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POTENTIAL AND PROSPECTS OF RABI CROPS CULTIVATION IN ASSAM

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P R E F A C E

The present study on "Potential and Prospects of Ravi Crops Cultivation in Assam" has been undertaken by the Centre with the approval of Directorate of Economics and Statistics, ministry of Agriculture, Government of India.

Agriculture continues to occupy a pre- eminent place in the economy of Assam and the farmers living in rural areas constitute the backbone of Assam agriculture. But, the State's agriculture is exposed to vagaries of monsoon. During monsoon, heavy rainfall causing extensive damage to summer and kharif crops. Therefore thrust now is being shifted to production of rabi crops which can be done in flood free season. The emergence of rabi crops are not only an opportunity to enhanced production, but also reduces the burden of production loss due to floods. In view of increasing demand for food crops for fast growing population, this study was undertaken with a focus on potentiality of growing rabi crops in the state.

The discussion and analysis of data clearly indicate that rabi crops have enormous potential in the study area despite a number of constraints being faced by the farmers. The study highlighted that major thrust should be given on development of irrigation, dissemination of new technology and assured input supply with strong marketing support.

In order to achieve the desired level of productivity of rabi crops the Government of Assam must come up in an effective way in creating basic infrastructural facilities and in co-ordinating with related departments. A selective 'area approach'has been considered more effective to consolidate the situation and to boost up the production of rabi crops. In chronically flood affected areas, special programmes should be taken up for oilseed, pulses and summer rice cultivation in rabi seasons. In view of the situation, it is necessary for the State Government to make concerted effort to bring all the potential areas under rabi cultivation with suitable adjustment of cropping sequence to attain self sufficiency in existing foodgrain production. However, it is desirable to involve the farmers in the decision making for successful implementation of agriculture development programmes.

We are thankful to the Directorate of Agriculture, Government of Assam for providing secondary level information related to the study. We are also thankful to the District Agriculture Officer and the officials of Nagaon District Agricultural Office for their help and assistance in conducting the field work.

I would like to express my gratefulness to the sample households for their spontaneous help and cooperation to the research team by providing the field data.

The study is an outcome of a joint effort of the Centre. The report was prepared by Dr. Moromi Gogoi and Rupam Kr. Bordoloi, with valued inputs from few others from the Centre and outside. I am thankful to all of them.

I hope the outcome of the study will be useful to the farmers and might help in formulation of programmes and policies for growth and development of rabi crops cultivation in the state.

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CHAPTER- I

Introduction

General Background

The summary of the importance of agriculture in overall development of our economy can best be put in the jargons used in the National Agricultural Policy 2000 of Government of India- "Agriculture is a way of life, a tradition, which, for centuries, has shaped the thought, the outlook, the culture and the economic life of the people of India. Agriculture, therefore, is and will continue to be central to all strategies for planned socio-economic development of the country. Rapid growth of agriculture is essential not only to achieve self-reliance at national level but also for household food security and to bring about equity in distribution of income and wealth resulting in rapid reduction in poverty levels"[1] . The majority of the rural population source their livelihood from agriculture and therefore the sector not only provides the much needed food and fibre but also employment to the rural mass, capital for economic transformation and there by responsible to increase the total rural welfare in a numerous way. The three primary objectives of agricultural development is "to provide food and fiber for an expanding for economic transformation, and to provide a direct increase in the rural welfare. Additional contributions to development from the agricultural sector are the labor force for expanding the industrial sector and a market for output of consumer goods and production supplies from the expanding industrial sector. All these objectives are closely associated with increased income in the agricultural sector[2].

The contribution of agricultural sector to foreign trade as on date can be viewed from the self revealing statistics. The share of agricultural exports to the total national export in value terms is about 13 per cent where as its import is about 6.19 per cent, which implies that this sector is net earner of foreign exchanges to support the supplementary and complementary foreign trade in other sectors.

1.Govt. of India: "National Agriculture Policy, 2000", Ministry of Agriculture, P.1

2.Mellor, Jhon W., "The Economics of Agricultural Development", Cornel University Press, New York, 1967,p.141

Agriculture Scenario of Assam

Agriculture is considered as the mainstay of the economy of Assam and plays a vital role in the State's economy. Agriculture and allied activities in Assam have overriding importance as source of livelihood to its people. It still contributes more than one forth (26.19 %) to the State's Net Domestic Product (NSDP) and supports about 70 Per cent of its population. The net cropped area of the state is 27.53 lakh hectares against gross cropped area of 39.57 lakh hectares. But the average operational holding is very small i.e.1.14 hectares only. The state of Assam experiences plenty of rainfall and possesses a fertile land which is extremely advantageous for cropping. The soil, topography, rainfall and climate of the state are quite congenial for producing variety of crops in different crop seasons. But, agriculture in the state characterized by low level of productivity due to recurring natural calamities , low level of mechanization, inadequate availability of quality inputs, poor soil health, low level of assured irrigation and inadequate marketing infrastructure. About 83 percent of the total land holdings are small and marginal which is one of the major obstacles of Assam agriculture.

In Assam, farmers grow crops mainly in two seasons i.e. kharif and rabi season. The major kharif crops are autumn rice, winter rice, maize, pulses, kharif oilseeds like seasamum, castor, soyabean, groundnut, kharif vegetables etc. There are some non food crops like jute, mesta, cotton etc. also grown in some extent by the farmers in the kharif season. On the other hand major *rabi* crops cultivated are summer rice, cereals, wheat, grams, rape & mustard, various rabi oilseeds, rabi vegetables, potato etc.

Rice is the main food crop in Assam as it is the main diet for the people of the state too. Rice predominate the rural economy of Assam providing food to more than 25 million people, in addition to generating income and employment directly and indirectly. The area under rapeseed and mustard, jute and potato stood at 226 thousand hectares, 60 thousand hectares and 78 thousand hectares respectively in 2008-09 as against 279 thousand hectares, 89 thousand hectares and 74 thousand hectares respectively in 2000-01. Some of the basic information of Assam agriculture are presented in Table-1.1

Being bestowed with the blessings of agro- climatic condition, the state has

Table-1.1

Assam Agriculture – General Profile

Net Cropped Area	27.53 lakh hectare (35 p.c. of Geographic Area)
Gross Cropped Area	38.39 lakh hectare
Area Sown more than Once	11.43 lakh hectare
Cropping Intensity	141.52%
Area Covered by Horticultural Crops	5.65 lakh hectare (14.71% of GCA)
Area Under Total Food grains	25.21 lakh hectare
Area Under Total Pulses	1.05 lakh hectare
Area Under Total Oilseeds	2.26 lakh hectare
Rice Area Covered by HYV	63% of Total Rice Area
Area Under Hybrid Rice	0.47 lakh hectare

Status of Farm Families :

No. of Farm Families	27.50 lakh
No. of Small & Marginal Farm Families	22.60 lakh (83.33% of Total Holdings)
Per Capita Land Holding	1.14 hectare

Irrigation & Mechanization:

Availability of Farm Power	0.70 HP per hectare (1.20 HP at National Level)

Integrated Nutrient Management:

Consumption of Chemical Fertilizers	63.2 kg. per hectare (kg. at National Level)
Average Consumption of Bio-fertilizers	50 gm. per hectare
Area under application of Micronutrients	3% of the Net Cropped Area
Consumption of Organic Manure	73 kg. per hectare
Consumption of Green Manure	111 Kg. per hectare

Integrated Pest Management:

Consumption of Chemical Pesticides	39 gm. per hectare
Consumption of Bio- Pesticides	6 gm. per hectare

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

become the natural abode of horticultural produce, which includes cultivation of wide range of horticultural crops like fruits, vegetables, spices, plantation crops, nuts and tuber crops. The most important horticultural crops of Assam are banana and orange which cover nearly 60 per

cent of production of food crops. The State produced 14.38 lakh MT fruits, 38.87 lakh MT vegetables, 21.36 lakh MT spices and 54.56 lakh MT tuber crops during 2006-07.

Summer Rice Cultivation in Assam

Excessive and untimely rainfall during *kharif* and autumn seasons and the havoc created by river flood has adversely affected the winter and autumn rice cultivation in the state. The farmers in the flood-prone areas are in search of alternative cropping pattern for producing staple grains and cash crops for income generation. Thus, summer rice has emerged as an important cereal crop in the state. During the past decade, the crop has taken a swing in the saucer-shaped marshy areas as a traditional rainfed crop and also in the non-traditional areas as an irrigated crop. Massive efforts have been made by the government for production of summer rice in the state through installation of STWs in the non-traditional areas and its cultivation in those areas has been identified as a capital-intensive, high- cost but highly productive crop, against the low-capital, low-cost and high-return rainfed summer rice in the traditional areas. Summer rice, which triggers green revolution in the State during 2000-01 with the aid of shallow tube wells installed under different departmental programmes resulted in 1.3 per cent increase in production in 2008-09 over 2002-03. But the area coverage under the crop decreased due to increases in the production cost mainly because of hike in price of diesel used in STW.

Although rice is the major food crop in the state, its vulnerability to natural disasters like flood, submergence and even drought affected the production system drastically. However, notwithstanding the dismal performance the farmers have shown dynamism in favour of summer rice (*boro*).In Assam, rice is grown in all the three seasons viz. autumn, winter and summer. The area under rice dominates the position ‘sharing about 64.70 per cent of total cropped area in 2008-09. The major rice is winter rice which occupies 1,805 thousand hectares in 1991, declined to 1,773 thousand hectares in 2008-09 while the area under *boro* rice increased from 128 thousand hectares to 360 thousand hectares during the same period. The productivity of *boro* rice is more than that of winter rice with 30-40 per cent yield premium. It is also relatively a safer option as it is cultivated in the flood free summer season. The emergence of this newer crop provided not only an opportunity to enhance production, but also reduces the burden of production loss due to floods. In recent years, with the

expansion of new farm technology, particularly in the flood affected areas, the farmers become interested in growing summer rice. The area under summer rice has increased by almost 60 per cent during the period 1991-92 to 2008-09 with a Compound Growth Rate (CGR) of 6.19 per cent. Area under autumn rice was declined slightly showing CGR of (-) 3.20 per cent. Winter rice has been still maintaining its predominant position due to higher demand notwithstanding its lower yield compared to summer rice. The decline in the area under winter rice can be attributed mainly due to floods in some years, but the area under this crop has again increased in the following flood free year.

Rice Development Programmes in Assam

Considering the importance of agriculture in the economy of the state, top most priority have been given in five year plans by the government on the supportive services for the development of agriculture sector. Consequently, various schemes has been taken by the government to increase the production and productivity of food grains. Some of the important Rice Development Schemes implemented by the government are: Special Rice Production Programme (SRPP), Special Food grains Production Programme (SFPP)-Rice, Integrated Programme for Rice Development (IPRD), Integrated Cereals Development Programme in Rice based Cropping System (ICDP-RICE), High Yielding Varieties Programme , Rice Seed Mini-Kit Programme, State-Level Training Programme on Rice Production Technology, Special Orientation TrainingProgramme on Rice Production Technology, Macro Management Scheme of Agriculture

Oilseed Production in Assam

Total oilseeds includes Rape & Mustard, Line seed, Sesamum, Nizer, Soyabean, Ground nut, Sun flower (Rabi Oilseeds) and Sesamum, Castor, Soyabean, Ground nut (Kharif oilseeds). Rape & Mustard is the principal oilseeds grown in the State which occupied about 8.00 per cent of the total crop area. The area of this crop was 1.37 lakh hectares in 1970-71 which steadily increases to 2.13 lakh hectare in 1980-81 to 2.94 lakh hectare in 1990-91 than declined to 2.45 lakh hectares in 2004-04 and further to 2.26 lakh hectare in 2008-09. Total production has increased from 56.50 thousand M.T. in 1970-71 to 102.40 thousand M.T. in 1980-81, 157.91 thousand M.T. in 1990-91 than it declined to 129 thousand M.T. in 2004-05

and 123 thousand M.T in 2008-09. The analysis indicate that area and productivity of rape and mustard had not increased to the desired level. It is significantly lower than the agriculturally advanced states like Punjab, Gujarat and Haryana. This lower productivity is mainly due to non adoption of improved method of cultivation, use of traditional seed varieties, low use of chemical fertilizer and other soil nutrients. Moreover, method of cultivation remains traditional and no technological breakthrough have been achieved and hence productivity of this crop has not increased.

Oilseeds Production Programme (OPP)

For increasing the production of oilseeds/edible oils and to attain self sufficiency in the production of oilseeds/edible oils, a Centrally Sponsored Oilseeds Production Programme (OPP) is being implemented in 28 States covering 408 selected districts in the country. Under this scheme financial assistance is being provided for various critical inputs like production and distribution of seed, distribution of seed minikits, distribution of improved farm implements, sprinkler sets, rhizobium culture and PSB/micro nutrients etc. In order to disseminate the production technology amongst farmers, frontline demonstrations are organized by the I.C.A.R. Besides, block and integrated pest management demonstrations are organized through State Department of Agriculture. A new component of crash programme for quality seed production of groundnut and soybean has also been introduced during the Ninth Plan. Implementation of Oilseesd Production Programme has helped in increasing the production of oilseeds from 10.83 million tonne in 1985-86 to 24.88 million tonne during 2009-10. There has been marginal decline in production during the last two years due to drought conditions in many oilseeds producing states.

Pulses Production in Assam

Pulses are considered as an indispensable constituent of Indian diet. The major pulses grown in Assam are black gram, green gram, linseed, lentil, peas, beans etc. Assam's share India's pulses production is very negligible. The area coverage is only 2.97 per cent of the gross cropped area in the year 2008-09. Area of pulses in Assam rose to 128 thousand hectares in 2001-02 from 113 thousand hectares in 1990-91, but after that it was declined to

107 thousand hectares on 2004-05 to 105 thousand hectares in 2007-08. Similarly, production also rose to 71 thousand M.T. in 2001-02 from 49 thousand M.T in 1990-91. It was increased to 57 thousand M.T. in 2004-05 and further slightly increased to 58 thousand M.T.in 2007-08. The cropping pattern of the state reveals that the farmers usually pay top priority in growing food crops and pulses and other crops are grown in small patches where food crops are not grown. In Assam pulses are generally grown in *rabi* season. However, some varieties are grown in *kharif* season in certain districts. But the area under such varieties is very small. Nearly 94 per cent of total pulses cropped area comes under *rabi* pulses.

National Pulse Development Programmes

In order to increase the production of pulses in the country the government of India introduced National Pulses Development Programme and Special Food Production Programme during the Seven Five Year Plan period. It was envisages to develop three basic foundations: Productive development package, effective delivery services along with remunerative prices and suitable market. From 1994-95 all these programmes have been merged in to a single scheme known as National Pulse Development Programme (NPDP).The scheme lays emphasis on increase in area through multiple/double cropping and inter cropping to increase the production level of pulses. Attention has been paid to improvement of technology, distribution of HYV seeds, fertilizers, plant protection chemicals and other modern inputs.

The agriculture in Assam has tremendous scope of growth and it is witnessing a number of positive developments. The department of agriculture has been implementing various development programmes for augmenting the agriculture productivity under different agro-climatic conditions of the state. For achieving this, it is important to adopt agricultural technologies with emphasis on efficient utilization and management of essential inputs for obtaining maximum economic returns.

National Food Security Mission-Pulses (NFSM-Pulses) is one of the components of the centrally sponsored scheme of National Food Security Mission and is under implementation since 2007-08 in 171 districts of 14 states. The objective of NFSM-Pulses is to increase the production of pulses by 2 million tons by the end of Eleventh Plan (2011-12).

Initially the NFSM-Pulses was meant only for additional areas but considering the implementation problems and unexploited yield potential in existing districts it was decided to cover 100% area in the identified NFSM-Pulses districts Recently following decision has been taken to further promote the pulses production in the country. These are

. Merger of all pulse components of ISOPOM with NFSM-Pulses
. Coverage of all districts by NFSM-pulses in all the 14 NFSM-Pulse states
. Inclusion of 10 districts of Assam and 15 districts of Jharkhand under NFSM-Pulses.
. Implementation of additional programmes

In 2010-11, in addition to above mentioned schemes, two new programmes relating to bringing green revolution to Eastern India and integrated development of 60000 Pulses and Oil seeds Villages in rainfed areas have been initiated under RKVY. National Food Security Mission has been strengthened from 1.4.2010 with the merger of pulses component of ISOPOM and inclusion of two new potential States for Pulses production in Assam and Jharkhand. A new programme has been started to cover 1000 unit of 1000 hectare each of five pulses crops in 16 pulses growing States of the country.

Climate and Rainfall

In a predominantly agrarian state climatic factor plays a very important role in determining the economic condition of the people. The State of Assam enjoys heavy summer rainfall, winter drought, high humidity and relatively low temperature during a year.

Rainfall in Assam is high but the distribution of rainfall is not uniform. The seasonal distribution of rainfall reveals heavy concentration during monsoon, relatively small quantity during pre and post monsoon periods and rather scanty rainfall during winter. So far as the distribution of rainfall is concerned, there is a marked variation within the State. The pattern of rainfall in Assam during the year 2008-09 in kharif and *rabi* season is presented in Table 1.2

It is apparent from the Table that the state experienced 1,951.0 mm of rainfall during 2008-09 out of which 1,773.3 mm was occurred during the kharif season. During the *rabi* season the state has received 178.3 mm of rainfall against normal rainfall of 302.2 mm, a

deviation was acute during the months of November 2008 to February 2009 as the state had received actual rainfall ranged between 1.4mm to 10.0 mm.

Table: 1.2

Rainfall in Assam during Kharif and Rabi season,2008-09

Months	Actual Rainfall (mm)	% departure from Normal	Status
Kharif Season:			
April	153.3	-24	Deficient
May	201.1	-45	Deficient
June	358.8	-21	Deficient
July	371.5	-11	Normal
August	440.2	33	Excessive
September	247.9	-7	Normal
Total	1772.8	-13	Normal
Rabi Season:			
October	120.9	-1.4	Normal
November	1.8	-93	Scanty
December	1.4	-89	Scanty
January	4.2	-77	Scanty
February	10.0	-63	Scanty
March	40.0	-49	Deficient
Total	178.3	-41	Deficient

Source: Economic Survey, Assam 2009-10

Assam experiences devastating floods and erosions causing immense sufferings to the people of the affected areas and damage to the standing crops including cattle heads. According to the Department of Agriculture, chronically flood prone area of the State is 247.9 thousand hectares and another 89.90 thousand hectares are susceptible to floods.

Land Holding Pattern

Agricultural economy depends much on the land holding as well as land use pattern, because the economic efficiency of the farming community depends much on the size of land holdings. The distribution of operational holdings by size groups of holdings of Assam is shown in Table- as reported by Agricultural Censuses conducted in different periods of time. Table shows that the percentage of operational holdings below 1.00 hectare to total number of holdings rose to 62.65 in 2000-01 from 57.04 in 1970-71, i.e. increased by about 5.18 per cent. In all other farm size groups percentage of operational holdings to total holdings found to have marginal differences.

In case of average size of operational holdings it shows a declining trend. It came down to 1.14 hectares in 2000-01 from 1.47 in 1970-71.

Table - 1.3

Average Size of Operational; Holdings and Percentage to Total Number of Holding in Assam

Census Year --> Farm Size (ha.)	1970-71		1985-86		1990-91		1995-96		2000-01	
	P.C. of operational Holding to total No. of Holding	Ave. size of Operational Holding	P.C. of operational Holding to total No. of Holding	Ave. size of Operational Holding	P.C. of operational Holding to total No. of Holding	Ave. size of Operational Holding	P.C. of operational Holding to total No. of Holding	Ave. size of Operational Holding	P.C. of operational Holding to total No. of Holding	Ave. size of Operational Holding
Below 1.00 ha.	57.04	0.47	59.95	0.41	60.28	0.40	62.22	0.37	62.65	0.39
1.00 - 2.00 ha.	23.76	1.41	22.59	13.93	22.19	1.40	20.91	1.37	20.69	1.30
2.00 - 4.00 ha.	16.25	2.99	13.40	2.69	13.58	2.68	13.09	2.63	12.96	2.73
4.00 - 10.00 ha.	2.56	5.53	3.82	5.21	3.75	5.16	3.59	5.16	3.52	5.22
10.00 ha. & above	0.39	54.25	0.24	18.08	0.20	18.01	0.19	65.60	0.18	53.02
Total	100.00		100.00		100.00		100.00		100.00	
Ave. Size of Holding		1.47		1.30		1.27		1.17		1.14

Source: Statistical Handbook of Assam, 2002,2006

Table - 1.4

Land Use Pattern of Assam

Years --->	1985-86	1987-88	1989-90	1992-93	1996-97	1998-99	2001-02	2004-05
Land Use Pattern :								
Geographical area	7852	7852	7852	7848	7844	7844	7844	7850
Non- Agricultural area	914	914	914	1013	1045	1050	1081	1065
P.C. to geo. Area	**11.64**	**11.64**	**11.64**	**12.91**	**13.32**	**13.39**	**13.78**	**13.57**
Net Sown Area	2706	2706	2706	2777	2744	2701	2774	2752
P.C. to geo. Area	**34.46**	**34.46**	**34.46**	**35.38**	**34.98**	**34.53**	**35.36**	**35.06**
Area Sown more than once	1092	995	1056	1149	1244	1240	1209	1143
P.C. to geo. Area	**13.91**	**12.67**	**13.45**	**14.64**	**15.86**	**15.81**	**15.41**	**14.56**
Land under Misc. tree/ Groves	247	247	247	220	243	236	209	209
P.C. to geo. Area	**3.15**	**3.15**	**3.15**	**2.8**	**3.1**	**3.01**	**2.66**	**2.66**
Barren & Uncultivated land	1541	1541	1541	1460	1448	1459	1453	1447
P.C. to geo. Area	**19.63**	**19.63**	**19.63**	**18.6**	**18.46**	**18.6**	**18.52**	**18.43**
Permanent Pasture & Grazing	184	184	184	183	169	167	160	160
P.C. to geo. Area	**2.34**	**2.34**	**2.34**	**2.33**	**2.15**	**2.13**	**2.04**	**2.04**
Fallow land other than Current Fallow	84	84	84	70	69	82	66	59
P.C. to geo. Area	**1.07**	**1.07**	**1.07**	**0.89**	**0.88**	**1.05**	**0.84**	**0.75**
Culturable Waste land	104	104	104	89	87	80	77	77
P.C. to geo. Area	**1.32**	**1.32**	**1.32**	**1.13**	**1.11**	**1.02**	**0.98**	**0.98**
Forest Area	1984	1984	1984	1984	1930	1930	1933	1954
P.C. to geo. Area	**25.27**	**25.27**	**25.27**	**25.28**	**24.6**	**24.6**	**24.64**	**24.89**
Total Cropped Area	3797	3700	3761	3926	3989	3941	3984	3896
P.C. to geo. Area	**48.36**	**47.12**	**47.9**	**50.03**	**50.85**	**50.24**	**50.78**	**49.63**

Sources: 1. Agriculture Statistics At a Glance, 2002 , 2. Statistical Handbook of Assam, 2002, 2003 3. Economic Survey, Assam 2005, 2006

Pattern of Land Utilisation in Assam

Table 1.4 shows the land utilization pattern of Assam in detail. Table reveals that there has been a slow increase in area under different crops. The gross cropped area in the State increased from 3,797 thousand hectare in 1985-86 to 3,896 thousand hectares in 2004-05 showing an increase from 48.36 per cent to 49.63 per cent of total geographical area in the respective period. The land under non-agricultural uses increased to 1,065 thousand hectares in 2004-05 from 914 thousand hectares in 1985-86.

Land under miscellaneous crops, barren and un-cultivable land, permanent pasture and grazing land, fallow land, cultivable waste land, forest land and current fallow showed a declining trend during the period from 1985-86 to 2004-05. The net sown area and double/multiple cropped area increased gradually during the period.

Cropping Pattern

Cropping pattern plays an important role in agricultural development of a region or a state as it is an important indicator to know the area under different crops at a particular

Table: 1.5

Compound Growth Rate of Area, Production and Productivity of Major Crops from 2003-04 to 2007-08

Crops	Compound Growth Rate		
	Area	Production	Productivity
Autumn Rice	-4.49	-3.97	0.21
Winter Rice	-0.62	-2.54	2.21
Summer Rice	3.28	5.75	2.40
Total Rice	**-0.69**	**-1.23**	**-0.81**
Wheat	0.55	2.61	1.93
Maize	1.04	0	0.53
Pulses	-0.48	-0.30	0.14
Oilseeds	0.32	0.25	0.62
Jute	-1.3	-0.18	1.11

Source: Department of Agriculture, Govt. of Assam

period of time. In Assam, cereal crops dominate the entire cropping pattern in the state. Rice is the major crop grown in Assam which occupies 2529 thousand hectares or 61.87 per cent of the total cropped area. Pulses occupy next place to rice with 2.53 per cent. Another principal crop jute occupied 1.57 per cent of gross cropped area, but it varies from year to year depending on price of jute. The other crops grown are wheat, rapeseed, maize, potato, mustard

etc. Different types of horticultural and plantation crops like banana, pineapple, orange, areca nut, coconut etc. are also grown in the State to a considerable extent. Tea is an important plantation crop growing extensively in the state.

From the Table - 1.5 , it is clear that although the area ,production and productivity of rice is declined, summer rice shows positive trend in case of area, production and productivity. Among the other crops, wheat, maize and oilseed shows positive growth while total pulses and jute shows negative compound growth rate.

In view of marked achievement of summer rice cultivation and potential of other *rabi* crops cultivation in Assam, it was suggested that a study on the "Potential and Prospects of rabi Crops Cultivation" should be taken by the Centre. Considering the regional importance of the study the Directorate of Economics and Statistics of the Ministry of Agriculture ,Government of India approved the proposal and included in the programme of work of the Centre for the year 2010-11.

Review of the Study

A few studies conducted elsewhere are reviewed herewith

Phukan (1990) in his research study on agricultural development in Assam opined that, to increase rice production by adopting double and multiple cropping in Assam, irrigation would be the most essential infrastructure. Low productivity of crops may be largely attributed to lack of irrigation. According to him, surface flow irrigation projects are not much helpful in providing assured water to the farmer's field. Therefore, surface lift and ground water lift irrigation under minor irrigation projects would be best suited to the local conditions provided they are installed properly and in areas where beneficiaries are willing to utilize the water and improve their land for using water.

Goswami (1998) conducted a study on economics of pulses production and identification of constraints in raising their production in Assam. He found that the area and production of total pulses decreased in both the selected districts of Jorhat and Nagaon. The decreases was faster in Jorhat district. The yield of total pulses maintained a nominal growth in both the districts during the period under observation. The decreasing trend of area coverage and production of pulses poses a matter of concern in the state no serious efforts on

the part of the state government to boost up production of pulse is observed. On the other hand, the central government's financial assistance for raising production of pulses to the state is also meager. The author found that the farmers in Assam is yet to accept the improved technology in the production of pulses because of poor extension facilities, poor infrastructure and lake of awareness of farmers. Most of the pulses are grown in rabi season in rainfed condition Weather condition is a governing factor in the production of pulses in Assam. But vagaries of rainfall and unfavourable weather condition very often damage crops and subsequently production of pulses in many parts of the state. He suggested that production and productivity of pulses can be increase through adoption of improved technology like use of HYV seed, and improved agronomic practices.

Bagchi (2003) considered that the basic inputs of agriculture are irrigation, fertiliser and agricultural credit were of crucial importance for dynamic agricultural sector. In the course of analysis the author observed that use of these vital inputs in the post reform period declined in comparison to pre-reform period. In absence of these basic inputs the productivity of principal crops has not increase in the North-Eastern States as expected.

The 59th round survey of National Sample Survey Organization (2003) on farmers Accessibility to Modern Technology has revealed a discernible picture with regard to mechanisation of farm sector, while in Assam 97 per cent of the energy used in farm sector flows from animals against 52 per cent at the all India level. Only 3 per cent of the total farm energy consumption comes from diesel, which in other words implies that the pace of mechanisation in the state is rather slow.

As per the findings under the Millennium Study (2004) on State of Indian farmers, agricultural research has not benefited all farmers and regions equally. Research has focused on solving the problem of small numbers of crops, grown mainly by farmers in irrigated areas. The problems faced by farmers living in dry lands, hills and other marginal areas, on the other hand, have received relatively less attention. There is also a growing concern that there is too much compartmentalization in research. The activities of most scientists are focused on either a discipline or a crop. This prevents them from treating the farmers' problems in their totality. It is in this context that a system's approach to agricultural research can be very

valuable. It is also important that while formulating research objectives and priorities, farmers' concerns and problems and their knowledge are given due importance.

Talukdar & Deka (2005) studied on cultivation of Summer Rice in the flood prone areas of Assam gained momentum through massive public investment on STW, specially in the non-traditional areas. The crop has shown high productivity in the medium land at higher level of technology, which needs repeated application every year. The study analysed the growth and stability of summer rice and economics of its cultivation in the flood prone districts of Assam. It has been observed that summer rice has grown faster than autumn and winter rice during the past few decades. Irrigated HYV summer rice in the medium land was costly to cultivate but was more productive at higher level of technology. Yield advantage of summer rice has been found to be higher than that of autumn and winter rice. The authors identified high cost and low product price, land degradation due to over use of chemical fertilizer, high cost of irrigation, prevailing market distortion and lack of short duration varieties etc. as main constraints for summer rice cultivation. He concluded that a strong linkage between commodity and money market would further encourage the marginal and small farmers for cultivating high cost boro rice in nontraditional areas.

Objectives

The proposed study is designed to analyse the potential and prospects of major *rabi* crops cultivated in the state. The objectives of the present study are:

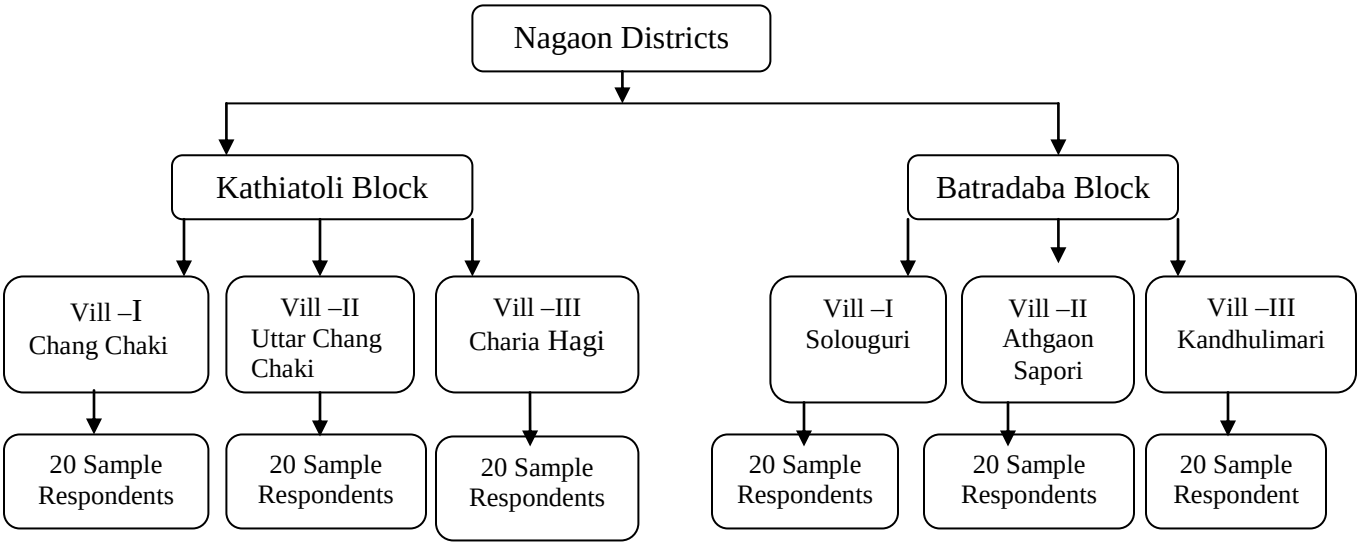
1. to analyse the area, production and productivity of *rabi* crops in Nagaon district vis-à-vis all Assam
2. to study the economics of production of *rabi* crops of the sample farmers
3. to study the factors affecting productivity of *rabi* crops
4. to find out the constraints of production of *rabi* crops and suggest policy measures

Methodology

The present study was undertaken in Nagaon district of Assam. The district was purposively selected as most of the *rabi* crops are grown exclusively in the district. Among the *rabi* crops; summer rice, pulses and oilseeds were covered by the study. Although *rabi* vegetables

are also grown by the farmers of the district for commercial purposes, the study was not cover it due to the fact that summer rice, pulses and oilseeds are the major food crops of Assam. From the district, two community development blocks i.e. Kathiatoli and Bratadrawa were selected for the study in consultation with the District Agriculture Officer. From each block, three villages are selected for field investigation where *rabi* crops were exclusively grown by the farmers. Accordingly, from Kathiatoli block Chang Chaki, Uttar Chang Chaki and Charia Hagi villages and from Batradave block Solouguri, Athgaon Chapori and Kandhulimari villages have been selected for data collection. Then from each selected village, 20 farmers of various farm size groups are selected by following random sampling method. Thus a total of 120 farmer households are covered by the study.

Chart –I : Flow Chart of Sample Design



The study was based on both primary and secondary level data. The relevant primary data were collected with the help of a set of specially designed schedules and questionnaire. The data were collected from the sample households through personal interview method.

The required secondary level time series data of area, production and productivity of summer rice, pulses and oilseeds were collected from the publications of the Directorate of

Economics and Statistics, Khanapara, Guwahati .Moreover; relevant secondary level data from various published and unpublished sources are used in the study.

The chapter plan, tabulation models and data analysis were made as per objectives to draw inferences. Some statistical tools were also used to draw inference with time series data as well as primary level data. Accordingly, benefit-cost ratio and regression analysis were done to draw inferences on data.

The study once accomplished expected to highlight some important observations and findings of potential and prospects of *rab*i crops cultivation in Assam as a whole and the sample district in particular.

Scope of the Study

The State's agriculture is affected by vagaries of monsoon. During monsoon heavy rainfall causes water logging and aggravates the flood problems causing extensive damage to summer and *kharif* crops. Therefore thrust should be given in production of *rabi* crops which can be done in flood free season .The emergence of *rabi* crops are not only an opportunity to enhance production, but also reduces the burden of production loss due to floods. Therefore, in view of increasing demand for food crops for fast growing population and potentiality of growing *rabi* crops this study will provide ample scope for increasing *rabi* crops production. It is expected that such an intensive study might help in formulation of programmes and policies for growth and development of *rabi* crops cultivation in the state.

Chapter Plan

The study comprises of five chapters. The first chapter is the introductory chapter as usual covering the State's basic features including economic aspects. It also includes some of the reviews of the study, objectives and methodology of the study. The second chapter contains trends analysis of area, production and productivity of summer rice, oilseeds and pulses in the sample district of Nagaon along with all Assam. This chapter is based on secondary level data collected from various departments of agriculture. The details of the socio-economic profile of the sample households are discuss in the third chapter. In the fourth chapter, an attempt has been made to analyze the economics of production of *rabi* crops and factor affecting productivity of *rabi* crops.

The fifth chapter deals with the constraints of production of *rabi* crops and provide some suggestions and policy implications and conclusions.

Limitations of the study

The data collected depends upon the farmers response to different quarries based on recall memory of the crop growers.

Reference period

The study relates to the year 2009-10

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CHAPTER- II

Trends of Area Production and Productivity of Rabi Crops in Assam

In this chapter an attempt has been made to analyse the trend of area, production and productivity of three major *rabi* crops i.e. summer rice, pulses and rape & mustard based on secondary level data in Assam and sample district Nagaon.

Agriculture in Assam has been playing a very important role in state's economy. Of the total cropped area of the state, the percentage of area under different crops constituted about 48.94 percent of the total geographical area in the year 2007-08.

From the available data for different crops, it is seen that paddy being the staple food, alone occupied more than 64.00 percent of the gross cropped area in 2007-08.

The dominant crop paddy is cultivated in three different seasons. Winter season (*Sali*), summer season (*Boro*) and autumn season (*Ahu*). During the year 2008-09, paddy cultivation occupied 90.20 percent of the net cropped area. The average area covered for normal paddy cultivation during the year was 24.84 lakh hectares or about 93.00 percent of the total area under food grains in the state.

However, there has been a gradual decline in respect of area covered under cultivation of autumn rice concomitant, with replacement of the area by the summer rice due to its higher productivity and hazard risk.

The area, production & productivity of summer rice, pulses and rape &mustard during last 11 years are presented in Table-2.1

Area

The area under summer rice showed an increasing trend over the period of last eleven years (1998-99 to 2008-09). The area under summer rice was 10.28 percent more in 2008-09 as compared to the area during 2007 - 08 (3.23 lakh hectares).

The area coverage under pulses and oilseeds in 2008-09 were found to shared it 1.14 lakh hectares and 2.26 lakh hectares, respectively against 0.99 lakh hectares and 2.38 lakh

Table – 2.1
Area, Production and Productivity of Summer Rice, Pulses and Rape and Mustard in Assam

(Area in Hectares, Production in Tonnes, Yield in Kg/Ha.)

Year	Summer Rice			Pulses			Rape and Mustard		
	Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1998-99	223913	446113	1992	126800	69222	546	288829	135631	470
1999-00	171522	303373	1733	116178	64688	546	286241	129425	443
2000-01	318588	620304	1908	111415	62240	547	274459	141231	504
2001-02	326000	666097	2003	119526	66406	544	272323	137056	493
2002-03	327468	634805	1901	112275	60420	527	261309	129784	487
2003-04	319480	584653	1794	103687	56743	536	264103	138296	513
2004-05	311437	622339	1959	95591	54386	558	244948	129395	518
2005-06	314671	571168	1780	108306	59563	550	212471	96992	447
2006-07	312471	642765	2017	99531	52963	521	238426	115874	476
2007-08	323000	732241	2267	105000	58000	555	235000	123000	523
2008-09	360000	768000	2133	114000	62000	545	226000	125000	551

Source: Basic Agricultural Statistics, Relevant Years, Department of Agriculture, Govt. of Assam

hectares in 2007-08. It is evident from the table that while the area under pulses gradually increased from 0.99 lakh hectares in 2006-07 to 1.14 lakh hectares in 2008-09, the area coverage under rape and mustard gradually decreased from 2.38 lakh hectares in 2006-07 to 2.26 lakh hectares in 2008-09. The following Figures show the area and trend line of three principal crops in Assam (The calculation of trend equations of the figures are shown in Appendix -)

Fig-1: Area under Summer Rice in Assam (Hectares)

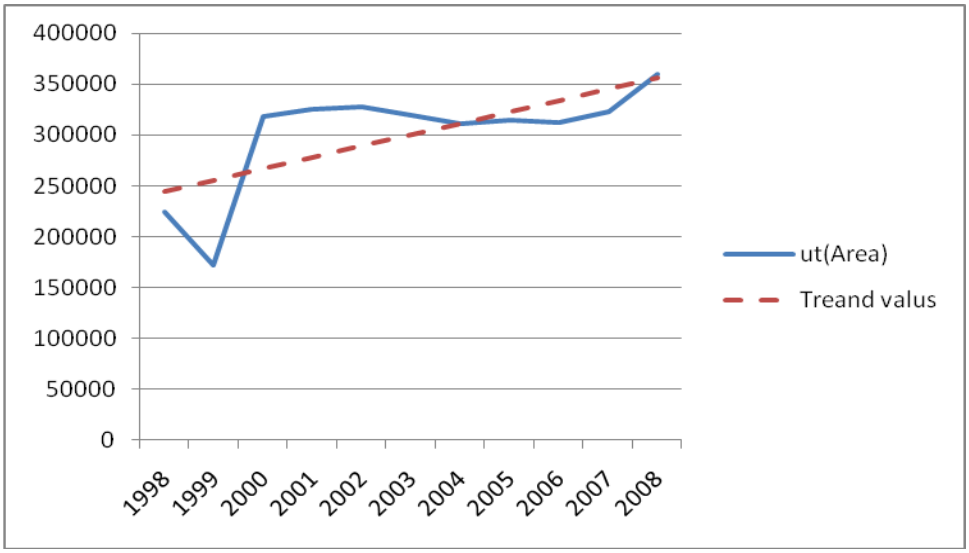


Fig-2: Area under Pulses in Assam (Hectares)

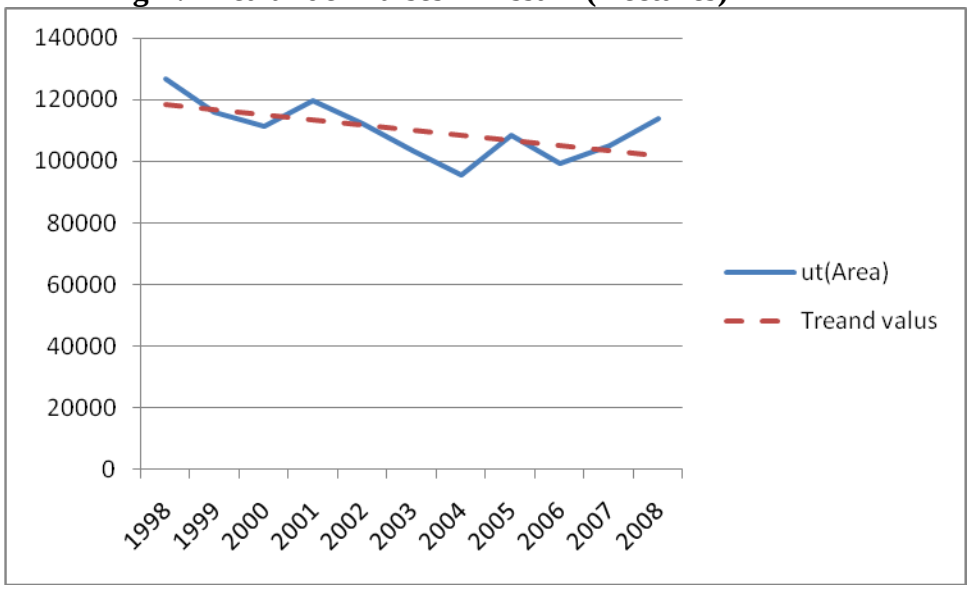
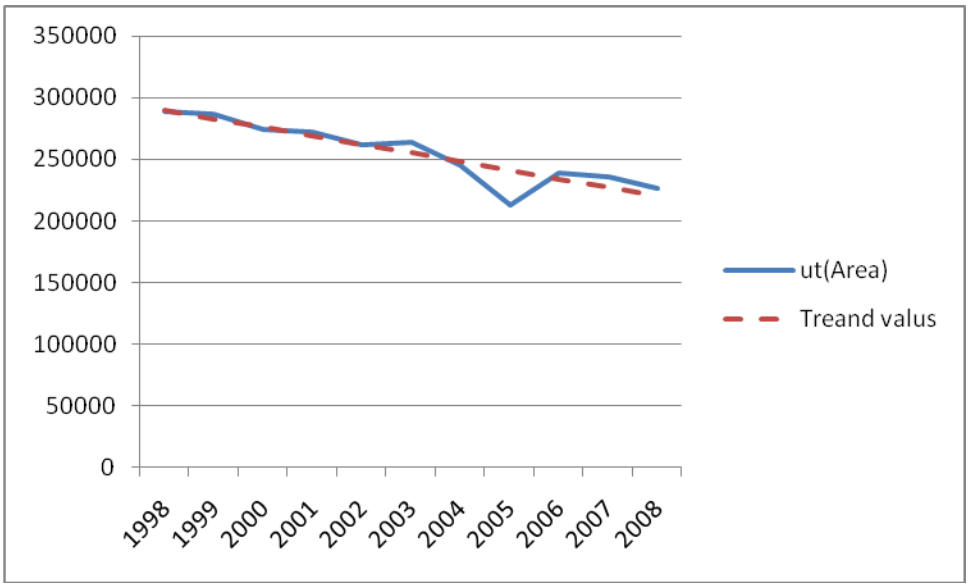


Fig-3: Area under Rape & Mustard in Assam (Hectares)



Production

The production of summer rice in the state was 7.68 lakh tones during the year 2008-09 which was recorded as all time high in the state. It was about 4.88 percent higher than for the year 2007-08 (7.32 lakh tones).

The production of pulses, on the other hand, increased from 0.58 lakh tones in

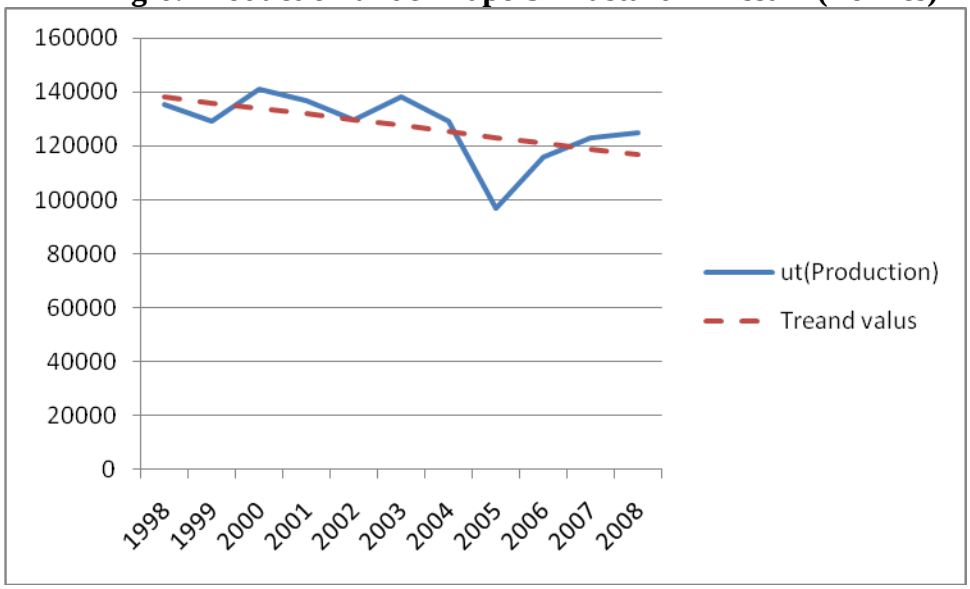
2007-08 to 0.62 tones in 2008-09. The increased in production of pulses during the year 2008-09 was 6.45 percent more as compared to the production of pulses during 2006-07

Fig-4: Production under Summer Rice in Assam (Tonnes)

(0.53 tonnes). During the year 2005-06, the production of pulses in the state was 0.59 lakh tones. The rape and mustard production was also increased marginally during the year 2008-09 with 1.25 lakh tones as against 1.23 tonnes in 2007-08. The production of rape and mustard

Fig-5: Production under Pulses in Assam (Tonnes)

Fig-6: Production under Rape & Mustard in Assam (Tonnes)



in the state was 0.97 lakh tones and 1.16 lakh tones during the year 2005-06 and 2006-07 respectively.

Productivity

The Table-1 shows the trend of yield rates of three principal *rabi* crops for the period 1998-99 to 2008-09.

The productivity of summer paddy continued to maintain its increasing trend

Fig-7: Productivity under Summer Rice in Assam (Kg/ha)

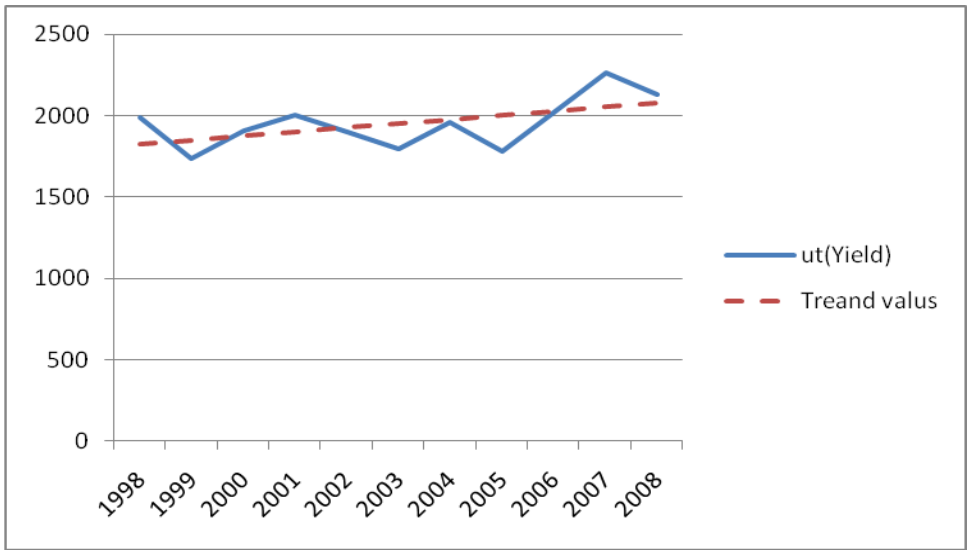
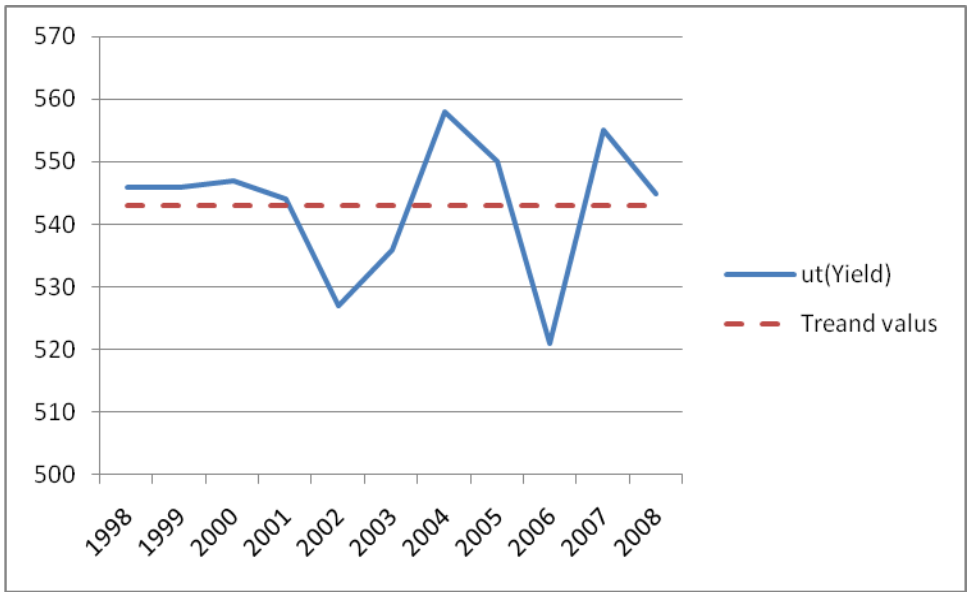


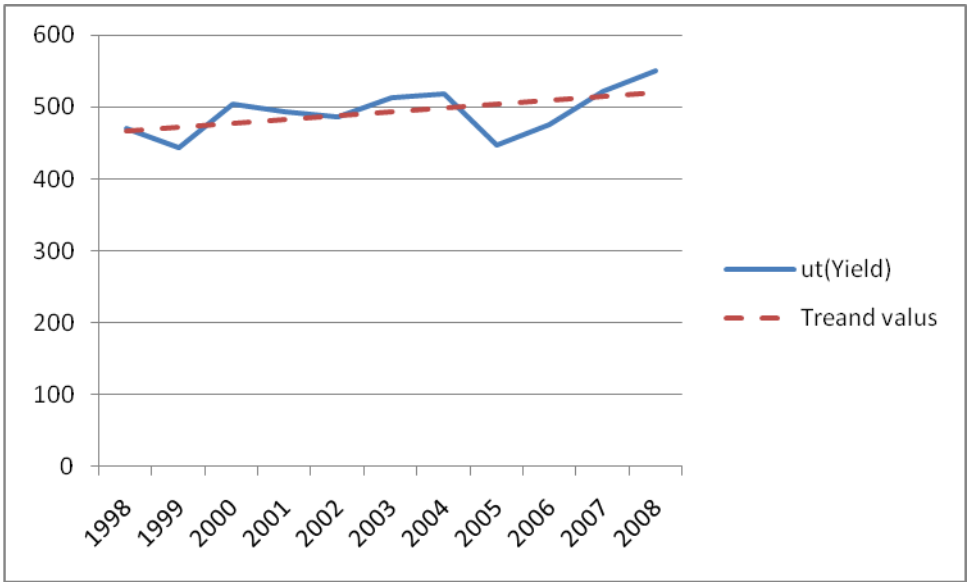
Fig-8:Productivity of Pulses in Assam (Kg/ha)



during the period 2004-05 to 2008-09 except for the year 200-06. However the yield rate of Summer paddy was marginally low during 2008-09 as compared to the yield rate of 2007-08.

The productivity of Pulses and rapeseed & mustard did not indicate any particular trend during the period of 2004-05 to 2008-09. While the productivity of pulses ranged between 558 kg/ha to 521 kg/ha during the period under consideration, the

Fig-9: Productivity of Rape & Mustard in Assam (Kg/ha)



productivity of rape and mustard recorded steady recovery from 2005-06 onwards. Nearly, 5.35 percent increase in yield was recorded in the year 2008-09 over the productivity of 2007-08.

Area, Production and Productivity of Summer Rice, Pulses and Rape & Mustard in Nagaon District

In this section, an attempt has been made to examine and assess the status of three selected *rabi* crops in the sample district i.e. Nagaon. The area, production and productivity of the three selected crops in Nagaon district for the period 1997-98 to 2007-08 were shown in the Table 2.2.

Summer Rice

Table-2.2 shows that the area, production and yield of summer rice showed an increasing trend except for the year 1999-2000.

Table 2.2
Area, Production and Productivity of Summer Rice, Pulses and Rape and Mustard in Nagaon

(Area in Hectares, Production in Tonnes, Yield in Kg/Ha.)

Year	Summer Rice			Pulses			Rape and Mustard		
	Area	Production	Productivity	Area	Production	Productivity	Area	Production	Productivity
1997-98	28013	65503	2338	12674	5816	459	22838	14837	650
1998-99	41679	100330	2407	12447	5865	471	26229	13525	516
1999-00	37363	75076	1969	15106	7244	480	26406	12278	456
2000-01	55989	127630	2234	13264	5433	401	26327	13951	519
2001-02	57920	138272	2341	11611	4915	415	28758	13287	453
2002-03	59833	133630	2190	11691	5641	473	28808	13774	469
2003-04	57686	134087	2279	11482	4899	418	27873	14263	501
2004-05	58736	137376	2293	9237	3940	418	27057	12349	447
2005-06	51349	110709	2114	10967	4618	413	16172	8722	529
2006-07	50412	111703	2172	13673	5808	416	18315	9980	534
2007-08	60591	134364	2218	8385	3376	395	16167	9412	582

Source: Basic Agricultural Statistics, Relevant Years, Department of Agriculture, Govt. of Assam

The area and production of summer rice in the year 2005-06 were 513,49 hectares and 1,10,709 tones, respectively and the figures in the same order reached 60,591 hectares and 1,34,364 tones in the year 2007-08. The area and production of summer rice for the year

2008-09 were estimated at 64,236 hectares and 1,43,262 tones respectively. The figures show the trend value of area of summer rice in Nagaon district.

Fig-10: Area under Summer Rice in Nagaon District (Hectares)

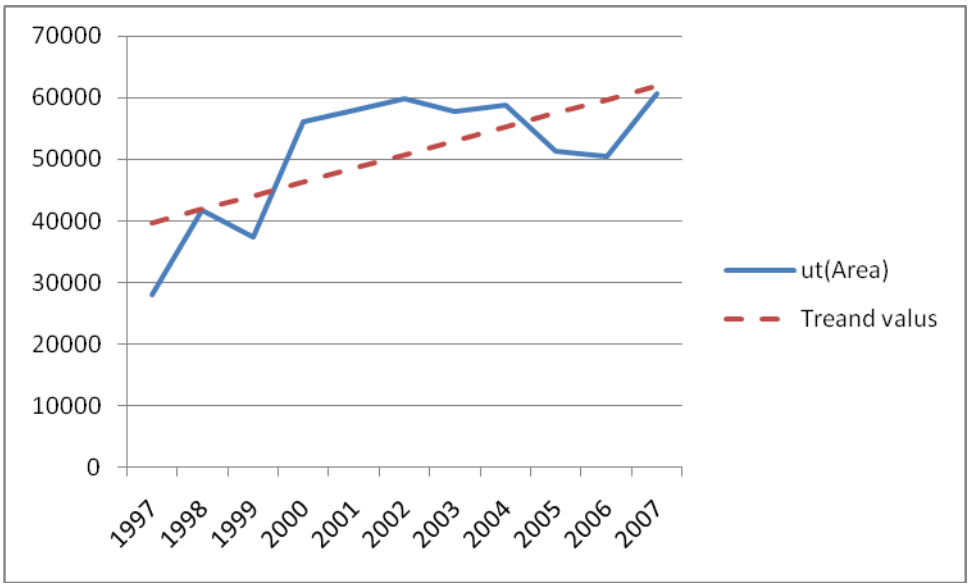
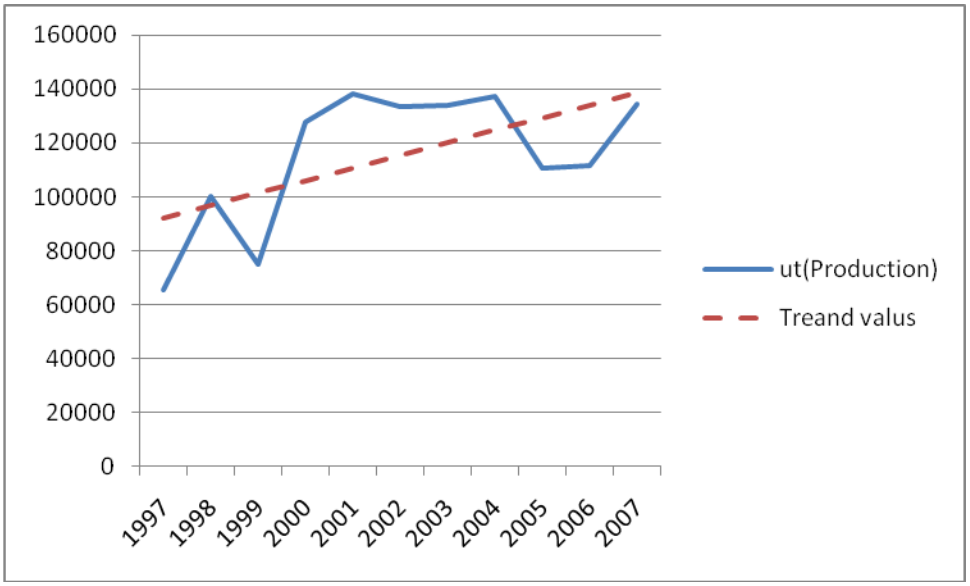


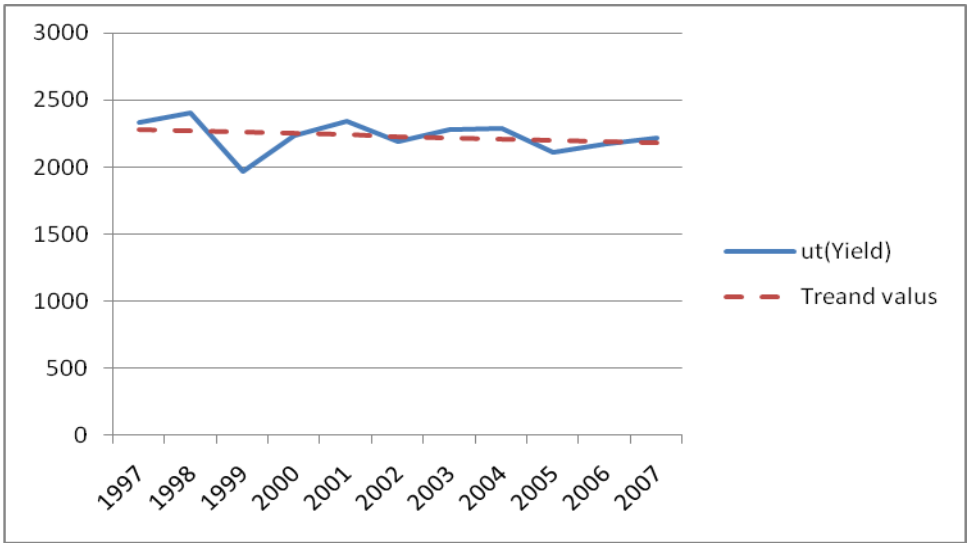
Fig-11: Production under Summer Rice in Nagaon District(Tonnes)



The yield rate of summer rice in the year 2005-06 was recorded at 2,114 kg/ha which increased to 2,218 kg/ha in the year 2007-08.

From the trend equation the estimated value of productivity rate for the year 2008-09 was found at 2,175 kg/ha.

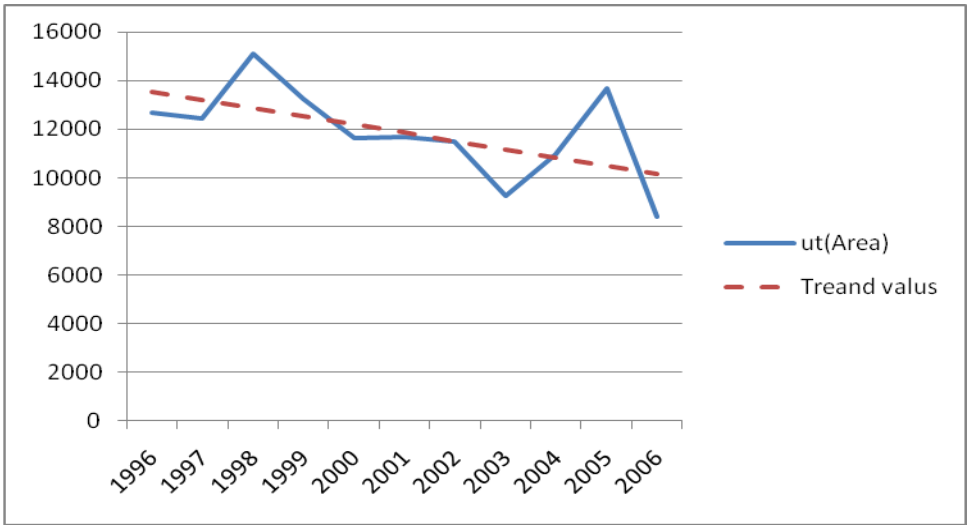
Fig-12: Productivity under Summer Rice in Nagaon District (Tonnes)



Pulses

From the data, it was seen that the area of pulses in Nagaon district did not show any particular trend. In 2005-06 the area under pulses was the highest with 13673 hectares, but it

Fig-13: Area under Pulses in Nagaon District (Hectares)



decreases to 8,385 hectares in 2006-07.

Trend line showed a decreasing trend in respect of area under pulses from 1996-97 to 2006-07. From the trend equation the area of pulses was found at 9841 hectares in 2007-08 and 9503 hectares in 2008-09.Table -2.2 shows that the production of pulses in 2004-05

Fig-14: Production of Pulses in Nagaon District (Tonnes)

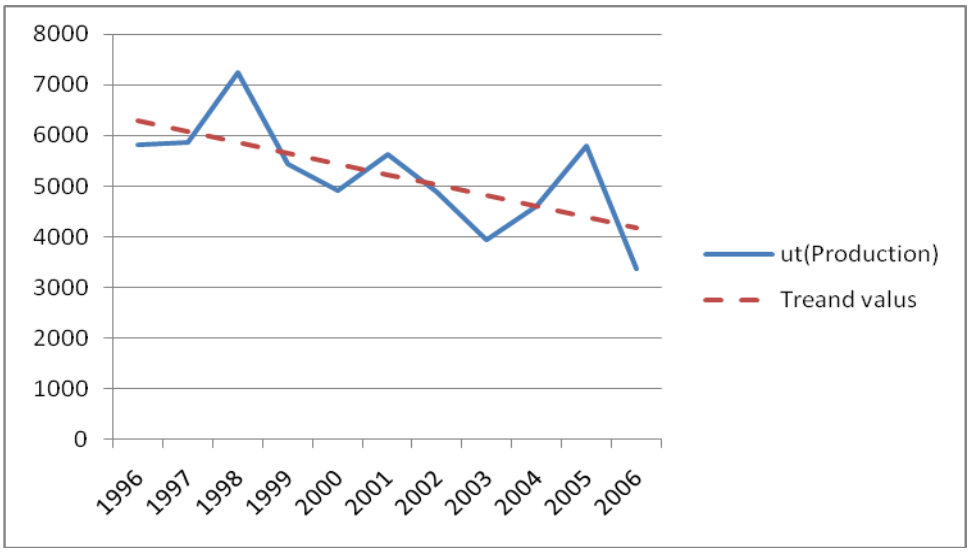
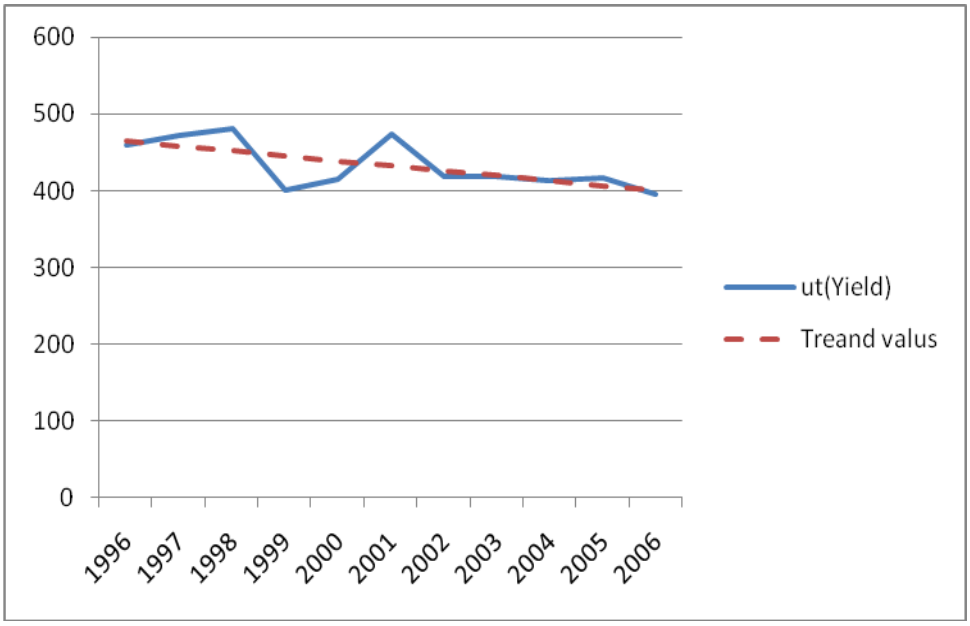


Fig-15: Productivity of Pulses in Nagaon District (Kg/ha)



was 4,618 tones, in 2005-06 it was increased to 5808 tones , again it decreased to 3,376 tones in the year 2006-07.

The estimated values of production were recorded at 3,961 tonnes and 3,749 tonnes in the years 2007-08 and 2008-09 respectively.

Yield rate of the pulses in the District showed a decreasing trend. In 2004-05, it was 413 kg/ha, in 2005-06 it was 416 kg/ha and in 2006-07 it decreased to 395 kg/ha.

The trend line showed a decreasing trend. The estimated value of the yield rate of pulses for the sample district was 394 kg/ha in 2007-08 and 388 kg/ha in 2008-09.

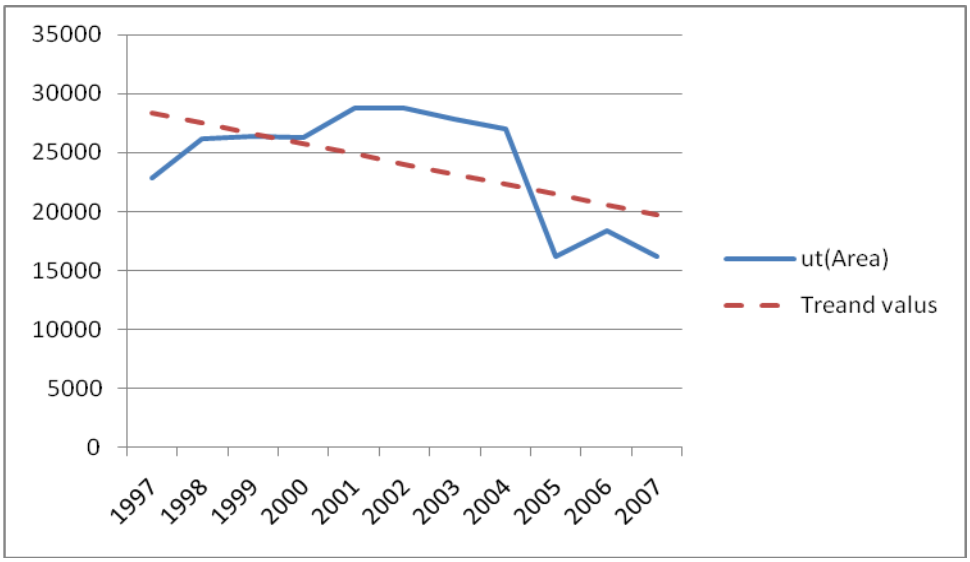
Rapeseed and Mustard

Rapeseed and mustard is the major oilseeds crop grown in the state and is cultivated in *rabi* season. The area, production and productivity of rape and mustard in Nagaon district over the years are shown in the Table-2.2.

The area under rapeseed and mustard did not indicate a particular trend. In 2005-06 it was 16,172 hectares, in 2006-07 it rose to 18,315 hectares and in 2007-08 the area decline to 16167.

The trend line for the area under rape and mustard showed a decreasing trend and the estimated value of area in 2008-09 stood at 18,897 hectares.

Fig-16: Area Under Rape & Mustard in Nagaon District (Hectares)



The production of rape and mustard decreased from 9,980 tones (2006-07) to 9,412 tones in the year 2007-08 and the estimated value of the production in 2008-09 was 9,442 tones.

Fig-17: Production of Rape & Mustard in Nagaon District (Tonnes)

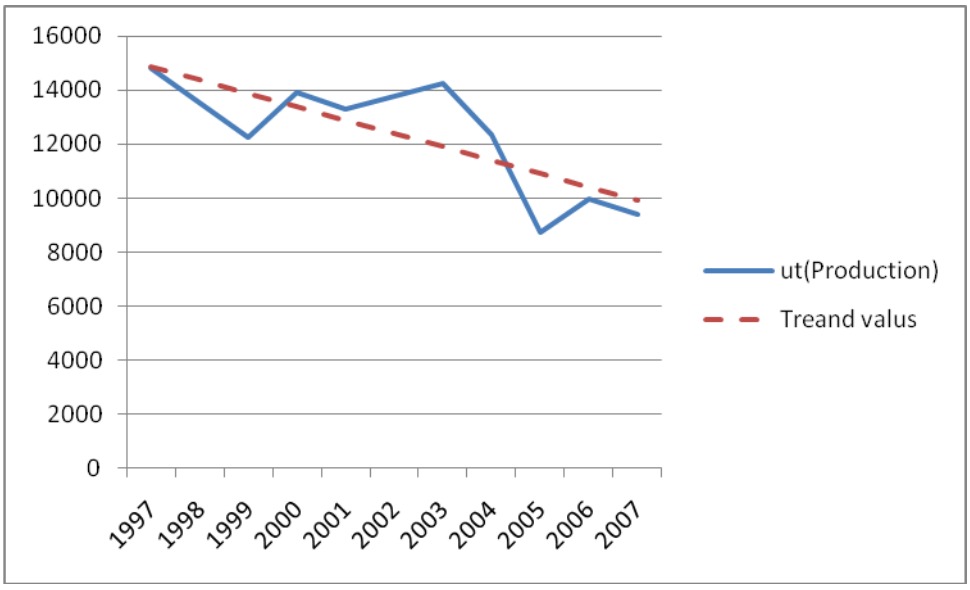
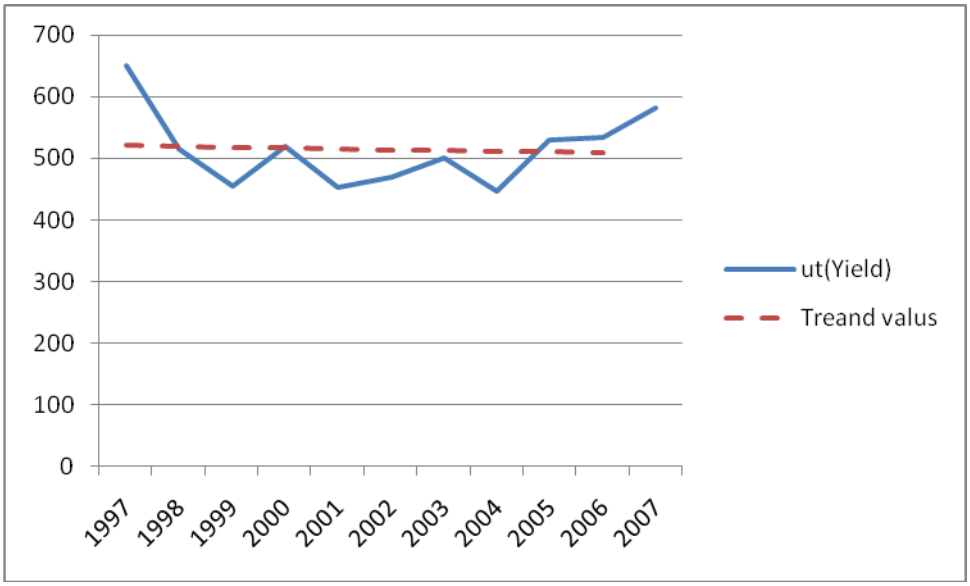


Fig-18: Productivity of Rape & Mustard in Nagaon District (Kg/ha)



The yield rate of rapeseed and mustard in Nagaon district was found in increase gradually from 447 kg/ha (2004-05) to 582 kg/ha in 2007-08.

From the trend equation the yield of rape and mustard for the year 2008-09 was estimated at 506 kg/ha

Conclusion

From the above analysis inference may be drawn that during the period 1998-99 to 2008-09 the area, production and productivity of summer rice increased continuously in Assam.

The area and production of pulses gradually increased in the State from 2007-08 to 2008-09 and the yield rate was found to be erratic from 1998-99 to 2008-09. The area under rape and mustard decreased during the period 1998-99 to 2008-09 and its production increased marginally from in 2007-08. The productivity of rape and mustard was found to be erratic during the period 1998-99 to2008-09 in Assam.

In Nagaon district area, production and productivity of summer rice was found to increased gradually from the year 2005-06 while it was decreases in case of pulses from the year 2005-06 onwards.

The area under rape and mustard in the district decreased largely in the year 2005-06 with some recovery thereafter. While the production registered similar trend as that of area, the productivity was found to be increased continuously from the year 2004-05 onwards.

It is observed that the area, production and productivity of summer rice increased continuously from the year 1998-99 to 2008-09 in Assam and sample district Nagaon. This is the positive trend to the farmers of the state and sample district as whole. In the other hand, pulses and rape and mustard crops show a declining trend. It was also observed that farmers grow oilseed (Rape and Mustard) and pulses in small patches of upland where kharif crops are not raised. Hence extension of area under these two varieties of rabi crops was limited. Productivity is another factor for decreasing the area of these crops.

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CHAPTER- III

Socio-Economic Profile and Farm Level Resources of the Sample Farmers

In this chapter an attempt has been made to analyze the socio-economic profile of the sample households pertaining to their demographic features, occupational pattern, age, educational level, economic conditions, land holding and land utilization pattern etc. These factors are responsible for bringing changes in the existing system and also in adoption of new farm technology in agriculture.

It is needless to mention that the agricultural growth of Assam remains sluggish as compared to agriculturally prosperous States of the country. The State is endowed with favourable agro-climatic conditions and rich soil; but the situation of rural economy of the State remains poor. The physiological characteristics like topography, rainfall, soil type, water resources and annual precipitation rate in different agro-climatic zones differs from one another. The scenario within the zones also differs in terms of facilities, socio- economic conditions of people, attainment of educational status, participation of work force in the agricultural sector and a host of other conditions and situations. The availability of basic infrastructural facilities plays a vital role in determination of production and productivity of crops which in fact determines the economic condition of the rural masses.

Basic information of the sample district

The district of Nagaon is situated in the central Brahmaputra Valley and has a total geographical area of 3,973 sq. km. which constitutes 5.06n per cent of the total geographical area of the state of Assam. The district is bounded by the hills of Karbi-Anglong on the east and south, by Morigaon district on the west and by the river Brahmaputra on the north. The climate of the district is characterised by hot and wet summer and dry and cool winter. Rainfall in the district varies quite significantly from place to place and is between 1200 mm to 2200 mm. The total population of the district is 23.15 lakh as per 2001 census. The density of population is 604per sq. km.

The economy of Nagaon district is basically agrarian. The district of undivided Nagaon (now Nagaon and Morigaon) is considered to be called the granary of Assam. The farmers in the district are enterprising and were found to be raised commercial crops. The net cultivated area in the district was 2,34,969 ha., and gross cropped area was 351714 ha.

Demographic Features

Demographic feature is one of the most important factors of a farming community as it is the primary source of labour for crop cultivation.

Population forms an important component of socio-economic development of a region. It is because of its dual role as a producer as well as a consumer. Hence, a proper appraisal of its size, growth composition and quality is considered pre-requisite for an effective planning for balanced and sustainable socio-economic development of a region. As such, an attempt in this regard is made to focus age-group composition of population, educational status, marital status, economic status, working population composition etc.

Classification of population by age groups and sex gives an idea of the composition of the family by size and availability of labour force as well as dependency ratio. Age group and sex-wise population classification of the sample households are shown in Table- 3.2. The sample households have a total population of 813 numbers comprising of 422 males and 391 females. The average family size was 6.77 persons. which was slightly higher than the state average of 5.42 according to 2001 Census. The sex ratio of population is worked out at 926 females per thousand males which is slightly lower than the State average of 930 in 2011.

Table also shows the age group composition of the sample households which determines the availability of work force for agricultural activities. The workers for agricultural activities are concentrated mainly in the age group of 15 to 60 years and non-workers are usually in the age groups of below 15 years and above 65 years of age. Table shows that 21.40 per cent population are in the age group of below 15 years and 4.18 per cent above 65 years while 74.42 per cent are between the age groups of 15 to 60 years which may be considered as potential work force. However,

it is to be mentioned here that persons below 15 years and above 60 years of age also sometimes participate in different activities if the working population is not adequate in the

Table :3.1

Distribution of the Sample Population by Age Groups and Sex

Age Group	Male	Female	Total
Below 15 Yrs	91	83	174 **21.40**
15 - 25	41	32	73 **8.98**
25 - 35	54	58	112 **13.78**
35 - 45	82	80	162 **19.93**
45 - 55	88	99	187 **23.00**
55 -65	45	26	71 **8.73**
65 & above	21	13	34 **4.18**
Total **P.C. to total**	422 **51.91**	391 **48.09**	813 **100.00**

Note: Figures in Parentheses indicates P.C. to Total

family. However, such type of working population is very low in the sample households. It was also noticed that there are a good number of school drop-outs children below 15 years of age and such children also actively participate in different household occupations as helper or earning dependent.

Marital Status

The marital status of sample population is presented in Table-.3.2 Table shows that in sample households, out of the total adult population of 639 persons i.e., 74.49 per cent are

Table - 3.2

Marital Status of Sample Beneficiary Households by Age Groups and Sex

Age Group	Married		Un- Married		Widow/Widower		Divorced or Separated		Total	
	M	F	M	F	M	F	M	F	M	F
Up to 15 Yrs.	-	-	-	-	-	-	-	-	-	-
15 - 25	10	18	31	14	0	0	0	0	41	32
25 - 35	30	40	24	18	0	0	0	0	54	58
35 -45	68	77	12	2	0	1	2	0	82	80
45 - 55	82	80	1	2	4	13	1	4	88	99
55 - 65	34	14	1	3	10	8	0	1	45	26
65 & above	14	9	0	0	7	4	0	0	21	13
Total	238	238	69	39	21	26	3	5	331	308

Note : M = Male F = Female

married 16.91 per cent unmarried 7.35 per cent widowed .The rest 1.25 per cent divorced or separated. After separation, the females generally go back to their parental home and engaged themselves in some household income earning activities.

Educational Status

Education is considered as one of the basic elements which determines the quality of man power. The standard of education plays an important role on quality of human resources engaged in productive activities including agriculture. It has a great influence over adoption of modern technology in agriculture in the sense that the level of awareness or the acceptability of a new proposition by and large, depend upon on the educational attainment of the people. Table -3.3 provides the details of educational status of the sample beneficiary households.

According to the Table out of the total population of 813 persons, 14.02 per cent are illiterate. The percentage of literate persons in the sample is much higher than the literacy rate of the state (2011Census). The literacy rate of Assam was 73.18 per cent while it was recorded to be 85.98 per cent in case of sample households. In the sample 43.17 per cent population are literate up to primary level, 25.09 per cent up to High School level, 10.21 per cent H.S.L.C. passed, 4.18 per cent H.S. passed, 1.85 per cent graduate and remaining 0.49 per cent population have education up to post graduate and above level and remaining per cent population have technical education.

From the analysis it is found that literacy rate of the sample population is by and large satisfactory as compared to literacy rate of the state. But so far as the literacy standard or quality of literacy levels were concerned, it was not so satisfactory. As a result they were not much aware of adopting modern farm technology which is become most important in the context of agricultural situation in the State. So far as attaining the professional qualification is concerned, poor financial condition of the farmers are the basic constraints in case of large majority of rural people in general and sample population in particular followed by inadequate educational infrastructure for higher education. School dropouts are observed to be quite substantial who engaged themselves in agriculture and allied activities.

Table - 3.3

Distribution of Population according to Educational Status of the Sample Households

Age Group	Illiterate			Up to Primary			Up to High School			HSLC Passed			HSSLC Passed			Graduate			PG			Tech. Education			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
Up to 15 Yrs.	32	37	69	39	28	67	20	18	38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	91	83	174
15 - 25	1	3	4	8	21	29	20	8	28	10	0	10	0	0	0	0	0	0	0	0	0	0	0	0	41	32	73
25 - 35	3	7	10	24	29	53	8	11	19	7	9	16	8	2	10	2	0	2	0	0	0	2	0	2	54	58	112
35 -45	2	4	6	32	21	53	19	29	48	9	12	21	9	9	18	6	4	10	2	1	3	3	0	3	82	80	162
45 - 55	5	6	11	41	47	88	19	28	47	19	14	33	2	2	4	2	1	3	0	1	1	0	0	0	88	99	187
55 - 65	4	5	9	22	15	37	13	6	19	3	0	3	2	0	2	0	0	0	0	0	0	1	0	1	45	26	71
65 & above	2	3	5	16	8	24	3	2	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	21	13	34
Total	49	65	114	182	169	351	102	102	204	48	35	83	21	13	34	10	5	15	2	2	4	6	0	6	422	391	813
P.C. to Total			14.02			43.17			25.09			10.21			4.18			1.85			0.49			0.74			100.00

Economic Status

In order to study the economic status of the sample population , they were classified in to earner or worker, helper and dependent or non-worker and were presented in Table - 3.4. The persons who are primarily engaged in any income earning activities are classified as earners or workers. Those persons who are though not the full time income earners, but help partially in economic pursuits of the household are classified as helper. The students below the working age group i.e. below 15 years of age group who participate in income earning activities seldom in their off time or in peak season of agriculture and the persons who are above working age group (about 60 years) are usually classified as helper.

Table: -3.4
Distribution of Sample Households by Economic Status

Economic Status :----->	Male	Female	Total	P. C.
Earner or Workers	295	248	543	66.79
Earning dependent or Helper	43	58	101	12.42
Dependent or Non - Worker	84	85	169	20.79
Total	422	391	813	100.00

Note: Figures in Parenthesis indicates Percentage to total

However, such participation was found to be very low in the sample area. It may also be mentioned that there were a good number of school dropout children below 15 years of age who actively participate in different family occupations as helper. The persons classified as dependent or non-workers are minor children, the students below 15 years of age and the peoples of 60 years or above age. Non-workers also include physically handicapped and disabled persons who were not able to participate in any productive activities.

Of the total population of 813 persons in the sample , 66.79 per cent were earner or worker 12.42 per cent helper and remaining 20.79 per cent were dependent or non-worker. In Assam, percentage of working population is 35.88 as per the 2001 Census. So, the work participation rate in the sample area seems to be quite high . The vast difference in work participation rate may be due to adoption of revised definition of worker and non-worker .In fact, almost all the able bodied family members directly or indirectly participated in agriculture and allied activities.

Occupational Status

The working population of the sample households are primarily engaged in agriculture and allied activities. Industrial category wise distribution of sample households is presented in Tables - 3.5. As stated in Table , out of the total population of 813 persons ,

Table: 3.5
Occupational Pattern of Sample Households by Category of Works

Category of Works	Primary			Secondary		
	Male	Female	Total	Male	Female	Total
Cultivators	121	51	172 **(21.16)**	22	6	28 **(24.14)**
Agricultural Labour	54	48	102 **(12.55)**	18	19	37 **(31.90)**
Non - Agril. Labour	35	35	70 **(8.61)**	9	8	17 **(14.66)**
Livestock, Forestry	17	48	65 **(7.10)**	5	7	12 **(10.34)**
Household Cottage Industry	11	46	57 **(7.01)**	4	9	13 **(11.21)**
Service & Profession	29	14	43 **(5.29)**	2	0	2 **(1.72)**
Trade, Commerce & Transport	28	6	34 **(4.18)**	6	1	7 **(6.03)**
Total Workers	295 **(69.91)**	248 **(63.43)**	543 **(66.79)**	66 **(56.90)**	50 **(43.10)**	116 **(100.00)**
Earning Dependent	43 **(10.19)**	58 **(14.83)**	101 **(12.42)**			
Non - Worker	84 **(19.91)**	85 **(21.74)**	169 **(20.79)**			
Total Population	422 **(100.00)**	391 **(100.00)**	813 **(100.00)**			

Note: Figures in Parentheses indicate Percentage to total Population.

66.79 per cent are workers comprising 69.91 per cent males and 63.43 per cent females. There are 20.79 per cent non-worker comprising of 19.91 per cent males and 21.74 per cent females. The non-workers were usually in the age group of below 15 years and above 60 years of age. Table shows that of the total working population, 21.16 per cent were primarily engaged in cultivation comprising of 70.35 per cent males and 29.65 per cent females. As per 2001 Census in Assam 39.11 per cent population were engaged in cultivation comprising of 38.34 per cent males and 4.11 per cent of females. Of the total workers in the sample households, 12.55 per cent were agricultural labour; the respective figure of Assam was 13.25 per cent in

2001. The occupational classification of other working population in the sample households were : 8.61 per cent non agricultural labour, 7.10 per cent in livestock, forestry and fishing, 7.01 per cent engaged in household cottage industry, 5.29 per cent in service and profession and 4.18 per cent engaged in trade, commerce and transport.

Landholding Pattern of the Sample Households

Land is the prime and dominant resource for the population dependent on agriculture. Land resource plays a strategic role in determination of economic, social and cultural progress of a farming community. Land is the basic input which provides food, employment and income to the people. Economic upliftment in the rural areas depends on availability land resources and its judicious utilisation.

The pattern of land ownership and operational holding play an important role in the determination of economic condition of a farm household. The level of employment and income in the rural areas mainly depend upon the size of operational holdings. The concept of operational holding used in the study indicated own land under personal cultivation and land taken on lease and mortgaged. There was no leased out and mortgaged out land found among the sample households.

Table -3.6 showed that of the total 120 households, there were 40.83 per cent marginal, 30.83 per cent small, 20.00 per cent medium and 8.34 per cent large farmers. The total operational holding of beneficiary farmers is 224.05 hectares, comprising of 93.75 per cent own land, 2.95 per cent leased in land and only 1.59 per cent mortgaged in land. Of the total operational holdings, 73.10 per cent were found to be irrigated and only 26.90 per cent

Table – 3.6
Land Inventory of Operational Holdings of Sample Households

Farm Size Group	No of HHs	Own Land		Leased in		Leased out		Mortgaged in		Mortgaged out		Net Ope. Holding		Total	Av. Size of Ope. Holding
		IR	U irr	IR	U irr	IR	U irr	IR	U irr	IR	U irr	IR	U irr		
Below 1 ha.	49	14.25	3.98	0.00	2.02	0.00	0.00	0.00	0.00	0.00	0.00	14.25	6.00	20.25	0.41
1 -- 2 ha.	37	54.26	9.32	1.08	0.00	0.00	2.24	0.94	0.00	0.00	0.00	56.28	11.56	67.84	1.77
2 -- 4 ha.	24	45.52	23.54	0.00	3.63	1.65	0.00	2.68	0.00	0.00	0.00	48.20	27.17	75.37	3.14
4 ha. & above	10	46.25	16.58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	46.25	16.58	62.83	6.28
Total	120	160.28	53.42	1.08	5.65	1.65	2.24	3.62	0.00	0.00	0.00	164.98	61.31	226.29	1.90
P.C		**70.83**	**23.61**	**0.48**	**2.50**	**0.73**	**0.99**	**1.60**	**0.00**	**0.00**	**0.00**	**72.91**	**27.09**	**100.00**	

are un-irrigated . Leased in and mortgaged in land also had irrigation facilities. The leased in land were taken in terms of share cropping or on case rent basis. The average size of operational holding was found at 1.90 hectares which was considerably higher than the state average of 1.15 hectares recorded in the year 2000-01.

Land Utilisation pattern of the Sample Households

Table-3.7 presents the utilization of own land for different purposes by different size groups of sample households. It was seen in the Table that out of total cultivated land 95.39 per cent of land holdings were allocated to field crops and only 4.16 per cent were under horticulture crop cultivation. Of the total uncultivable holding of 23.77 hectares, 46.57 per cent are under homestead, 11.44 per cent fellow land and remaining 41.99 per cent were allocated under miscellaneous tree crops and groves.

Table-3.7
Utilisation of Own Land according to Farm Size Groups of Operational Holdings

Farm Size groups--->	Below 1ha.	1 -2 ha	2 - 4 ha.	4 & above ha.	Total
No. of HHs.	49	37	24	10	120
Cultivated Land :					
a. Field Crops	18.23	65.56	72.10	59.96	215.85
	(72.04)	**(85.75)**	**(88.10)**	**(90.27)**	**(86.48)**
b. Horticultural Crops	2.02	2.28	3.27	2.87	10.44
	(8.98)	**(3.19)**	**(1.52)**	**(4.32)**	**(3.51)**
Uncultivated Land :					
a. Homestead/Courtyard	3.18	3.69	2.55	1.65	11.07
	(14.13)	**(5.16)**	**(3.31)**	**(2.48)**	**(4.66)**
b. Fellow Land	0.22	1.02	1.22	0.26	2.72
	(0.98)	**(1.43)**	**(1.58)**	**(0.39)**	**(1.15)**
c. Land Under Misc. tree	0.87	3.20	4.23	1.68	9.98
Crops & Groves	**(3.87)**	**(4.48)**	**(5.49)**	**(2.53)**	**(4.20)**
Total Owned Holdings	22.50	71.49	77.06	66.42	237.47
Total Cultivated Holdings	**(18.23)**	**(63.58)**	**(69.06)**	**(62.83)**	**(213.70)**

Note: Figures in Parentheses indicates Percentage to total

Table shows that, total land possessed by the sample farmers in the size group of below 1.00 hectare was 9.47 per cent, size group of 1.00 to 2.00 hectares was 30.10 per cent, size group between 2.00 to 4.00 hectares was 32.45 per cent and 27.97 per cent land possessed by the size group of 4.00 and above hectares.

Cropping pattern of the Sample Districts

Cropping pattern reflects the relative dominance of the individual crops to total cropped area. It is an important indicator to show the proportion of area under different crops at definite point of time.

In Nagaon district, the agricultural crop season is divided into two main seasons i.e. Kharif and *Rabi*. Rice and Jute are two important crops grown in *Kharif* season while *rabi* crops

Table – 3.8
Cropping Pattern of Nagaon District

Crops	Area (Hectare)	Production (Tonnes)	Yield (Kg/ha.)
Autumn Rice	18,656	27,553	1,501
Winter Rice	1,36,199	2,06,018	1,536
Summer Rice	40,344	84,738	2,091
Total Rice	**1,95,199**	**3,17,934**	**1,629**
Wheat	5,732	4,582	799
Maize	410	275	671
Rape & Mustard	18,315	9,980	545
Total Cereals	2,59,178	4,58,270	1,789
Total Pulses	9,238	4,015	435
Total Oilseeds	21,052	11,415	542
Cotton	42	17	69
Sugar cane	8,044	2,90,766	36,147
Jute (bales of 180kg)	9,506	1,38,946	2,631
Mesta	70	242	622
Potato	4,920	29,735	6,044
Kharif Vegetables	3,111	48,812	15,688
Rabi Vegetables	8,266	1,92,745	23,317

Source: Handbook of Agricultural Statistics,2008

include pulses, wheat, rape and mustard and other oilseeds and winter vegetables. Table- 3.9 shows the cropping pattern of Nagaon district. It was seen from the Table that rice is the dominant crop in the cropping system which occupied more than 55.50 per cent of the total cropped area; Sali paddy covered more than 69.77 per cent of total area under rice. Summer rice occupied 20.67 per cent of total area under rice. Total pulses occupied 2.63 cent of the total cropped area. Another important crop of the district is rape and mustard which covers about 5.21per cent of the gross cropped area. Assured irrigation through STW has encouraged the farmers to grow *Boro* paddy

and vegetables during *per-kharif* and summer seasons. With the introduction of HYV seeds and the farmers attitudes towards acceptance of new technology package had steadily been increasing. The area under HYV rice stands at 1,16,803 hectares which is about 33.21 per cent of the total cropped area. Although the district was traditionally a mono cropped district, with the adoption of modern technology as well as with the provision of irrigation facilities in limited areas, the farmers have inclined to cultivate at least two crops in a year which helped in increasing the cropping intensity to 150 per cent in the year 2007-08.

Agricultural Extension Services

The agricultural extension services is meant for building a professional extension service to assist farmers in raising production by providing appropriate support for agricultural development.

Agricultural extension is the basic services to the farmers which provides technical support to adopt scientific method of cultivation. The technologies generated by the agricultural scientists are disseminated to farmer's through regular monthly workshop and fortnightly training followed by field visit by Village Level Extension Workers (VLEWs).In fact agriculture department is making all possible measures to narrow the gap between lab to

Table: 3.9
Agriculture Extension Network in Nagaon District and all Assam

Particulars	Nagaon	Assam
1. Agricultural Sub Division	4	63
2. Agricultural Development Officer Circle	32	382
3. VLEW Elaka	289	2,948
4. No.of Training Centres of Farmers Under Agriculture Department	2	7
5. No. of Seed Village	31	318
6. No. of Fertiliser Dealer	5	125
7. No. of Pesticide Dealer	-----	62
8. Soil Testing Laboratory	-----	12
9. No. of Cold Storage	1	10

Source: Assam agriculture in Bief,2007-08

land i.e. farmers field. The information wing of the state agriculture department assists in spreading development information among the farmer's. The basic objective of the agriculture extension services in Assam is to provide training to the farmers regarding agriculture and allied activities.

Table – 3.9 indicates the basic agricultural extension network in the sample districts and also at all Assam level. The farmers in the sample district reported that the visit to Village Level Extension Workers (VLEWs) and Agricultural Extension Officer (AEO) was not regular and they occasionally came to the farmer's field. However, some farmers of the sample area received certain short duration training on adoption of new farm technology in crop cultivation. Under centrally sponsored schemes some field trials and demonstration plots of paddy were laid by the State Department under mini-kit programme for training and motivating the farmers.

Soil testing services are not satisfactory in the sample area. Most of the sample farmers of the selected districts opined that their soil need to be tested for better and efficient use of fertilizer and for adoption of better soil management practices. Although the State has 12 soil testing laboratories,(8 static & 4 mobile) only a very few respondents got their soil tested in soil testing laboratories at the instance of State Government's Agricultural Department.

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CHAPTER- IV

Economics of Production of Rabi Crops by the Sample Households

In this chapter an attempt has been made to work out the economics of *rabi* crops cultivation based on primary data collected from the sample farmers. Together with this, the general agricultural scenario of the study area is presented in the following paragraphs.

Cropping Pattern of the Sample Households

The cropping pattern and crops grown by the sample farmers are presented in Table-4.1.The cropping pattern and crops grown by all the farmers were mainly traditional. But some varietals changes had taken place in recent years. The local varieties were replaced by HYV to a considerable extent. Cultivation of winter paddy after harvesting of summer paddy and cultivation of rabi vegetables as a second crop after harvesting of summer/winter paddy have become popular among the sample farmers in potential areas. Traditionally *sali* or winter paddy occupied dominant place both under irrigated and un-irrigated conditions. However, after introduction of STW a considerable part of the net cropped area has been brought under double cropping where generally *Ahu* and *Boro* paddy were grown as first crop and *Sali* paddy is grown as second crop. In areas having irrigation facilities, some other *rabi* crops like mustard, pulses, potato and other *rabi* vegetables are also grown after harvesting of *Sali* paddy in late september and early october. The major cash crop, jute was also grown in rotation with winter paddy by some of the farmers in sample district.

Table-4.1 shows that of the total gross cropped area of 394.07 hectares operated by 120 number sample households, 75.85 per cent were irrigated and only 24.15 per cent were un-irrigated. The expansion of irrigation facility has significantly influenced the cropping intensity in the study area. Paddy alone occupied 89.51 per cent (352.72 hectares) of which 80.41 per cent are irrigated and only 19.59 per cent of area was under rain fed condition. The other crops grown were rape & mustard, black gram, green gram, potato, jute and vegetables which occupied 10.49 per cent of the total cultivable area of which 36.98 per cent were irrigated and 60.02 per cent were unirrigated land.

Table - 4.1

Cropping Pattern and Crops Grown by the Sample Farmers by Farm size Groups

Crops	Farm Size										
	below 1 ha.		1 -- 2ha.		2 -- 4 ha.		4h. & above		Total		Grand Total
	Irri	Un irri.	Irri	Un irri.	Irri	Un irri.	Irri	Un irri.	Irri	Un irri.	
Autumn Paddy	0	0	5.06	2.91	1	4.65	3.36	1.9	9.42	9.46	18.88
Winter Paddy	17.27	2.98	58.26	3.34	34.94	31.05	34.25	22.27	144.72	59.64	204.36
Summer Paddy	7.03	0	36.10	0	47.83	0	38.52	0	129.48	0	129.48
Rape & Mustard	0.55	1.25	1.14	2.25	0.81	1.65	0.96	1.23	3.46	6.38	9.84
Black Gram	0.94	2.08	1.82	2.95	0	1.45	1.65	0	4.41	6.48	10.89
Green Gram	0	1.65	0	2.05	1.34	0	1.6	0	2.94	3.7	6.64
Potato	0	1.57	0.98	1.96	0	1.36	0	0	0.98	4.89	5.87
Jute	0	0	0.98	0.77	0	0.56	0	0	0.98	1.33	2.31
Vegetables	0.91	0	1.35	1.85	0	1.43	0.26	0	2.52	3.28	5.8
Total	26.7	9.53	105.69	18.08	85.92	42.15	80.6	25.4	298.91	95.16	394.07

Expansion of irrigation facility through installation of STW had significantly influenced the adoption of HYV paddy, as it is evident from Table- 4.2

Table-4.2

Area Under HYV and Local Paddy Grown by the Sample Households

Farm Size	HYV			Total	Local			Total	Grand Total
	Autumn	Winter	Summer		Autumn	Winter	Summer		
Below 1ha.	0.00	16.52	5.98	21.98	0.00	4.25	1.05	5.30	27.28
1 -- 2 ha	3.76	42.35	24.35	70.46	4.21	19.25	11.75	35.21	105.67
2 -- 4 ha.	2.90	37.94	30.23	71.07	2.75	28.05	17.60	48.40	119.47
4 & above ha.	4.22	50.05	33.05	87.32	1.04	6.47	5.47	12.98	100.30
Total	**10.88**	**146.34**	**93.61**	**250.83**	**8.00**	**58.02**	**35.87**	**101.89**	**352.72**
P.C to Total	3.08	41.49	26.54	71.11	2.27	16.45	10.17	28.89	100.00

The Table shows that the sample farmers used HYV seed of paddy in 71.11 per cent of the total rice area and they used local paddy in 28.89 per cent of total rice area. It is 23.47 per cent higher than the State average of 61.45 per cent recorded in the year 2006-07.

Distribution of Area, Production and Productivity of Crops Grown by the Sample Farmers

Land is the basic factor of production for a farm family particularly in less developed countries. The size of land holding and quality of land owned by a farm family determines the economic condition of the family. Table -4.3 and Table -4.4 shows the area, production and productivity of crops grown by the sample farmers in the study area.

It was observed that although the sample farmers had gradually opted for summer paddy, the winter paddy still occupied an important place in the cropping pattern in Assam. It may

be mentioned that the sample farmers are accustomed to grow some special local variety of paddy for home consumption which were also used in religious and social functions and ceremonial etc. So, the farmers used to allocate some part of irrigated and also un-irrigated holdings for growing such special local varieties of paddy in *kharif* season according to the requirement of the household. Table- 4.3 shows the almost all the sample farmers of different farm size groups grew local paddy. It was also revealed from Table-4.2 that out of the total rice area 101.89 hectares were (28.89 per cent) were under local varieties.

Table -4.3 shows the area, production and yield of different variety of paddy under irrigated and un-irrigated conditions. Under irrigated conditions the yield of HYV autumn paddy varied from 3,369 kg/ha to 3,483 kg/ha with an overall average yield of 3,430 kg/ha. The yield of local autumn paddy under irrigated condition varied from 3,252 kg/ha to 3,258 kg/ha and the overall average yield was recorded at 3,253 kg/ha. The yield of winter paddy of both HYV and local and irrigated and rain fed condition was comparatively lower. The yield of HYV *Sali* paddy in irrigated condition varied between 3,309kg/ha to 3,658 kg/ha and the overall average is worked out at 3,460 kg/ha.

The overall yield of local *Sali* paddy in irrigated condition was 3,271 kg/ha and in un-irrigated situation it was 3,102 kg/ha. The sample farmers reported to have used irrigation water occasionally when there were drought spell in monsoon season despite having irrigation facility for *Sali* crop.

The summer paddy achieved a remarkable production in irrigated holdings. The productivity of HYV *boro* paddy in irrigated condition varied from 5,976 kg/ha to 6,145 kg/ha. The yield of local summer paddy under irrigated condition was also quite high; the aggregate yield rate is found at 4,548 kg/ha. It was noticed that the increase in area, production and yield of *boro* paddy boosted by assured irrigation has lead to a noticeable increase in consumption of other farm inputs as well.

Table - 4.3
Paddy Production Details of the Sample Households by Farm Size Groups

Crops ---->		Autumn Local		Autumn HYV		Winter Local		Winter HYV		Summer Local		Summer HYV		Total Paddy		Grand
		Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Total
Below 1 ha.	A	0	0	0	0	14.77	1.75	2.5	1.23	1.05	0	5.98	0	24.30	2.98	27.28
	P					480.91	56.09	91.45	41.25	46.75		367.47		986.58	97.34	
	Y					3256	3205	3658	3354	4452		6145		4060	3266	
1 --2 ha.	A	3.15	1.06	1.91	1.85	17.45	1.80	40.81	1.54	11.75	0	24.35	0	99.42	6.25	105.67
	P	102.44	32.05	64.35	61.09	579.69	56.25	1467.94	50.8	541.91		1481.7	0	4238.02	200.2	
	Y	3252	3024	3369	3302	3322	3125	3597	3299	4612		6085	0	4263	3203	
2 --4 ha.	A	0	2.75	1.00	1.90	14.74	17.74	20.20	13.31	17.60	0	30.23	0	83.77	35.70	119.47
	P		82.03	34.22	61.39	481.11	547.99	680.34	420.46	797.1		1806.54		3799.23	1111.87	
	Y	0	2983	3422	3231	3264	3089	3368	3159	4529		5976		4535	3114	
4 ha. & above	A	1.04	0	2.32	1.90	6.47	0	27.78	22.27	5.47	0	33.05	0	76.13	24.17	100.30
	P	33.88	0	80.81	62.66	206.07	0	919.24	687.03	245.55		2001.18	0	3486.72	749.69	
	Y	3258	0	3483	3298	3185	0	3309	3085	4489		6055	0	4580	3102	
Total	A	4.19	3.81	5.23	5.65	53.43	21.29	91.29	38.35	35.87	0	93.61	0	283.62	69.10	352.72
	P	136.32	114.08	179.38	185.14	1747.78	660.33	3158.97	1199.54	1631.31		5656.89		12510.6	2159.10	
	Y	3253	2994	3430	3277	3271	3102	3460	3128	4548		6043		4411	3125	

Table - 4.4
Other Crops Cultivation Details by the Sample Households Under Irrigated and Un irrigated Conditions

Crops ---->		Rape & Mustard		Black Gram		Green Gram		Potato		Jute		Vegetables		Total	
		Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.	Irri	Un irr.
Below 1 ha.	A	0.55	1.25	0.94	2.08	0	1.65	0	1.57	0	0	0.91	0	1.40	6.55
	P	3.62	7.50	5.36	11.34		7.46		95.96			150.38			
	Y	658	600	570	545		452		6,112			16,525			
1 --2 ha.	A	1.14	2.25	1.82	2.95	0	2.05	0.98	0.77	0	0.77	1.35	1.85	5.29	10.64
	P	7.49	13.26	10.23	14.63		9.37	57.3	46.35		12.17	218.7	281.26		
	Y	657	589	562	496		457	5,847	6,019		1,581	16,200	15,203		
2 --4 ha.	A	0.81	1.65	1.45	0	1.34	0	0	1.36	0	0.56	0	1.43	3.60	5.00
	P	5.20	9.65	8.08		6.28			71.62		8.15		213.81		
	Y	642	585	557		469			5,266		1,455		14,952		
4 ha. & above	A	0.96	1.23	1.65	0	1.60	0	0	0	0	0	0.26	0	4.47	1.23
	P	5.77	7.06	8.99		7.33						37.86			
	Y	601	574	545		458						14,562			
Total	A	3.46	6.38	5.86	5.03	2.94	3.70	0.98	3.70	0	1.33	2.52	3.28	14.76	23.42
	P	22.08	37.47	32.66	25.97	13.61	16.83	57.3	213.93		20.32	406.94	495.07		
	Y	638	587	557	516	463	455	5,847	5,782		1,528	16,148	15,094		

Summer paddy was not grown under rain fed condition due to uncertainty of rainfall in pre *kharif* season. With the expansion of irrigation facilities the farmers particularly of the flood affected areas became interested in summer paddy cultivation for an assured harvest as a chance crop before the onset of monsoon and floods.

It was also observed that few of the sample progressive farmers adopted the System of Rice Intensification (SRI) of paddy cultivation and able to harvest more production than the traditional method of paddy cultivation. The sample farmer were of the opinion that SRI method was effective with less amount of water and therefore was suitable for those areas with limited irrigation facilities. When normal paddy cultivation requires 25-30 kgs of seed per hectare , SRI needed only 1-2 kgs. The farmers also viewed adoption of SRI as a risk hedging strategy. SRI method could also be used in the low rainfall years. In such conditions farmers preferred to grow in their small plots to meet the household needs.

The other crops grown by the sample farmers were mustard, pulses, vegetables, and some other minor crops like potato, jute etc. which were grown both under irrigated and un-irrigated conditions. Table – 4.4 shows the area, production and productivity of these crops by farm size groups. The yield of all crops were found to be higher in irrigated conditions than the un-irrigated conditions. So far as yield of other crops grown by the sample farmers are concerned mustard, vegetables, potato, pulses etc., are found to be quite encouraging. These crops are grown in rotation as a second crop after harvesting of autumn and winter paddy. The area under potato and jute were quite low, but yield rate is found to be satisfactory.

The observations and analysis of primary data clearly reveals that irrigation is the prime technology which encouraged the farmers to go for adoption of HYV seed, farm mechanization ,application of soil nutrients, pest management etc., which in turn induced and enhanced the rice production in particular. The process was facilitated through efficient land use planning, assured irrigation and farm management practices.

Cropping Intensity

Cropping intensity is an important indicator of adoption of crop production technology and intensification of use of land resources. Taking all the crops together grown

by the sample farmers both under irrigated and un-irrigated conditions the cropping intensity has been worked out and

Table – 4.5
Cropping Intensity in Irrigated and Un - irrigated Holdings of Sample Farmers

Farm Size (Hectare)	Gross Cropped Area		Net Cropped Area		Cropping Intensity	
	Irri.	Un - Irri.	Irri.	Un - Irri.	Irri.	Un - Irri.
Below 1ha.	26.70	9.53	14.25	6.00	187	159
1 -- 2 ha	100.63	18.08	56.28	11.56	179	156
2 -- 4 ha.	85.92	42.15	48.20	27.17	178	155
4 & above ha.	80.60	25.40	46.25	16.58	174	153
Over all	293.85	95.16	164.98	61.31	178	155

presented in Table - 4.5. Table shows that the cropping intensity in the sample irrigated holdings varied between 174 per cent to 187 per cent and in un irrigated holdings it varied from 153 per cent and 159 per cent. The overall cropping intensity was worked out at 178 per cent for irrigated holdings and 155 per cent in un-irrigated holdings. Cropping intensity under both the conditions were highest in marginal group followed by medium holdings.

The analysis of field level data presented in the Table revealed that cropping intensity in irrigated holdings was much higher than un irrigated holdings. However in both the situation it was considerably higher than the state average of 144 per cent recorded in the agricultural census of 2004-2005.

Resource Position of the Sample Farmers

The availability of farm level resources like land, bullock labour, machine labour, agricultural tools and implements determine the level of adoption of technology in farm operations. In fact it is an index of agricultural development. The resources with the sample households is presented in Table – 4.6. It was observed that the sample farmers widely used bullock labour for preparation of land, carrying of harvest and threshing of grains. In the sample households there are 197 number of bullocks, 51 number of cows and 34 buffaloes used in different agricultural operations. In Nagaon district cows are used as draught animal by the muslim community. It was observed that there are certain unevenness in respect of possession of bullocks in different size groups of holdings. Some of the farmers owned two to three plough units while a few farmers of small and marginal groups did not own any. The

Table - 4.6

Resource Position of the Sample Households by Farm Size Groups

Resource Particulars	<----- Farm Size -------->									
	Below 1 ha.		1 -- 2 ha.		2 -- 4 ha.		4 ha. & above		Total	
	Nos.	Value	Nos.	Value	Nos.	Value	Nos.	Value	Nos.	Value
No. of Households	49		37		24		10		120	
Bullock Labour :										
Bullocks	78	416,018	63	330,687	42	230,538	14	91,448	197	1,068,691
Cows	24	60,000	14	36,204	11	32,175	2	4,900	51	133,279
Buffaloes	11	123,585	6	63,534	9	108,288	8	45,056	34	340,463
Machine Labour :										
Tractor	0	0	0	0	1	155,200	2	291,200	3	446,400
Power Tiller	0	0	1	55,000	2	110,840	2	112,400	5	278,240
Power Pump	44	350,460	40	318,600	26	204,100	12	94,320	122	967,480
Weeder	0	0	3	2,100	5	4,225	2	1,718	10	8,043
Seed Drill	19	26,695	0	0	1	1,450	18	26,640	38	54,785
Sprayers	62	44,330	7	5,964	16	11,520	1	855	86	62,669
Duster	1	1,800	0	0	1	1,780	1	1,800	3	5,380
Rice Hauller Mill	0	0	0	0	1	15,800	0	0	1	15,800
Other Agril. Tools & Implements :										
Mould Board Plough	29	16,066	28	15,512	32	22,080	10	7,150	99	60,808
Desi Plough	69	24,219	46	19,320	12	6,060	2	1,130	129	50,729
Sickles	210	9,450	152	6,384	116	4,872	45	1,575	523	22,281
Hoes	74	26,640	59	18,880	44	11,396	43	8,385	220	65,301
Total Value	1,099,263		872,185		920,324		688,577		3,580,349	
Per HHs Value	22,434		23,573		38,347		68,858		29,836	

reason behind this is that the marginal farmers cannot afford to buy a pair of bullock as the prices of plough bullock was fairly high. They used to hire bullock labour to perform farm operations. The size and health of plough bullock determine the drought power and the value of bullock also by and large depends upon these factors.

Machine labour is one of the important items of the farm households. In the sample of 120 farmers, there are 3 tractors, 5 power tillers, 122 power pumps, 10 weeders, 38 seed drills, 86 sprayers, 3 dusters and only 1 rice hauller mill. The sample farmers reported that power tillers have been exclusively used for farm operations while the tractors are used for multiple purposes. These are also hired out to other farmers on custom hiring basis. Out of the 122 power pumps possessed by the sample farmers, 106 pump sets were acquired under ARIASP and NABARD programmers. Prior to that, there were only 16 pump sets in possession of the sample farmers in the whole sample. The weeders, sprayers, dusters were also used by the sample farmers in all size group of holdings.

Table shows that the total value of all tools and implements of all the farm size groups is Rs. 3,580,349.00. The investment per household is varied between Rs. 22,433.93 to Rs. 68,857.70 with an overall average of Rs. 29,836.24.

Cost of Cultivation of Major Crops and Benefit-Cost Ratio (BCR) of the Sample Farms

The basic inputs which contributed towards enhanced production include HYV seed, irrigation, chemical fertilizer, manure, plant protection measures and use of improved farm machinery etc. It was observed that although the food production capacity has increased tremendously, yet, the problem of providing adequate quantity of food items to everyone at the minimum level of requirement for normal growth and activity continuous to hunt the economist, social scientists and people in general.

The analysis of cost of cultivation of crops grown by the sample farm households is the most important factor for determining the economic feasibility of cultivation of crops. In other words, the various inputs used by the farmers in production of different crops is of great importance in agricultural farm business. Capital investment is the major factor in determining the production costs which play a crucial role in increase of production and productivity of crops.

In this section an attempt has been made to estimate the cost of cultivation of three major rabi crops i.e. summer paddy, rape & mustard and pulses grown by the sample farmers by adopting cost accounting method and based on primary level data collected from the sample area. The items of cost cover both paid out cost and imputed costs. The items covered under paid out costs are hired human labour, expenses on material inputs such as on seed, fertilizer, pesticides, farm yard manure (owned and purchased), hired bullock/machine labour and other miscellaneous expenses. The imputed costs include inputs like home produced organic manure, family labour etc. The imputed value of family labour was worked out on the basis of statutory wage rate in the study area, organic manure etc. were valued at the rates prevailing in the study area, and the land revenue as fixed by the land legislation of the State. Moreover, interest on capital cost and interest on working capital charged at the rate of 3.50 per cent for the crop period and interest @2.00 per cent was charged on total costs as miscellaneous expenses.

The cost of inputs used by the sample farmers in summer paddy cultivation were worked out and presented separately for HYV and local variety.

The inputs used and costs incurred by the sample farmers in local summer paddy

Table - 4.7

Cost of Cultivation of Summer Rice (Local) Under Irrigated Condition by Farm Size Groups of the Sample Households

Usages of Inputs	Below 1 ha. 1.05	P.Ha.	1 -- 2 ha. 11.75	P.Ha.	2 -- 4 ha. 17.6	P.Ha.	4 ha. & above 5.47	P.Ha.	Total 35.87	P.Ha.
A. Variable Cost :										
Seed (Qty. in Kg.)	43.32	41.26	471.76	40.15	727.58	41.34	225.36	41.20	1468.02	40.93
Value (in Rs.)	552.37	526.07	5684.74	483.81	8629.15	490.29	2609.72	477.10	17475.98	487.20
manure (Qty. in Kg.)	2.15	2.05	31.14	2.65	38.84	2.21	16.9	3.09	89.03	2.48
Value (in Rs.)	570.41	543.25	5884.99	500.85	10784.4	612.75	4901.67	896.10	22141.47	617.27
Fertiliser (Qty. in Kg.)	47.63	45.36	543.2	46.23	844.98	48.01	263.11	48.10	1698.92	47.36
Value (in Rs.)	607.26	578.34	6817.19	580.19	10105.91	574.20	3088.88	564.69	20619.24	574.83
Pesticides (Qty. in Ltr.)	3.17	3.02	35.02	2.98	43.12	2.45	21.72	3.97	103.03	2.87
Value (in Rs.)	792.75	755.00	6495.28	552.79	8553.28	485.98	3699.52	676.33	19540.83	544.77
Plant Protection Measures(Rs.)	194.51	185.25	1860.73	158.36	3213.06	182.56	1344.42	245.78	6612.72	184.35
Hired Human Labour (mandays)	0		181.54	15.45	293.04	16.65	116.24	21.25	590.82	16.47
Value (in Rs.)	0		21846.96	1859.32	35138.99	1996.53	13917.94	2544.41	70903.89	1976.69
Family Labour (Mandays)	136.66	130.15	1354.07	115.24	2115.52	120.20	647.10	118.30	4253.35	118.58
Value (in Rs.)	16632	15840.00	177992.40	15148.29	264457.5	15026.00	80937.19	14796.56	540019.13	15054.90
Bullock Labour (Rs.) :										
Owned	1622.88	1545.60	17110.94	1456.25	23486.14	1334.44	5647.99	1032.54	47867.95	1334.48
Hired	0	0	0	0	0	0	0	0	0	0
Machine labour (Rs.)										
Owned	0		3671.88	312.50	8248.24	468.65	3052.37	558.02	14972.49	417.41
Hired	0		2350.00	200.00	5499.12	312.45	1476.24	269.88	9325.36	259.98
Irrigation Charges (fuel)	308.18	293.50	3507.38	298.50	5706.80	324.25	2328.52	425.69	11850.88	330.38
Interest on Variable Cost	744.81	709.34	8958.41	678.56	13529.50	768.72	4305.16	787.05	27537.88	767.71
Total Variable Cost	22025.1	20976.29	262180.88	22313.27	397352.14	22576.83	127609.61	23329.00	809167.7	22558.34
B. Fixed Cost :										
Rental Value on Leased in Land	0	0	0	0	0	0	0	0	0	0
Interest on Working Capital	257.51	245.25	3505.73	298.36	5371.52	305.20	1727.86	315.88	10862.62	302.83
Interest on Capital Cost	323.66	308.25	4212.02	358.47	9248.45	525.48	2179.03	398.36	15963.16	445.03
Depreciation on Tools and Implements	616.61	587.25	6415.50	546.00	10544.34	599.11	2315.56	423.32	19892.01	554.56
Land Revenue (Rs.)	94.12	89.64	1053.27	89.64	1577.66	89.64	490.33	89.64	3215.38	89.64
Total Fixed Cost	1291.91	1230.39	15186.52	1292.47	26741.97	1519.43	6712.78	1227.20	49933.18	1392.06
Total (A+B)	23317.01	22206.68	277367.40	23605.74	424094.11	24096.26	134322.39	24556.20	859100.91	23950.40
Misc. (2%)	466.34	444.13	5582.29	475.09	8476.12	481.60	2680.45	490.03	17205.20	479.65
Grand Total	23783.35	22650.81	282949.69	24229.49	432570.23	24561.48	137002.84	24991.38	876306.11	24430.06
BCR	1.47		1.44		1.38		1.34		1.4	

cultivation under irrigated condition are presented in Table – 4.7. Table shows that per hectare input costs in various items varied between Rs. 22,650.81 and Rs. 24,991.38 with an overall average of Rs. 24,430.06. The costs involved in the higher farm size groups were found to be higher than the marginal and small farm size groups. This was mainly because of the fact that the farmers in the higher farm size groups could invest more on modern farm inputs. The worked out BCRs remained at 1:1.47,1:1.44, 1:1.38 and 1:1.34 for marginal, small, medium and large farm size groups respectively. The over all BCR was found as 1:1.40

It was found that quantity of seed per hectare was by an large same in all the farm sizes. The fertilizer consumption per hectare varied from 45.36 kg to 48.01 kg with an overall

Table - 4.8

Cost of Cultivation of Summer Rice (HYV) Under Irrigated Condition by Farm Size Groups of the Sample Households

Usages of Inputs	Below 1 ha. 5.98	P.Ha.	1 -- 2 ha. 24.35	P.Ha.	2 -- 4 ha. 30.23	P.Ha.	4 ha. & above 33.05	P.Ha.	Total 93.61	P.Ha.
A. Variable Cost :										
Seed (Qty. in Kg.)	47.18	7.89	187.01	7.68	237.61	7.86	250.52	7.58	722.32	7.72
Value (in Rs.)	10380.08	1735.80	41141.76	1689.60	52273.72	1729.20	55114.18	1667.60	158909.74	1697.57
manure (Qty. in Kg.)	12.86	2.15	64.53	2.65	90.99	3.01	117.66	3.56	286.04	3.06
Value (in Rs.)	3728.53	623.50	18413.57	756.20	25955.55	858.60	34120.82	1032.40	82218.47	878.31
Fertiliser (Qty. in Kg.)	311.68	52.12	1279.84	52.56	1689.55	55.89	1852.45	56.05	5133.52	54.84
Value (in Rs.)	4254.4	711.44	17725.73	727.96	22166.96	733.28	25100.73	759.48	69247.82	739.75
Pesticides (Qty. in Ltr.)	23.02	3.85	103.49	4.25	119.71	3.96	144.1	4.36	390.32	4.17
Value (in Rs.)	8058.05	1347.50	29551.89	1213.63	41898.78	1386.00	45569.55	1378.81	125078.27	1336.16
Plant Protection Measures(Rs.)	1771.34	296.21	8422.18	345.88	12459.29	412.15	13172.41	398.56	35825.22	382.71
Hired Human Labour (mandays)	0		424.91	17.45	591.3	19.56	679.51	20.56	1695.72	18.11
Value (in Rs.)	0		50988.9	2094.00	70955.86	2347.20	81540.96	2467.20	203485.72	2173.76
Family Labour (Mandays)	796.89	133.26	2887.91	118.60	3553.23	117.54	3909.82	118.30	11147.85	119.09
Value (in Rs.)	95627.38	15991.20	346549.20	14232.00	426388.1	14104.80	469177.8	14196.00	1337742.48	14290.59
Bullock Labour (Rs.) :										
Owned	20704.91	3462.36	54933.6	2256.00	73646.33	2436.20	74570.72	2256.30	223855.56	2391.36
Hired	0	0	3575.8	0	4534.5	0	0	0	0	0
Machine labour (Rs.)										
Owned	0		18155.36	745.60	21930.66	725.46	29389.38	889.24	69475.4	742.18
Hired	1823.9		0.00	0.00	0.00	0.00	0	0.00	1823.9	19.48
Irrigation Charges (fuel)	3924.32	656.24	14907.07	612.20	19899.20	658.26	24648.69	745.80	63379.28	677.06
Interest on Variable Cost	5259.55	879.52	21252.78	872.80	27023.81	893.94	29834.18	902.70	83370.32	890.61
Total Variable Cost	155670.5	26031.86	625235.27	25677.01	799132.75	26435.09	882239.42	26694.08	2462277.94	26303.58
B. Fixed Cost :										
Rental Value on Leased in Land	0	0	22530.08	0	0	0	0	0	0	0
Interest on Working Capital	2464.96	412.20	10354.35	425.23	15671.84	518.42	18254.51	552.33	46745.66	499.37
Interest on Capital Cost	2130.67	356.30	11166.91	458.60	15074.49	498.66	23019.33	696.50	51391.4	548.99
Depreciation on Tools and Implements	3661.55	612.30	15800.72	648.90	25765.03	852.30	29627.34	896.44	74854.64	799.64
Land Revenue (Rs.)	536.05	89.64	2182.73	89.64	2709.82	89.64	2962.6	89.64	8391.2	89.64
Total Fixed Cost	8793.23	1470.44	62034.79	2547.63	59221.17	1959.02	73863.78	2234.91	203912.97	2178.32
Total (A+B)	164463.7	27502.30	687270.06	28224.64	858353.93	28394.11	956103.2	28928.99	2666190.92	28481.90
Misc. (2%)	3285.01	549.33	5075.21	208.43	17167.08	567.88	19093.85	577.73	44621.15	476.67
Grand Total	167748.7	28051.63	692345.27	28433.07	875521.01	28961.99	975197.04	29506.72	2710812.07	28958.57
BCR	1.64		1.6		1.55		1.54		1.57	

average 47.36 kg/ha. The overall consumption of fertilizer in the sample farms was found to be lower than the state average of 69.03kg/ha in 2008-09.

The sample farmers prefer to grow HYV paddy in potential areas with irrigation facilities may be because of the fact that they are as short duration variety and highly responsive to fertilizer. The farmers however viewed that HYV paddy are more prone to pests and diseases necessitating adoption of plant protection measures which was one of the costly inputs to the farmers. The extent of using bullock labour, human labour, machine labour etc. is as per requirement of the farmer depending on soil condition. Most of the sample farmers

used hired labour to perform some specific agricultural operations due to shortage of family labour.

Due to inadequacy of bullock labour and machine labour, some of the farmers used to hire bullock or machine labour from the co-villagers. In aggregate, bullock labour cost was worked out at Rs. 1,334.48/ha and machine labour was Rs.677.39/ha. It is evident from the Table that the expenditure incurred on labour (including family and hired) is highest for all the farm size groups due to its labour intensive nature. The cost of family labour varied between Rs. 15,840.00/ha for marginal farmers to Rs. 14,796.56/ha for large farm size group with an overall average investment of Rs. 15,054.90/ha.

It was noticed in the sample area that some of the farmers usually grow some special local variety of paddy for home consumption. In such cases, seeds are home produced and they applied seed according to their traditional knowledge and experience. The application of fertilizer and other inputs in local paddy was less than HYV paddy.

Table -4.8 reflects the inputs used by the sample farms in irrigated HYV summer paddy. The per hectare input costs varied from Rs. 28,051.63 to Rs. 29,506.70 and the overall average was worked out at Rs.28,958.57. The inputs like human labour, bullock labour, machine labour etc., were in accordance with the requirement in different farm sizes for various operations. The overall input costs in irrigated local variety of paddy was 15.64 per cent than the irrigated HYV paddy cultivation. The BCRs was worked out at 1:1.64, 1:1.60, 1:1.55 and 1:1.51 for marginal, small, medium and large farm size groups respectively with an overall average of 1:1.57.

It was seen from the above analysis that the input costs on human labour and bullock labour are the two major inputs required in summer paddy cultivation which are by an large same in both types of cultivation. The other inputs like seed, fertilizer, manure, plant protection measures etc. varied significantly from one to another. The HYV seeds are purchased from the seed distribution agencies and also from the co-villagers, the costs of which varied depending on the sources. The chemical fertilizer and plant protection chemicals are procured from the dealers and the quantum of investment in these two items varied considerably in irrigated and local paddy cultivation. However, the analysis reveals that the

investment in HYV paddy cultivation is higher amongst the sample farmers than the local variety of paddy grown under irrigated condition.

The other important rabi crops grown by the sample farmers are pulses and rape & mustard. These crops are grown for both household uses and commercial purposes. The cost of cultivation was worked out for these crops also under irrigated and rainfed condition and presented in Table- 4.9(a) and Table- 4.9(a) (b) , Table- 4.10 (a) and Table- 4.10 (b)

Table- 4.9 (a) shows the cost of cultivation of pulses under irrigated conditions by using same cost concept as that of summer paddy. Table reveals that total

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Table - 4.9 (a)
Cost of Cultivation of Pulses Under Irrigated Condition by Farm Size Groups of the Sample Households

Usages of Inputs	Below 1 ha. 0.94	P.Ha.	1 -- 2 ha. 1.82	P.Ha.	2 -- 4 ha. 2.79	P.Ha.	4 ha. & above 3.25	P.Ha.	Total 8.8	P.Ha.
A. Variable Cost :										
Seed (Qty. in Kg.)	12.33	13.12	23.68	13.01	36.21	12.98	41.24	12.69	113.46	12.89
Value (in Rs.)	369.98	393.6	710.35	390.3	1014	363.44	1154.79	355.32	3249.1	369.22
manure (Qty. in Kg.)	1.2	1.28	3.86	2.12	8.31	2.98	9.91	3.05	23.28	2.65
Value (in Rs.)	288.77	307.2	792.36	435.36	1872.77	671.24	2180.75	671	5134.7	583.48
Fertiliser (Qty. in Kg.)	11.52	12.26	25.75	14.15	45.2	16.2	60.35	18.57	142.82	16.23
Value (in Rs.)	138.76	147.62	300.02	164.85	547.8	196.34	733.28	225.62	1719.9	195.44
Pesticides (Qty. in Ltr.)	1.14	1.21	2.24	1.23	3.49	1.25	6.96	2.14	13.83	1.57
Value (in Rs.)	250.23	266.2	460.17	252.84	732.38	262.5	1434.4	441.35	2877.2	326.95
Plant Protection Measures(Rs.)	136.54	145.26	269.63	148.15	432.92	155.17	337.87	103.96	1177	133.75
Hired Human Labour (mandays)	0		18.56	10.2	34.88	12.5	55.41	17.05	108.85	12.37
Value (in Rs.)	0		2227.68	1224	4185	1500	6649.5	2046	13062	1484.3
Family Labour (Mandays)	59.46	63.26	99.54	54.69	142.01	50.9	148.04	45.55	449.05	51.03
Value (in Rs.)	7134.6	7590	11944.3	6562.8	17041.3	6108	17764.5	5466	53885	6123.3
Bullock Labour (Rs.) :										
Owned	989.12	1052.26	1192.56	655.25	2064.93	740.12	2665.98	820.3	6912.6	785.52
Hired	0	0	267.27	0	418.5	0	0	0	0	0
Machine labour (Rs.)										
Owned	0		446.81	245.5	586.46	210.2	992.55	305.4	2025.8	230.21
Hired	0		0	0	0	0	0	0	0	0
Irrigation Charges (fuel)	165.05	175.59	337.52	185.45	721.75	258.69	942.08	289.87	2166.4	246.18
Interest on Variable Cost	331.56	352.72	663.2	364.4	1036.62	371.55	1219.95	375.37	3251.3	369.47
Total Variable Cost	9804.61	10430.4	19611.9	10775.8	30654.5	10987.3	36075.64	11100.2	96147	10926
B. Fixed Cost :										
Rental Value on Leased in Land	0	0	0	0	0	0	0	0	0	0
Interest on Working Capital	230.54	245.26	453	248.9	731.87	262.32	894.92	275.36	2310.3	262.54
Interest on Capital Cost	107.69	114.56	229.96	126.35	406.78	145.8	982.15	302.2	1726.6	196.2
Depreciation on Tools and Implements	89.64	95.36	186	102.2	432.09	154.87	442.81	136.25	1150.5	130.74
Land Revenue (Rs.)	84.26	89.64	163.14	89.64	250.1	89.64	291.33	89.64	788.83	89.64
Total Fixed Cost	512.12	544.81	1032.1	567.09	1820.84	652.63	2611.21	803.45	5976.3	679.12
Total (A+B)	10316.73	10975.2	20644	11342.8	32475.3	11639.9	38686.86	11903.7	102123	11605
Misc. (2%)	206.33	219.5	412.88	226.86	649.51	232.8	773.74	238.07	2042.5	232.1
Grand Total	10523.07	11194.8	21056.8	11569.7	33124.8	11872.7	39460.59	12141.7	104165	11837
BCR	1.46		1.36		1.29		1.23		1.3	

investment in HYV paddy cultivation is higher amongst the sample farmers than the local variety of paddy grown under irrigated condition.

The other important rabi crops grown by the sample farmers are pulses and rape & mustard. These crops are grown for both household uses and commercial purposes. The cost of cultivation was worked out for these crops also under irrigated and rainfed condition and presented in Table- 4.9 (a) and Table- 4.9 (a) (b) , Table- 4.10 (a) and Table- 4.10 (b)

Table- 4.9 (a) shows the cost of cultivation of pulses under irrigated conditions by using same cost concept as that of summer paddy. Table reveals that total operated area of pulses in irrigated holdings was 8.80 hectares of which 10.68 per cent (0.94 hectares) was operated by marginal farmers, 20.68 per cent (1.82 hectares) by small farmers, 31.70 per cent

(2.79 hectares) by medium farmers and rest 36.93 per cent (3.25 hectares) by large farmers. Table shows that per hectare variable cost varied between Rs. 10,430.44 for marginal holdings

Table - 4.9 (b)
Cost of Cultivation of Pulses Under un- Irrigated Condition by Farm Size Groups of the Sample Households

Usages of Inputs	Below 1 ha.	P.Ha.	1 -- 2 ha.	P.Ha.	2 -- 4 ha.	P.Ha.	4 ha. & above	P.Ha.	Total	P.Ha.
	3.73		5.00		0		0		8.73	
A. Variable Cost :										
Seed (Qty. in Kg.)	45.32	12.15	61.5	12.3	0	0	0	0	106.82	12.24
Value (in Rs.)	1359.59	364.5	1845	369	0	0	0	0	3204.59	367.08
manure (Qty. in Kg.)	4.63	1.24	9.45	1.89	0	0	0	0	14.08	1.61
Value (in Rs.)	1110.05	297.6	2318.65	463.73	0	0	0	0	3428.7	392.75
Fertiliser (Qty. in Kg.)	45.28	12.14	70.05	14.01	0	0	0	0	115.33	13.21
Value (in Rs.)	545.65	146.29	851.11	170.22	0	0	0	0	1396.76	160
Pesticides (Qty. in Ltr.)	3.54	0.95	5.6	1.12	0	0	0	0	9.14	1.05
Value (in Rs.)	779.57	209	1151.14	230.23	0	0	0	0	1930.71	221.16
Plant Protection Measures(Rs.)	448.05	120.12	642.5	128.5	0	0	0	0	1090.55	124.92
Hired Human Labour (mandays)	0		45.7	9.14	0	0	0	0	45.7	5.23
Value (in Rs.)	0		5484	1096.8	0	0	0	0	5484	628.18
Family Labour (Mandays)	235.92	63.25	262.9	52.58	0	0	0	0	498.82	57.14
Value (in Rs.)	28310.7	7590	31548	6309.6	0	0	0	0	59858.7	6856.67
Bullock Labour (Rs.) :										
Owned	3823.62	1025.1	5341.25	1068.25	0	0	0	0	9164.87	1049.81
Hired	0	0	0	0	0	0	0	0	0	0
Machine labour (Rs.)										
Owned	0	0	1276.25	255.25	0	0	0	0	1276.25	146.19
Hired	0	0	0	0	0	0	0	0	0	0
Irrigation Charges (fuel)	0	0	0	0	0	0	0	0	0	0
Interest on Variable Cost	1232.24	330.36	1511.72	302.34	0	0	0	0	2743.96	314.31
Total Variable Cost	37609.46	10083	51969.6	10393.9	0	0	0	0	89579.1	10261.06
B. Fixed Cost :							0	0		
Rental Value on Leased in Land	0	0	0	0	0	0	0	0	0	0
Interest on Working Capital	448.53	120.25	793.45	158.69	0	0	0	0	1241.98	142.27
Interest on Capital Cost	355.69	95.36	662.9	132.58	0	0	0	0	1018.59	116.68
Depreciation on Tools and Implements	293.1	78.58	576.3	115.26	0	0	0	0	869.4	99.59
Land Revenue (Rs.)	334.36	89.64	448.2	89.64	0	0	0	0	782.56	89.64
Total Fixed Cost	1431.69	383.83	2480.85	496.17	0	0	0	0	3912.54	448.17
Total (A+B)	39041.15	10466.8	54450.5	10890.1	0	0	0	0	93491.6	10709.23
Misc. (2%)	780.82	209.34	1089.01	217.8	0	0	0	0	1869.83	214.18
Grand Total	39821.97	10676.1	55539.5	11107.9	0	0	0	0	95361.4	10923.42
BCR	1.39		1.28		0		0	0	1.33	

and Rs. 11,100.20 for large farm size groups with over all average of Rs. 10,925.75 while fixed cost varied from Rs.544.81/ ha. to Rs.803.45 /ha. with an over all average of Rs.679.12. Taking both the cost together it was highest in case of large farms (Rs12,141.72**)** and lowest in marginal farms (Rs. 11,194.75).The over all BCR was found as 1:1.30.

Table - 4.10 (a)

Cost of Cultivation of Rape & Mustard Under Irrigated Condition by Farm Size Groups of the Sample Households

Usages of Inputs	Below 1 ha. 0.55	P.Ha.	1 -- 2 ha. 1.14	P.Ha.	2 -- 4 ha. 0.81	P.Ha.	4 ha. & above 0.96	P.Ha.	Total 3.46	P.Ha.
A. Variable Cost :										
Seed (Qty. in Kg.)	2.27	4.13	5.2	4.56	3.79	4.68	4.75	4.95	16.01	4.63
Value (in Rs.)	45.32	82.40	103.97	91.20	75.82	93.60	95.04	99.00	320.15	92.53
manure (Qty. in Kg.)	1.18	2.15	3.48	3.05	2.15	2.65	2.93	3.05	9.74	2.82
Value (in Rs.)	118.25	215.00	347.7	305.00	214.65	265.00	292.8	305.00	973.4	281.33
Fertiliser (Qty. in Kg.)	7.29	13.25	17.74	15.56	13.24	16.35	17.52	18.25	55.79	16.12
Value (in Rs.)	84.24	153.16	199.2	174.74	153.09	189.00	209.36	218.08	645.89	186.67
Pesticides (Qty. in Ltr.)	0.47	0.85	1.15	1.01	0.89	1.10	1.08	1.13	3.59	1.04
Value (in Rs.)	102.85	187.00	236.68	207.61	187.11	231.00	269.06	280.27	795.7	229.97
Plant Protection Measures(Rs.)	25	45.45	59.64	52.32	48.76	60.20	58.79	61.24	192.19	55.55
Hired Human Labour (mandays)	0		10.49	9.20	9.47	11.69	14.64	15.25	34.6	10.00
Value (in Rs.)	0		1153.68	1012.00	1041.58	1285.90	1610.4	1677.50	3805.66	1099.90
Family Labour (Mandays)	38.82	70.58	72.16	63.30	49.01	60.51	54.61	56.89	214.6	62.02
Value (in Rs.)	4270.09	7763.80	7937.82	6963.00	5390.55	6655.00	6007.58	6257.90	23606.04	6822.55
Bullock Labour (Rs.) :										
Owned	525.91	956.20	978.91	858.69	798.09	985.30	1008.75	1050.78	3311.66	957.13
Hired	0	0	279.44	0	144.66	0	0	0	0	0
Machine labour (Rs.)										
Owned	0		244.25	214.25	201.44	248.69	336	350.00	781.69	225.92
Hired	0		0	0	0	0	0	0	0	0
Irrigation Charges (fuel)	85.58	155.60	226.36	198.56	174.31	215.20	246.11	256.36	732.36	211.66
Interest on Variable Cost	184	334.55	411.87	361.29	295.05	364.26	354.69	369.47	1245.61	360.00
Total Variable Cost	5441.24	9893.16	12179.51	10683.78	8725.11	10771.74	10488.58	10925.60	36834.44	10645.79
B. Fixed Cost :										
Rental Value on Leased in Land	0	0	0	0	0	0	0	0	0	0
Interest on Working Capital	61.71	112.20	157.68	138.32	160.79	198.51	197.09	205.30	577.27	166.84
Interest on Capital Cost	35.81	65.11	99.82	87.56	90.72	112.00	134.67	140.28	361.02	104.34
Depreciation on Tools and Implements	52.45	95.36	130.19	114.20	125.44	154.86	198.24	206.50	506.32	146.34
Land Revenue (Rs.)	49.3	89.64	102.19	89.64	72.61	89.64	96.05	100.05	320.15	92.53
Total Fixed Cost	199.27	362.31	489.88	429.72	449.56	555.01	616.05	641.72	1754.76	507.16
Total (A+B)	5640.51	10255.47	12669.39	11113.50	9174.67	11326.75	11104.63	11567.32	38589.20	11152.95
Misc. (2%)	112.81	205.11	253.39	222.27	183.49	226.53	222.09	231.34	771.78	223.06
Grand Total	5753.32	10460.58	12922.78	11335.77	9358.17	11553.30	11326.72	11798.67	39360.99	11376.01
BCR	1.57		1.45		1.39		1.27		1.38	

The cost of cultivation of pulses in un irrigated area were presented in Table- 4.9 (b). No area under pulses was found against medium and large farm size groups under rainfed situation. The over all per hectare cost is worked out at Rs.10,923.42 which was 8.39 per cent lower then the cost incurred by the farmers with irrigated holdings. BCR was found higher in the marginal groups (1:1.39) than the small size group (1:1.28)

Table- 4.10 (a) and Table- 4.10 (b) presents the cost of cultivation of rape & mustard under irrigated and rainfed condition. The per hectare total variable cost in irrigated and un irrigated holding were recorded at Rs. 10,645.79 and Rs. 10,223.51 respectively,

Table - 4.10 (b)
Cost of Cultivation of Rape & Mustard Under Un Irrigated Condition by Farm Size Groups of the Sample Households

Usages of Inputs	Below 1 ha. 1.25	P.Ha.	1 -- 2 ha. 2.25	P.Ha.	2 -- 4 ha. 1.65	P.Ha.	4 ha. & above 1.23	P.Ha.	Total 6.38	P.Ha.
A. Variable Cost :										
Seed (Qty. in Kg.)	5.6	4.48	10.91	4.85	8.28	5.02	6.27	5.1	31.06	4.87
Value (in Rs.)	112	89.6	218.25	97	165.66	100.4	125.46	102	621.37	97.39
manure (Qty. in Kg.)	2.79	2.23	6.5	2.89	4.42	2.68	3.7	3.01	17.41	2.73
Value (in Rs.)	278.75	223	650.25	289	442.2	268	370.23	301	1741.43	272.95
Fertiliser (Qty. in Kg.)	16.5	13.2	33.3	14.8	28.41	17.22	23.76	19.32	101.97	15.98
Value (in Rs.)	190.74	152.59	373.96	166.2	328.45	199.06	283.98	230.88	1177.13	184.5
Pesticides (Qty. in Ltr.)	1.23	0.98	2.36	1.05	2.06	1.25	1.67	1.36	7.32	1.15
Value (in Rs.)	269.5	215.6	485.64	215.84	433.13	262.5	418.6	340.33	1606.87	251.86
Plant Protection Measures(Rs.)	69	55.2	131.06	58.25	140.75	85.3	122.48	99.58	463.29	72.62
Hired Human Labour (mandays)	0		20.09	8.93	17.09	10.36	20.05	16.3	57.23	8.97
Value (in Rs.)	0		2210.18	982.3	1880.34	1139.6	2205.39	1793	6295.91	986.82
Family Labour (Mandays)	85.73	68.58	140.29	62.35	98.42	59.65	66.76	54.28	391.2	61.32
Value (in Rs.)	9429.75	7543.8	15431.63	6858.5	10826.48	6561.5	7344.08	5970.8	43031.94	6744.82
Bullock Labour (Rs.) :										
Owned	1191.88	953.5	1907.08	847.59	1592.25	965	1216.47	989	5907.68	925.97
Hired	0	0	554.27	0	297.33	0	0	0	0	0
Machine labour (Rs.)										
Owned	0		482.06	214.25	410.34	248.69	430.5	350	1322.9	207.35
Hired	0		0	0	0	0	0	0	0	0
Irrigation Charges (fuel)	0	0	0	0	0	0	0	0	0	0
Interest on Variable Cost	403.96	323.17	785.56	349.14	578.09	350.36	438.1	356.18	2205.71	345.72
Total Variable Cost	11945.58	9556.46	23230.12	10324.5	17095.01	10360.6	12955.29	10532.8	65226	10223.51
B. Fixed Cost :										
Rental Value on Leased in Land	0	0	0	0	0	0	0	0	0	0
Interest on Working Capital	138.25	110.6	298.13	132.5	300.96	182.4	240.71	195.7	978.05	153.3
Interest on Capital Cost	81.39	65.11	197.01	87.56	184.8	112	172.54	140.28	635.74	99.65
Depreciation on Tools and Implements	118.5	94.8	236.75	105.22	224.73	136.2	196.01	159.36	775.99	121.63
Land Revenue (Rs.)	112.05	89.64	201.69	89.64	147.91	89.64	110.26	89.64	571.91	89.64
Total Fixed Cost	450.19	360.15	933.57	414.92	858.4	520.24	719.53	584.98	2961.69	464.21
Total (A+B)	12395.76	9916.61	24163.69	10739.42	17953.4	10880.9	13674.82	11117.7	68187.67	10687.72
Misc. (2%)	247.92	198.34	483.27	214.79	359.07	217.62	273.5	222.36	1363.76	213.76
Grand Total	12643.68	10114.94	24646.97	10954.21	18312.47	11098.5	13948.32	11340.1	69551.44	10901.48
BCR	1.48		1.36		1.32		1.26		1.38	

whereas fixed cost was Rs 507.16 in irrigated and Rs. 464.21 in un irrigated area. Total cost combining of variable cost and fixed cost on rape & mustard stood at Rs. 11,376.01 in irrigated and Rs. 10,901.48 in un irrigated holding. The overall BCRs were found as 1:1.38 for both irrigated and unirrigated conditions.

In the study area it was observed that a major section of farmers have opted for HYV even under rainfed condition and applied chemical fertilizer and adopted pest and disease control measures as and when required. The overall investment in un irrigated farms

were found to be lower than the irrigated farms may be because of the fact that irrigation facility obtained by the STWs encouraged the farmers to invest more on modern inputs in crop cultivation. The inputs cost on HYV paddy was found to be higher because of the fact that HYV seeds were usually purchased from the seed sale agencies at much higher cost , fertilized use was also higher and the labour input per unit of area was higher for weeding and other inter cultural operations as a result of which the overall cost of HYV paddy cultivation is higher than the local paddy.

It may be mentioned here that in spite of many problems and limitations under rainfed condition the farmers proved themselves efficient in farm planning and farm management to raise varieties of crops depending upon the available resources. Crop diversification was very limited as the farmers have not opted for more remunerative crops yet, as expected and continue with traditional cropping pattern. The farmers concentrated more on food grain production specially rice. However, with the creation of irrigation facilities there lies ample scope of crop diversification in the study area.

Generation of Income from Crop Production

The study revealed that the adoption of modern technology in agriculture in Assam is at a slow pace even in areas with assured irrigation facilities. Due to a number of constraints the state agricultural sector could not make much headway towards achieving self sufficiency in food front. The small and fragmented size of holding, non availability of certified seed within easy reach of the farmers, non availability of institutional credit, scanty use of fertilizer, natural factors, like floods etc. are the major obstacles in the path of modernization of agriculture in the study area. Besides these, poor extension network coupled with lack of motivation on the part of the farmers was identified to be another obstacle. Nevertheless, whenever, assured irrigation support is provided, the farmers have tried to do something positive in increasing production and productivity of *rabi* crops through double/multiple cropping programme. This has also immensely enhanced the employment potential to the workers dependent on agriculture. In a research study entitled " Nature and Extent of Rural Unemployment in Assam." It was revealed that the situation of mounting unemployment and under employment in rural areas are basically due to mono-cropped nature of cropping pattern

under rainfed condition. It was also stated that in areas with irrigation facilities where at least 150 to 165 per cent cropping intensity is followed average mandays of employment goes up to 215 mandays per hectare of cropped area. It is higher by 21 per cent than that of un irrigated mono -cropped area.

Table 4.11 shows the annual gross income of the sample farmers from *rabi* crops cultivation by different size group of farm . Table shows that the sample farmers received Rs. 5,466,150.50 from summer crop, Rs. 266,572.00 from pulses cultivation and Rs.157,425.00 from the cultivation of rape and mustard.

The total income from all the rabi crops cultivated by the sample farmers were worked out at Rs. 5,890,147.50. Taking the value of main products of all crops at farm harvest prices (as per prevailing market rate) the per hectare income from crop production of the sample farmers found to have varied from Rs. 30,303.48 to Rs. 40,350.33 and overall per hectare income is worked out at Rs.37,180.58.Table shows that per hectare income from summer paddy is higher than the cultivation of pulses and rape & mustard. Again, in case of summer paddy cultivation, large size groups of farmers

Table – 4.11
Income Generated from Crop Cultivation of the Sample Farmers by Farm Size Groups

(Value in Rs)

Farm Size Groups	Summer Paddy		Pulses		Rape & Mustard		Total
	Net Area	Income	Net Area	Income	Net Area	Income	
Below 1ha.	7.03	310,665.00 **(44,191.32)**	4.67	70,632.00 **(15,124.63)**	1.80	27,800.00 **(15,444.44)**	409,097.00 **(30,303.48)**
1 -- 2 ha	36.10	1,517,708.00 **(42,041.77)**	6.82	99,592.00 **(14,602.93)**	3.39	52,375.00 **(15,449.85)**	1,669,675.00 **(36,054.31)**
2 -- 4 ha.	47.83	1,952,730.00 **(40,826.47)**	2.79	47,720.00 **(17,103.94)**	2.46	37,125.00 **(15,091.46)**	2,037,575.00 **(38,386.87)**
4 & above ha.	38.52	1,685,047.50 **(43,744.77)**	3.25	48,628.00 **(14,962.46)**	2.19	40,125.00 **(18,321.92)**	1,773,800.50 **(40,350.33)**
Total	129.48	5,466,150.50 **(42,216.18)**	17.53	266,572.00 **(15,206.62)**	11.41	157,425.00 **(13,797.11)**	5,890,147.50 **(37,180.58)**

Note: Figures in Parentheses indicates Per Hectare Income

received more production and more income than other size groups of farms. This indicated that cultivation of summer paddy is now becoming more popular and more remunerative among the sample farmers , and large farmers can also enjoy the economies of production.

Annual Income from Non-agricultural Sources

The analysis of non agricultural sources of income is important because the economic well being of the farmers and use of modern farm technology is highly depends on the overall income of the farmers. Table- 4.12 reflects the annual income of the sample households received from non-agricultural sources. Table shows that out of the total income earned from non agricultural sources of (Rs. 11,432,207), 22.43 per cent came from service and profession, 17.94 per cent from trade, commerce and transport,15.68 per cent from livestock, 9.73 per cent from household cottage industry and remaining 34.22 percent was earned from wages. The service holders were mainly school teacher and fourth grade job holders in the State Government Departments and non governmental organizations. Livestock was another prominent allied source of the sample households. The income from trade, commerce and transport etc. usually comprises of grocery shop owners and retail sellers of vegetables, milk etc. produced in their locality. The cottage industries in the sample area included cane & bamboo works, weaving, bee keeping, carpentry etc.

Table-4.12

Annual Income from Non Agricultural Sources of the Sample Households

(Value in Rs.)

Farm Size groups	HHs	Service & Profession	Trade, Com & Transport	Livestock	Cottage Industry	Wage Earning	Total
Below 1ha.	49	480,600 **(11.68)**	726,408 **(17.66)**	764,807 **(18.59)**	147,364 **(3.58)**	1,994,400 **(48.48)**	4,113,579 **(100.00)**
1 -- 2 ha	37	721,838 **(23.84)**	558,960 **(18.46)**	459,750 **(15.19)**	105,716 **(3.49)**	1,181,334 **(39.02)**	3,027,598 **(100.00)**
2 -- 4 ha.	24	834,896 **(28.63)**	501,512 **(17.20)**	455,273 **(15.61)**	401,588 **(13.77)**	723,096 **(24.79)**	2,916,365 **(100.00)**
4 & above ha.	10	526,810 **(38.31)**	263,684 **(19.18)**	112,740 **(8.20)**	458,064 **(33.31)**	13,767 **(1.00)**	1,375,065 **(100.00)**
Total	120	2,564,042 **(22.43)**	2,050,492 **(17.94)**	1,792,512 **(15.68)**	1,112,678 **(9.73)**	3,912,484 **(34.22)**	11,432,207 **(100.00)**

Note: Figures in Parentheses indicates Percentage to Total

Estimates of Benefit-Cost Ratio of the sample Farms

The analysis of income earned by and costs incurred in production process indicates the operational efficiency of crop cultivation. The BCRs were worked out by taking in account the value of main product at the prevailing market price for different varieties of crops by dividing the total operational costs.

Table-4.13(a) presents per hectare income, cost and BCR of sample farms in local summer rice cultivation. The analysis of BCR shows that all the category of farms enjoyed profit as reflected by positive BCR which ranged between 1:1.34 and 1:1.47with some variations in different farm size groups. The overall BCRs was recorded

Table -4.13(a)
Per hectare Benefit-Cost Ratio of the Sample farms in Local Summer Rice Cultivation by Farm Size Groups

Farm Size groups	Gross Income	Cost Incurred	Net Income	BCR
Below 1ha.	33,392.86	22,650.81	10,742.05	1:1.47
1 -- 2 ha	34,590.00	24,229.49	10,360.51	1:1.43
2 -- 4 ha.	33,967.33	24,561.48	9,405.85	1:1.38
4 & above ha.	33,667.73	24,991.38	8,676.35	1:1.34
Total	34,108.80	24,443.06	9,665.74	1:1.40

at 1:1.40 . Table also reflects that the per hectare gross income and net income decreased with the increase in farm size.

Table -4.13(b) shows the per hectare BCR of the sample farms in summer rice cultivation with HYV seed. The estimated BCRs varied between 1:1.54 for below 1.00 hectare group and 1:1.64 for 4.00 & above hectare farm size groups. The average was worked out at 1:1.57

Table -4.13(b)
Per hectare Benefit-Cost Ratio of the Sample farms in HYV Summer Rice Cultivation by Farm Size Groups

Farm Size groups	Gross Income	Cost Incurred	Net Income	BCR
Below 1ha.	46,087.37	28,051.63	18,035.74	1.64
1 -- 2 ha	45,637.58	28,443.07	17,194.51	1.60
2 -- 4 ha.	44,819.88	28,961.99	15,857.89	1.55
4 & above ha.	45,412.56	29,506.72	15,905.84	1.54
Overall	45,322.80	28,958.57	16,364.23	1.57

The above analysis reveals that the per hectare net income and BCRs were much higher in HYV rice cultivation as compared to local rice. It was observed at the field level that investment in modern inputs in local rice cultivation was comparatively low for which low level of productivity and income per unit of area was obtained by the farmers. Nevertheless,.

Table -4.13(c)
Per hectare Benefit-Cost Ratio of the Sample farms in Pulses Cultivation in Irrigated Condition by Farm Size Groups

Farm Size groups	Gross Income	Cost Incurred	Net Income	BCR
Below 1ha.	16,344.34	11,194.75	5,149.59	1.46
1 -- 2 ha	15,734.78	11,569.69	4,165.09	1.36
2 -- 4 ha.	15,315.77	11,872.69	3,443.08	1.29
4 & above ha.	14,934.32	12,141.72	2,792.60	1.23
Overall	15,388.05	11,836.96	3,551.09	1.30

BCRs were found to be positive in all the farm size groups . It may be due to normal and also presence of other independent variable factors congenial to crop growth in the year under study

Table-4.13(c) shows the per hectare BCR in pulses cultivation under irrigated condition by farm size groups. Table reveals that net return and BCRs decreased with the increase in farm size. It may due to lack of proper care on the part of the large farmers. However, BCRs were found positive all through out which ranged between 1:1.23 and 1:1.46 with overall average of 1:1.30

The per hectare return and the various direct operational costs involved in pulses cultivation in un irrigated condition are presented in Table-4.13(d). There was no pulses area found against 2.00-4.00 hectare and 4.00 & above hectare farm size. The BCR varied between 1:1.28 and 1:1.39 leaving on overall average of 1:1.33.

Table -4.13(d)
Per hectare Benefit-Cost Ratio of the Sample farms in Pulses Cultivation in Un-irrigated Condition by Farm Size Groups

Farm Size groups	Gross Income	Cost Incurred	Net Income	BCR
Below 1ha.	14,839.82	10,676.13	4,163.69	1.39
1 -- 2 ha	14,218.10	11,107.89	3,110.21	1.28
2 -- 4 ha.	0.00	0.00	0.00	0.00
4 & above ha.	0.00	0.00	0.00	0.00
Overall	14,528.15	10,923.42	3,604.73	1.33

It was so because, sample farmers also use HYV seed and invested on modern inputs like fertilizer, plant protection chemicals etc. It was interesting to note that overall BCR

of pulses cultivation under irrigated condition was slightly lower than that of un irrigated conditions. It may because of the fact that irrigation alone cannot play effective role if the other inputs were not used proportionately and the sample farmers have not been able to use the best available recommended technology in agriculture for maximizing production of crops.

Table-4.13(e) represents the per hectare BCR of mustard cultivation under irrigated condition. BCRs were found to be quite encouraging for all the farm size groups which

Table -4.13(e)
Per hectare Benefit-Cost Ratio of the Sample farms in Rape & Mustard Cultivation in Irrigated Condition by Farm Size Groups

Farm Size groups	Gross Income	Cost Incurred	Net Income	BCR
Below 1ha.	16,423.11	10,460.58	5,962.53	1.57
1 -- 2 ha	16,436.87	11,335.77	5,101.10	1.45
2 -- 4 ha.	16,059.07	11,553.29	4,505.78	1.39
4 & above ha.	14,984.31	11,798.67	3,185.64	1.27
Overall	15,698.89	11,376.01	4,322.88	1.38

reflected the potentiality of mustard cultivation in the study area. The BCRs ranged between 1:1.27 to 1:1.57 with an average of 1:1.38.

Per hectare BCR was also worked out for mustard cultivated in rainfed condition which was shown in Table-4.13 (f). The estimated BCRs were 1:1.18, 1:1.36, 1:1.32 and 1:1.26 for marginal, small, medium and large farm size groups respectively. The overall BCR was found at 1:1.38.

Table -4.13(f)
Per hectare Benefit-Cost Ratio of the Sample farms in Rape & Mustard Cultivation in Un-irrigated Condition by Farm Size Groups

Farm Size groups	Gross Income	Cost Incurred	Net Income	BCR
Below 1ha.	14,970.11	10,114.94	4,855.17	1.48
1 -- 2 ha	14,897.73	10,954.21	3,943.52	1.36
2 -- 4 ha.	14,649.98	11,098.47	3,551.51	1.32
4 & above ha.	14,288.51	11,340.09	2,948.42	1.26
Overall	15,044.04	10,901.48	4,142.56	1.38

It was a point to be noted that overall BCR of pulses cultivation under irrigated condition was slightly lower than that of un irrigated condition and in case of rape and mustard cultivation overall BCRs were found similar under both the irrigated and un irrigated condition. It might be of the fact that, irrigation alone cannot play effective role if the other

inputs was not used proportionately and the sample farmers had not been able to use the best recommended technology in agriculture for maximizing production of crops owing to financial crisis or unavailability of inputs in the market at the time of need. It was observed that investment on essential inputs were comparatively low for which productivity and income per unit of area were at the lower level.

Factors Affecting Productivity of Rabi Crops

The New Agricultural Technology such as use of machinery, application of required doses of fertilizer, HYV seed, plant protection measures, water management and inter-cultural operations etc. are the factors which effects the production of crops. It was seen from the study that the farmers had tried to the best of their ability to use the required inputs. The quantum of inputs also varied over different farm size groups resulting in variations of yield in different size groups.

The estimates of productivity of crops under irrigated and rainfed condition highlighted the quantum of variations of yield in different farm size groups.

Table - 4.14
Factors Affecting Productivity of Rabi Crops

Variables	Summer Paddy		Pulses		Signifi cance	Rape & Mustard		Signifi cance
	Marginal Product	t - value	Marginal Product	t - value		Marginal Product	t - value	
Constant	34877	4.0901	13641	12.51993		15924	8.4688	
Human Lab.	-27.64631	-0.6843	-5.34651	-0.42674		-28.6448	-1.6624	
Bullock lab.	0.17687	0.2417	0.11111	0.30019		-0.32421	-0.5296	
Machine Lab.	3.19287	1.2228	1.15151	1.30163		-0.74729	-0.9116	
Seed	2.65833	0.9280	-0.51007	-0.39476		2.39348	0.2262	
Fertiliser	1.93294	0.7146	-3.45217	-2.41857	**	-3.34462	-2.2975	**
Plant Protection	4.67057	1.2173	3.77144	1.36769		2.52691	0.9125	
Irrigation	0.78531	0.3400	7.68663	11.06305	*	7.59369	10.1154	*
R2	0.03440		0.56016			0.52745		
F - Value	0.56997		20.37668			17.85916		
No. of Obs.	120		120			120		

Note: ** indicates 5% and * 1% level of significance

It was tried to examine how different inputs affected the productivity of summer paddy, mustard and pulses in the sample households. For this analysis, a multiple linear model was fitted to examine the factors (variables) that affected the productivity of crops.

For summer paddy cultivation, all the inputs were found to had in significant affect on production. For pulses cultivation, fertilizer and irrigation were found significant affects on production at 5% and 1% level respectively. In case of other variables, i.e. inputs such as bullock labour, machine labour , plant protection, human labour, seed had no impact on productivity. In rape & mustard cultivation, fertilizer and irrigation were significant affects on productivity at 5% and 1% level respectively. The other variables like bullock labour, machine labour , plant protection, human labour, seed had positive but those variables did not have significant impact on productivity.

Opinion Attitude of the Sample Farmers

The opinions of the sample farmers were also taken to find out the individual difficulties faced by them crop cultivation. This kind of analysis would be helpful in assessing the factors that are affecting the production and productivity of crops. Also some farmers could not answer some of the questions properly which indicate that they did not have adequate knowledge about the issues. However, after a series interaction with the farmers through direct and indirect approaches, the following tables were emerged.

Extension Service

Agricultural extension services are not proper and adequate in the study area. It is factually true that training of farmers in adoption of modern technology including water management practices at different stages of plant growth can go a long way in accelerating the agricultural production and productivity. The farmers in the study area opined that field trial demonstration in adoption of new farm technology in the farmers field would be more

Table-4.15
Extension Service Scenario of the Sample Households

Farm Size	HHs	Sources of Information about New Farm Technology				
		Self	Relatives	Friends	Extension workers	Media
Below 1ha.	49	12	14	9	12	2
1 -- 2 ha	37	10	4	9	14	4
2 -- 4 ha.	24	6	1	7	10	3
4 & above ha.	10	2	1	2	5	2
Total	120	30	20	27	41	11
Percentage	100.00	25.00	16.67	22.50	34.17	9.17

educative to them. Table-4.14 shows that only 34.17 percent farmers got information about modern farm technology from extension workers. Of the total sample of 120 households,

16.67 per cent acquired information from relatives, 22.50 per cent from friends, 9.17 per cent from media and 25.00 per cent on their own. But, some of the farmers opined that these information were not scientific as it was based on eye estimation only .

Soil Testing

Soil testing is one of the most important aspects of fertilizer application as it determines the existing prevailing fertility level of soil. After the soil test, the farmers would know the required doses of fertilizer and could select proper crop varieties for better harvest.

Table –4.16
Soil Testing Scenario of the Sample Households

Farm Size	HHs	Yes	No	Percentage	
				Yes	No
Below 1ha.	49	1	48	2	98
1 -- 2 ha	37	2	35	5	95
2 -- 4 ha.	24	4	20	17	83
4 & above ha.	10	2	8	20	80
Total	120	9	111	8	92

Of the total 120 samples, only 8 percent of the respondents have got their soil tested in soil testing laboratory at the instance of State Government Agricultural Government of Assam and rest 92 percent sample farmers applied fertilizer based on their limited knowledge and experiences (Table- 4.15) .However, all the respondents opined that the soil test may result in better harvest.

Distance of Fertiliser Distribution Centres from the Sample Households

The sample farmers procured fertilizer from various sources including the retail depots in the village or nearby towns for which they have to bear an extra over head cost on

Table –4.17
Distance of Fertiliser Distribution Centre from the Sample Households

Farm Size	HHs	Distance			
		Less than 1 K.M	1 - 2 K.M	2 - 5 K.M	5 K.M & above
Below 1ha.	49	14	12	16	7
1 -- 2 ha	37	11	7	13	6
2 -- 4 ha.	24	10	8	4	2
4 & above ha.	10	2	3	4	1
Total	120	37	30	37	16
Percentage	100.00	31.00	25.00	31.00	13.00

account of transportation. Table -4.17 shows the distance of the fertilizer outlets from which the respondents procured fertilizer for the crops they grew. Accordingly, 31 per cent

respondents procured fertilizer from less than 1 k.m.,25 per cent from 1 – 2 k.m,31 per cent from 2 – 4 k.m and remaining 13 per cent respondents purchased fertilizer from a distance beyond 5 k.m. From the Table it was observed that majority of the respondents did not face any problems in purchasing fetiliser at the time of need.

Sources of Seed

The production and productivity of a crop mainly depends upon the quality of seed used in cultivation and judicious use of other inputs. The sample farmers

Table –4.18
Different Sources of Seed Procured by the Sample Households

Farm Size	HHs	Sources of Seed Procurement				
		Seed Corporation	Open Market	Domestic	Agriculture Department	Retail Shop
Below 1ha.	49	2	10	16	9	12
1 -- 2 ha	37	1	9	10	8	9
2 -- 4 ha.	24	2	7	3	4	8
4 & above ha.	10	1	2	0	5	2
Total	120	6	28	29	26	31
Percentage	100.00	5.00	23.00	24.00	22.00	26.00

purchased seed as per their requirement from different sources and it is presented in Table- 4.18. The Table shows that 5 per cent of the total respondents purchased seed from the Seed Corporation, 23 per cent from open market, 26 percent from retail shop and 24 per cent sample farmers kept seed domestically . The rest 22 per cent of the total seed requirement was acquired by the sample farmers from State Agriculture Department free of cost. Although, the Central and State Government have set up several agencies for supplying agricultural inputs to the needy farmers, these agencies however failed to supply quality seed on time and place. As such, most of the sample farmers relied either retail shop or open market for their seeds.

Credit

Availability of credit to the farmers is an important criteria to encourage them for intensive cultivation and adoption of new farm technology in crop cultivation. The per capita credit disbursement to farmers in the State is very low, not even Rs.100.00. It was seen that most of the farmers were mainly small and marginal land holders and could not afford to purchase required farm inputs .Still they have to depends on their own farm income , as the

existing credit facilities were not easily accessible to them. Moreover, the rate of interest of both formal and informal sources of credit were very high for which
the farmers were not willing to apply for credit.

Various sources of credit as availed off by the sample farmers are depicted in

Table –4.19
Sources of Credit taken by the Sample Households

Farm Size	HHs	Sources of Credit					
		Commercial Banks	Co-operative Banks	Professional Money Lender	SHGs	KCC	No Credit
Below 1ha.	49	2	0	3	5	2	37
1 -- 2 ha	37	2	1	6	9	3	16
2 -- 4 ha.	24	0	1	0	6	3	14
4 & above ha.	10	1	0	1	1	4	3
Total	120	5	2	10	21	12	70
Percentage	100.00	4.00	2.00	8.00	18.00	10.00	58.00

Table-4.19. Of the total sample, 58 per cent farmers purchased farm inputs from their own,4 per cent farmers secured credit from commercial banks, 2 per cent from co-operative banks,8 per cent from professional money lenders,18 per cent from SHGs and 10 per cent of the sample farmers took credit against KCC. Table also reflects that large amount of credit was acquired by the sample farmers from informal sources (28 per cent) for which they has to pay an exorbitant rate of interest. It was seen during field investigation that, some sample farmers suggested that bank credit system should be simplified to the extent possible . At times, the farmers were required to visit the bank 4-5 times to get KCC or other bank credits which badly affected their working time during cultivation period.

Mode of Transportation of the Farm Product

Mode of transportation of the farm out put to the sale point is one of the important activities related with crop production and marketing as most of the sample farmers had to carry their produce to a long distance for delivery and sale against reasonable prices. Table-4.20 shows the mode of transportation of farm output used by the sample farm households. It can be seen from the Table that , 40 percent of the total respondents used bicycle, 30 per cent used hand cart, 7 per cent bullock cart and 23 per cent used other vehicles like Auto, Van, Mini Truck etc. for carrying their produced to the market place.

Table –4.20
Mode of Transportation of Production to the Market

Farm Size	HHs	Mode of Transportation			
		Bicycle	Hand Cart	Bullock Cart	Other Vehicles
Below 1ha.	49	22	13	3	11
1 -- 2 ha	37	14	12	4	7
2 -- 4 ha.	24	11	7	0	6
4 & above ha.	10	1	4	2	3
Total	120	48	36	9	27
Percentage	100.00	40.00	30.00	7.00	23.00

From the foregoing discussion and analysis of data, one can sufficiently proved that there is vast potentialities of *rabi* crops cultivation in Assam. The farmers in the sample areas reap a very good harvest from the cultivation of rabi crops especially summer rice. The yield rate of summer rice was found to be quite encouraging as it stood at 6,145 kg/ha against the State average of 2,275kg/ha. The productivity of black gram, green gram and rape & mustard was also recorded to be higher or comparable to the state average. It was found 538 kg/ha, 458 kg/ha and 607 kg/ha. against 514 kg/ha.,460 kg/ha. and 514 kg/ha. respectively in the same order.

In Assam, flood is a regular phenomenon which affects *kharif* season badly. Except two hill districts, each and every districts of Assam is more or less flood affected due to the Brahmaputra and Barak river systems. Most of the chronically flood affected areas came under the districts of Dhemaji, Lakhimpur, Jorhat, Nagaon, Darrang, Sivasagar, Kamrup,Tinsukia, Dibrugar and Cachar districts. So there is urgent need for restructuring the existing crops sequences so as to make suitable adjustment to such a situation. Hence emphasis should shift towards growing more *rabi* crops in flood free areas with assured irrigation support. There is ample opportunity for increasing the production of summer rice in the sample area in particular and Assam in general. In recent years, summer rice has got a new dimension after creation of irrigation facilities through installation of STWs at the instance of World Bank and NABARD.

A research group analysed the advantages and disadvantages of growing different crops in two seasons i.e. *kharif* and *rabi* seasons which clearly revealed the potentiality of *rabi* crops cultivation in Assam. Their findings are shown in the form of Table (Table-4.21) The Table shows that all the important factors responsible for crop production are

quite favourable for *rabi* crops cultivation in Assam. It is expected that bringing more areas under *rabi* crops can meet or even the increasing requirement on food grains and oilseeds for fast growing population in the state.

Table – 4.21
Comparison of Some Factors Affecting Crop Production During Kharif & Rabi Season in Assam

Factors	Season	
	Kharif	**Rabi**
Rainfall	Heavy	Scanty(Irrigated)
Humidity	Very High	Less
Pest and Diseases	High Incidence	Lesser
Weeds	Heavy Infestation	Much less
Sunshine Hours	450-500 hrs.	650-700 hrs.
Intensity of Sunshine	Less	High
Cloudy Sky	Prevalent	Not Prevalent
Fertiliser Response	Poor(Up to 40-50 kg/ha only)	Very Good (Up to 50-60 Kg./ha)
Flood	Susceptible	Free
Average Yield of Rice	1200 to 1400	2500-4000

Considering the importance and potentials of *rabi* crops cultivation in Assam, state government has taken some initiative measures with the introduction of various agriculture development programmes during the plan periods which increases the prospects of rabi crops cultivation in Assam.

Table-4.22 shows the additional area targeted during 2010-2011 for some major *rabi* crops in the state.

Table- 4.22

Area coverage of Major Crops in Assam

Major Crops	Area coverage (in lakh hectare)			
	2008-09	2009-10 (anticipated)	2010-11 (target)	Additional area targeted in 2010-11
Summer Rice	3.60	4.10	5.00	0.90
Food grains	5.28	6.38	7.93	1.55
Vegetables	1.67	1.85	1.95	0.10
Oilseeds	2.55	2.90	3.55	0.65

In view of the declining trend in per capita land holding the State Agriculture Department has taken various measures to increase the productivity of crops and cropping intensity as well. Table - 4.22 shows that it is targeted to produce additional 2.25 lakh MT of

summer rice, 2.36 lakh MT of vegetables and 0.44 lakh MT of oilseeds during the period of 2010-11against the year 2009-10.

In consideration of the food security, the State Government has come up with a host of new activities/ schemes to bring more areas under *rabi* crops and also to upscale the production to meet the increasing requirements. The NFSM and RKVY are two of the major central sector schemes which are intended to bring about tangible changes in agriculture sector. The development programmes undertaken by the Government are expected to deliver the good and it is certainly going to enhance the prospects of *rabi* crops in the state if taken up in right earnest.

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CHAPTER- V

Constraints, Ameliorative Measures and Conclusion

Agriculture continues to occupy a pre-eminent place in the economy of Assam and the farmers living in rural areas constitute the backbone of Assam agriculture. However, the socio-economic standard of this huge segment of rural population is far than satisfactory mainly due to under- utilisation of available resources, unemployment and underemployment, low per capita income and poverty. The state has completed 10th Five Year Plan by the end of the year, 2007, and yet, the state has been chronically suffering from food deficit since early 60s due to low productivity of food crops shortage of infrastructural and institutional support and high growth of population. Moreover, poor performance of agriculture sector can be attributed to small holdings, low cropping intensity, low level of adoption of new farm technology, inadequate irrigation facility and consequently low productivity of principal crops as compared to the national average. The increase in production has failed to keep pace with the increase in population which it led to a fail in per capita availability of food grain. The state maintained near self sufficiency level in food production till 1960s. There after the state started to face the problem of food deficit continuously. The nutritional requirement of food grains in Assam increased from 29.16 lakh tones in 1980-81 to 52.10 lakh tones in 2007-08. Thus, food security to all is became the major challenge behind the state. A healthy agricultural economy is the only solution for all round socio-economic development of the state in context of on going economic reforms with liberalized trade policy. But despite of having much potentiality, agriculture sector of Assam is still far behind as compared to the other developed states of the country.

Although, the Government of Assam is putting much emphasis on enhancing the production and productivity of crops by harnessing the best in frontier technologies there exists a host of limitations for enhanced crop production. Based on the analysis of the sample data, field visits, and the discussions with agricultural extension functionaries some of the

constraints in increasing the production and productivity of *rabi* crops were identified. The constraints may vary from one agro-climatic zone to another, yet, it may reflect on average picture of the constraints being by Assam farmers.

1. **Pre-dominance of Small and Fragmented Holdings**

In Assam, about 82 per cent of the farmers belong to small and marginal category. It is one of the major factors hindering the proper utilization of new farm technology. Due to scattered and tiny plots of land irrigation potential created through STW cannot be utilized properly. Most of sample farmers possessing STWs do not have the compact minimum area of land required for maximum utilization of the created potential of STWs. In our sample 35 per cent per cent of small and marginal farmers possessed 3 to 5 numbers of scattered tiny plots for which all the plots could not be irrigated for optimum utilization of land. In fact ,about 60 per cent of the sample farmers possessing STWs have operational holdings less than the full capacity of the pump sets. With such small and fragmented holdings, full utilization of created potential was not possible. This is considered to be one of the major problems for which most of the STW irrigation sources remained under-utilised.

2. **Lack of Institutional Credit and Banking Services**

The flow of credit to the farmers is an important criteria to encourage them for intensive cultivation and adoption of new farm technology in crop cultivation. Availability of agricultural credit in Assam per hectare is only 30 per cent of the national average. The per capita credit disbursement to farmers in the State is very low, not even Rs.100/-. The credit-deposit ratio was only 32.50 per cent for Schedule Commercial Banks and 39.93 per cent for Regional Rural Banks . The number of bank branches were only 1,619 and each branch covers 1,646 persons**.** Most of the farmers faced financial problem in their pursuit to crop cultivation. Although Government provides two third subsidies to install pump sets for irrigation, yet, a large majority of farmers were unable to manage even the fuel costs to run the pump-sets. Modern farm production technology is highly capital intensive in nature. The scientific crop production technology and crop planning has created unprecedented upsurge in the demand for various types of inputs such as HYV seed, fertilizer, pesticide,

farm machineries etc. At the same time, the new farm technology has created heavy demand for credit to invest on modern inputs. Institutional credit is not available for the farmers within easy reach. Moreover, lots of formalities are to be followed to obtain institutional credit and time lags are substantial for which the illiterate farmers failed to avail institutional credit. Most of the sample farmers reported that they have to go to the loan disbursing authorities a number of times and it took quite a long time to acquire the loan. Therefore, most of the farmers were not willing to take credit from those agencies. The small and marginal farmers in particular failed to take the advantage of owing STW with pump-sets despite a number of developmental schemes being run by the Government.

3. **Non-adoption of Proper Cropping Pattern**

Non- adoption of proper cropping pattern is one of the major problems of *rabi* crops cultivation on the part of the farmers. It was found in the study area that although some of the sample farmers cultivating winter paddy after harvesting of summer paddy and/or *rabi* vegetables as a second crop yet, most of the farmers were not cultivating second or third crop by using scientific crop rotation with available irrigation potential. The rabi crops cultivated by the farmers included mustard, pulses, potato etc. in high land. Later, the farmers used to cultivate those crops in flood prone areas as a chance crop, when main crop winter paddy is damaged by floods. After flood also erratic distribution of rain and prolonged drought during November/December affects the growth and yield of crops. Besides, most of the farmers were found to be risk averter and were skeptical in trying new crop varieties. It was also observed that the farmers were not aware of the concept of crop planning and the efforts made by the state agriculture department to educate the farmers did not yield much.

4. **Limited Use of Short Duration HYV Seeds**

The supply of short duration HYV seeds were reported to be very limited in the sample area. The use of HYV seed of paddy was only about 60.91 percent in the state in the year 2008-09 as against 71.11 per cent in the study area. The supply of improved variety of pulses and mustard seed were not available in the study area. The farmers usually adopted

the traditional variety of seeds whose average yield rate is almost half the yield of improved variety. Although some of the farmers keep HYV seed of paddy for the subsequent years, it was found to degenerated over time due to and productivity also decreases. The irrigation potential was also not fully utilized in cultivation of traditional variety of crops. It was also to be noted that the urban people of the state preferred fine varieties of rice to coarse varieties. As per statistics available the state (2010-11) produced 9876 lakh M.T. of summer rice of which only 50 percent was of fine varieties. So, the state is still importing rice from the other states of the country. It was observed that in the area under study there was no authorized seed distribution agency. Some private traders supplied seed to the farmers at a higher rate and many a time its authenticity remained doubtful. So, the use of HYV seed remained limited in the study area and production of *rabi* crops could not reach the desired level.

5. **Under Utilisation of STWs**

Existing irrigation facilities created in the study areas have many shortcomings. Although the sample farmers have STW irrigation yet, it is difficult to extract the necessary water during *rabi* crop season because of low water table .

Besides, farmers of the sample area generally cultivate mustard and pulses for home consumption with little commercial motive. Hence due attention has not been paid on irrigation for better production. It was reported during the field survey that a large number of STW pump – sets become non-operational due to lack of proper maintenance. The STW required periodical repairing due to high iron content by the water sources. But due to absence of technically trained manpower in the locality these pump-sets remained dry and non-operational which affected the maximum utilization of STWs to its potential.

6. **Poor Extension Services**

Absence of adequate extension and training facility was yet another constraint of *rabi* crops as identified by the farmer respondents. It is needless to mention that training of farmers on available modern technology packages can go a long way in accelerating the agricultural production and productivity. But, the sample farmers in the study area reported that they remained unaware of the new knowledge and farm practices due to lack of

adequate exposure. In the study area pulses and rape & mustard were susceptible to pests and diseases and the farmers did not have proper knowledge on plant protection measures. The farmers in the study area opined that field trial demonstration on new farm technology could be more educative to them. This would require re-orientation of the whole extension network in the state to make the system more respective to the farming community.

7. **Instability in Prices and Income**

It was observed that instability in prices of agricultural commodity was one of the major determinant in the production planning process. The instability in again is related to instability in output and income. Normally, the prices of agricultural commodity and agricultural income move in the same direction.

It is to be noted that price instability of agricultural commodity has far reaching consequences; the entire process of crop planning on the part of the farmers may get affected by any kind of instability. The bitter experience of farmers in selling their produce at lower prices may discourage them to adopt input intensive technology. In order to guard against price fluctuations of crops the farmers may resort to measures like diversification of crops or flexibility in the production process. However, greater price fluctuations in case of agricultural products lie in the nature of supply and demand. Sample farmers reported that relative profitability of pulse crops were lower than other crops. In fact, prices of whole pulses were not that attractive and the margin between prices of split and whole pulses was quite high which usually went to middleman.

8**. Lack of Agricultural Research and Backup Support**

Agricultural research in Assam is very poor as compared to its requirement. Whatever research is conducted on varietals development and in adoption of technology are not made available to the farmers. The farmers in the study area apprehended that they used some variety of crops and irrigated the area with STW where iron content in water is reported to be high which might affect the productivity of land in the long run. The soil testing facilities in the study area are also not available which caused great concern to the farmers. The problems faced by the farmers remain unattended.

It was assumed that some back up support of research management system is considered necessary. The newly generated crop varieties and technologies should be evaluated for their adaptability across different environment depending upon the soil condition and soil type in different localities. Development of disease and pest resistance varieties are needed for better yield of pulses and oilseeds. For this the Field Trial Stations (FTS) and soil testing services has a greater role to play. But, the services of FTS and soil testing services are broadly lacking in the study area. The research programmes on problems in specific situation in wide diversities of farming conditions may go a long way in guiding the farmers in adoption of suitable farm technologies for higher return.

9 **Migration Out of Agriculture Sector**

It was the common notion of the sample respondents that agriculture is not recommended as compared to other sector of the economy. It is for this reason, the educated and enlightened section of the villages moved away from agriculture over time.

10**. The Problem of Iron Toxicity**

The soil of Assam in general is acidic with poor base saturation and low exchange capacity which restrict productivity potential of soil. Also the iron content of soil and ground water sources is very high and continuous use of such water may lead to complex iron toxicity problem in the soil which may caused nutritional imbalance and may affect the production of crops and environment. The problem was also witnessed in water logging areas and chronically flood affected areas of the sample district and was identified as one of the factors retarding the productivity of rice and other cereal crops.

11. **Low and Imbalanced Rate of Fertilizer Consumption**

Fertilizer is one of the most important inputs constituting towards crop production. The average rate of fertilizer consumption in the state is very low, only 58.30kg/ha as against 128.58 at the national level. This has resulted in to low and erratic yield responses under rainfed conditions. The situation was not different in the study area. Moreover, the sample farmers were not so financially sound to purchase the required

amount of fertilizer on time. Further, they were unaware of the recommended doses for different crops and the farmers could not harvest the benefits to desired level.

12. **Marketing Constraints**

Availability of market with assured price is one of the best incentives to motivate the farmers to adopt new farm technology for enhancing crop production. However, there was no regulated market or marketing cooperatives for marketing the surplus produce in the study area. The village traders or middle man and commission agents played a vital role in marketing of mustard and pulses and the traders took full advantage of the situation. Certain fraudulent practices were reported to be followed by the traders to earn big margin. Moreover, the traders financed some of the needy farmers at the time of flowering of mustard and pulses and they were constrained to be satisfied with lower price dictated by the traders. The farmers opined that they were not getting the expected return for their produce and hence incurred losses at time in cultivation of crops.

13. **Lack of Soil Testing Facilities**

Soil testing is considered to be an important step to determine the requirement of soil nutrients for different crops for better production. The basic objectives of soil testing is to guide the farmers for efficient and economic use of soil nutrients and other required inputs in crop cultivation. In fact soil testing services leads to better use of fertilizer and soil management practices. Although the state has 12 soil testing centres, most of the sample farmers in the study area were not aware about the benefit of soil testing and failed to reap better harvest from their cultivation practices.

14. **First Growing Prices of Fuel and Electricity**

Continuous rise of fuel price and irregular electricity supply are also responsible for lower production and productivity of *rabi* crops .Due to the financial hardships and lack of institutional credit facilities, farmers are unable to run the diesel operated pump sets as and when required and thus huge amount of potential created remained under utilized. It was also observed that the supply of electricity was quite irregular in the study area.

15. **High Cost of Fertilisers and Plant Protection Chemicals**

Fertilizer and plant protection chemicals are very expensive and most of the sample farmers were not in a position to purchase the same from their own saving due to poor economic conditions. Moreover, sometimes required amount of fertilizers and plant protection chemicals were not available on proper time within the easy reach of the farmers. It was reported that pulses and oilseeds were more susceptible to pests and diseases and the farmers' knowledge on IPM and IDM was far from satisfactory.

16. **Inadequate Post Harvest Technology**

The post harvest handling of summer rice i.e. drying and milling is a major problem as its harvesting time of coincides with high rainfall period. The processing of pulses oilseeds is also created some problems. Despande and Singh[1] reported, among post harvest operations, storage is responsible for maximum loss of 7.5 per cent, processing, threshing and transportation cause 1 per cent, 05 per cent and .5 per cent losses respectively aggregating 9.5 per cent total loss of production. For this reason, farmers were forced to sell their produce immediately after harvest due to lack of storage facilities. The post harvest technology would continue to be a problem till some innovative measures are introduces.

Based on the findings of the study and observations and problems identified at the grass root level, following ameliorative measures are suggested for increased production and productivity of *rabi* crops.

1. **Consolidation of Holding**

The study established that due to small and scattered holdings, the farmers could not utilize the full potential of irrigation facility created through STW. For modernization of agriculture and to utilized full potential of STWs consolidation of holding is essential to make agriculture economically viable. The uneconomic small

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Despande,S.D.& Singh,G.(2001): " Long Term Storage Structures in Pulses National Symposium on Pulses for Sustainable Agriculture and Nutritional Security, Indian Institute of Pulses Research,April,17-19, 2001 ,New D3elhi

farms and fragmented small holdings needs to be grouped through land consolidation and cooperative farming type of organization be formed. Some incentives should be provided for formation of group farming or co-operative farming. It is needless to mention that the farmers must adopt new farm technology for raising agricultural productivity. If the lands consolidated, the small and marginal farmers will be benefited through optimum utilization of irrigation potential. In this regard, the FMCs (Field Management Committee) and SHGs operating in the locality can be utilized to motivate the farmers in respect of benefit of land consolidation**. (Attention : Revenue Department ,Government of Assam and FMCs of concerned area)**

2. **Supply of Institutional Credit**

There is reasonably good network of branches of Commercial Banks, Regional Rural Banks and Co-operative Credit Institutions in the state. But such bank branches are located in towns and urban areas. Also, the delivery of credit to the farm sector has not been found satisfactory. Banks are in fact less interested in providing credit to agriculture because of uncertainty. Therefore, lack of institutional credit for investment on modern inputs is one of the important problems faced by the farmers for adoption of scientific package of practices. Some of the small and marginal farmers reported to have availed credit from private sources at a very high rate of interest which caused additional burden to the poor farmers. Institutional credit in the form of crop loans should be provided in easy terms, so that the farmers are not compelled to take loans from the private traders on pre-condition of selling the produce at a low price. In the study area not a single farmer reported to have short term loan or crop loan which had been waived as per relief package declared by the Government. The state government may negotiate with the banking system in this regard. **(Attention : Commercial Banks, Regional Rural Banks and Co-operative Credit Institutions)**

3. **Strengthening of Agricultural Extension and Farmer Linkage Support Services**

Due to poor and inadequate extension services and farmer linkage support services, the farmers were not aware about the government's programmes and policies for agricultural development. There are wide variations among sample farmers regarding the

use of HYV seeds, soil nutrients and water management practices within the same locality. The farmers applied their own knowledge and experiences for growing different crops. It was also learned that the farmers sometimes consulted with fertilizer dealer/sellers regarding requirement of fertilizer and other inputs. This may sometimes proved injurious and harmful for the soil health and plant growth. It is therefore desirable that an agricultural extension services has to be strengthened to educate the farmers. For that, frequent training and visit programme of extension officials particularly the subject matter specialist can help the farmers in increasing the production and income thereby improving their economic condition. **(Attention : Directorate of Agriculture, Extension Wing, Govt. of Assam)**

4. **Multiple Cropping, Crop Rotation, Demonstration and Adoptive Trials at Farmers Field**

Field demonstration and application of scientific methodologies at farmers field on double/multiple cropping and crop rotation technologies are considered essential to provide technological support to the farmers . Practical field trial and demonstration on intensive cropping with HYV seed, application of soil nutrients, prophylactic measures, water management etc. would encourage the farmers to take up crop cultivation more seriously. For introduction and popularization of new crop varieties, adoptive and result oriented field demonstration may be encouraged. In selected areas, short duration variety of winter paddy may be planned to harvest in early October it should be followed by mustard under improved technology in quick succession. **(Attention: Extension Wing, Govt. of Assam)**

5. **Creation of Single Window Input Delivery System**

Farm inputs like certified seed, fertilizer, manure, plant protection chemicals, planting materials etc. should made available at proper time to the farmers at the doorstep. Development of single window input delivery system is considered essential to ensure timely supply of critical inputs. Farmers requirements of HYV seed, fertilizer, planting materials, improved machineries and implements, credit needs etc. should be assessed and provided by the government agencies in easy ways and with single channel. The farmers

in the study area reported that these items were not available on time, particularly non availability of HYV seed was the major constraint. The single window system of input delivery may help the farmers to get their all the required inputs within a short time at a reasonable price **(Attention : Directorate of Agriculture, Govt. of Assam)**

6. **Supply of Diesel and Electricity in the Rural Areas at Subsidiary Rate**

Irrigation is one of the essential inputs for *rabi* crops cultivation. So in the greater interest of the farmers in general and the farmers in the study area in particular, diesel may be supplied at subsidized rate. The electricity used for energization of pump sets also needs to be subsidized as these two items are not within the affordable range of the poor farmers. The farmers in the study area cited that the prices of diesel is too high and it is proved to be much higher than maintaining two pairs of bullocks. Also, the supply of electricity is irregular and per unit costs is also very high. So, the sample farmers viewed that the prices of diesel and electricity used for the agricultural purposes be subsidized for the benefit of the farmers. **(Attention : Government of Assam)**

7. **Supply of HYV Seeds within the Easy Reach of the Farmers**

Making available adequate quantity of certified seeds before sowing time is a pre-requisite for any crop enterprise .Good quality certified seeds should be made available to the farmers at reasonable prices at the time of need. The department of agriculture should popularized short duration crop varieties of all crops together with judicious application of fertilizers particularly phosphatic fertilizers in pulses cultivation. The Department of Agriculture, Government of Assam may take up schemes for production of improved seeds of mustard and pulses within the state. **(Attention: Extension Wing, Assam Seed Corporation, Department of Agriculture Govt. of Assam).**

8. **Development of Rural Roads and Transport Facilities**

It is of utmost necessary to develop the road communication system to facilitate the transportation of marketable produce to the places of assembling and marketing. To provide minimum road communication facilities link roads should be built to connect cluster of villages. Improvement of road communication facilities would ensure

marketing of produce and reduce the cost of transportation as well as the transit losses. Moreover, the development of rural roads will not only ensure easy marketing it will also be helpful in improvement of the status of socio-economic conditions of the people at large. **(Attention: State PWD Department, DRDA, Govt. of Assam)**

9. **Development of Multi Purpose Co-operative Societies**

A multipurpose co-operative society with cold storage and transport facilities may ensure remunerative return to the crop growers. Such co-operatives with sound financial position, good management equipped with needed infrastructural support can go a long way in eliminating the monopolistic trade practices of market functionaries. Such multipurpose co-operative societies should be supported by State Co-operative Banks, Nationalised Commercial Banks and also by the State Government to make the co-operative viable and farmer's need oriented. **(Attention: Commercial Banks, Regional Rural Banks and Co-operative Credit Institutions, State Marketing Board, Govt. of Assam)**

10. **Soil Testing Services**

Soil testing services should be made available in the study area. Because it is not possible on the part of the farmers to identify the potential land for a particular crop, proper doses of fertilizer and appropriate plant protection measures without knowing the quality of soil. Therefore, the numbers of soil testing laboratories should be increased to cater the needs of the farmers so that each farmer can tested their soil within the easy reach for better harvest. **(Attention: Soil Testing Laboratory, Department of Soil Science, Govt. of Assam)**

11. **Improvement of Marketing System**

There is need to strengthen the regulated market systems which can eliminate unhealthy practices and also ensure fair price to the producer. The State Government must operate in an effective way in regulating the marketing of agricultural produce in general and oilseeds and pulses in particular. Through regulated market and through procurement drive, the farmers may get remunerative prices for their producers. **(Attention: Assam State Agriculture Marketing Board**)

12. **Improvement of Post Harvest Technology**

Lack of machinery for different post harvest operations of most of the *rabi* crops, together with non-existent storage and processing facilities are responsible for low production and damage and loses of crops in the state. In the study area, there was no quality milling facilities for oilseeds and pulses as well. Therefore, farmers were compelled to sell their produce at raw form for which they were deprived of getting higher price attributed to value addition. The State government should take initiatives for development of rural go downs, storage facilities at market places, establishment of quality processing mills and creating infrastructural facilities at strategic points. **(Attention: Department of Agriculture Govt. of Assam)**

Conclusion

The forgoing discussion and analysis of data clearly indicate that *rabi* crops have enormous potential in the study area despite a number of constraints being faced by the farmers. The study highlighted that major thrust should be given on development of irrigation , dissemination of new technology, assured input supply and strong marketing support. The officials in the State Agriculture Department and the scientists of agricultural university are to work in tandem to ensure that the fruits of technology reached the farmer at the grass roots. Unless farm power develop agriculture cannot developed and the scientists should go for location specific and need based solutions.

In order to achieved the desired level of productivity of *rabi* crops in the state, government must operate in a big and effective way in creating basic infrastructural facilities and in co-ordinating with related departments. There are possibilities of brining in more land under *rabi* crops with suitable adjustment of cropping sequences. A selective 'area approach' has been considered more effective to consolidate the situation and to boost up the production of *rabi* crops. In chronically flood affected areas, special programmes should be taken up for oilseed, pulses and summer rice cultivation in *rabi* seasons .In view of the situation, it is necessary for the state government to make concerted effort to bring all the potential areas under *rabi* cultivation to attain self sufficiently in foodgrain production. However, all efforts to increase agricultural production will have no impact unless the farmers are effectively

involved in development programmes. For successful implementation of the agricultural development programmes, it is desirable to involve the farmers in the decision making process as well as in implementation of the programmes.

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APPENDIX

Table – I
Area Under Summer Rice in Assam (Hectare)

X(Year)	ut(Area)	t	t*ut	t2	Trend values
1998	223913	-5	-1119565	25	244900
1999	171522	-4	-686088	16	256075
2000	318588	-3	-955764	9	267251
2001	326000	-2	-652000	4	278426
2002	327468	-1	-327468	1	289602
2003	319480	0	0	0	300777
2004	311437	1	311437	1	311953
2005	314671	2	629342	4	323128
2006	312471	3	937413	9	334304
2007	323000	4	1292000	16	345479
2008	360000	5	1800000	25	356655
Total	3308550		1229307	110	

y=a+bt a=300777 b=11176

Estimated value of 2009 367830

2010 379006

Table – II
Area Under Pulses in Assam (Hectare)

X(Year)	ut(Area)	t	t*ut	t2	Trend values
1998	126800	-5	-634000	25	118550
1999	116178	-4	-464712	16	116882
2000	111415	-3	-334245	9	115214
2001	119526	-2	-239052	4	113546
2002	112275	-1	-112275	1	111878
2003	103687	0	0	0	110210
2004	95591	1	95591	1	108542
2005	108306	2	216612	4	106874
2006	99531	3	298593	9	105206
2007	105000	4	420000	16	103538
2008	114000	5	570000	25	101870
Total	1212309		-183488	110	

y=a+bt a=110210 b=-1668.07

Estimated value of 2009 100201

2010 98533

Table – III
Area Under Rape & Mustard in Assam (Hectare)

X(Year)	ut(Area)	t	t*ut	t2	Trend values
1998	288829	-5	-1444145	25	289613
1999	286241	-4	-1144964	16	282674
2000	274459	-3	-823377	9	275736
2001	272323	-2	-544646	4	268797
2002	261309	-1	-261309	1	261858
2003	264103	0	0	0	254919
2004	244948	1	244948	1	247980
2005	212471	2	424942	4	241041
2006	238426	3	715278	9	234102
2007	235000	4	940000	16	227164
2008	226000	5	1130000	25	220225
Total	2804109		-763273	110	

y=a+bt a=254919 b=-6939

Estimated value of 2009 213286

2010 206347

Table –IV
Production of Summer Rice in Assam (Tonne)

X(Year)	ut(Production)	t	t*ut	t2	Trend value
1998	446113	-5	-2230565	25	454261
1999	303373	-4	-1213492	16	483261
2000	620304	-3	-1860912	9	512261
2001	666097	-2	-1332194	4	541260
2002	634805	-1	-634805	1	570260
2003	584653	0	0	0	599260
2004	622339	1	622339	1	628259
2005	571168	2	1142336	4	657259
2006	642765	3	1928295	9	686259
2007	732241	4	2928964	16	715259
2008	768000	5	3840000	25	744258
Total	6591858		3189966	110	

b=29000

y=a+bt a=599260

Estimated value of 2009 773258

2010 802258

Table – V
Production of Pulses in Assam (Tonne)

X(Year)	ut(Production)	t	t*ut	t2	Trend values
1998	69222	-5	-346110	25	65622
1999	64688	-4	-258752	16	64618
2000	62240	-3	-186720	9	63614
2001	66406	-2	-132812	4	62610
2002	60420	-1	-60420	1	61607
2003	56743	0	0	0	60603
2004	54386	1	54386	1	59599
2005	59563	2	119126	4	58595
2006	52963	3	158889	9	57592
2007	58000	4	232000	16	56588
2008	62000	5	310000	25	55584
Total	666631		-110413	110	

y=a+bt a=60603 b=-1004

Estimated value of 2009 54580

2010 53577

Table – VI
Production of Rape & Mustard in Assam (Tonne)

X(Year)	ut(Production)	t	t*ut	t2	Trend values
1998	135631	-5	-678155	25	138128
1999	129425	-4	-517700	16	135987
2000	141231	-3	-423693	9	133847
2001	137056	-2	-274112	4	131707
2002	129784	-1	-129784	1	129566
2003	138296	0	0	0	127426
2004	129395	1	129395	1	125285
2005	96992	2	193984	4	123145
2006	115874	3	347622	9	121005
2007	123000	4	492000	16	118864
2008	125000	5	625000	25	116724
Total	1401684		-235443		

y=a+bt a=127426 b=-2140

Estimated value of 2007 114583

2008 112443

Table – VII
Productivity of Summer Rice in Assam (Kg/ha.)

X(Year)	ut(Yield)	t	t*ut	t2	Trend values
1998	1992	-5	-9960	25	1827
1999	1733	-4	-6932	16	1852
2000	1908	-3	-5724	9	1878
2001	2003	-2	-4006	4	1903
2002	1901	-1	-1901	1	1928
2003	1794	0	0	0	1953
2004	1959	1	1959	1	1979
2005	1780	2	3560	4	2004
2006	2017	3	6051	9	2029
2007	2267	4	9068	16	2054
2008	2133	5	10665	25	2080
Total	21487		2780	110	

y=a+bt a=1953.36 b=25.27

Estimated value of 2009 2105

2010 2130

Table – VIII
Productivity of Pulses in Assam (Kg/ha.)

X(Year)	ut(Yield)	t	t*ut	t2	Trend values
1998	546	-5	-2730	25	543
1999	546	-4	-2184	16	543
2000	547	-3	-1641	9	543
2001	544	-2	-1088	4	543
2002	527	-1	-527	1	543
2003	536	0	0	0	543
2004	558	1	558	1	543
2005	550	2	1100	4	543
2006	521	3	1563	9	543
2007	555	4	2220	16	543
2008	545	5	2725	25	543
Total	5975		-4	110	

y=a+bt a=543.18 b=-0.04

Estimated value of 2009 543

2010 543

Table - IX
Productivity of Rape & Mustard in Assam (Kg/ha.)

X(Year)	ut(Yield)	t	t*ut	t2	Trend values
1998	470	-5	-2350	25	467
1999	443	-4	-1772	16	472
2000	504	-3	-1512	9	477
2001	493	-2	-986	4	483
2002	487	-1	-487	1	488
2003	513	0	0	0	493
2004	518	1	518	1	498
2005	447	2	894	4	504
2006	476	3	1428	9	509
2007	523	4	2092	16	514
2008	551	5	2755	25	520
Total	5425		580	110	

y=a+bt a=493.18 b=5.27

Estimated value of 2009 525

2010 530

Table - X
Area Under Summer Rice in Nagaon District (Hectare)

X(Year)	ut(Area)	t	t*ut	t2	Trend values
1997	28013	-5	-140065	25	39732
1998	41679	-4	-166716	16	41960
1999	37363	-3	-112089	9	44187
2000	55989	-2	-111978	4	46415
2001	57920	-1	-57920	1	48643
2002	59833	0	0	0	50870
2003	57686	1	57686	1	53098
2004	58736	2	117472	4	55325
2005	51349	3	154047	9	57553
2006	50412	4	201648	16	59781
2007	60591	5	302955	25	62008
Total	559571		245040	110	

y=a+bt a=50870 b=2228

Estimated value of 2008 64236

2009 66464

Table – XI

Production of Summer Rice in Nagaon District (Tonne)

X(Year)	ut(Production)	t	t*ut	t2	Trend values
1997	65503	-5	-327515	25	92062
1998	100330	-4	-401320	16	96716
1999	75076	-3	-225228	9	101371
2000	127630	-2	-255260	4	106025
2001	138272	-1	-138272	1	110680
2002	133630	0	0	0	115335
2003	134087	1	134087	1	119989
2004	137376	2	274752	4	124644
2005	110709	3	332127	9	129298
2006	111703	4	446812	16	133953
2007	134364	5	671820	25	138607
Total	1268680		512003	110	

y=a+bt a=115335 b=4655

Estimated value of 2008 143262

2009 147917

Table – XII

Productivity of Summer Rice in Nagaon District (Kg/ha.)

X(Year)	ut(Yield)	t	t*ut	t2	Trend values
1997	2338	-5	-11690	25	2280
1998	2407	-4	-9628	16	2270
1999	1969	-3	-5907	9	2261
2000	2234	-2	-4468	4	2251
2001	2341	-1	-2341	1	2242
2002	2190	0	0	0	2232
2003	2279	1	2279	1	2223
2004	2293	2	4586	4	2213
2005	2114	3	6342	9	2204
2006	2172	4	8688	16	2194
2007	2218	5	11090	25	2185
Total	24555		-1049	110	

y=a+bt a=2232 b=-10

Estimated value of 2008 2175

2009 2166

Table – XIII
Area Under Pulses in Nagaon District (Hectare)

X(Year)	ut(Area)	t	t*ut	t2	Trend values
1996	12674	-5	-63370	25	13555
1997	12447	-4	-49788	16	13218
1998	15106	-3	-45318	9	12880
1999	13264	-2	-26528	4	12542
2000	11611	-1	-11611	1	12205
2001	11691	0	0	0	11867
2002	11482	1	11482	1	11529
2003	9237	2	18474	4	11192
2004	10967	3	32901	9	10854
2005	13673	4	54692	16	10516
2006	8385	5	41925	25	10179
Total	130537		-37141	110	

y=a+bt a=11867 b=-338

Estimated value of 2007 9841

2008 9503

Table – XIV
Production of Pulses in Nagaon District (Tonne)

X(Year)	ut(Production)	t	t*ut	t2	Trend values
1996	5816	-5	-29080	25	6292
1997	5865	-4	-23460	16	6080
1998	7244	-3	-21732	9	5868
1999	5433	-2	-10866	4	5656
2000	4915	-1	-4915	1	5444
2001	5641	0	0	0	5232
2002	4899	1	4899	1	5020
2003	3940	2	7880	4	4808
2004	4618	3	13854	9	4597
2005	5808	4	23232	16	4385
2006	3376	5	16880	25	4173
Total	57555		-23308	110	

y=a+bt a=5232 b=-212

Estimated value of 2007 3961

2008 3749

Table – XV
Productivity of Pulses in Nagaon District (Kg/ha.)

X(Year)	ut(Yield)	t	t*ut	t2	Trend values
1996	459	-5	-2295	25	465
1997	471	-4	-1884	16	458
1998	480	-3	-1440	9	452
1999	401	-2	-802	4	445
2000	415	-1	-415	1	439
2001	473	0	0	0	433
2002	418	1	418	1	426
2003	418	2	836	4	420
2004	413	3	1239	9	413
2005	416	4	1664	16	407
2006	395	5	1975	25	401
Total	4759		-704	110	

y=a+bt a= 432.62 b=-6.42

Estimated value of 2007 394

2008 388

Table – XVI
Area Under Rape & Mustard in Nagaon District (Hectare)

X(Year)	ut(Area)	t	t*ut	t2	Trend values
1997	22838	-5	-114190	25	28411
1998	26229	-4	-104916	16	27546
1999	26406	-3	-79218	9	26681
2000	26327	-2	-52654	4	25816
2001	28758	-1	-28758	1	24951
2002	28808	0	0	0	24086
2003	27873	1	27873	1	23221
2004	27057	2	54114	4	22357
2005	16172	3	48516	9	21492
2006	18315	4	73260	16	20627
2007	16167	5	80835	25	19762
Total	264950		-95138	110	

y=a+bt a= 24086 b=-865

Estimated value of 2008 18897

2009 18032

Table – XVII
Production of Rape & Mustard in Nagaon District (Tonne)

X(Year)	ut(Production)	t	t*ut	t2	Trend values
1997	14837	-5	-74185	25	14862
1998	13525	-4	-54100	16	14369
1999	12278	-3	-36834	9	13876
2000	13951	-2	-27902	4	13383
2001	13287	-1	-13287	1	12891
2002	13774	0	0	0	12398
2003	14263	1	14263	1	11905
2004	12349	2	24698	4	11413
2005	8722	3	26166	9	10920
2006	9980	4	39920	16	10427
2007	9412	5	47060	25	9934
Total	136378		-54201	110	

a=

y=a+bt 12398 b=-493

Estimated value of 2008 9442

2009 8949

Table – XVIII
Productivity of Rape & Mustard in Nagaon District (Kg./ha)

X(Year)	ut(Yield)	t	t*ut	t2	Trend values
1997	650	-5	-3250	25	521
1998	516	-4	-2064	16	519
1999	456	-3	-1368	9	518
2000	519	-2	-1038	4	517
2001	453	-1	-453	1	515
2002	469	0	0	0	514
2003	501	1	501	1	513
2004	447	2	894	4	512
2005	529	3	1587	9	510
2006	534	4	2136	16	509
2007	582	5	2910	25	508
Total	5656		-145	110	

a=

y=a+bt 514.15 b=-1.32

Estimated value of 2008 506

2009 505

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Strength, Weakness Opportunity and Threat of/to Assam Agriculture:

The strategies for agricultural development in Assam adopted by the State government essentially rests with the SWOT (Strength, Weakness Opportunity and Threat) analysis and therefore due weightage to different thrust areas are given on the basis of the above

analysis. The sources of strength, support and succor that the state has include 25 number of plain districts and 2 hill districts as high potential zone for raising agricultural productivity, installation of shallow tube wells (STW) numbering 2 lakhs with the assistance of World Bank Project and NABARD for assured irrigation facility in the State for rapid crop diversification and increasing trend of use of high yielding variety of summer rice due to this. All these are corroborated by the technical support through the Assam Agricultural University for different agro-climatic situations in the State. The weaknesses that have constantly kept the state behind the national race is the depressing factors like low rate of fertilizer consumption due to pro-long monsoon, lack of adequate certified seeds resulting low SRR, low level of farm mechanisation that affect timely sowing, non-availability of specific variety under summer rice that have good market demand and lack of suitable technology of rice based cropping system to raise another profitable crop like pulses and oilseeds. The opportunities that await to be exploited for a strategic agricultural growth and development include vast mono-crop area with rich ground water and surface water potential in high rainfall region for raising a second crop (Rabi) by installing shorter gestation period irrigation projects, introduction of short duration rice crops to raise rice twice before and after the flash floods; a perennial problem in the state and introduction of suitable variety of rain fed upland rice for rice based cropping system to raise profitable crop like pulses and oilseeds as second crop. The threats that are and may impede the agricultural growth in the state are land degradation

due to heavy deposition of sand caused by flood and non-remunerative trend of rice cultivation.