghbar hillocks.
6. The topography of Barpeta district is classified into four categories, i.e., (i)The northern high plain region, (ii)The middle built-up plain (iii) Hillocks and (iv)The southern low-lying plain (Char area).
7. Barpeta has a great significance for religious composition, Muslims are majority with 70.74% and Hindu's are minority with 29.11% in 2011.
8. Agriculture and allied sector has highest employer among all sectors and it has employed 54.14% worker in Barpeta district during 2011. It has estimated that cultivators account for 36.53% and agricultural labours records 17.61% in Barpeta district.
9. 36.15% household has own land and 63.85% household has no land in Barpeta district. The number of marginal land holder is 57.09 percent and occupying 23.39 percentage of land. Marginal land holder is highest but semi medium land holder is holding highest land 35.16%.
10. The development of agricultural system has focused on increasing productivity by extensively use of high yielding varieties, fertilizer, liming, promoting diversification and farm mechanization.
11. About 70% total working forces are engaged in agriculture in rural area and allied sectors in Assam. The shares of main and marginal

workers are respectably, cultivators 36.53%, agricultural labourers 17.61% in Barpeta district as per 2011 census.

12. The major crops in Barpeta has divided into four categories viz. Food grains (Rice, Wheat, Maize and Pulses), Cash Crops (Jute, Sugarcane, Tobacco, and Oilseeds), Plantation Crops (Tea & Coconut) and Horticulture crops such as Fruits and Vegetables.
13. The crops has divided into Rabi and Kharif crops. Major Kharif crops of Barpeta district include Sugarcane, Turmeric, Paddy (Rice), Jute, Mesta, Maize, Brinjal, Green and Red Chilies, etc. And Major Rabi crop in Barpeta are Wheat, Barley, Mustard, Sesame, Peas, pulses, Onion, Potato etc.
14. Barpeta district has used 9.25 percentage fertilizer of the state in 2011-12. Per hectare consumption of fertilizer is higher in the district than state average, which is 104.36 kg per hectares in Barpeta and 74.58 kg per hectares in Assam.
15. In the region Rabi crop consumes highest number of fertilizer than Kharif crops. Rabi crop consumes 56.44% fertilizer followed by Kharif crops 43.56% fertilizer in Barpeta during 2011-12.
16. In 2011-12, total irrigated area is 1066 hectares in Barpeta. Rabi crops are highly irrigated than the Kharif crops in Barpeta district. Gross irrigated area of Barpeta district is 159700 hectares and net irrigated area is 4914 hectare.
17. Total area under HYV is 115481 hectares in Barpeta district in 2012-13. Mandia Development Block occupies highest area with 21470

hectares (i.e. 18.59%) under HYV crops followed by Bajali Development Block with 15005 hectares (12.99%) in 2012-13. Gumafulbari Development Block has least area (i.e. 4.94% / 5701

hectares) under HYV seeds among the Development Blocks in Barpeta district.

18. Average cropping intensity is 140.52 in 2012-13 in Barpeta district and cropping intensity is highest in Sarupeta Revenue Circle with180.96 intensity and lowest in Sarthebari Revenue Circle along with 107.98 intensity.
19. The average productivity of entire paddy has increased to two times in the district from 1163 kg per hectare in 2005-06 to 2235 kg per hectare in 2013-14.
20. The productivity of wheat occupies fourth position next to summer paddy, winter paddy and jute among the major crops of the district in 2013-14.
21. According to Gibb's and Martin crop diversification index for the year 2003-04 to 2012-13 has negative trend in the district during. In 2003-04 crop diversification was 0.74 and shows highest as 0.78 in 2006-07. Crop diversification has decreased the lowest level in 2012-13 with 0.72 diversification in the Barpeta district.
22. Crops cultivation is not uniform among households and the villages. Mono crop pattern is practices in Jakuapara village of Chakchaka

development Block, double crops cultivation are practiced in Byaskuchi, Tetelirtol, KapaharTari, Maripur Anandapur and Bogriguri Gaon with one Kharif crop and another Rabi crop.

23. Four crops are practiced at Malipara Char, KharBalli and Kaltali char. Fifth crops pattern is practiced in Chaulia Bori village of Bhawanipur Development Block with both modern and traditional method of agriculture.
24. Soil depletion, yield stagnation, natural hazards, increase in production cost and low returns are main causes of decreasing the crop diversification in the district. The crop diversification is more in Char (delta) area of Chenga, Mandia and Ruposhi Development Blocks in Barpeta district and is very low in Sarukhetri, Bajali and Bhawanipur Development Blocks in the district.
25. The major natural problems of agriculture are soil, uncertainty rainfall, flood, drought etc. in the Barpeta district.
26. Socio-economic problem is another major problem of agricultural development in Barpeta. Socio-economic problems are infrastructural development, population pressure, technological, Infrastructural Development, Small and fragmented landholdings, Landholding System, Poverty sickness, Poor inputs and lack of mechanization, Scarcity of capital, Low consumption of chemical fertilizer, Indebtedness of farmer, Inadequate research, etc.

27. The population pressure has created number of problems like fragmentation and subdivision of land holdings, supply of modern practices and services has fallen short of requirement.
28. Among the sample villages, farmers has 60.52% own lands, share copper 35.33% and contractual 4.15% for cultivation. The distributions of land tenure systems are not equal among the villages. The cultivators of Tetelirtol village is highest own land for cultivation with 75% and lowest own land has Jakua Para village with 47% of total cultivated land.
29. Among sample villages more than 52% families has less than 5000 monthly income and 37.82% people has 5000-15000 monthly income and 10.18% household has above 15000 monthly income only.
30. The outstanding bank credit is 5244967 thousand and personal loan is 2929388 thousand in all Commercial banks as on March 2011 in Barpeta district. Barpeta district has 2.67% outstanding bank credit and 3.41% personal loan and 2.09% bank balance on March 2011.
31. About 89.82% people of sample villages are using Assam Type house and 7.64% people are using Thatch house and 2.55% people are RCC building for storage crops. The char villages are mostly using Thatch houses.
32. The price of rape mustard, onion and jute has increased to double in between season and offseason in 2015-16. The price of potato increased more than 3 times and the price of onion shifted to double between peak season and offseason.

33. The profits of Jute are highest followed by Irri (HYV) paddy, Sali paddy, Wheat, Oilseeds and Ahu Paddy among the crops in sample villages. The production cost of Jute is Rs. 1736.00, output value is Rs. 4900.00 and profit is Rs. 3164.00.
34. 71.27% people faces scarcity of labour at the time of crop sowing and post harvesting period and 12% people faces scarcity of labour for cultivation among the sample villages. The main cause of scarcity of agricultural labour is for the migration of labour from village to urban areas (household survey).
35. Production and productivity of crops increased through rational use of high yield varieties, fertilizers, liming, irrigation, pesticides, herbicides etc. The productivity can also increase through adopting of new practices and management like diversification to higher value of crops, developing value chains to reduce marketing costs, increasing cropping intensity, crop rotation, crop combination etc.
36. The modern agricultural technology will reduce the problem of water, scarcity of labour and effect pest, disease and weed. Post crop harvesting losses can be dipping through use of technology.
37. The main measures for flood control is taken up by construction of embankments and flood walls, river training and bank protection works, anti-erosion and town protection works, river channelization with pro siltation devices, drainage improvement/ sluices, raised platform, flood forecasting and warning, flood zoning etc.

38. The development of irrigation is most important for development of agriculture. Underground water is available to lifting water for development of irrigation facilities in study area. The high densely of Perennial Rivers are available to generate cannel irrigation facility. The rain water harvesting can also facilitate for irrigation because monsoon season receives heavy rainfall in Barpeta.
39. Encouraging farmers to diversify to higher value commodities will be a significant factor for higher agricultural growth, particularly in rain-fed areas, where poverty is more.
40. Crop rotation can adopt to improve soil structure and fertility by alternating deep-rooted and shallow-rooted plants. In the study area Rabi crops like rape and mustards, pulses and other species of small rooted plant can help to create soil nitrogen level.
41. The small land holding size has badly influence in the cropping pattern and use of modern technology in the agricultural field. The problem can be manage through forming farmer SHG participatory approach and community action on cluster basis.
42. Agricultural awareness provides information of new adaptation and management of agriculture. The agricultural awareness includes planning information of documents, training and education campaigns.
43. Efficient regulated market is most important for the development of agriculture. The regulated market will enables to getting optimum price to the farmer, through effective marketing policy, proper infrastructural

development, free grading facilities for agricultural commodities and issuing pledge loan during distress sale.

6.2. Suggestion

Efforts should give to increase agricultural production through the use of modern eco-friendly technologies, to meet the demand of ever increasing population that it will have surplus production and will export to improve economic condition.

For the improvement of agricultural productivity in the study area the quality of farmer must be improved through training both general and technical.

To save the agricultural labour from epidemics and other diseases, adequate public health measures must be undertaken.

Priority should be given to improve irrigation network that will help to cultivate during dry season and traditional crop should replace by High Yield Verities.

Diversification to high marketability crops like jute, vegetables, fish farming, dairy farming etc. has more profit than subsistence type of paddy farming.

Transformation to vegetable farming during rainy season (offseason) in upland area into greenhouse farming because shortage of vegetable happen during this season.

Alternative source of employment should develop by opening food processing industries in rural areas. This will help and develop the economic condition of the farmers and the consumers will get good price for procurable goods.

To introduce social security measures for the agricultural farmers, labours and should introduce compulsory insurance on marginal contribution and also to initiate old age pension scheme for the agricultural workers by the government.

Government should allot reserve land and agricultural labourers to the farmers which will increase the agricultural productivity and to help the eroded farmers

Flood and River Erosion measures must be taken to overcome the problems of agriculture in Barpeta district by long term measures like digging of river bed and construction of heavy wall in both side of river to save the agricultural land and labourers.

To make agriculture move remunerative active economic measures must be introduced. Subsidiary agro-based industries must set up in rural area so that surplus labour in agriculture sector can be utilised in industries. Proper steps must be taken to break the vicious circle of poverty.

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PHOTO PLATES

Plate 3.1: Irri Paddy at Bahari

Plate 3.2: Wheat field

Plate 3.3: Mustard Field at Nagaon

Plate 3.4: Jute and Paddy field at Malipara Char

Plate 3.5: Tractor for ploughing in field

Plate 3.6: Tractor Ploughing for Mustard

Plate 3.7: Cart for transport paddy

Plate 3.8: Tractor for transport paddy

Plate 3.9: Irrigation for Irri Paddy

Plate 3.10: Modern Cannel of irrigation at Haldia village

Plate 3.11: Spread of Pesticides in irri paddy field

Plate 3.12: Paddy harvesting by harvester

Plate 3.13: Paddy field submerged by flood

Plate 4.1: Flooded road and home at Balartari village

Plate 4.2: Land erosion at Bhogerpar by Brahmaputra River

Plate 4.3: Brahmaputra river erosion at Balartari village

Plate 4.4: Land eroded people house on Embankment

Plate 4.5: Drought effected Ahu paddy field

Plate 4.6: Boat on Brahmaputra river at Baghbar market

Plate 4.7: Rural Godown at Palhazi

Plate 4.8: Cold Storage at Barpeta

ANNEXURE I

LOCAL TERMS USED

Beel	wetland
Char	Riverine delta (sand bar)
Sali paddy	rain-fed crop cultivated during the rainy season and harvested in the winter months of November and December.
Ahu paddy	pre-autumn upland variety of paddy
Bao paddy	semi-deep and deep water variety of paddy
Kharif	crop season corresponding to the monsoon period (June-September)
Rabi	crop season covering the post-monsoon period (October onward)
Panchayat	a body for rural governance at the village and higher levels
Gaon	village
Lakh	one hundred thousand

CONVERSION TABLE

WEIGHTS

1 Gram	=	0.035270 Ounce
		0.085735 Tola
1 Pound	=	0.4536 Kilograms
1 Mun	=	40 Kilogram
1 Kilogram	=	2.20462 Pounds.
1 Tonne (Matric Ton)	=	1000 Kilograms.
		1.10231 (short) Tons
		0.984207 (long) Tons
		5.624 bales of Cotton

LENGTH

1 Centimetre	=	Centimetre
1 Inch	=	25.4 Millimetres
		0.0254 Metres.
1 Feet	=	0.3048 Metres
		30.48 Centimetres.
1 Meter	=	1.09361 Yards
1 Yard	=	0.9144 Metres
1 Mile	=	1.609344 Kilometres
1 Kilometre	=	0.62137 Miles

AREA

1 Acre	=	0.404686 Hectares.
		3.025 Bighas
		4840 Sq. Yards.
1 Hectare	=	10000 Square Metres
		7.45993 Bighas.
		2.47105 Acres.
1 Bigha	=	0.13387 Hectres.
		0.33058 Acres.
		14,400 square feets

ANNEXURE II

QUESTIONNAIRES

Part-I

1. Name of Respondent: ....

Village/Ward: ....   Sub-division: Barpeta/ Bajali

Block/Circle: ....   State: Assam

District: Barpeta   Contact No.:

2. Religion: Hindu/Muslim/Christian/ Buddhist.

3. Nature of Family: Nuclear/ Joints/Unitary/Extended.

4. Cast: Gen./ SC / ST/ OBC.

5. Occupation:-

Year	Agriculture	Govt. Service	Pvt. Service	Business	Labour	Other

6. Total family member (in Numbers)

Male	
Female	
Total member	

7. Age group

Age	Bellow 10	10-20	20-45	45- 60	Above 60
No					

8. Educational Status:

Educ. status	Illiterate	Bellow HSLC	HSLC Passed	Higher Educ.	Technical	Total

9. Monthly income:

Monthly income	Bellow 2000	2000- 5000	Above 5000

Part-II

10. Land holding size & Nature of agricultural Land (in Bighas):

Nature of Land	
Own/ Madhi	
Eksona	
Tauji	
Contractual	
Share cropping	
Total land holding	

11. Intensity of Cropping (in Bighas):

Year	One time crops	Two times Crops	More than two	Net sown area	Gross cropped area

12. Use of chemical fertilizers (Per Bigha/ in Kg.):

Fertilizer use in Crops	Kharif Crops	Rabi Crops	Autumn crops	Per Bighas	Total

13. Irrigation facilities (in bighas)

Year	Diesel engine	Electric engine	Rain fed	Other	Total	Govt.	Personal	Private

14. Land under irrigation (in bighas):

Sl. No.	Nature of land	
1	Net sown area	
2	More than one	
3	Gross irrigated	
4	Sufficient	Yes/ no

15. Labour facilities:

Sl. No.	Labour status	
1	Labour available	
2	Seasonal shortage	
3	Not available	

16. Pesticides & insecticides (in bighas):

Sl. No.	Pesticides	

1	Insecticides	
2	Herbicides	
3	Remaining	

17. Use of Seeds (in Bighas):

Sl. No.	Seeds	
1	Traditional Seeds	
2	HYV Seeds	

18. Transport facilities & intensity of vehicles from agri. land to market:

Sl. No.	Year	
1	Rail line	
2	Boat	
3	Concrete road	
4	Mud road	
5	No road	
6	Vehicles availability	Yes/ no

19. Tractor or animals force use (in bighas):

Animals force	
Tractors	

20. Use of post crops harvesting devices:

Yes	
No	

21. Area under different major crops:

Field crops	Autumn (ha)		Winter (hac)		Summer (hac)		Total
	Irrigated	Rainfed	Irrigated	Rainfed	Irrigated	Rainfed	
Rice							
Wheat							
Oil seeds							
Jute							
Sugarcane							
Pulses							
Maize							
Potatoes							
Coconut							
Fruits							
Vegetables							
Others							

22. Productivity of crops (in per bigha/quintals):

Year	Autumn rice	Winter rice	Summer rice	Jutes	Potatoes	Wheat	Oilseeds	pulses	Veget.

23. Subsistence in agriculture:

Foodgrain	
Oilseeds	
Vegetables	

24. Surplus of crops for sale (in quintals):

Years	
Foodgrain	
Oilseeds	
Vegetables	
Pulses	

25. Profit in agriculture per bighas & Total Marketing:

Crops	Production cost	Out put	Profit	Total Profit		Total production	Marketing
HYV rice							
Tradit. Rice							
Wheat							
Oil seeds							
Jute							
Sugarcane							
Pulses							
Maize							

Potatoes							
Coconut							
Fruits							
Vegetables							
Others							

Part- III

26. Infrastructural development:

a. MPHC/PHC distance
b. Free Ambulance facilities
c. Electrification at village
d. Electrification at field
e. Fertilizer sale depot dist.
f. Food processing industries.

27. Flood effect on standing crops (in Bighas)

Crops	
Rice	
Jute	
Sugarcane	
Vegetables	
Others	

28. Damage of crops by flood:

Year	
Rice	

Jute	
Sugarcane	
Vegetables	
Others	

29. Floods effect on agri. lands:

a. Land erosion

b. Sand deposition

c. Fertile soil washes away

30. Droughts effects on crops:

Year	
Rice	
Pulses	
Oilseeds	
Vegetables	
Others	

31. Agricultural equipment use:

Equipment	
Reaper cum binder	
Combine harvester	
Tractor operated seed cum fertilizer drill	
Rice trans planter	

Laser land leveller	

32. Storage facilities:

House type	
A.T.	
R.C.C.	
Thatch	
Cold storage	
Rented	

33. Market facilities:

Year	
Govt. Regulated	
No Govt. Regulated	
Local market	
Distance of market	
Market intelligence	
Grading/ standard	

34. Time of crop sale:

Years	Yes/No	Causes of sale	
		Poorness	Lack Storage facilities
After production			

Time of high price			

35. Purpose of agriculture:

Purpose of agri.	
Own consumption	
Business purpose	
others	

36. New adaptation in agriculture:

a. Crops pattern:

b. Replaced crops:

c. Modern inputs

d. Methods:

e. Others

37. Debt position:

a. Institutional:

b. Non institutional:

c. Rate of interest:

38. Why don’t you practice commercial agriculture?

a. Communication problem b. Price less

. c. Production cost high d. Lack of storage facilities,

e. Less agri. land, f. Lack of capital,

g. Less profit, h. Natural calamities

39. Government agencies participation:

a. Do you know Agriculture extension officer?
b. Has he visited in your area?
c. Have you gone agri. Office?
d. Have you got training?
e. Was held any awareness camp on agri.?
f. Do you know soil composition?
g. Do you know the govt. price of crops?

40. Government helps:

Years	
Seeds	
Fertilizers	
Pesticides/ ince./herb	
Storage facilities	
Equipment's	
Funds	
Agricultural awareness camp	

41. Is right person getting the govt. helps? ....

....

42. Why do you support agriculture?

....

43. Why don't you support agriculture?

....

44. What is your future plan for agricultural development?

....

45. Do you feel needs of any government project in agri.?

....

46. Do you think about the quality of the food, when you use modern inputs?

....

46. Any suggestions/opinions/ remarks:

....

Research Scholar

ANNEXURE III

Research paper published in peer reviewed journals:

Sl. No.	**Title of the research paper**	**Name of journal**	**Remarks**
1	Impact of Road Transportation on Economic Development in Assam	QUEST International Multidisciplinary Research Journal, Vol-IV Issue – VI/June 2015, ISSN: 2278-4497, Publish World, Anand, Gujarat, India.	Published
2	Agricultural Market Scenario and Economy Condition of Farmer in Barpeta District, Assam	International Journal of Reviews and Research in Social Sciences, Volume No. : 4, Issue No. : 3, Year : 2016, Pages : 171-176, ISSN Print : 2347-5145	Published
3	Transportation and Communication for Tourist in Barpeta District	Hadira, a Souvenir, Published on the occasion of Namami Brahmaputra Festival, by Barpeta District Administration.	Published

- **Seminar/ Conference Participated**

1. 36th Indian Geographer's Meet cum International Seminar and presented a paper on "Impact of Road Transportation on

Economic Development in Assam". Organized by Geography Department, Gauhati University, on 25th to 28th February, 2015.

2. National Seminar on Environmental Awareness, Issues, Concerns and Challenges, Organized: Nalbari College, Nalbari, on 27th& 28th August, 2016.

- Life member of International Geographers Association.