Baseline Surver Report of Pirojpur, Gopalganj and Bagerhat Districts

Integrated Agricultural Development Project In Pirojpur-Gopalganj-Bagerhat

ON FARM RESEARCH DIVISION

Bangladesh Agricultural Research Institute

Joydebpur, Gazipur

Establishment of Agriculture Research Station at Gopalgong District for Developing Eco-friendly Agriculture in South-western Part through Strengthening of Research: A Baseline Survey

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LIST OF ABBREVIATION

AB	:	Agricultural Block
AEZ	:	Agro Ecological Zone
BARI	:	Bangladesh Agricultural Research Institute
BBS	:	Bangladesh Burau of Statistics
BCR	:	Benefit Cost Ratio
BINA	:	Bangladesh Institute of Nuclear Agriculture
BRRI	:	Bangladesh Rice Research Institute
DAE	:	Department of Agriculture Extension
DAP	:	Di Amonium Phosphate
FRG	:	Fertilizer Recommendation Guide
FRS	:	Fertilizer Recommendation System
GDP	:	Gross Domestic Production
GoB	:	Government of Bangladesh
ha	:	Hectare
HH	:	Household
HSC	:	Higher Scondary Certificate
HYV	:	High Yielding Variety
MoP	:	Muriate of Potash
MT	:	Metric Ton
NGO	:	Non-Governmental Organization
NPK	:	Nitrogen, Phospate and Potash
OFRD	:	On-Farm Research Division
PI	:	Principal Investigator
PT	:	Power Tiller
SAAO	:	Sub-Assistant Agriculture Officer
SPSS	:	Statistical Package for Social Scientists
SSC	:	Secondary School Certificate
STW	:	Shallow Tube Well
Tk.	:	Bangladeshi Currency Taka
TSP	:	Triple Supper Phosphate

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Executive Summary

Pirojpur, Gopalgonj, Bagherhat, Khulna and Satkhira districts are situated in the southern part of the country. Visible development in agriculture has not been occurred in this region due to adverse ecosystems and climate change hazards. Most farmers are suffering from various socio-economic constraints that affect negative impact on overall agricultural production. However, there is potential in this region for increasing production, productivity sustainability through efficient utilization of natural resources and adoption of BARI developed improved technologies related to fruits, vegetables, pulses, oilseeds and postharvest handling. These technologies should be disseminated among interested farmers for increasing crop productivity, farmer's income, and improving their livelihoods. BARI is launching a project titled *Establishment of agriculture research station at Gopalgong district for developing eco-friendly agriculture in south-western part through strengthening of research*. Without a baseline, it's not possible to know the future impact of the project. This baseline study generates some baseline indicators such as respondents' socioeconomic characteristics, cropping patterns, crop variety, profitability and constraints of crop production, and opportunities for future development.

The study used 750 (5 districts × 3 Upazilas × 2 Agricultural Blocks × 25 samples) samples collected from purposively selected five districts namely Bagherhat, Gopalgonj, Khulna, Pirojpur, and Satkhira. Data were collected using a pre-tested interview schedule during October to December in 2019. Proportionate stratified random sampling technique was used in selecting farm households different farm categories of farmers. In most cases descriptive statistics were used to analyse the data.

The primary occupation of the farmers were crop farming having average farm size of 198 decimal and 23 years of experience followed by business as the secondary occupation. Agriculture and service ranked respectively third and fourth as secondary occupation. More than half of the farmers had primary level education followed by 33% secondary and 9.0% degree and above level education. They could receive some agricultural related training (3.61No./person) from DAE, research institutes, and pesticides/seed companies. Some farmers owned modern agricultural machineries like STW (0.42 No./HH), PT (0.09 No./HH), thresher (0.11 No./HH), and weeder (0.17 No./HH) along with different traditional equipment. Their average annual income was Tk.1,91,865 of which the highest share come from crop production (45%) followed by livestock & poultry (14%), labour sell (10%), business (9%), service (8%), and fisheries (7%).

The cropping patterns practiced by the sample farmers were found different across the study areas. However, *Boro-Fallow-T.Aman* was the dominant cropping pattern practiced by the farmers of Bagherhat, Khulna and Satkhira districts. The second most important cropping pattern was *Fallow-Fallow-T.Aman.* Again, *Fallow-Fallow-T.Aman* was the major practiced cropping pattern in Pirojpur district, whereas *Boro-Fallow-Fallow* was the major pattern found in Gopalgonj district. All the maize and wheat farmers and majority of the rice farmers used improved variety of seed. But still some respondent farmers are using local cultivars of rice. A lion share of the respondent pulses, oilseeds, sweet potato, vegetables and chili farmers used local variety of seed. Most of the banana, mango, guava, malta, litchi and dragon fruit farmers used improved variety of seed, but still a good percentage of farmers are

using local cultivars. Many traditional varieties of the minor fruits are being used by the majority of the farmers in the study areas.

The profitability analysis revealed that the cultivations of different crops at farm level were financially profitable having different scales. The highest profitable crops were tomato (BCR ranged from 2.83 to 3.46), brinjal (BCR: 2.35-2.37) and potato (BCR: 1.73-2.04), and the lowest profitable crops were cereal crops (i.e. *Aus, Aman* & wheat) having BCRs ranged from 1.07 to 1.25. The economic performances of cultivating aforesaid crops are more or less same when considered the net returns. However, the cultivation of jute (BCR: 1.27-1.69) and pulse crops (BCR: 1.22-1.51) were in the middle group.

Respondent farmers encountered different abiotic stresses like salinity (29%), drought (40%), flooding (25%) and heavy rainfall (32%) in the last five years. They took several actions against unfavorable climate. About 15% farmers used Gypsum fertilizer against salinity, 35% provided supplement irrigation against drought, and 16% drained flood water. However, during these stress situations many farmers received advice (74%), production inputs (42%), training (57%), Government subsidies (8%), demonstration facility (31%), and loan (6%) from DAE, research institutes, NGOs and financial institutions.

Respondent farmers also faced various problems relating to crop production, processing and marketing having different magnitudes. Production related problems in the study areas were lack of improved seed (65%), scarcity of human labour (61%), lack of irrigation facility (36%), untimely rainfall (36%), lack of agricultural machinery (32%), drought (27%), adulteration of seed (23%) and pesticides (11%), and lack of technical know-how (17%). Major marketing problems were lack of fair price (71%), low price due to traders' syndicate (24%), lack of cold storage (26%), and higher price of fertilizer (17%).

Chapter I

INTRODUCTION

1.1 Background

Bangladesh is predominantly an agricultural country where agriculture sector plays a vital role in overall economic development of Bangladesh. This sector contributes a lot to the country's GDP (15%), provides employment for about 41% of the labour force and supplies raw materials to the agro-based industries (BBS, 2018). It is, therefore, important to have a profitable, sustainable and environment-friendly agricultural system in order to ensure long-term food security for people. Agriculture sector has been given the highest priority for making Bangladesh self-sufficient in food. The Government determined to develop this sector keeping in view of the goals set out in the 7th Five Year Plan and National Agriculture Policy.

Pirojpur, Gopalgonj, Bagherhat, Khulna and Satkhira districts are situated in the southern part of the country. Visible development in agriculture has not been occurred in this region due to diverse agro-ecological situation. Most farmers in this region are suffering from various socio-economic constraints that affect negative impact on overall agricultural production. Again, this region is prone to different climate change hazards and the intensity of the hazards are much higher compared to other regions of Bangladesh. Several adverse ecosystems also affect the cultivation of different crops. As a result the cropping intensity in this region is much lower than the other region like Bogura, Dinajpur and Jashore (Mustafizur et al., 2017). Diversified cropping pattern may be an option for the farmers as a coping strategy against risks (Mandal and Bezbaruah, 2013). Despite significant improvements in rural development in many areas, challenges remain to be addressed in this region with increasing population, climate change, salinity intrusion, aging polders, tidal submergence, continued erratic and unpredictable monsoon and surges and longer draughts.

There is significant potential in this region for increasing production, productivity sustainability through more efficient utilization of surface water and adoption of improved variety of crops specifically adapted to southern agro-ecological zones. The Ministry of Agriculture's Southern Master Plan targets the opportunities and challenges for increasing food production in the region and the necessary investments to fulfill the agriculture potential of the area. Bangladesh Agricultural Research Institute (BARI) has developed a good number of different commodity and non-commodity technologies related to fruits, vegetables, pulses, oilseeds and postharvest handling. The access of these improved technologies is very much limited to most of the farmers of this region. These technologies should be disseminated among interested farmers in order to increase crop productivity, farmer's income, and improve their livelihoods. Realizing the importance of overall development of the region, BARI is launching a project titled *Establishment of agriculture research station at Gopalgong district for developing eco-friendly agriculture in south-western part through strengthening of research*. Without a baseline, it's not possible to know the impact of the project. Besides, future development strategy will be come out from this baseline information of the areas.

A baseline survey is a study that is done at the beginning of a project to get knowledge of the current status of an item of study before a project commences important for they are the starting point for a project. It is done to act as a benchmark for measuring project success or failure. Without a baseline, it's not possible to know the impact of a project. That's why, a baseline survey was carried out to understand existing crop, variety, cropping pattern, input use, cost of production, socio-economic and agro-climatic situation, problems and potentials affecting the present farming systems. The results of baseline survey help to develop appropriate research program for increasing farm productivity and to develop sustainable land use, which will optimize farm resources, minimum degradation with consideration to regenerative capacity, increase income and employment for farm families and promote quality of life. However, the specific objectives of the study are as follows.

1.2 Objectives

1. To know the socioeconomic characteristics of the respondent farmers;
2. To find out the present cropping patterns and crop variety used by the farmers;
3. To estimate the cost and benefit of different crop production in the study areas; and
4. To explore the constraints and opportunities related to crop production and socioeconomic aspects of the respondent farmers.

1.3 Organization of the Report

The report contains a total of seven chapters, which have been organized in the following sequence. *Chapter I* introduces the contribution of the agriculture sector in the overall development of Bangladesh. The significance and purpose of the study are also outlined in this chapter. Methodological aspects of the study are discussed in *Chapter II* in accordance with objectives of the study. *Chapter III* describes the socioeconomic profile of the respondent farmers. Detailed cropping patterns and crop variety used in the study areas are discussed in *Chapter IV*. The cost and benefit of different crop production are discussed in detailed in *Chapter V.* Problems and constraints of crop production are delineated in *Chapter VI*. Finally, *Chapter VII* presents conclusions and recommendations regarding the purpose of the study.

Chapter II

METHODOLOGY

2.1 Introduction

The reliability of a socioeconomic research mostly depends on its proper methodology. Therefore, it should be chosen carefully to fulfill the purpose of the study. An attempt has been made in this section to present a clear idea about the selection of study areas, selection of samples and sample size, sources and the coverage of data used for the study and also deals with the analytical techniques for the study. The present research is based on both the primary and secondary data. Secondary data were collected from various secondary sources and primary data were collected from the respondents through personal interviews.

2.2 Study Design

A simple study design is shown in the following flow chart (Figure 3.1). At first a concept note was prepared based on preliminary consultation with the team leader, which was refined later based on further consultation. A draft proposal was then prepared and finalized after couple of interactions among research team members. Accordingly, survey instrument was prepared and pre-tested with interviewing five respondents. Then data were collected through administering field survey. After collection of data, it was edited, coded, categorized, and analyzed in connection with the specific study objectives. A draft report is prepared and submitted to the concerned authority, after having overall feedback, the final baseline report is submitted.

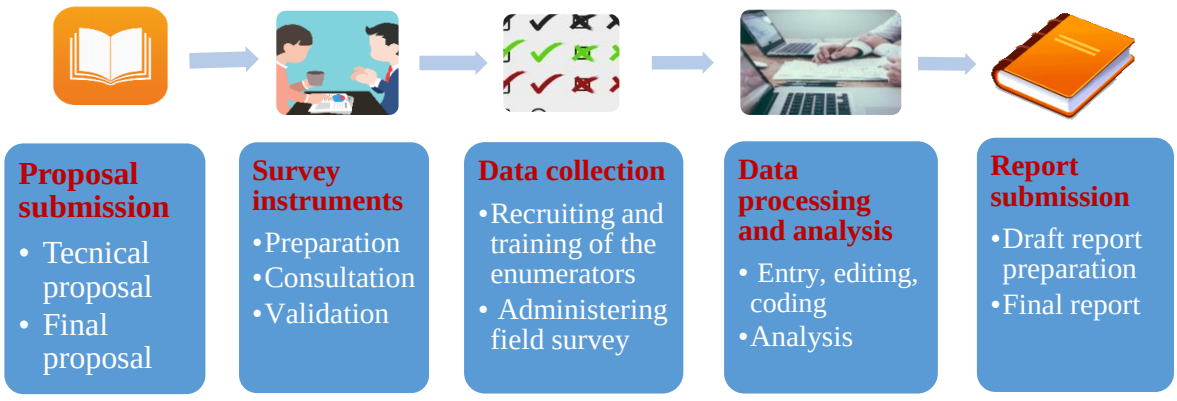

Figure 2.1 Flow diagram of the study design

2.3 Selection of the Study Area

The overall activities of the project are being launched in the five districts namely Bagherhat, Gopalgonj, Khulna, Pirojpur, and Satkhira (Figure 2.2). Baseline information of these areas are needed for the scientists of other disciplines (i.e. Agronomy, Soil Science, OFRD) for successful implementation of the project, and to evaluate the project output at the end of the project. Therefore, the socio-economic team selected the above mentioned districts purposively for the present study. However, the study areas were fifteen *Upazilas* (three from

each district) purposively selected from aforesaid five districts. Again, two agricultural blocks (AB) from each selected *Upazila* were purposively selected through consultation with Agriculture Officer of the respective *Upazila*. Thus the total number of AB's was 30. The population of this study are those farm-households who engaged with crop farming.

Selected districts are the major rice along-with other agriculture crops growing areas. The major growing crops in these areas are rice, maize, jute, khesari, lentil, mungbean, mustard, sesame, groundnut, chili, brinjal, potato, tomato, okra, leafy vegetables etc. In fact, in these areas, new cropping patterns are emerged, changes in phenology of existing crops, market demand, national and family needs. Hence, documentation of existing crop farming add value for future interventions to change the direction.

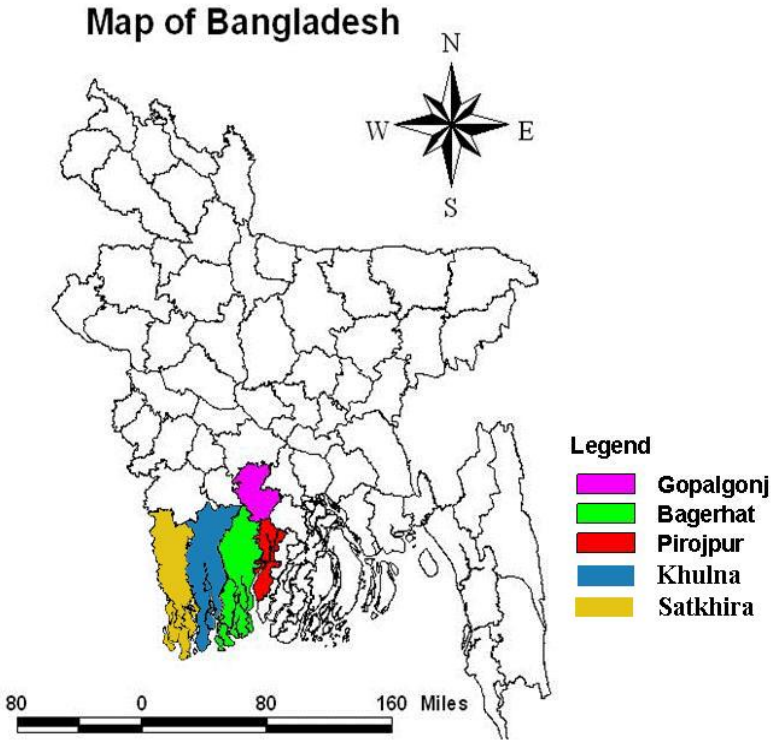

Figure 2.2 Map of Bangladesh showing study areas of the project

2.4 Determination of Sample Size and Sampling Procedure

It was assumed that the level of input use and farm practices differ from one farm category to another. So, these issues were taken into consideration during farm survey. However, before selecting sample respondents, a full list of farm-households by different farm sizes was prepared with the help of Upazilla Agriculture Officers in respective Upazila. At first, the listed farm-households were categorized according to their farm sizes. The farm size categories was defined as follows: (i) marginal farmers (less than 0.49 acres of land) (ii) Small farmers (0.50-2.49 acres) and (iii) medium and large farmers (2.50 and above 2.5 acres). These categories are based on the Department of Agricultural Extension (DAE) for farm size. In the second stage of sampling, a total of 25 farmers (approx. 10% of each AB) from each of the selected AB were propotionately selected for interview. The selection was

done to select sample farmers from different farm categories. Thus, the total sample was 150 in each district. The total sample size was 750 (5 districts × 3 Upazilas × 2 AB × 25 samples). In selecting the farms from different farm categories proportionate stratified random sampling was used. Following Table 3.1 shows the sample distribution across district and farm category.

Table 2.1 Distribution of the samples across district and farm category

Farm category	Bagherhat	Gopalgonj	Khulna	Pirojpur	Satkhira	All area
Marginal	14	36	11	14	27	102
Small	91	82	100	85	98	456
Medium & large	45	32	39	51	25	192
All category	150	150	150	150	150	750

2.5 Methods of Data Collection

To collect required data, interview schedule was prepared in accordance with the objectives set for the study. In connection to the objectives, a semi-structured interview schedule was prepared and then pre-tested in the field before final data collection. Necessary correction and modification were made based on the responses received from the respondent farmers. Before going to data collection, general techniques and ethics of data collection and objectives of the study were thoroughly described to the enumerators. Attempts were made to ensure a uniform pattern in administering the survey. The training plan would put more emphasis on skill training on the real situation rather than classroom training. The following training strategy was maintained:

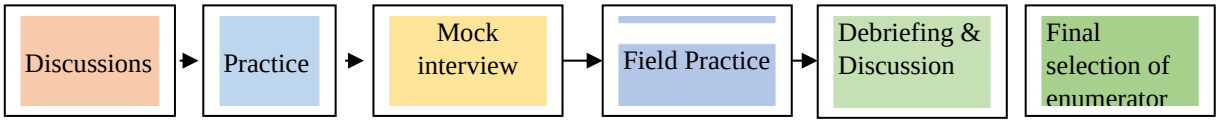

Fig 2.2 Interviewing farmers in Bagherhat district

Figure 2.4 Interviewing farmers in Khulna district

Data were collected by the trained enumerators of the Agricultural Economics Division of BARI from 750 farmers through face to face interview under direct supervision of the Principal Investigator (PI) of the project (Figures 2.3 and 2.4). It was supposed to collect 750 samples across regions, but researcher collected additional ten samples due to possibility of out-layer samples. The enumerator stayed in the field to have better access to the sample

farmers. In most cases PI visited with the enumerators and stay together for providing instant clarification. Data were collected during October to December in 2019.

2.6 Data Processing and Analysis

Despite close supervision in data collection, some errors obviously found in the filled-in interview schedules in various forms such as inaccuracy, incompleteness, inconsistencies, local unit etc. Each schedule, therefore, was edited and coded before final entry into the computer. Computer operators were trained and supplied data entry format for data entry into the computer. Research team cleaned the data set. In case of any inconsistency, re-checked the filled in schedules and sometimes talked to the farmers over mobile phone for clarification.

Data were analyzed by using SPSS software. Descriptive statistics were used to generate statistical measures such as averages, percentages, ratio, frequency, etc. The following techniques were adopted to calculate cost and return of crop production.

Fixed cost (FC): A resource or input is called a fixed resource if its quantity is not varied during the producing period and thereby, costs of fixed inputs are called fixed costs. Fixed costs included the cost of family labour, interest on loan, interest on the value of machinery, depreciation on building, lease value of land, and depreciation on tools & equipment. In this study, only the lease value of land was considered as fixed cost.

Variable cost (VC): A resource is a variable resource if its quantity is varied at the start of or during the production period. Variable costs in crop farming included the cost of hired labour, land preparation, seed, manures & fertilizers, irrigation, pesticides, and interest on operating capital.

Interest on operating capital (IOC): IOC is computed by taking all variable costs incur for various operations throughout the year in crop farming. In this report, interest rate was assumed to be 6% (interest rate of saving accounts of commercial banks). Since farmers spend costs for different inputs in a certain period of time or throughout the year for producing outputs, to get an average figure of cost associated with invest, the interest rate has been divided by 2. The following formula is generally used for calculating IOC:

$$\text{Interest on Operating Capital} = \frac{\text{Total operating capital} \times \text{Interest rate} \times \text{Period of time}}{2}$$

*Gross return (GR)***:** The monetary value of total outputs plus total value of by-products plus total value of other unused farm materials is considered as annual gross returns for an enterprise. The following equation was used for calculating GR.

GR = Output×product price+value of by-products+other values of farm materials

Gross Margin (GM) = Gross return (GR) – Total variable cost (TVC)

Net return = Gross return (GR) – Total cost (TVC+TFC)

Benefit Cost Ratio (BCR): This refers to the ratio of gross/total return to the gross/total cost. It indicated the amount of taka a farmer receives for every taka he spent. The following equation was used for calculating BCR.

$$BCR = \frac{Total\ Income or\ Gross\ return}{Total\ Cost\ or\ Gross\ Cost}$$

If BCR>1, the crop production is profitable; BCR<1 the crop production is not profitable; BCR=1 indifferent about specific crop production

Farm size: (Own cultivable land + Homestead + Pond + Fruit orchard + Fallow land + Shared in land+ Mortgaged in land+ Leased in land)-(Shared out land+ Mortgaged out land+ Leased out land)

Chapter III

SOCIODEMOGRAPHIC PROFILE AND HOUSEHOLD ECONOMICS

3.1 Introduction

This section describes the socioeconomic characteristics of respondent farmers by farm category and district. It is very essential to know the socioeconomic features of respondent farmers because it influences farmer's decision making ability to produce crops under various stress situations and different kinds of management. Variables such as family size, education, occupational status, ownership pattern of land, household assets, and annual household income of sample farm households have been taken into consideration for the present study. The following sections of this chapter discuss socio-demographic and household economics of sample farmers.

3.2 Age Distribution of Bagherhat District

Age of farmers plays an important role in the crop production and better management of the farming activities. The age of the respondent was examined by classifying the farmers into six groups: 18-30, 31-40, 41-50, 51-60, 61-70 and 71-80 years (Table 3.1). The highest percent of famers (24.7%) was under the age group 31-40 years followed by 51-60, 18-30 and 41-50 years. The lowest percent of farmers were under the age group of 71-80 years. Most of the large and medium category farmers belonged to the age group 51-60 and 18-30 years.

Table 3.1 Age of the respondent farmers of Bagherhat district

Age group (year)	% of farmer's responses			
	Large & medium	Small	Marginal	All category
	n=45	*n=91*	*n=14*	*n=150*
18-30	22.2	18.7	28.6	20.7
31-40	17.8	29.7	14.3	24.7
41-50	11.1	14.3	35.7	15.3
51-60	24.4	25.3	7.1	23.3
61-70	15.6	11.0	14.3	12.7
71-80	8.9	1.1	--	3.3

3.3 Age Distribution of Gopalgonj District

The highest percent of famers (23.3%) was under the age group 41-50 years followed by 18-30, 51-60 and 31-40 years. The lowest percent of farmers were under the age group of 71-80 years. Most of the large & medium category farmers belonged to the age group 41-50 and 31-40 years. Again, majority of the small and marginal farmers belonged to the age group 18-30 (Table 3.2).

Table 3.2 Age of the respondent farmers of Gopalgonj district

Age group (year)	% of farmer's responses			
	Large & medium	Small	Marginal	All category
	n=32	*n=82*	*n=36*	*n=150*
18-30	6.3	23.2	36.1	22.7
31-40	31.3	13.4	22.2	19.3
41-50	25.0	23.2	22.2	23.3
51-60	18.8	22.0	16.7	20.0
61-70	9.4	12.2	2.8	9.3
71-80	9.4	6.1	--	5.3

3.4 Age Distribution of Khulna District

The highest percent of famers (29.3%) was under the age group 31-40 years followed by 41-50, 51-60 and 61-70 years. The lowest percent of farmers were under the age group of 71-80 years. In farm categories, the highest percent of large & medium famers (35.9%) was under the age group 31-40 years followed by 51-60 years. Again, the highest percent of small (34.0%) and marginal famers (36.4%) were under the age group of 41-50 and 31-40 years respectively (Table 3.3).

Table 3.3 Age of the respondent farmers of Khulna district

Age group (year)	% of farmer's responses			
	Large & medium	Small	Marginal	All category
	n=39	*n=100*	*n=11*	*n=150*
18-30	7.7	6.0	9.1	6.7
31-40	35.9	26.0	36.4	29.3
41-50	15.4	34.0	27.3	28.7
51-60	23.1	25.0	27.3	24.7
61-70	15.4	5.0	--	7.3
71-80	2.6	4.0	--	3.3

3.5 Age Distribution of Pirojpur District

The highest percent of famers (27.3%) was under the age group of 41-50 years followed by 51-60, 31-40 and 18-30 years. The lowest percent of farmers were under the age group of 71-80 years (Table 3.4). In farm categories, the highest percent of large & medium famers (33.3%) was under the age group 41-50 years followed by 51-60 years. Again, the highest percent of small farmers (25.9%) were under the age group of 41-50 and 51-60 years. But these age groups were 18-30 and 31-40 for marginal farmer.

Table 3.4 Age of the respondent farmers of Pirojpur district

Age group (year)	% of farmer's responses			
	Large & medium	Small	Marginal	All category
	n=51	*n=85*	*n=14*	*n=150*
18-30	7.8	18.8	28.6	16.0
31-40	15.7	20.0	28.6	19.3
41-50	33.3	25.9	14.3	27.3
51-60	27.5	25.9	7.1	24.7
61-70	9.8	4.7	21.4	8.0
71-80	5.9	4.7	--	4.7

3.6 Age Distribution of Satkhira district

The highest percent of famers (28.7%) was under the age group 41-50 years followed by 31-40, 51-60 and 18-30 years. The lowest percent of farmers were under the age group of 71-80 years. Most of the large & medium category farmers belonged to the age group 41-50 and 31-40 years. Again, majority of the small and marginal farmers belonged to the age group 41-50 and 31-40 years respectively (Table 3.5).

Table 3.5 Age of the respondent farmers of Satkhira district

Age group (year)	% of farmer's responses			
	Large & medium	Small	Marginal	All category
	n=25	*n=98*	*n=27*	*n=150*
18-30	4.0	10.2	25.9	12.0
31-40	28.0	23.5	29.6	25.3
41-50	32.0	30.6	18.5	28.7
51-60	28.0	24.5	14.8	23.3
61-70	8.0	10.2	11.1	10.0
71-80	--	1.0	--	0.7

3.7 Overall Age Distribution in the Study Areas

The highest percent of famers (25%) was under the age group 41-50 years followed by 31-40, 51-60 and 51-60 years. The lowest percent of farmers were under the age group of 71-80 years (Figure 3.1).

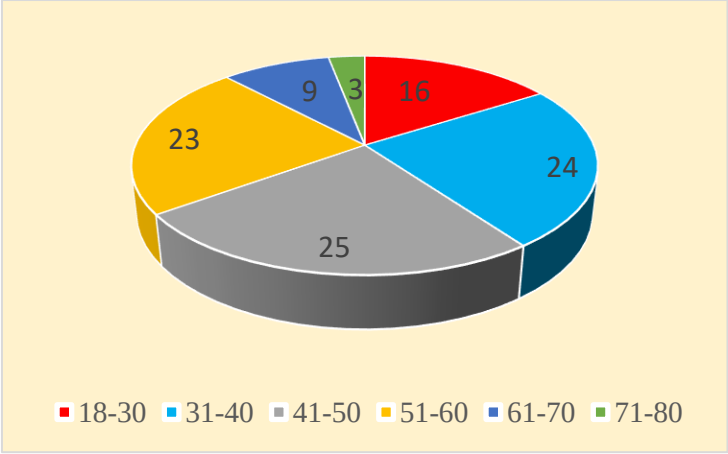

Figure 3.1 Percent distribution of overall age of the farmers

3.8 Educational Status of Bagherhat District

Farmer's education is expected to increasing farming output. Both formal and informal education can influenced farming activities. Adoption of new technology and efficiently use of farm resources to make maximum profit there is no alternative of farmers education. On the basis of education level, the literacy status of the respondent farmers has been grouped into five categories. The categories were (1) Illiterate, (2) Primary, (3) Secondary, (4) Higher secondary, and (5) Degree & above. Information on the educational levels of the respondents is presented in Table 3.6. It was observed that 5.3% did not have any formal education, whereas the same percent of farmers have degree and above level education. The highest 46.7% farmers have primary level education followed by 34.7% have secondary level, and 8% have higher secondary level. Among farmers' category that the highest level of education was reported to be primary level for small and marginal farmers and secondary level for large and medium category farmers.

Table 3.6 Literacy level of the respondent farmers of Bagherhat district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Literacy level	*n=45*	*n=91*	*n=14*	*n=150*
Illiterate	8.9	4.4	--	5.3
Primary	33.3	50.5	64.3	46.7
Secondary	40.0	35.2	14.3	34.7
Higher Secondary	4.4	8.8	14.3	8.0
Degree & above	13.3	1.1	7.1	5.3

3.9 Educational Status of Gopalgonj District

Information on the educational levels of the respondents is presented in Table 3.7. It was observed that 9.3% did not have any formal education. The highest 53.3% farmers have primary level education followed by 28.0% have secondary level, 5.3% have higher secondary level, and 4% have degree and above level education (Table 3.7). Again, the highest level of education was reported to be primary level for all categories of farmers in the study areas followed by secondary level.

Table 3.7 Literacy level of the respondent farmers of Gopalgonj district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Literacy level	*n=32*	*n=82*	*n=36*	*n=150*
Illiterate	6.3	9.8	11.1	9.3
Primary	46.9	51.2	63.9	53.3
Secondary	31.3	30.5	19.4	28.0
Higher Secondary	9.4	4.9	2.8	5.3
Degree & above	6.3	3.7	2.8	4.0

3.10 Educational Status of Khulna District

Table 3.8 shows the educational levels of the respondent farmers of Khulna district. It was observed that 1.3% did not have any formal education. The highest 55.3% farmers have primary level education followed by 30.7% have secondary level, 3.3% have higher secondary level, and 9.3% have degree and above level education. Again, the highest level of

education was reported to be primary level for all categories of farmers in the study areas followed by secondary level.

Table 3.8 Literacy level of the respondent farmers of Khulna district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Literacy level	*n=39*	*n=100*	*n=11*	*n=150*
Illiterate	--	2.0	--	1.3
Primary	53.8	56.0	54.5	55.3
Secondary	33.3	33.0	--	30.7
Higher Secondary	2.6	3.0	9.1	3.3
Degree & above	10.3	6.0	36.4	9.3

3.11 Educational Status of Pirojpur District

Information on literacy levels of the respondent farmers of Pirojpur district has been presented in Table 3.9. It was reported that 4% farmers did not have any formal education. The highest 52.7% farmers have primary level education followed by 34.7% have secondary level, 6.7% have higher secondary level, and 2% have degree and above level education. Like other study areas, primary level education was the highest level of education for all categories of farmers in the study areas followed by secondary level of education.

Table 3.9 Literacy level of the respondent farmers of Pirojpur district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Literacy level	*n=51*	*n=85*	*n=14*	*n=150*
Illiterate	3.9	4.7	0.0	4.0
Primary	45.1	52.9	78.6	52.7
Secondary	41.2	32.9	21.4	34.7
Higher Secondary	5.9	8.2	--	6.7
Degree & above	3.9	1.2	--	2.0

3.12 Educational Status of Satkhira District

Data shown in Table 3.10 represent the educational levels of farmers in Satkhira district. It was observed that 7.3% did not have any formal education. The highest 47.3% farmers have primary level education followed by 34% have secondary level, 6.0% have higher secondary level, and 5.3% have degree and above level education. Like other study areas, primary level education was the highest level of education for all categories of farmers in the study areas followed by secondary level of education.

Table 3.10 Literacy level of the respondent farmers of Satkhira district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Literacy level	*n=25*	*n=98*	*n=27*	*n=150*
Illiterate	4.0	8.2	7.4	7.3
Primary	48.0	45.9	51.9	47.3
Secondary	32.0	36.7	25.9	34.0
Higher Secondary	8.0	3.1	14.8	6.0
Degree & above	8.0	6.1	--	5.3

3.13 Overall Educational Status of the Respondent Farmers

Figure 3.2 represent the overall educational levels of the respondent farmers in the study areas. It was observed that on an average about 5% farmers did not have any formal education. More than half of the respondent farmers have primary level education followed by 33% have secondary level and 9.0% have degree and above level education. Higher secondary level educated farmers is only 6%.

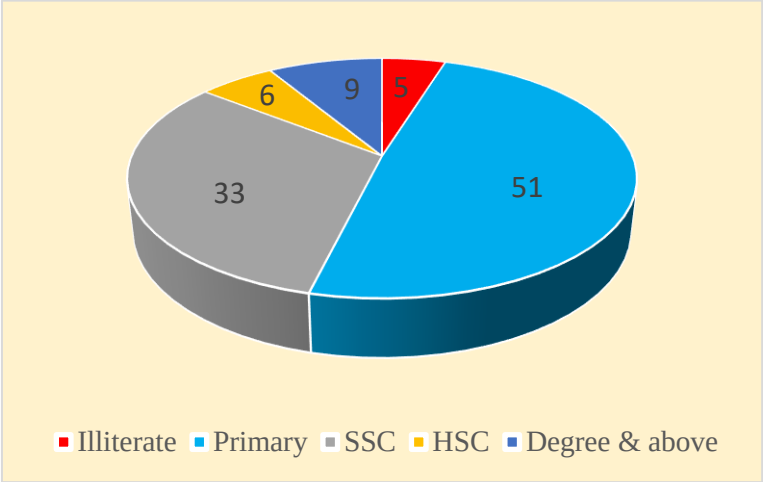

Figure 3.2 Percent distribution of overall educational level

3.14 Occupational Status of Bagherhat District

The occupation of the respondent farmers was classified into various categories. The work for which an individual is engaged throughout the year is known as their main occupation. As Bangladesh is an agro-based country, most of the people in the rural areas engage in agriculture as their main occupation. Respondent farmers were asked to report on their primary occupation and secondary occupation. Accordingly in this study, primary occupations were grouped into three major activities: agriculture, business, and other occupations (mix category), and the secondary occupation were classified into four categories such as agriculture, business, services, and other secondary occupations. Farm activities exclusively related to crop and livestock production.

Table 3.11 Occupation of the respondent farmers of Bagherhat district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Occupation type	*n=45*	*n=91*	*n=14*	*n=150*
A. Primary				
Agriculture	95.6	90.1	92.9	92.0
Business	--	1.1	7.1	1.3
Other	4.4	8.8	--	6.7
B. Secondary				
Agriculture	11.1	12.1	14.3	12.0
Business	11.1	7.7	14.3	9.3
Service	--	4.4	--	2.7
Other	8.9	17.6	14.3	14.7

Table 3.11 presents the occupational status of the respondent farmers in Bagherhat district. On an average, about 92% of the sample farmers were solely engaged in agriculture followed by other occupations (6.7%). Only 1.3% farmers reported that business was their primary occupation. In the case of secondary occupation, the highest 14.7% respondent farmers engaged in other occupations followed by agriculture (12%), business (9.3%) and service (2.7%).

3.15 Occupational Status of Gopalgonj District

Table 3.12 presents the occupational status of the respondent farmers of Bagherhat district. On an average, about 99.3% of the sample farmers were solely engaged in agriculture. Only 0.7% farmers reported that service was their primary occupation. Again, the highest 12.7% respondents engaged in business as secondary occupation. It was also found that 3.3% respondent farmers engaged in service and 19.3% farmers involved in other secondary occupations. Similar observations were observed among different farm categories.

Table 3.12 Occupation of the respondent farmers of Gopalgonj district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Occupation type	*n=32*	*n=82*	*n=36*	*n=150*
A. Primary				
Agriculture	96.9	100.0	100.0	99.3
Service	3.1	--	--	0.7
B. Secondary				
Business	12.5	14.6	8.3	12.7
Service	3.1	2.4	5.6	3.3
Other	15.6	15.9	30.6	19.3

3.16 Occupational Status of Khulna District

Table 3.13 presents the occupation status of the respondent farmers of Khulna district. About 94% of the sample farmers were solely engaged in agriculture as primary occupation followed by service (2.7%), business (2.0%), and other occupations (1.3%). In case of secondary occupation, the highest 32.7% respondent farmers engaged in business followed by agriculture (10.7%) and service (8.0%).

Table 3.13 Occupation of the respondent farmers of Khulna district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Occupation type	*n=39*	*n=100*	*n=11*	*n=150*
A. Primary				
Agriculture	89.7	95.0	100.0	94.0
Business	5.1	1.0	--	2.0
Service	5.1	2.0	--	2.7
Other	--	2.0	--	1.3
B. Secondary				
Agriculture	10.3	10.0	18.2	10.7
Business	41.0	29.0	27.3	32.0
Service	2.6	6.0	9.1	5.3
Other	--	10.0	18.2	8.0

3.17 Occupational Status of Pirojpur District

Table 3.14 reveals the occupational status of the respondent farmers of Pirojpur district. On an average, 98% of the sample farmers were solely engaged in agriculture as primary occupation followed by service (0.7%), business (0.7%), and other occupations (0.7%). Again, the highest 18.0% of the respondent farmers engaged in business as secondary occupation followed by agriculture (10.7%) and service (8.0%). Similar trend of observations were observed among different farm categories.

Table 3.14 Occupation of the respondent farmers of Pirojpur district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Occupation type	*n=51*	*n=85*	*n=14*	*n=150*
A. Primary				
Agriculture	100.0	96.5	100.0	98.0
Business	--	1.2	--	0.7
Service	--	1.2	--	0.7
Other	--	1.2	--	0.7
B. Secondary				
Agriculture	--	5.9	--	3.3
Business	15.7	17.6	28.6	18.0
Service	5.9	5.9	7.1	6.0
Other	9.8	20.0	7.1	15.3

3.18 Occupational Status of Satkhira District

Table 3.15 shows that the occupational status of the respondent farmers of Satkhira district. On an average, 95.3% of the farmers were solely engaged in agriculture as primary occupation followed by service (2.0%) and business (0.7%). Again, the highest 22.7% respondent farmers engaged in agriculture as secondary occupation followed by business (15.3%) and service (8.0%). Similar trend of observations were observed among different farm categories.

Table 3.15 Occupation of the respondent farmers of Satkhira district

	% of farmer's responses			
	Large & medium	Small	Marginal	All category
Occupation type	*n=25*	*n=98*	*n=27*	*n=150*
A. Primary				
Agriculture	96.0	93.9	100.0	95.3
Business	--	1.0	--	0.7
Service	--	3.1	--	2.0
Other	4.0	2.0	--	2.0
B. Secondary				
Agriculture	16.0	22.4	29.6	22.7
Business	20.0	14.3	14.8	15.3
Service	4.0	2.0	3.7	2.7
Other	--	18.4	37.0	18.7

3.19 Overall Occupational Status of the Farmers

The following figures (3.3 & 3.4) represent the overall occupational status of the respondent farmers in the study areas. Figure 3.3 clearly depicts that agriculture is the dominant primary occupation of the major respondent farmers in the study areas. On the other side, business is the major secondary occupation of the farmers followed by other occupations. Agriculture and service ranked third and fourth respectively as secondary occupation (Fig 3.4).

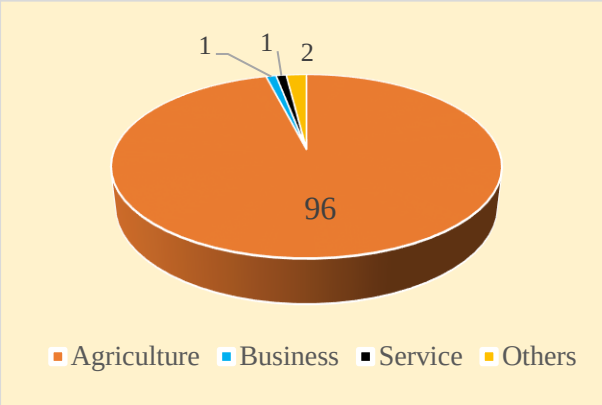

Fig 3.3 Percent distribution of primary occupation

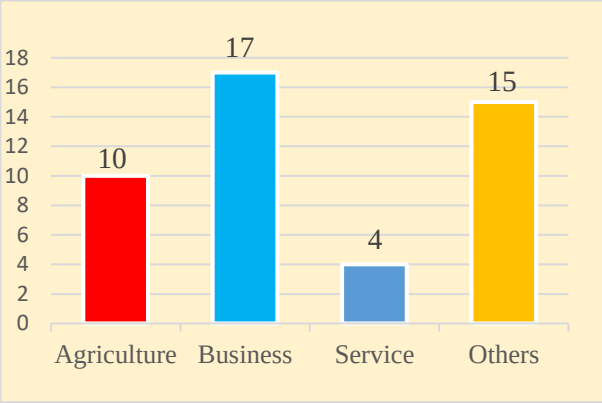

Fig 3.4 Percent distribution of secondary occupation

3.20 Farming Experience

To increase productivity of an individual farmer farming experience play a vital role. Experienced farmers are more efficient their farming operations than none experienced farmers. It has also positive role in the adoption of modern technologies in crop production (Ainembabazi and Mugisha, 2014). The average experience of farmers in farming is 23.1 years (Table 3.16). The farmers of Khulna district are more experienced (26.1 years) and that of Gopalgonj are less experienced (21.4 years). Large and medium category farmers are more experienced (25.16 years) compared to small (23.22 years) and marginal farmers (17.98 years).

Table 3.16 Length of farming experience of the respondent farmers

Study area	Farming experience (year)			
	Large & medium	Small	Marginal	All category
Bagherhat	27.8	22.1	14.5	23.1
Gopalgonj	20.9	23.4	17.4	21.4
Khulna	27.2	26.1	20.5	26.1
Pirojpur	23.9	20.3	19.4	21.5
Satkhira	26	24.2	18.1	23.4
All area	25.16	32.22	17.98	23.1

3.21 Training

Training is a process of acquisition of new skills, attitude and knowledge in the context of preparing for entry into a vocation or improving one's productivity in an organization or enterprise. The basic needs of farmers are detail crop wise information viz., improved seed, inter cultural operations, fertilizers, soil testing, irrigation, new implements, plant protection measures, and credit information (Babu and Singh, 1986). The respondent farmers received a number of trainings pertinent to crop production and crop protection from different

organizations. The average training received by farmers in farming is 3.61 per farmer. The farmers of Pirojpur district received more number of training (4.45/farmers) and that of Gopalgonj farmers are less received less training (2.98 Nos./farmer). In the case of farmer's category, large & medium category farmers received the highest number of training (3.96 Nos./farmer) followed by small farmers (3.48 Nos./farmer) and marginal farmers (3.4 Nos./farmer). Detailed training information is shown in Table 3.17.

Table 3.17 Number of agricultural training received by the respondent farmers

Study area	No. of training received			
	Large & medium	Small	Marginal	All category
Bagherhat	3.5	2.8	2.4	2.99
Gopalgonj	2.2	3.0	3.6	2.98
Khulna	3.2	3.4	2.6	3.27
Pirojpur	5.0	3.9	4.9	4.38
Satkhira	5.9	4.3	3.5	4.45
All	3.96	3.48	3.4	3.61

3.22 Source of Training

As shown in Table 3.18 most of the respondent farmers in the study areas received training from DAE (71.5%) followed by research institute (57.3%) and NGOs (20.9%). They also trained by some other organizations like pesticides or other companies and other local personnel. The highest 78.7% famers received training from DAE in Satkhira district followed by Khulna (72.0%), Bagherhat (71.3%), Pirojpur (70.7%) and the lowest in Gopalgonj district (64.5%). A good percentage of farmers received training from different research organizations. It was also reported that 44% farmers in Satkhira district got training from NGOs.

Table 3.18 Farmers received agricultural training from different organizations

Study area	% of farmer's responses				
	DAE	Research Institute	NGO	Company	Others
Bagherhat	71.3	50.0	6.0	--	0.7
Gopalgonj	64.7	58.0	10.0	2.7	1.3
Khulna	72.0	43.3	32.0	7.3	0.7
Pirojpur	70.7	59.3	12.7	0.7	--
Satkhira	78.7	76.0	44.0	1.3	1.3
All area	71.5	57.3	20.9	2.4	0.8

3.23 Farm Size of Bagherhat District

Farm size plays a critical role in agricultural sustainability. The relationship between farm size and productivity has long been discussed amongst productivity economists, yet no consensus has emerged from an empirical perspective. An inversed farm size–productivity relationship is widely observed in developing Asian countries (Bardhan, 1973; Lipton, 2009), following the notion of "small is beautiful" initially observed by Chaianov (Chaianov, 1986). Land ownership plays an important role in providing food security at household level. As shown in Table 3.19, the average farm size of the respondent farmers was 0.90 ha. As expected, large and medium category farmers had the largest farm size (1.65 ha) followed by small category farmers (0.65 ha) and marginal category farmers (0.16 ha).

Table 3.19 Farm size (decimal) of the respondent farmers of Bagherhat district

Land category	Amount of land (decimal)			
	Large & medium	Small	Marginal	All category
	n=45	*n=91*	*n=14*	*n=150*
Own cultivable	185.3	96.0	59.1	119.4
Homestead	29.7	16.8	11.6	20.2
Pond	20.8	6.9	1.6	10.6
Fruit orchard	38.3	12.6	4.4	19.5
Fallow land	0.3	0.1	--	0.2
Shared in	12.4	10.6	1.8	10.3
Shared out	0.6	--	20.6	2.1
Mortgaged in	1.5	0.6	--	0.8
Mortgaged out	2.8	7.6	15.9	7.0
Leased in	122.4	30.5	8.2	56.0
Leased out	--	5.9	9.4	4.4
Farm size (decimal)	407.3	160.5	40.6	223.3
Farm size (ha)	1.65	0.65	0.16	0.90

3.24 Farm Size of Gopalgonj District

Information on farm size of Gopalgonj district has been presented in Table 3.20. The average farm size of the respondent farmers of Gopalgonj district was 0.73 ha. As expected, large and medium category farmers had the largest farm size (1.75 ha) followed by small category farmers (0.57 ha) and marginal category farmers (0.18 ha).

Table 3.20 Farm size (decimal) of the respondent farmers of Gopalgonj district

Land category	Amount of land (decimal)			
	Large & medium	Small	Marginal	All category
	n=32	*n=82*	*n=36*	*n=150*
Own cultivable	193.5	74.7	34.4	90.4
Homestead	34.3	20.5	14.9	22.1
Pond	11.8	2.9	1.2	4.4
Fruit orchard	23.2	6.6	1.6	8.9
Fallow land	2.8	2.6	--	2.0
Shared in	96.9	34.7	17.2	43.8
Shared out	34.1	10.5	2.9	13.7
Mortgaged in	22.6	2.5	--	6.2
Mortgaged out	7.8	12.2	23.3	13.9
Leased in	88.8	18.3	1.3	29.2
Farm size (decimal)	432.0	140.1	44.4	179.4
Farm size (ha)	1.75	0.57	0.18	0.73

3.25 Farm Size of Khulna District

The average farm size of the respondent farmers of Khulna district was 0.85 ha. Like other areas, large & medium category farmers had the largest farm size (1.80 ha) followed by small category farmers (0.55 ha) and marginal category (0.11 ha) farmers (Table 3.21).

Table 3.21 Farm size (decimal) of the respondent farmers of Khulna district

Land category	Amount of land (decimal)			
	Large & medium	Small	Marginal	All category
	n=39	*n=100*	*n=11*	*n=150*
Own cultivable	279.1	101.7	50.7	144.1
Homestead	32.4	14.3	10.1	18.7
Pond	14.9	6.9	3.1	8.7
Fruit orchard	25.3	10.8	2.9	14.0
Fallow land	1.1	2.4	--	1.9
Shared in	58.7	17.9	2.7	27.4
Shared out	26.2	11.2	--	14.2
Mortgaged in	9.8	6.2	--	6.7
Mortgaged out	12.8	15.1	30.6	15.6
Leased in	70.2	17.7	--	30.0
Leased out	6.8	15.0	11.3	12.6
Farm size (decimal)	445.6	136.5	27.7	208.9
Farm size (ha)	1.80	0.55	0.11	0.85

3.26 Farm Size of Pirojpur District

The average farm size of the respondent farmers of Pirojpur district was 0.90 ha. As expected, large & medium category farmers had the largest farm size (1.60 ha) followed by small category farmers (0.60 ha) and marginal category (0.16 ha) farmers (Table 3.22).

Table 3.22 Farm size (decimal) of the respondent farmers of Pirojpur district

Land category	Amount of land (decimal)			
	Large & medium	Small	Marginal	All category
	n=51	*n=85*	*n=14*	*n=150*
Own cultivable	161.5	56.8	65.6	93.2
Homestead	33.4	18.6	23.2	24.1
Pond	11.7	4.1	0.8	6.4
Fruit orchard	23.7	9.4	3.4	13.7
Fallow land	2.2	0.2	0.4	0.9
Shared in	84.9	26.6	6.1	44.5
Shared out	--	1.2	11.8	1.8
Mortgaged in	5.3	--	0.4	1.8
Mortgaged out	5.6	5.0	50.1	9.4
Leased in	91.5	39.9	1.3	53.8
Leased out	12.9	--	--	4.4
Farm size (decimal)	395.6	149.3	39.1	222.7
Farm size (ha)	1.60	0.60	0.16	0.90

3.27 Farm Size of Satkhira District

Results shown in Table 3.23 reveal that the average farm size of the respondent farmers of Satkhira district was 0.64 ha. As expected, large & medium category farmers had the largest farm size (1.63 ha) followed by small category farmers (0.53 ha) and marginal category farmers (0.11 ha).

Table 3.23 Farm size (decimal) of the respondent farmers of Satkhira district

Land category	Amount of land (decimal)			
	Large & medium	Small	Marginal	All category
	n=25	*n=98*	*n=27*	*n=150*
Own cultivable	239.2	66.9	31.6	89.3
Homestead	27.1	12.8	7.1	14.1
Pond	19.6	5.3	1.0	6.9
Fruit orchard	41.3	6.9	1.1	11.6
Fallow land	4.6	0.8	0.1	1.3
Shared in	34.4	24.2	4.5	22.4
Shared out	6.6	4.0	--	3.7
Mortgaged in	--	1.4	--	0.9
Mortgaged out	4.0	2.7	20.7	6.2
Leased in	46.5	22.3	4.6	23.1
Leased out	--	3.2	1.2	2.3
Farm size (decimal)	402.0	130.7	28.0	157.4
Farm size (ha)	1.63	0.53	0.11	0.64

3.28 Overall Farm Size of the Respondent Farmers

Results shown in Table 3.24 reveal that the average farm size of the respondent farmers in the study areas was 0.80 ha. As expected, large & medium category farmers had the largest farm size (1.69 ha) followed by small category farmers (0.58 ha) and marginal category farmers (0.15 ha).

Table 3.24 Overall farm size (decimal) of the respondent farmers in the study areas

Land category	Amount of land (decimal)			
	Large & medium	Small	Marginal	All category
	n=45	*n=91*	*n=14*	*n=150*
Own cultivable	211.72	79.22	48.28	107.28
Homestead	31.38	16.60	13.38	19.84
Pond	15.76	5.22	1.54	7.40
Fruit orchard	30.36	9.26	2.68	13.54
Fallow land	2.20	1.22	0.10	1.26
Shared in	57.46	22.80	6.46	29.68
Shared out	13.50	5.38	7.06	7.10
Mortgaged in	7.84	2.14	0.08	3.28
Mortgaged out	6.60	8.52	28.12	10.42
Leased in	83.88	25.74	3.08	38.42
Leased out	3.94	4.82	4.38	4.74
Farm size (decimal)	416.50	143.42	35.96	198.34
Farm size (ha)	1.69	0.58	0.15	0.80

3.29 Annual Income of Bagherhat District Farmer

The annual income of the respondent farmers of Bagherhat district includes both from on-farm, off farm and non-farm activities were estimated and shown in Table 3.25. Income earned from different sources were categorized like agriculture (which includes sale of vegetable, paddy, crop byproducts, fruit, timber, livestock, etc.), service, day labour, and business. Irrespective of farmers category, the average income from crop production was estimated at Tk.1,00,483 which shared about 51% of the total annual income. It is evident that the annual income of the large & medium, small, and marginal categories farmers in the study areas were Tk.3,08,388, Tk.1,57,703 and Tk.92,446 respectively. Among the different sources of income, the share of crop production was the highest (43-55%) followed by livestock & poultry (8-22%), Service (9-11%) and business (4-12%).

Table 3.25 Annual income of the respondent farmers of Bagherhat district

	Farmer's category			
	Large & medium	Small	Marginal	All category
Sources of income	*n=45*	*n=91*	*n=14*	*n=150*
Aus	1344	692	714	890
Aman	30601	14551	15575	19462
Boro	18367	12939	7700	14078
Wheat/Maize	2084	688	--	1043
Jute	10724	7866	5986	8548
Vegetables	20433	15064	3657	15610
Oilseeds	6014	2509	286	3353
Pulses	6329	3534	3593	4378
Fruits	48842	8234	1857	19821
Other crops	24244	9934	--	13300
Crop total	**168984 (55)**	**76011 (48)**	**39368 (43)**	**100483 (51)**
Fisheries	14833 (5)	6143 (4)	--	8177 (4)
Livestock & poultry	26026 (8)	20611 (13)	20321 (22)	22208 (11)
Business	12533 (4)	18879 (12)	7143 (8)	15880 (8)
Service	34667 (11)	14440 (9)	8571 (9)	19960 (10)
Labour sell	7200 (2)	13802 (9)	13929 (15)	11833 (6)
Remittance	26667 (9)	--	--	8000 (4)
Timber	10578 (3)	3769 (2)	714 (1)	5527 (3)
Crop byproducts	6900 (2)	4048 (3)	2400 (3)	4750 (2)
Total Income	**308388 (100)**	**157703 (100)**	**92446 (100)**	**196818 (100)**

Note: Figures in the parentheses are percentage of total

3.30 Annual Income of Gopalgonj District Farmer

The average annual income of the respondent farmers of Gopalgonj district was estimated at Tk. 1,57,413 of which the highest share was crop production (49%) followed by livestock & poultry (12%), labour sell (12%), business (11%), fisheries (4%) and remittance. It is also evident that the annual income of large & medium, small and marginal categories farmers in study areas were Tk.2,19,043, Tk.1,57,451 and Tk.1,02,543 respectively. The similar trend of shares of different sources of income were found among farm categories (Table 3.26).

Table 3.26 Annual income of the respondent farmers of Gopalgonj district

Sources of income	Farmer's category			
	Large & medium	Small	Marginal	All category
	n=32	*n=82*	*n=36*	*n=150*
Aus	2244	672	447	953
Aman	19800	7548	7635	10183
Boro	31613	16899	6288	17491
Wheat/Maize	1813	405	0	608
Jute	27834	15985	8617	16744
Vegetables	7000	10406	1500	7542
Oilseeds	6036	2014	1008	2631
Pulses	13344	4899	4989	6722
Fruits	6438	3846	458	3586
Other crops	9125	14856	0	10068
Crop total	**125246 (57)**	**77531 (49)**	**30942 (30)**	**76528 (49)**
Fisheries	23078 (11)	1860 (1)	3333 (3)	6740 (4)
Livestock & poultry	26985 (12)	19405 (12)	13775 (13)	19670 (12)
Business	12375 (6)	21378 (14)	10167 (10)	16767 (11)
Service	8250 (4)	8524 (5)	13000 (13)	9540 (6)
Labour sell	6250 (3)	17805 (11)	30002 (29)	18267 (12)
Remittance	10938 (5)	6683 (4)	0	5987 (4)
Timber	3656 (2)	1650 (1)	556 (1)	1815 (1)
Crop byproducts	2266 (1)	2616 (2)	769 (1)	2098 (1)
Total Income	**219043 (100)**	**157451 (100)**	**102543 (100)**	**157413 (100)**

Note: Figures in the parentheses are percentage of total

3.31 Annual Income of Khulna District Farmer

The annual income of the respondent farmers of Khulna district is shown in Table 3.26. It is revealed that the average annual income of the respondent farmers was Tk. 2,07,333 of which the highest share come from crop production (34%) followed by livestock & poultry (17%), fisheries (14%), business (11%), service (11%) and labour sell (10%). As expected, the annual income of large & medium, small and marginal categories farmers in study areas were Tk. 2,61,185, Tk. 1,95,218 and Tk. 1,26,536 respectively. The highest share of total income of marginal farmers come from labour sell (31%) followed by livestock & poultry (28%), whereas it was crop production and livestock & poultry for large & medium and small farmers (Table 3.27).

Table 3.27 Annual income of the respondent farmers of Khulna district

Sources of income	Farmer's category			
	Large & medium	Small	Marginal	All category
	n=39	*n=100*	*n=11*	*n=150*
Aus	1076	932	--	901
Aman	40131	19204	4091	23537
Boro	35929	29640	15809	30261
Wheat/Maize	564	220	--	293
Jute	546	140	--	235
Vegetables	10564	6769	3545	7519
Oilseeds	769	155	--	303
Pulses	164	110	--	116
Fruits	12667	4633	3791	6660
Other crops	5128	350	--	1567
Crop total	**107538 (41)**	**62153 (32)**	**27236 (22)**	**71393 (34)**
Fisheries	37679 (14)	26545 (14)	13682 (11)	28497 (14)
Livestock & poultry	36621 (14)	34858 (18)	34819 (28)	35313 (17)
Business	30256 (12)	21220 (11)	10182 (8)	22760 (11)
Service	23564 (9)	23980 (12)	--	22113 (11)
Labour sell	14359 (5)	20320 (10)	38636 (31)	20113 (10)
Timber	7308 (3)	3850 (2)	455 (0.4)	4500 (2)
Crop byproducts	3859 (1)	2292 (1)	1527 (1)	2643 (1)
Total Income	**261185**	**195218**	**126536**	**207333**

Note: Figures in the parentheses are percentage of total

3.32 Annual Income of Pirojpur District Farmer

The annual income of the respondent farmers of Pirojpur district is shown in Table 3.28. It is revealed that the average annual income of the respondent farmers was Tk. 1,71,712 of which the highest share come from crop production (42%) followed by livestock & poultry (20%), labour sell (12%), business (9%), and service (8%). It is also evident that the annual income of large & medium, small, and marginal categories farmers in the study areas were Tk. 2,31,671, Tk. 1,44,899 and Tk. 1,16,079 respectively. The highest share of total income was crop production (35-48%) for all categories of farmers. Livestock & poultry was the second most important source of income (18-23%) for large & medium and small farmers, whereas it was business (27%) for marginal farmers (Table 3.28).

Table 3.28 Annual income of the respondent farmers of Pirojpur district

Sources of income	Farmer's category			
	Large & medium	Small	Marginal	All category
	n=51	*n=85*	*n=14*	*n=150*
Aus	706	127	429	352
Aman	44581	17465	18507	26782
Boro	4353	4431	3750	4341
Wheat/Maize	2627	565	--	1213
Jute	6159	4212	1786	4647
Vegetables	7961	6734	3179	6819
Oilseeds	1461	487	71	779
Pulses	14510	3195	3186	7041
Fruits	26303	16223	9421	19016
Other crops	1569	1294	--	1267
Crop total	**110230 (48)**	**54733 (38)**	**40329 (35)**	**72258 (42)**
Fisheries	9137 (4)	2235 (2)	--	4373 (3)
Livestock & poultry	52320 (23)	25969 (18)	14678 (13)	33875 (20)
Business	16765 (7)	13388 (9)	31429 (27)	16220 (9)
Service	15451 (7)	13694 (9)	10000 (9)	13947 (8)
Labour sell	10373 (4)	26259 (18)	16929 (15)	19987 (12)
Remittance	--	235 (0.2)	--	133 (0.1)
Timber	9549 (4)	5071 (3)	1143 (1)	6227 (4)
Crop byproducts	7847 (3)	3314 (2)	1571 (1)	4693 (3)
Total Income	**231671 (100)**	**144899 (100)**	**116079 (100)**	**171712 (100)**

Note: Figures in the parentheses are percentage of total

3.33 Annual Income of Satkhira District Farmers

The annual income of the respondent farmers of Satkhira district is shown in Table 3.29. Irrespective of farmers' category, the average annual income of the respondent farmers was Tk. 2,26,049 of which the highest share come from crop production (49%) followed by labour sell (13%), livestock & poultry (11%), fisheries (9%), and business (7%). It is also evident that the annual income of large & medium, small, and marginal categories farmers in the study areas were Tk. 4,56,193, Tk. 1,84,013 and Tk. 1,65,526 respectively. The source of the highest share of total income was crop production (33-57%) for all categories of farmers. Labour sell was the second most important source of income (15-36%) for small and marginal farmers, whereas it was fisheries (13%) for large and medium farmers (Table 3.29).

3.34 Overall Annual Income of the Respondent Farmers

Table 3.30 presents the detailed annual income of the respondent farmers of the study areas. Irrespective of farmers' category, the average annual income of the respondent farmers was Tk.1,91,865 of which the highest share come from crop production (45%) followed by livestock & poultry (14%), labour sell (10%), business (9%), service (8%), and fisheries (7%). In different farm categories, the source of the highest share of total income was also crop production (32-52%). Labour sell was the second most important source of income (26%) for marginal farmers, whereas it was livestock and poultry (13-14%) for large & medium and small farmers (Table 3.30).

Table 3.29 Annual income of the respondent farmers of Satkhira district

Sources of income	Farmer's category			
	Large & medium	Small	Marginal	All category
	n=25	*n=98*	*n=27*	*n=150*
Aus	0	510	1407	587
Aman	49284	18617	10170	22208
Boro	45397	12405	10019	17474
Wheat/Maize	2832	1790	564	1743
Jute	3104	3626	1689	3190
Vegetables	108420	40745	29013	49912
Oilseeds	10504	3760	433	4285
Pulses	688	710	--	579
Fruits	41530	5641	1293	10840
Other crops	140	221	--	168
Crop total	**261899 (57)**	**88026 (48)**	**54589 (33)**	**110986 (49)**
Fisheries	60400 (13)	14173 (8)	4444 (3)	20127 (9)
Livestock & poultry	46640 (10)	20094 (11)	26026 (16)	25586 (11)
Business	28360 (6)	12694 (7)	13556 (8)	15460 (7)
Service	2000 (0.4)	16520 (9)	4444 (3)	11927 (5)
Labour sell	4800 (1)	27588 (15)	59259 (36)	29491 (13)
Remittance	40000 (9)	--	--	6667 (3)
Timber	800 (0.2)	801 (0.4)	--	657 (0.3)
Crop byproducts	11294 (2)	4117 (2)	3207 (2)	5149 (2)
Total Income	**456193 (100)**	**184013 (100)**	**165526 (100)**	**226049 (100)**

Note: Figures in the parentheses are percentage of total

Table 3.30 Overall annual income of the respondent farmers in the study areas

Sources of income	Farmer's category			
	Large & medium	Small	Marginal	All category
Crop production	154779 (52)	71691 (43)	38493 (32)	86330 (45)
Livestock & poultry	37718 (13)	24187 (14)	21924 (18)	27330 (14)
Labour sell	8596 (3)	21155 (13)	31751 (26)	19938 (10)
Business	20058 (7)	17512 (10)	14495 (12)	17417 (9)
Service	16786 (6)	15432 (9)	7203 (6)	15497 (8)
Fisheries	29025 (10)	10191 (6)	4292 (4)	13583 (7)
Remittance	15521 (5)	1384 (1)	0	4157 (2)
Timber	6378 (2)	3028 (2)	574 (0.5)	3745 (2)
Crop byproducts	6433 (2)	3277 (2)	1895 (2)	3867 (2)
Total income	**295296 (100)**	**167857 (100)**	**120626 (100)**	**191865 (100)**

Note: Figures in the parentheses are percentage of total

3.35 Availability of Agricultural Tools at Household Level

Farm mechanization is one of the major cause of change in agricultural sector now a days in Bangladesh. Labor shortage and high labor wage rate compelled the farmers to accept farm mechanization. Power availability in farming sector increased at visible rate due to intervention of government policy in mechanized cultivation. Adoption of mechanized cultivation increased rapidly due to active involvement of public, private, donors and non-

government organization. Bangladesh agriculture is now one of the most mechanized agricultural economies in south Asia (Baudron et al., 2015; Islam, 2009). This was facilitated by a focus on small-scale machinery more adapted its socio-economic context be it through cheap imports or local production and manufacturing. An attempt was made to investigate the availability of different agricultural tools and equipment at household level in the study areas. The availability of agricultural tools and equipment and their current values have been discussed in the following sections.

3.35.1 Availability of agricultural tools in Bagherhat district

The average numbers of agricultural tools and equipment like power tiller, shallow tube well, crop thresher, weeder, country plough, ladder and others tools were 0.13, 0.41, 0.07, 0.18, 0.08, 0.17 and 0.24 per farm household respectively. Among different categories of farmers, the highest number of agricultural tools was found in the large & medium category households followed by small and marginal categories of farmers (Table 3.31).

Table 3.31 Number of agricultural tools and their current values in Bagherhat district

	Large & Med *(n=45)*		Small *(n=91)*		Marginal *(n=14)*		All category *(n=150)*	
Agricultural tools	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)
Power tiller	0.24	8000	0.09	2527	0.00	0	0.13	3933
Shallow tube well	0.56	5456	0.40	3657	0.07	429	0.41	3895
Crop thresher	0.11	511	0.07	286	0.00	0	0.07	327
Weeder	0.22	211	0.16	155	0.14	143	0.18	171
Country plough	0.04	24	0.10	55	0.07	36	0.08	44
Ladder	0.18	71	0.18	55	0.14	43	0.17	59
Other tools	0.38	268	0.21	51	0.00	0	0.24	111

3.35.2 Availability of agricultural tools in Gopalgonj district

As shown in Table 3.32, the average numbers of agricultural tools such as power tiller, shallow tube well, crop thresher, weeder, country plough, ladder and others tools were 0.08, 0.40, 0.08, 0.13, 0.07, 0.27 and 1.30 per farm respectively. Among different categories of farmers, large & medium category farmers owned the highest number of agricultural tools followed by small and marginal category farmers.

Table 3.32 Number of agricultural tools and their current values in Gopalgonj district

	Large & Med *(n=32)*		Small *(n=82)*		Marginal *(n=36)*		All category *(n=150)*	
Agricultural tools	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)
Power tiller	0.28	11250	0.04	1000	0.00	0	0.08	2947
Shallow tube well	0.81	6906	0.40	4000	0.03	528	0.40	3787
Crop thresher	0.22	656	0.05	177	0.03	89	0.08	258
Weeder	0.19	159	0.15	104	0.03	33	0.13	99
Country plough	0.13	67	0.07	48	0.03	11	0.07	43
Ladder	0.44	184	0.26	101	0.14	57	0.27	108
Other tools	1.81	427	1.10	257	1.31	169	1.30	272

3.35.3 Availability of agricultural tools in Khulna district

The average numbers of agricultural tools namely power tiller, shallow tube well, crop thresher, weeder, country plough, ladder and others tools were 0.05, 0.61, 0.22, 0.12, 0.29, 0.82 and 0.79 per farm respectively. The highest number of agricultural tools was available in the large & medium category farmers' households followed by small and marginal category farmers (Table 3.33).

Table 3.33 Number of agricultural tools and their current values in Khulna district

	Large & Med *(n=39)*		Small *(n=100)*		Marginal *(n=11)*		All category *(n=150)*	
Agricultural tools	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)
Power tiller	0.10	8333	0.04	2400	--	--	0.05	3767
Shallow tube well	0.82	11282	0.55	6411	0.45	5636	0.61	7621
Crop thresher	0.31	959	0.18	601	0.27	636	0.22	697
Weeder	0.21	431	0.07	97	0.27	291	0.12	198
Country plough	0.67	353	0.18	100	--	--	0.29	158
Ladder	1.26	497	0.67	230	0.64	209	0.82	298
Other tools	0.97	344	0.60	264	1.82	609	0.79	310

3.35.4 Availability of agricultural tools in Pirojpur district

The household survey revealed that the average numbers of agricultural tools namely power tiller, shallow tube well, crop thresher, weeder, country plough, ladder and others tools were 0.16, 0.12, 0.04, 0.09, 0.33, 0.47 and 0.33 per farm respectively. As expected, large & medium category farmers owned the highest number of agricultural tools and equipment compared to small and marginal category farmers (Table 3.34).

Table 3.34 Number of agricultural tools and their current values in Pirojpur district

	Large & Med *(n=51)*		Small *(n=85)*		Marginal *(n=14)*		All category *(n=150)*	
Agricultural tools	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)
Power tiller	0.37	13529	0.05	1971	0.07	2143	0.16	5917
Shallow tube well	0.20	1602	0.09	882	0.00	0	0.12	1045
Crop thresher	0.08	373	0.02	118	0.00	0	0.04	193
Weeder	0.14	178	0.07	75	0.07	93	0.09	112
Country plough	0.47	415	0.28	194	0.14	71	0.33	258
Ladder	0.59	253	0.41	135	0.36	125	0.47	174
Other tools	0.24	75	0.44	142	0.00	0	0.33	106

3.35.5 Availability of agricultural tools in Satkhira district

Household level investigation indicated that the average numbers of agricultural tools and equipment such as power tiller, shallow tube well, crop thresher, weeder, country plough, ladder and others tools were 0.04, 0.57, 0.15, 0.35, 0.01, 0.22 and 0.13 per farm respectively. As expected, large & medium category farmers owned the highest number of agricultural tools and equipment compared to small and marginal category farmers (Table 3.35).

Table 3.35 Number of agricultural tools and their current values in Satkhira district

Agricultural tools	Large & Med *(n=25)*		Small *(n=98)*		Marginal *(n=27)*		All category *(n=150)*	
	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)	No.	Value (Tk)
Power tiller	0.08	3600	0.04	1561	--	--	0.04	1620
Shallow tube well	1.28	9840	0.49	3577	0.22	1926	0.57	4323
Crop thresher	0.52	1720	0.09	276	0.04	74	0.15	480
Weeder	0.72	604	0.28	187	0.26	191	0.35	257
Country plough	0.08	38	--	--	--	--	0.01	6
Ladder	0.64	246	0.13	43	0.15	54	0.22	79
Other tools	0.12	267	0.14	328	0.07	17	0.13	262

3.36 Availability of agricultural tools in the study areas

The average numbers of agricultural tools namely power tiller, shallow tube well, crop thresher, weeder, country plough, and ladder were 0.09, 0.42, 0.11, 0.17, 0.16, and 0.62 per farm respectively (Figure 3.5). As expected, large & medium category farmers owned the highest number of agricultural tools and equipment compared to small and marginal category farmers.

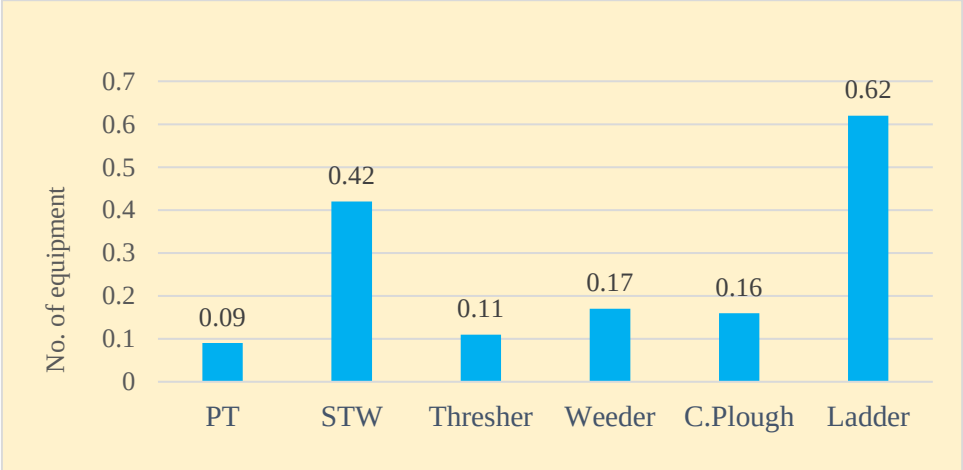

Figure 3.5 Availability of agricultural tools in the study areas

Chapter IV

CROPPING PATTERNS AND CROP VARIETY USE

4.1 Introduction

Usages of agricultural land in Bangladesh is highly dynamic and there is unique biodiversity of crops throughout the year (Nasim et al., 2017). The yearly sequence or distribution of crops in an area is expressed as cropping pattern (CP). This section describes the present cropping patterns normally practiced and different crop varieties used by the respondent farmers in the study areas. The present scenario of cropping patterns and crop variety use will disclose the scope of introducing new crops in the existing cropping patterns along with improved varieties in order to enhance the income and livelihood of the farmers in the study areas. The cropping patterns and crop variety use have been discussed in the following subsequent sections.

4.2 Cropping Patterns Followed in Bagherhat District

A total of 41 different types of cropping patterns were reported by the respondent farmers in Bagherhat district. Among these patterns irrespective of land category, *Boro-Fallow-T.Aman* was the highest reported pattern which was practiced by 20.2% respondent farmers in the study areas. The other prominent cropping patterns were *Fallow-Fallow-T. Aman*; *Khesari-Jute-T.Aman*; and *Lentil=Jute-T.Aman*. In the high land, the highest practiced cropping pattern were *Vegetable-Vegetable-Vegetable* and *Lentil-Jute-T.Aman*. Again, *Boro-Fallow-T.Aman* and *Fallow-Fallow-T.Aman* cropping patterns were reported to be the highest practiced patterns in the medium and low land respectively (Table 4.1). Table 4.1 further reveals that *T.Aman* rice is more or less common crop, whereas the presence of *Aus* rice is meager in the existing cropping patterns in Bagherhat district. However, there are still scope of transforming two crop patterns into three crop patterns in the study areas.

4.3 Cropping Patterns Followed in Gopalgonj District

A total of 26 different types of cropping patterns were reported by the respondent farmers in Gopalgonj district. Considering all land categories, Boro-Fallow-*T.Aman* was found highest cropping pattern which was practiced by 24.0% respondent farmers in the study areas followed by Khesari-Jute-*T.Aman* (19.5%) and Lentil-Jute-*T.Aman* rice cropping pattern (17.4%). About 30.2% respondent farmers practiced Lentil -Jute-*T.Aman* rice cropping pattern in high land. On the other hand the highest practiced cropping pattern were Khesari-Jute-*T.Aman* and Boro-Fallow-Fallow in medium land and low land, respectively (Table 4.2).

Table 4.1 Percent cropping patterns practiced by the farmers of Bagherhat district

Cropping pattern	High land *n=78*	Medium land *n= 124*	Low land *n=75*	Overall *n=277*
1. Boro-Fallow-*T.Aman*	1.3	36.3	13.3	20.2
2. Fallow-Fallow-*T.Aman*	--	11.3	48.0	18.1
3. Khesari-Jute-*T.Aman*	9.0	9.7	--	6.9
4. Lentil-Jute-*T.Aman*	16.7	4.8	--	6.9
5. Boro-Fallow-Fallow	--	1.6	20.0	6.1
6. Vegetable-Vegetable-Vegetable	17.9	0.8	--	5.4
7. Maize-Fallow-*T.Aman*	--	2.4	10.7	4.0
8. Chili-Vegetable-Vegetable	9.0	1.6	--	3.2
9. Mustard-groundnut-*T.Aman*	5.1	2.4	--	2.5
10. Vegetable-Vegetable-*T.Aman*	5.1	1.6	--	2.2
11. Sunflower-Fallow-*T.Aman*	2.6	2.4	--	1.8
12. Khesari-Fallow-*T.Aman*	--	1.6	4.0	1.8
13. Betel leaf-Betel leaf-Betel leaf	3.8	1.6	--	1.8
14. Fruit-Fruit-Fruit	5.1	0.8	--	1.8
15. Khesari-Aus-*T.Aman*	--	3.2	--	1.4
16. Boro-Vegetable-Vegetable	1.3	1.6	--	1.1
17. Mustard-Jute-*T.Aman*	--	2.4	--	1.1
18. Potato-Fallow-*T.Aman*	1.3	1.6	--	1.1
19. Mustard-Sesame-*T.Aman*	--	2.4	--	1.1
20. Other patterns	21.8	9.7	4.0	11.6

Note: Other patterns included 22 different types of minor cropping patterns

Table 4.2 Percent cropping patterns practiced by the farmers of Gopalgonj district

Cropping pattern	High land *n=116*	Medium land *n= 79*	Low land *n=92*	Overall *n=287*
1. Boro-Fallow-Fallow	3.4	--	70.7	24.0
2. Khesari-Jute-*T.Aman*	24.1	30.4	4.3	19.5
3. Lentil-Jute-*T.Aman*	30.2	19.0	--	17.4
4. Boro-Fallow-*T.Aman*	0.9	8.9	10.9	6.3
5. Mustard-Jute-*T.Aman*	10.3	2.5	--	4.9
6. Khesari-Fallow-*T.Aman*	0.9	10.1	3.3	4.2
7. Fallow-Fallow-*T.Aman*	--	2.5	8.7	3.5
8. Khesari-Jute-Fallow	0.9	8.9	--	2.8
9. Vegetable-Vegetable-Vegetable	6.0	--	--	2.4
10. Vegetable-Jute-*T.Aman*	4.3	1.3	--	2.1
11. Vegetable-Vegetable-*T.Aman*	3.4	2.5	--	2.1
12. Khesari-Sesame-*T.Aman*	1.7	2.5	--	1.4
13. Khesari-Boro-*T.Aman*	0.9	3.8	--	1.4
14. Betel leaf-Betel leaf-Betel leaf	4.3	--	--	1.7
15. Mustard-Sesame-*T.Aman*	0.9	2.5	--	1.0
16. Khesari-Jute-Groundnut	1.7	--	--	0.7
17. Mustard-Mungbean-*T.Aman*	1.7	--	--	0.7
18. Other patterns	4.3	5.1	2.2	3.8

Note: Other patterns included 9 different types of minor cropping patterns

4.4 Cropping Patterns Followed in Khulna District

Cropping patterns differs on land type, farm category and AEZ due to climate, soil and farmers attention of crop production. About 23 different types of cropping patterns were

identified in Khulna district. Among the major cropping patterns, the highest percentage of farmers practiced Boro-Fallow-*T.Aman* (22.9%) followed by Boro-Fallow-Fallow (22.4%) and Fallow-Fallow-*T.Aman* (16.7%). Most of the farmers practiced Fruit-Fruit-Fruit pattern in high land (17.5%), Boro-Fallow-*T.Aman* rice cropping pattern in medium land (33.3%) and Boro-Fallow-Fallow cropping pattern (33.7%) in low land of the study area (Table 4.3).

Table 4.3 Percent cropping patterns practiced by the farmers of Khulna district

Cropping pattern	High land *n= 57*	Medium land *n= 99*	Low land *n= 89*	Overall *n=245*
1. Boro-Fallow-*T.Aman*	3.5	33.3	23.6	22.9
2. Boro-Fallow-Fallow	8.8	20.2	33.7	22.4
3. Fallow-Fallow-*T.Aman*	3.5	22.2	19.1	16.7
4. Boro-Fish-Fish	--	3.0	14.6	6.5
5. Fruit-Fruit-Fruit	17.5	2.0	1.1	5.3
6. Vegetable-Vegetable-*T.Aman*	15.8	3.0	--	4.9
7. Vegetable-Vegetable-Vegetable	12.3	4.0	--	4.5
8. Vegetable-Fallow-Fallow	10.5	1.0	1.1	3.3
9. Boro-Aus-*T.Aman*	1.8	3.0	2.2	2.4
10. Boro-Vegetable-Vegetable	3.5	2.0	1.1	2.0
11. Boro-Aus-Fallow	--	2.0	1.1	1.2
12. Mustard-Fallow-Fallow	3.5	1.0	--	1.2
13. Vegetable-Black gram-Fallow	3.5	--	--	0.8
14. Vegetable-Jute-Fallow	3.5	--	--	0.8
15. Maize-Fallow-*T.Aman*	3.5	--	--	0.8
16. Other patterns	8.8	3.0	2.2	4.1

Note: Other patterns included 8 different types of minor cropping patterns

4.5 Cropping Patterns Followed in Pirojpur District

The cropping patterns were calculated on the basis of area coverage. The major cropping patterns of Pirojpur district were found Fallow-Fallow-*T.Aman* (26.6%), Khesari-Jute-Fallow (13.1%) and Boro-Fallow-*T.Aman* (8.4%) in the study areas. Vegetable-Vegetable-*T.Aman* and Khesari-Jute-*T.Aman* rice cropping pattern were practiced by the most of respondent farmers in high land. Major 30.8% and 46.2% farmers practiced Fallow-Fallow-*T.Aman* in medium land and low land in the study area (Table 4.4).

4.6 Cropping Patterns Followed in Satkhira District

About 33 different types of cropping patterns exist in Satkhira district. Among the major cropping patterns, the highest percentage of farmer were under Boro-Fallow-*T.Aman* (17.9%) followed by Boro-Fish-Fish (11.1%) and Mustard-Boro-*T.Aman* (9.4%) considering land type. Most of the farmers in the high land practiced Vegetable-Vegetable-Vegetable pattern (25%) while Boro-Fallow-*T.Aman* (26.4%) and Boro-Fish-Fish (32.1%) pattern practiced by the respondent farmers in medium land and low land, respectively (Table 4.5).

Table 4.4 Percent cropping patterns practiced by the farmers of Pirojpur district

Cropping pattern	High land *n= 87*	Medium land *n= 117*	Low land *n= 93*	Overall *n=297*
1. Fallow-Fallow-*T.Aman*	--	30.8	46.2	26.6
2. Khesari-Jute-Fallow	11.5	12.8	15.1	13.1
3. Boro-Fallow-*T.Aman*	1.1	9.4	14.0	8.4
4. Boro-Fallow-Fallow	--	1.7	21.5	7.4
5. Vegetable-Vegetable-*T.Aman*	13.8	2.6	--	5.1
6. Mungbean-Fallow-*T.Aman*	1.1	8.5	2.2	4.4
7. Khesari-Jute-*T.Aman*	13.8	--	--	4.0
8. Potato-Fallow-*T.Aman*	8.0	1.7	--	3.0
9. Vegetable-Vegetable-Vegetable	8.0	0.9	--	2.7
10. Khesari-Mungbean-*T.Aman*	--	6.0	--	2.4
11. Lentil-Jute-*T.Aman*	--	5.1	--	2.0
12. Mustard-Mungbean-*T.Aman*	1.1	3.4	--	1.7
13. Maize-Fallow-*T.Aman*	4.6	--	--	1.3
14. Potato-Boro-*T.Aman*	4.6	--	--	1.3
15. Vegetable-Mungbean-*T.Aman*	1.1	2.6	--	1.3
16. Fruit-Fruit-Fruit	2.3	0.9	--	1.0
17. Khesari-Boro-*T.Aman*	3.4	--	--	1.0
18. Chili-Fallow-*T.Aman*	2.3	0.9	--	1.0
19. Vegetable-Jute-*T.Aman*	2.3	0.9	--	1.0
20. Khesari-Aus-*T.Aman*	--	2.6	--	1.0
21. Other patterns	20.7	9.4	1.1	10.1

Note: Other patterns included 23 different types of minor cropping patterns

Table 4.5 Percent cropping patterns practiced by the farmers of Satkhira district

Cropping pattern	High land *n= 32*	Medium land *n= 121*	Low land *n= 81*	Overall *n=234*
1. Boro-Fallow-*T.Aman*	6.3	26.4	9.9	17.9
2. Boro-Fish-Fish	--	--	32.1	11.1
3. Mustard-Boro-*T.Aman*	6.3	14.0	3.7	9.4
4. Fallow-Fallow-*T.Aman*	--	3.3	19.8	8.5
5. Mustard-Fallow-*T.Aman*	12.5	6.6	2.5	6.0
6. Boro-Vegetable-Vegetable	--	9.1	1.2	5.1
7. Mustard-Jute-*T.Aman*	12.5	5.8	1.2	5.1
8. Vegetable-Vegetable-Vegetable	25.0	1.7	--	4.3
9. Boro-Fallow-Fallow	--	1.7	8.6	3.8
10. Wheat-Fallow-*T.Aman*	--	5.0	3.7	3.8
11. Boro-Jute-*T.Aman*	--	6.6	1.2	3.8
12. Fish-Fish-*T.Aman*	--	--	9.9	3.4
13. Fallow-Tomato-Tomato	--	4.1	--	2.1
14. Sweet Potato-Jute-*T.Aman*	--	1.7	2.5	1.7
15. Vegetable-Vegetable-*T.Aman*	3.1	1.7	--	1.3
16. Potato-Jute-*T.Aman*	6.3	0.8	--	1.3
17. Wheat-Mungbean-*T.Aman*	--	2.5	--	1.3
18. Other patterns	28.1	9.1	3.7	9.8

Note: Other patterns included 16 different types of minor cropping patterns

4.7 Distribution of Farmers According to Variety Use in Cereal Crops

Most of the farmers in the study area produced rice crop as cereal compared to maize and wheat. The respondent farmers were found to use local *Boro rice* variety as Gotamala, Sada mota, Vazon, Kaliboro, Fatema, Lalziram, Moina, Sathi, Asamboro. They also used Prita, Nooncha, Bahoi, Ratul as local *Aus* rice variety. On the other hand, they used local *Aman rice* variety as Jamaibabu, Chikon dhan, Lalmota, Karagel, Dudkomol, Rani salut, Lairi, Mala, Kalozira, Zabra, Sorna, Burkus, Bipass, Bounkhil, Balam, Moinamoti, Hugli, Chinigura etc. They used high yielding varieties of Boro, Aus and *T.Aman* rice with local. Considering all study areas about 58.3% farmers used BRRI dhan variety for *T.Aman* rice, 36.9% for Boro rice and 2.5% for Aus rice variety compared to BINA dhan, Hybrid and local rice variety. In case of Bagherhat district most of the farmers used BRRI dhan variety for *T.Aman* and Boro rice. They used more local variety for Aus rice than BRRI variety. BINA rice variety was used limited by the respondent farmers in Aman and Boro season in the study area except Satkhira district. BARI variety of Maize and wheat were also found to use in Bagherhat, Khulna, Pirojpur and Satkhira district. There is an ample scope to introduce high yielding varieties of cereal crops in Rabi and Kharif seasons in the study area.

Table 4.6 Percent distribution of farmers according to variety use in cereal crops

Crop variety	% use of crop variety					
	Bagherhat *(n=150)*	Gopalgonj *(n=150)*	Khulna *(n=150)*	Pirojpur *(n=150)*	Satkhira *(n=150)*	All area *(n=750)*
A. Boro						
BINA dhan	--	2.0	8.0	--	14.7	4.9
BRRI dhan	16.7	43.3	63.3	8.0	53.3	36.9
Hybrid dhan	11.3	15.3	28.7	6.7	1.3	12.7
Local dhan	0.7	1.3	1.3	19.3	--	4.5
B. Aus						
BRRI dhan	0.7	0.7	4.7	5.3	1.3	2.5
Local dhan	3.3	--	2.0	3.3	--	1.7
C. T. Aman						
BINA dhan	12.0	9.3	7.3	--	16.0	8.9
BRRI dhan	88.7	44.0	63.3	34.0	61.3	58.3
Hybrid dhan	0.7	0.7	--	0.7	2.7	0.9
Local dhan	20.0	22.0	6.7	17.3	5.3	14.3
D. Maize						
BARI vutta	4.0	--	--	2.7	--	1.3
Hybrid vutta	9.3	--	2.0	--	1.3	2.5
E. Wheat						
BARI gom	1.3	--	--	1.3	8.0	2.1

Note:

Local *Boro* variety: Gotamala, Sada mota, Vazon, Kaliboro, Fatema, Lalziram, Moina, Sathi, Asamboro
Local *Aus* variety: Prita, Nooncha, Bahoi, Ratul
Local *Aman* variety: Jamaibabu, Chikon dhan, Lalmota, Karagel, Dudkomol, Rani salut, Lairi, Mala, Kalozira, Zabra, Sorna, Burkus, Bipass, Bounkhil, Balam, Moinamoti, Hugli, Chinigura
BINA *Boro* dhan: BINA dhan10 & -14; BINA *Aman* dhan: BINA dhan-7, -11, -16, & -17
BRRI *Boro* dhan: BRRI dhan28, 29, 50, 58, 59, 67, 74 & 81; BRRI *Aus* dhan: BRRI dhan8, 12, 20, 24, 26 & 48
BRRI *Aman* dhan: BRRI dhan10, 11, 22, 23, 30, 31, 33, 34, 39, 49, 51, 52, 62, 71, 72, 75, 76, 78, 80, 87, & 94
BARI Vutta: BARI *Vutta-5 and 9;* BARI gom*:* BARI gom-25, 30, Kanchan and Satabdi

4.8 Distribution of Farmers According to Variety Use in Pulse and Oilseed Crops

Farmers in the study area cultivated pulses crop as lentil, mungbean, khesari, motor etc. Cultivation of lentil with little or without fertilizers was the common practice in this area. They used mainly local variety resulting low yield. They also used HYV of pulse crop as BARI Masur, BARI Mung, BARI Khesari, etc. The highest 17.3% farmers of Gopalgonj district used BARI Masur followed by Bagherhat (10%) and Pirojpur district (6.7%).

Mungbean is also an important pulse crop that can be a rich source of protein; it maintains soil fertility through biological nitrogen fixation in soil. Among the grain legumes, it is one of the important conventional pulse crops of Bangladesh. It is a short duration crop therefore has less water requirement as compared to summer crops. About 5.7% farmers used BARI Mung while it was 0.04% for BINA Mung and 1.9% for local variety. It was noted that about the highest 20.7% farmers were found to use BARI Mung in Pirojpur district. Farmers in the study area mostly used local variety of Khesari which was about 16.3% compared to BARI and BINA khesari. In the case of Motor, they used local variety in the study area. The respondent farmers did not produce pulse crops except lentil in the study area.

Table 4.7 Percent distribution of farmers according to variety use in pulse and oilseed crops

Crop variety	% use of crop variety					
	Bagherhat *(n=150)*	Gopalgonj *(n=150)*	Khulna *(n=150)*	Pirojpur *(n=150)*	Satkhira *(n=150)*	All area *(n=750)*
Lentil						
BARI Masur	10.0	17.3	3.3	6.7	--	7.5
Indian Masur	1.3	--	0.7	--	--	0.4
Local	5.3	11.3	1.3	--	0.7	3.7
Mungbean						
BARI Mug	2.0	3.3	--	20.7	2.7	5.7
BINA Mug	--	--	--	--	2.0	0.4
Local	1.3	2.0	--	4.7	1.3	1.9
Khesari						
BARI Khesari	2.7	20.0	--	7.3	--	6.0
BINA Khesari	--	0.7	--	--	--	0.1
Local	16.7	26.7	--	34.7	3.3	16.3
Motor						
Local	2.0	3.3	--	2.0	--	1.5
Mustard						
BINA Sarisa	--	--	--	--	3.3	0.7
BARI Sarisa	9.3	14.7	5.3	8.0	26.0	12.7
Tori-7 & Rai	3.3	4.7	2.0	2.7	6.7	3.9
Sesame						
BARI Til	3.3	3.3	--	1.3	2.7	2.1
Local	1.3	2.0	--	2.0	1.3	1.3
Groundnut						
BARI Badam	1.3	--	2.0	--	--	0.7
BINA Badam	--	2.7	--	--	--	0.5
Dhaka-1	6.7	2.0	1.3	1.3	--	2.3

Note:
BARI Masur: BARI Masur-3, -4, -6, -7 & -14; BARI Mug: BARI Mug-4, -5 & -6; BARI Khesari: BARI Khesari-2, -5 & -6
BARI Sarisha: BARI Sarisha-11, -14 & -15; BARI Til: BARI Til-2, -3, -4, -5 & -6; BARI Badam: BARI Badam-8

Mustard is the main oil crop in Bangladesh. It is cultivated in farmer's field in a traditional system with local variety of mustard variety. Now a days they are using BARI developed HYV of mustard variety. It was observed that about 12.7% farmers used BARI Sarisa followed by Tori-7 and Rai (3.9%) and BINA Sarisa (0.07%) in the study area. The highest 26% farmers were found to use BARI Sarisa in Satkhira district.

4.9 Distribution of Farmers According to Variety Use in Tuber Crops

Potato is widely grown tuber crop in Bangladesh. Respondent farmers used cut tubers or tuber eye for single eye planting with closer spacing of potato is a common practice of growing potato in the study area. Cardinal, Diamond, Granola, Madrazi, Local, etc. were produced by the sample farmers. About 3.9% farmers used diamond variety for potato cultivation followed by Cardinal (2.8%) and local (1.3%). Sweet potato is a carbohydrate containing crop. It contains high amount of vitamin-A. Farmers mostly produced local varieties (0.9%) that produced lower yield followed by HYV Tripti sundori (0.7%) which is also susceptible to different pest and diseases. So, they get very poor economic return.

Mukhi kachu is an important edible aroid. It is widely cultivated and very much popular to all groups of people for its palatability. Eye rate, hybrid and some local varieties were being also cultivated by the farmers. There are ample scope to use HYV varieties of Mukhi kachu at farmers' level in the study area (Table 4.8).

Table 4.8 Percent distribution of farmers according to variety use in tuber crops

Crop variety	% use of crop variety					
	Bagherhat *(n=150)*	Gopalgonj *(n=150)*	Khulna *(n=150)*	Pirojpur *(n=150)*	Satkhira *(n=150)*	All area *(n=750)*
Potato						
Cardinal	2.0	0.0	4.0	3.3	4.7	2.8
Diamond	2.7	0.0	2.7	11.3	2.7	3.9
Granola	1.3	0.0	0.7	2.0	1.3	1.1
Madrazi	5.3	0.0	0.0	0.0	0.7	1.2
Local	2.0	0.0	1.3	2.0	1.3	1.3
Sweet potato						
Tripti sundori	0.0	0.0	0.0	1.3	2.0	0.7
Local	0.0	0.0	0.0	2.0	2.7	0.9
Mukhi kachu						
Eyerate	2.7	0.0	2.0	0.0	0.0	0.9
Hybrid	2.0	0.0	0.7	0.0	0.0	0.5
Local	1.3	2.0	2.7	0.0	0.0	1.2

4.10 Distribution of Farmers According to Variety Use in Spice Crops

Very few percent of respondent farmers used HYV of spices in the study area. About 2.8% farmers used local variety of chili while it was 1.2% for Hybrid & BARI Morich-2. About 5.3%, 2%, 2.7% and 4% of the farmers of Bagherhat, Gopalgonj, Khulna and Pirojpur used local variety of chili respectively. About 1.3%, 0.7%, 1.3% and 2% farmer of Bagherhat, Gopalgonj, Khulna and Pirojpur used local variety of onion respectively. On the other hand about 0.7%, 2.7%, 1.3% and 1.3% farmer of Bagherhat, Gopalgonj, Khulna and Pirojpur used BARI Piaz-4 & HYV of chili respectively. In case of betel leaf only 3.3% farmers used local variety of betel leaf only in Gopalgonj district (Table 4.9).

Table 4.9 Percent distribution of farmers according to variety use in spice crops

Crop variety	% use of crop variety					
	Bagherhat *(n=150)*	Gopalgonj *(n=150)*	Khulna *(n=150)*	Pirojpur *(n=150)*	Satkhira *(n=150)*	All area *(n=750)*
Chili						
Hybrid & Bari-2	3.3	0.7	1.3	0.7	--	1.2
Local	5.3	2.0	2.7	4.0	--	2.8
Onion						
BARI-4 & HYV	0.7	2.7	1.3	1.3	--	1.2
Local	1.3	0.7	1.3	2.0	--	1.1
Betel leaf						
Local	--	3.3	--	--	--	0.7

4.11 Distribution of Farmers According to Jute Variety Use

Considering all locations, the highest 9.3% respondent farmers used GRO-524 HYV of jute crop followed by local (6.8%) and Bangkim (6.3%).About 14% farmers produced jute by using Bangkim variety compared to local (4%) and GRO-524 (6.7%) in Bagherhat district. The highest 35.3% farmers produced jute by using GRO-524 variety compared to Bangkim (10%) and local (8.7%) in Gopalgonj district. About 3.3% farmers produced jute by using local variety compared to O-9897(2.7%) and Bangkim (2%) in Khulna district. In Pirojpur district about 8.7% farmers used local variety followed by Bangabir (6%) and Indian variety (5.3%). About 9.3% farmers produced jute by using local variety compared to Katabogi (3.3%) and Bangkim & GRO-524 (2%) in Satkhira district (Table 4.10).

Table 4.10 Percent distribution of farmers according to jute variety use

Jute variety	% use of jute variety					
	Bagherhat *(n=150)*	Gopalgonj *(n=150)*	Khulna *(n=150)*	Pirojpur *(n=150)*	Satkhira *(n=150)*	All area *(n=750)*
GRO-524	6.7	35.3	1.3	1.3	2.0	9.3
Bangkim	14.0	10.0	2.0	3.3	2.0	6.3
Indian	2.0	5.3	1.3	5.3	1.3	3.1
Bangabir	1.3	4.0	0.7	6.0	0.7	2.5
O-9897	1.3	3.3	2.7	2.0	1.3	2.1
Katabogi	1.3	0.7	1.3	0.7	3.3	1.5
Moharastro	0.7	4.7	0.7	--	--	1.2
Local	4.0	8.7	3.3	8.7	9.3	6.8

4.12 Distribution of Farmers According to Variety Use in Vegetable Crops

Considering all location, the highest 1.7% respondent farmers used local variety of brinjal followed by BARI Begun-14 & HYV (1.5%) and *Bt* brinjal (1.2%) in the study area. In Bagherhat district, about 8% farmers used local variety, 2.7% farmers used BARI Begun-14 & HYV and 2% farmers used *Bt* variety for brinjal production. About 3.3% farmers used local variety, 2.0% farmers used BARI Begun-14 & HYV and 1.3% farmers used *Bt* variety for brinjal production in Gopalgonj district. About 2% farmers used local variety, 2.7% farmers used BARI Begun-14 & HYV and 4% farmers used *Bt* variety for brinjal production in Khulna district. About 3.3% farmers used local variety, 2.7% farmers used BARI Begun-14 & HYV and 0.7% farmers used *Bt* variety for brinjal production in Pirojpur district.

Table 4.11 Percent distribution of farmers according to variety use in vegetable crops

Crop variety	% use of crop variety					
	Bagherhat *(n=150)*	Gopalgonj *(n=150)*	Khulna *(n=150)*	Pirojpur *(n=150)*	Satkhira *(n=150)*	All area *(n=750)*
Brinjal						
Bari-14, HYV	2.7	2.0	2.7	2.7	0.0	1.5
Bt brinjal	2.0	1.3	4.0	0.7	0.0	1.2
Local	8.0	3.3	2.0	3.3	0.0	1.7
Okra						
Hybrid	0.7	1.3	2.0	1.3	1.3	1.2
Local	3.3	5.3	1.3	2.0	1.3	2.0
Tomato						
Bari-8, -14	3.3	2.0	4.7	2.0	16.7	5.7
Hybrid	0.7	1.3	2.0	1.3	3.3	1.7
Cauliflower						
HYV	0.0	2.0	3.3	1.3	2.7	1.9
Local	0.0	0.7	0.7	0.7	0.0	0.4
Bottle gourd						
Bari-5, -2, -4	1.3	1.3	2.0	2.7	1.3	1.7
Hybrid	0.7	0.0	0.7	1.3	0.0	0.5
Local	1.3	2.0	2.7	4.7	1.3	2.4
Bitter gourd						
Hybrid	0.0	0.0	1.3	0.0	0.0	0.3
HYV	0.0	0.0	1.3	0.0	0.0	0.3
Pumpkin						
Bari-5, HYV	2.7	1.3	2.7	2.0	2.0	2.1
Local	0.7	1.3	2.0	5.3	0.7	2.0
Radish						
Bari-1, HYV	2.0	2.7	0.0	2.0	0.0	1.3
Local	1.3	1.3	0.0	2.7	0.0	1.1
Country bean						
HYV, Bari-11	0.7	0.0	1.3	1.3	0.0	0.7
Local	2.0	0.7	2.0	3.3	1.3	1.9
Red amaranth						
Bari-1 & HYV	2.0	1.3	2.0	1.3	1.3	1.2
Local	6.0	2.0	6.0	1.3	0.7	3.2
Stem amaranth						
Local	0.0	2.0	0.0	2.7	0.0	0.9
Indian spinas						
Local	0.0	2.7	3.3	4.7	2.0	2.5

The highest 2% respondent farmers used local variety of okra followed by hybrid variety (1.2%) in the study area. Most of the farmers used local variety of okra in all districts except Khulna district. For tomato production, most of the farmers used BARI Tomato 8, and BARI Tomato 14 in all districts compared to hybrid variety of tomato in the study area. Majority respondent farmers used HYV of cauliflower compared to local variety in all districts. Most of the farmers used local of bottle gourd compared to BARI Lau-2, BARI Lau-4 and BARI Lau-5 variety as well as hybrid of bottle gourd in all districts. Only farmers of Khulna district used HYV and hybrid for bitter gourd production in the study area. About 2.1% farmer used BARI Mistikumra-5 and HYV of pumpkin and 2% farmer used local variety of pumpkin in the study area. The highest 2.1% farmer used BARI Mula-1 and HYV of radish compared to

local variety of radish. The highest 1.9% respondent farmers used local variety of country bean followed by BARI Sheem-11 & HYV variety (0.7%) in the study area. Similar trend was observed in Red amaranth, Stem amaranth and Indian spinach (Table 4.11).

4.13 Varietal Status of Fruit Trees in Bagherhat District

The major trees of sample farmers in Bagherhat district were observed in Table 4.12. All varieties were listed local except Banana (50%), Guava (33.3%) and Mango (29.3%). The information regarding fruit trees were considered as maximum and minimum number of fruit trees, mean, improved and local variety of fruit trees. The detailed in formations were shown in Table 4.12.

Table 4.12 Availability of fruit trees and their varietal status in Bagherhat district

Sl. No.	Fruit tree	N	Number of fruit trees owned			Variety use (%)	
			Minimum	Maximum	Mean	Improved	Local
1	Hog plum	2	8	30	19.0	0.0	100.0
2	Bullock heart	1	2	2	2.0	0.0	100.0
3	Banana	2	20	50	35.0	50.0	50.0
4	Jujube	5	1	3	1.8	0.0	100.0
5	Pomelo	2	5	6	5.5	0.0	100.0
6	Black berry	2	1	2	1.5	0.0	100.0
7	Coconut	100	1	100	15.5	0.0	100.0
8	Dates	2	120	120	120.0	0.0	100.0
9	Guava	9	1	70	12.4	33.3	66.7
10	Jackfruit	24	1	50	9.0	0.0	100.0
11	Carambola	4	1	5	2.5	0.0	100.0
12	Lemon	8	1	65	12.3	0.0	100.0
13	Litchi	3	1	2	1.3	0.0	100.0
14	Mango	82	1	75	10.0	29.3	70.7
15	Nut	76	3	300	61.0	0.0	100.0
16	Plum	1	2	2	2.0	0.0	100.0
17	Sapota	19	1	5	1.9	0.0	100.0
18	Tamarind	1	1	1	1.0	0.0	100.0
19	Wood apple	1	1	1	1.0	0.0	100.0
20	Wax apple	2	2	2	2.0	0.0	100.0

4.14 Varietal Status of Fruit Trees in Gopalgonj District

A total of 25 different types of fruit trees were reported by the respondent farmers in Gopalgonj district. Among these fruit trees per farmer owned the highest average 82.9 no. of banana trees, of which 43.8% were found improved variety followed by lemon (35) and nut (32). It was observed that most of farmers used local variety of fruit trees while 100% improved variety of multa and orange in the study area (Table 4.13).

Table 4.13 Availability of fruit trees and their varietal status in Gopalgonj district

Sl. No.	Fruit tree	N	Number of fruit trees owned			Variety use (%)	
			Minimum	Maximum	Mean	Improved	Local
1	Hog plum	9	1	11	3.3	0.0	100.0
2	Bullock heart	2	1	2	1.5	0.0	100.0
3	Banana	16	5	200	82.9	43.8	56.3
4	Jujube	5	1	4	1.6	20.0	80.0
5	Pomelo	7	1	6	2.7	0.0	100.0
6	Black berry	11	1	5	1.8	0.0	100.0
7	Coconut	73	1	40	6.0	0.0	100.0
8	Dates	5	1	6	3.0	0.0	100.0
9	Guava	79	1	20	3.1	57.0	43.0
10	Jackfruit	70	1	40	5.0	0.0	100.0
11	Carambola	1	2	2	2.0	0.0	100.0
12	Lemon	5	2	160	35.0	20.0	80.0
13	Litchi	9	1	50	6.7	88.9	11.1
14	Mango	119	1	400	9.6	49.6	50.4
15	Multa	5	2	5	2.6	100.0	0.0
16	Nut	6	8	100	32.0	0.0	100.0
17	Olive	1	1	1	1.0	0.0	100.0
18	Orange	2	1	1	1.0	100.0	0.0
19	Papaya	10	1	20	7.4	20.0	80.0
20	Pomegranate	1	1	1	1.0	0.0	100.0
21	Plum	16	1	10	3.8	0.0	100.0
22	Sapota	9	1	2	1.2	0.0	100.0
23	Tamarind	1	1	1	1.0	0.0	100.0
24	Wood apple	3	1	1	1.0	0.0	100.0
25	Wax apple	11	1	2	1.4	0.0	100.0

4.15 Varietal Status of Fruit Trees in Khulna District

A total of 21 different types of fruit trees were listed by the respondent farmers in Khulna district. Among these fruit trees per farmer owned the highest average 109.7 no. of banana trees, of which 88% were found improved variety followed by nut (77.6) and multa (23). It was observed that most of farmers used local variety of fruit trees while 100% improved variety of multa and dragon fruit in the study area (Table 4.14).

4.16 Varietal Status of Fruit Trees in Pirojpur District

A total of 18 different types of fruit trees were listed by the respondent farmers in Pirojpur district. Among these fruit trees per farmer owned the highest average 211 no. of nut trees, of which 100% were found local variety followed by banana (42.5) and Malta (21.2). It was observed that most of farmers used local variety of fruit trees while 100% improved variety of Malta and orange fruit in the study area (Table 4.15).

Table 4.14 Availability of fruit trees and their varietal status in Khulna district

Sl. No.	Fruit tree	N	Number of fruit trees owned			Variety use (%)	
			Minimum	Maximum	Mean	Improved	Local
1	Hog plum	4	1	1	1.0	0.0	100.0
2	Banana	25	5	400	109.7	88.0	12.0
3	Jujube	14	1	50	6.0	28.6	71.4
4	Pomelo	1	3	3	3.0	0.0	100.0
5	Black berry	28	1	15	2.6	0.0	100.0
6	Coconut	79	2	56	13.6	2.5	97.5
7	Dragon fruit	3	1	50	21.0	100.0	0.0
8	Guava	51	1	25	6.1	66.7	33.3
9	Jackfruit	25	1	20	5.3	0.0	100.0
10	Wood apple	9	1	5	2.5	0.0	100.0
11	Lemon	6	1	100	22.0	0.0	100.0
12	Litchi	8	1	3	1.6	87.5	12.5
13	Mango	113	1	200	16.5	97.3	2.7
14	Multa	2	6	40	23.0	100.0	0.0
15	Nut	13	4	500	77.6	0.0	100.0
16	Papaya	3	2	20	10.7	0.0	100.0
17	Pomegranate	1	2	2	2.0	0.0	100.0
18	Plum	3	1	2	1.7	0.0	100.0
19	Sapota	30	1	12	2.7	0.0	100.0
20	Bel	3	2	4	3.3	0.0	100.0
21	Wax apple	11	1	4	2.1	0.0	100.0

Table 4.15 Availability of fruit trees and their varietal status in Pirojpur district

Sl.No.	Fruit tree	N	Number of fruit trees owned			Variety use (%)	
			Minimum	Maximum	Mean	Improved	Local
1	Hog plum	10	1	10	5.0	0.0	100.0
2	Banana	4	20	100	42.5	0.0	100.0
3	Jujube	2	1	4	2.5	0.0	100.0
4	Black berry	1	1	1	1.0	0.0	100.0
5	Coconut	99	1	100	10.8	0.0	100.0
6	Guava	18	1	10	4.2	50.0	50.0
7	Jackfruit	28	1	40	9.2	0.0	100.0
8	Lemon	3	1	10	7.0	0.0	100.0
9	Litchi	4	2	10	4.0	50.0	50.0
10	Lotkon	2	1	5	3.0	0.0	100.0
11	Mango	64	1	50	8.4	60.9	39.1
12	Malta	11	1	100	21.2	100.0	0.0
13	Nut	110	5	2000	211.0	0.0	100.0
14	Olive	1	1	1	1.0	0.0	100.0
15	Orange	5	1	15	7.0	100.0	0.0
16	Sapota	5	1	2	1.6	0.0	100.0
17	Pomelo	1	10	10	10.0	0.0	100.0
18	Wax apple	1	2	2	2.0	0.0	100.0

4.17 Varietal Status of Fruit Trees in Satkhira District

A total of 13 different types of fruit trees were listed by the respondent farmers in Satkhira district. Among these fruit trees per farmer owned the highest average 53 no. of nut trees, of which 100% were found local variety followed by mango (16.2) and guava (14.5). It was observed that most of farmers used local variety of fruit trees while 100% improved variety of jujube, litchi and orange fruit in the study area (Table 4.16).

Table 4.16 Availability of fruit trees and their varietal status in Satkhira district

Sl. No.	Fruit tree	N	Number of fruit trees owned			Variety use (%)	
			Minimum	Maximum	Mean	Improved	Local
1	Hog plum	1	2	2	2.0	0.0	100.0
2	Jujube	4	1	3	1.5	100.0	100.0
3	Black berry	2	1	1	1.0	0.0	100.0
4	Coconut	66	1	50	6.3	0.0	100.0
5	Guava	10	1	120	14.5	60.0	40.0
6	Jackfruit	27	2	30	7.4	0.0	100.0
7	Lemon	11	1	30	5.9	0.0	100.0
8	Litchi	5	1	17	5.0	100.0	100.0
9	Mango	99	1	200	16.2	99.0	1.0
10	Nut	7	4	200	53.0	0.0	100.0
11	Orange	1	4	4	4.0	100.0	0.0
12	Sapota	14	1	10	2.5	0.0	100.0
13	Wax apple	2	1	2	1.5	0.0	100.0

Chapter V

COST AND RETURN OF CROP PRODUCTION

5.1 Introduction

An attempt has been made to analyze the cost, return and profitability scenarios of different crops grown in the study areas. These base indicators can later be used to evaluate the socioeconomic impact of on-farm research to be implemented especially on improved cropping patterns. However, detailed current input use pattern and the profitability of crop production in the study areas have been discussed in the following sections.

5.2 Input Use and Profitability of Crop Production in Bagherhat District

5.2.1 Transplanted Aman (*T. Aman)* rice

Transplanted Aman (*T.Aman*) is an important *Kharif-2* season (16 July-15 October) rain-fed rice crop in Bangladesh. Its seeding time starts from late June and continues up to late August. Its seedling transplantation generally starts from August and harvests completed between mid-December to early January depending on seedling transplantation. *T.Aman* rice contributes to the total food grain production in Bangladesh. In 2017-18, the total volume of rice grains production in Bangladesh was 362.78 lakh MT of which the share of *T.Aman* in Bagherhat district was estimated at 128.216 thousand MT (0.353%) from 71.50 thousand hectares (BBS, 2019).

Respondent farmers in the study areas used a total number of 83.58 man-days of human labour and about 46 kg of seed per hectare in producing *T.Aman* rice. Human labour was mainly used for land preparation, seeding, transplanting, weeding and crop harvesting. They also applied different types of fertilizers and cow dung manure in cultivating *T.Aman* rice. Irrespective of farm category, they used 170.17 kg urea, 129.43 kg TSP, 75.97 kg MoP, 64.61 kg Gypsum and 5.22 kg Zinc sulphate per hectare. Except urea, they used over dose of these fertilizers compared to their recommended doses (FRG, 2012). In addition, all the respondent farmers used on average 542.47 kg of cow dung manure in their rice field. No particular pattern of using fertilizers did not find among farm categories. However, large and medium category farmers used higher amount of TSP, MoP, Gypsum and Zinc sulphate compared to other category of farmers in the study areas (Table 5.1).

Table 5.1 Per hectare input use in *T.Aman* rice production in Bagherhat district

Particulars	Large & medium	Small	Marginal	All category
	n= 31	*n=70*	*n=14*	*n=115*
Human labour (man-day)	84.90	81.89	89.14	83.58
Seed (kg)	43.97	46.64	43.34	45.52
Urea (kg)	176.19	161.36	200.93	170.17
TSP (kg)	152.65	119.09	129.79	129.43
MoP (kg)	99.52	67.17	67.79	75.97
Gypsum (kg)	81.06	58.04	61.00	64.61
Zinc sulphate (kg)	6.30	4.89	4.49	5.22
Boron (kg)	1.51	1.51	2.04	1.57
Manure (kg)	406.97	299.30	2058.36	542.47

The average cost of *T.Aman* rice production was estimated at Tk. 71,885 per hectare of which 78.9% was variable cost and the rest (21.1%) was fixed cost. In terms of variable inputs, human labour incurred the highest share of the total cost (46.5%) followed by land preparation (9.9%), manure & fertilizer (9.7%), and seed (Table 5.2). Table 5.2 further reveals that the cost of production was higher for large & medium farmers followed by marginal and small farmers.

The average yield of *T.Aman* rice was estimated at 4.24 t/ha in the study areas which was much higher than the national average of 2.464 t/ha (BBS, 2019). The highest yield (4.633 t/ha) was recorded for large and medium farmer and the lowest (4.058 t/ha) for small farmer. The higher yields were attributed to the higher use of fertilizers. This rice crop is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 87,852 and Tk.15,985 respectively. Due to higher yield and price large and medium farmers received the highest gross as well as net return. The average benefit cost ratios (BCRs) on variable cost and full cost basis were 1.55 and 1.22 respectively (Table 5.2).

Table 5.2 Per hectare cost and return of *T.Aman* rice production in Bagherhat district

Particulars	Large & medium (n= 31)	Small (n=70)	Marginal (n=14)	All category (n=115)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**58342**	**54990**	**61791**	**56721**	**78.9**
Labour	33923	32744	35573	33407	46.5
Land preparation	7338	7096	6948	7143	9.9
Seed	1742	1791	1668	1763	2.5
Urea	2963	2689	3462	2857	4.0
TSP	3669	2923	3270	3166	4.4
MoP	1534	1037	1042	1172	1.6
Gypsum	1673	1113	943	1243	1.7
Zinc sulphate	1032	786	704	842	1.2
Boron	271	278	353	285	0.4
Manure	214	159	1029	280	0.4
Irrigation	754	957	3013	1152	1.6
Pesticides	2658	2880	3181	2857	4.0
Interest on OC	572	539	606	556	0.8
B. Fixed cost					
Land use cost	15179	15191	14996	15164	21.1
C. Total cost (A+B)	**73520**	**70181**	**76787**	**71885**	**100.0**
Total production (kg)	4633	4058	4266	4238	
Product price (Tk/kg)	17.82	17.66	17.86	17.73	
Return from main product	82573	71667	76171	75137	
Return from byproduct	13899	12174	12797	12715	
D. Total return	**96472**	**83841**	**88968**	**87852**	
E. Gross margin (D-A)	38131	28851	27177	31131	
F. Net return (D-C)	22952	13661	12181	15985	
G. Benefit cost ratio					
Over total cost	1.31	1.19	1.16	1.22	
Over variable cost	1.65	1.52	1.44	1.55	

5.2.2 Transplanted Aus rice

Transplanted *Aus* (*T.Aus*) is a less popular *Kharif-1* season (16 March-15 July) rain-fed and irrigated rice crop in Bangladesh. Bangladesh Government has been trying to popularize this rice among farmers because it needs less irrigation and can utilize large amounts of fallow land (current fallow) throughout the country. Its seeding time starts from late March and continues up to late April. The seedling transplantation of this rice generally starts from mid-April and harvests completed between mid-July and mid-August depending on seedling transplantation. It contributes little to the total food grain production in Bangladesh. In 2017-18, the total volume of rice grains production in Bangladesh stood at 362.78 lakh MT of which *T.Aus* accounted for 14.30 thousand MT (0.039%) from 5.79 thousand hectares of lands (BBS, 2019).

Among the five study areas, only the respondent farmers of Bagherhat and Khulna district cultivated *T.Aus* rice. Respondent farmers in the study areas used a total number of 81.3 man-days of human labour and about 74.8 kg of seed per hectare in producing *T.Aus* rice. The respondent farmers applied both organic and inorganic fertilizers in cultivating *T.Aus* rice. They applied on an average 127.4 kg of Urea per hectare which is lower than the recommended dose. Again, they used TSP, MoP and Gypsum at the rate of 101.1 kg, 51.1 kg and 38.7 kg per hectare respectively which are higher than the recommended dose (FRG, 2012). Respondent farmers did not use Cowdung manure at all. There is a positive relationship between farm size and input use meaning that farmers having higher land resources apply higher amount of inputs and vice versa (Table 5.3).

Table 5.3 Per hectare input use in Aus rice production in Bagherhat district

Particulars	Large & medium	Small	Marginal	All
	n= 2	*n=6*	*n=2*	*n=10*
Human labour (man-day)	82.00	80.83	82.00	81.30
Seed (kg)	74.80	74.80	74.80	74.80
Urea (kg)	168.50	131.17	75.00	127.40
TSP (kg)	131.00	99.83	75.00	101.10
MoP (kg)	73.00	47.17	41.00	51.10
Gypsum (kg)	48.50	36.00	37.00	38.70

The average cost of *T.Aus* rice production was estimated at Tk. 59,728 per hectare of which the share of variable cost was 83.5% and the rest 16.5% was fixed cost. In terms of the various inputs, labour costs incurred the highest share (54.6%) of total cost followed by land preparation (11.8%), fertilizers (9.8%) and pesticides (Table 5.4). There is a positive relationship exist between farm size category and production cost meaning that large category farmers incur the higher cost of production due to higher use of inputs and vice versa.

The average yield of *T.Aus* rice was reported to be 3.862 t/ha in the study areas which was higher than the national average of 2.51 t/ha (BBS, 2019). *T.Aus* rice is reported to be a marginally profitable crop in the study areas. The average gross return and net return were estimated at Tk. 65,654 and Tk. 5,927 respectively. The benefit cost ratios (BCRs) on variable cost and full cost basis were 1.32 and 1.10 respectively (Table 5.34). The main reasons for producing less return were lower yield, lower price of output and higher cost of land preparation compared to *Boro* and *T.Aman* rice. Table 5.4 further reveals that there is a negative relationship between farm size and rate of return (BCR) in the study areas due to higher production and lower cost of production.

Table 5.4 Per hectare cost and return of Aus rice production in Bagherhat district

Particulars	Large & medium (n= 2)	Small (n=6)	Marginal (n=2)	All category (n=10)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**51957**	**49358**	**49208**	**49848**	**83.5**
Labour	32933	32434	32933	32634	54.6
Land preparation	6924	6924	7485	7036	11.8
Seed	1871	1871	1871	1871	3.1
Urea	2695	2096	1198	2036	3.4
TSP	3144	2395	1796	2425	4.1
MoP	1095	711	618	769	1.3
Gypsum	730	573	580	606	1.0
Pesticides	2058	1871	2245	1983	3.3
Interest on OC	509	484	482	489	0.8
B. Fixed cost					
Land use cost	9880	9880	9880	9880	16.5
C. Total cost (A+B)	**61837**	**59238**	**59088**	**59728**	**100.0**
Total production (kg)	3817	3867	3892	3862	
Product price (Tk/kg)	13.75	13.75	13.75	13.75	
Return from main product	52484	53171	53515	53103	
Return from byproduct	12406	12568	12649	12552	
D. Total return	**64890**	**65739**	**66164**	**65654**	
E. Gross margin (D-A)	12932	16382	16956	15807	
F. Net return (D-C)	3052	6502	7076	5927	
G. Benefit cost ratio					
Over total cost	1.05	1.11	1.12	1.10	
Over variable cost	1.25	1.33	1.34	1.32	

5.2.3 Boro rice

Boro is one of the most important *Rabi* season (16 October-15 March) irrigated rice crops in Bangladesh. Its seeding time starts from November and continues up to mid-January. Its seedling transplantation generally starts from December and harvests are completed within April and June depending on seedling transplantation. It significantly contributes to the total food grain production in Bangladesh. According to the national estimates (BBS, 2019), the total volume of rice grains production in 2017-18 stood at 362.78 lakh MT of which *Boro* accounted for 219.58 thousand MT (0.605%) from 50.83 thousand hectares.

Per hectare input use pattern by farm category in *Boro* rice production is presented in Table 5.5. Respondent farmers in the study areas used a total number of 95.24 man-days of human labour and about 44.02 kg of seed per hectare in producing *Boro* rice. They used different types of fertilizers and cowdung manure in cultivating *Boro* rice. Irrespective of farm categories, in comparison with the guidelines they used a lower dose of urea, MoP, and Gypsum, and an over dose of TSP and Zinc fertilizers in *Boro* rice cultivation (FRG, 2012). However, more or less similar fertilizer use trends were found among different farm categories (Table 5.5).

Table 5.5 Per hectare input use in Boro rice production in Bagherhat district

Particulars	Large & medium	Small	Marginal	All
	n= 11	*n=35*	*n=3*	*n=49*
Human labour (man-day)	92.45	95.49	102.67	95.24
Seed (kg)	44.58	43.79	44.60	44.02
Urea (kg)	238.82	204.00	177.67	210.20
TSP (kg)	227.64	170.63	182.00	184.12
MoP (kg)	125.18	76.97	91.00	88.65
Gypsum (kg)	100.82	67.83	76.00	75.73
Zinc sulphate (kg)	8.03	7.16	6.60	7.32
Boron (kg)	4.24	2.66	0.00	2.85
Manure (kg)	2728.09	2134.80	1086.67	2203.82

The productivity of a crop depends on many factors such as time of sowing, seed quality, variety, crop protection, intercultural operations, weather, rate of manure and fertilizer use, inherent soil fertility, and so on. Notwithstanding the differences in the crop production in the study areas the average yield of *Boro* rice was 7.00 t/ha which was much higher that national average of 4.02 t/ha (BBS, 2019). The highest yield was received by the marginal farmer and the lowest yield by the large and medium category farmers in the study areas. Attaining higher yield might be due to intensive care (involve more labour), much irrigation and crop protection (use higher amount of pesticides).

The average cost of *Boro* rice production was Tk. 96,275 per hectare of which the share of variable cost was 84.1% and the rest (15.9%) was fixed cost. In terms of the various inputs, labour costs incurred the highest share (39.6%) of total cost followed by irrigation (15%) and manure & fertilizer (14.9%) (Table 5.6). *Boro* rice is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 1,17,145 and Tk. 20,870 per hectare respectively. The overall rate of return (BCR) was 1.22 over full cost and 1.45 over variable cost basis. The lowest net return was received by large & medium category farmers and the highest net return was received by marginal category farmers. The reasons behind receiving lower net return were higher cost of production, lower yield and comparatively low selling price of output (Table 5.6).

Table 5.6 Per hectare cost and return of Boro rice production in Bagherhat district

Particulars	Large & medium (n= 11)	Small (n=35)	Marginal (n=3)	All category (n=49)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**83014**	**80265**	**82221**	**81002**	**84.1**
Labour	36971	38196	40957	38090	39.6
Land preparation	6594	6654	6113	6607	6.9
Seed	2484	2676	2658	2632	2.7
Urea	4079	3472	3086	3585	3.7
TSP	5663	4247	4425	4575	4.8
MoP	1921	1191	1389	1367	1.4
Gypsum	1835	1295	1534	1431	1.5
Zinc sulphate	1269	1185	1186	1204	1.3
Boron	765	532	--	552	0.6
Manure	1931	1443	817	1514	1.6
Irrigation	14657	14327	14870	14434	15.0
Pesticides	4032	4260	4381	4216	4.4
Interest on OC	814	787	806	794	0.8
B. Fixed cost					
Land use cost	15718	15208	14408	15274	15.9
C. Total cost (A+B)	**98732**	**95473**	**96629**	**96275**	**100.0**
Total production (kg)	6751	7042	7501	7005	
Product price (Tk/kg)	16.48	16.43	16.67	16.45	
Return from main product	111240	115686	125017	115255	
Return from byproduct	2285	1821	1260	1891	
D. Total return	**113525**	**117507**	**126277**	**117145**	
E. Gross margin (D-A)	30511	37242	44056	36144	
F. Net return (D-C)	14793	22034	29647	20870	
G. Benefit cost ratio					
Over total cost	1.15	1.23	1.31	1.22	
Over variable cost	1.37	1.46	1.54	1.45	

5.2.4 Brinjal

Brinjal is an important and popular vegetable in Bangladesh which is consumed throughout the year. Brinjals are classified into two categories in respect of their production period. These are Rabi brinjal and Kharif brinjal. Though it is more or less available throughout the year, its peak supply comes during December to April (Mollika, 2015). According to the national estimates (BBS, 2019), the total volume of brinjal production in 2017-18 stood at 3.85lakh MT from 2813.76 hectares.

Human labour was required for land development, planting, application of manures, fertilizing, spraying, weeding, irrigating and harvesting. On average 513 man-days/ha was required for brinjal cultivation. Manure and fertilizer is essential for better production of Brinjal. In the survey area farmer apply cowdung, TSP, MoP, gypsum, boron, zinc and Urea. On an average 4968 kg manures, 450 kg Urea, 488 kg TSP, 70 kg MoP, and 9 kg zinc per hectare were applied for brinjal production in the study area. The average cost of *Brinjal* production was Tk. 3,02,077 per hectare of which the share of variable cost was 94.1% and the rest (5.9%) was fixed cost. The average yield of brinjal was estimated 35.79MT per hectare. The average gross return and net return were estimated at Tk. 431601and Tk. 413817 per hectare respectively. The overall rate of return (BCR) was 2.37 over full cost and 2.52 over variable cost basis.

Table 5.7 Per hectare input use and profitability of brinjal production in Bagherhat district

Particulars	Input use *(n= 10)*	Unit price *(n=10)*	Total cost/return (Tk/ha) *(n=10)*	% of total cost
A. Variable cost			**284293**	**94.1**
Labour (man-day)	513	400	205240	67.9
Land preparation			8892	2.9
Seed (kg)	1.0	2900	2900	1.0
Fertilizer (kg)				
Urea	450	17.0	7647	2.5
TSP	488	26.0	12683	4.2
MoP	70	16.2	1140	0.4
Gypsum	152	15.0	2276	0.8
Zinc sulphate	9	191.0	1744	0.6
Boron	0.80	180.0	144	0.0
Manure (kg)	4968	0.75	3726	1.2
Irrigation			12735	4.2
Pesticides			20967	6.9
Interest on OC			4201	1.4
B. Fixed cost				
Land use cost			17784	5.9
C. Total cost (A+B)			**302077**	**100.0**
Total production (kg)	35795	20.0	715894	
Return from byproduct			0	
D. Total return			**715894**	
E. Gross margin (D-A)			431601	
F. Net return (D-C)			413817	
G. Benefit cost ratio				
Over total cost			2.37	
Over variable cost			2.52	

5.2.5 Chili

Chili (Capsicum spp.) is an important commercial crop that is grown all over the world. It is used in almost every cuisine as spices for its pungency, color and flavor. Both green and red chilies are used for preparing different palatable item such as chili chicken, chili poneer, chili sauce, chili jam etc. The plethora of nutritional and medicinal quality gives it an extra importance. Soil and environmental conditions of Bangladesh most favorable to chili cultivation. In Bangladesh across the country both *Robi* and *Kharif* season chili cultivated. According to the national estimates (BBS, 2019), the total volume of chili production in 2017-18 stood at 141thousand MT from 101.214 thousand hectares.

Per hectare input use and profitability of chili cultivation in Bagherhat shown in Table 5.8. Respondent farmers in the study areas used a total number of 202 man-days of human labour and about 8.70 kg of seed per hectare in producing chili. Human labour was mainly used for land preparation, seeding, transplanting, weeding and crop harvesting. They also applied different types of fertilizers and cow dung manure in cultivating chili. Irrespective of farm category, they used 329 kg urea, 248 kg TSP, 174.08 kg MoP, 73.50 kg Gypsum and 5.54 kg Zinc sulphate per hectare. The sample farmers opined that on an average per hectare1128.83 kg manures applied chili field.

The total cost of chili cultivation was estimated Tk 138790 per hectare of which the share of variable cost was 87.6% and the rest (12.4%) was fixed cost. The average yield of chili was estimated 6.8 t/ha. The gross return and net return were estimated at Tk. 70508 and Tk. 53321 per hectare respectively. The overall rate of return (BCR) was 1.38 over full cost and 1.58 over variable cost basis.

Table 5.8 Per hectare input use and profitability of Chili production in Bagherhat district

Particulars	Input use *(n= 12)*	Unit price *(n=12)*	Total cost/return (Tk/ha) *(n=12)*	% of total cost
A. Variable cost			**121603**	**87.6**
Labour (man-day)	202	400.00	80967	58.3
Land preparation			6954	5.0
Seed (kg)	8.70	339.17	2951	2.1
Fertilizer (kg)				
Urea	329.00	17.00	5593	4.0
TSP	248.00	25.00	6200	4.5
MoP	174.08	15.58	2713	2.0
Gypsum	73.50	15.00	1103	0.8
Zinc sulphate	5.54	160.00	887	0.6
Manure (kg)	1128.83	0.75	847	0.6
Irrigation			8657	6.2
Pesticides			3541	2.6
Interest on OC			1192	0.9
B. Fixed cost				
Land use cost			17187	12.4
C. Total cost (A+B)			**138790**	**100.0**
Total production (kg)	6829	28.13	192111	
Return from byproduct			0	
D. Total return			**192111**	
E. Gross margin (D-A)			**70508**	
F. Net return (D-C)			53321	
G. Benefit cost ratio				
Over total cost			1.38	
Over variable cost			1.58	

5.2.6 Jute

Jute one of the golden fibers of Bangladesh has been considered an important source of foreign exchange earnings of the country. Bangladesh is the major jute producing country of the world. Climatic condition of Bangladesh are most favorable jute cultivation. The optimal range of temperature required is 18-33 degree Celsius. Jute is cultivated in the rainy season. In Bangladesh seed sowing usually starts at the end of February and continuous up to the end of May depending on the species. According to the national estimates (BBS, 2019), the total volume of jute production in 2017-18 stood at 1930 thousand MT from 7,58,218 hectares. Average yield rate has been estimated at 2.56 MT per hectare in 2017-18.

Table 5.9 shows that per hectare input use and profitability of jute production in Bagherhat district. A total of 151.27 man-days human labour and 6.63 kg seed were used per hectare jute production in the study area. Human labour was mainly used land preparation, fertilizer application, weeding, harvesting etc. The respondent in the study areas applied different dose of fertilizer like urea (96kg), TSP (89.77), MoP (59.43 kg), gypsum (62.87 kg) and zinc sulphate (2.12 kg). Per hectare variable cost was estimated Tk. 80826 which 83.8 % of total

cost and the rest 16.4% was fixed cost. The total yield of per hectare was estimated 3.50 MT in the study areas which is higher than national average. Estimation of jute cultivation found that it was a profitable crop in Bagherhat district. The total return was estimated Tk. 163464 per hectare which Tk.18900 from byproduct of raw materials. Irrespective of different farm categories gross margin and net margin were estimated Tk. 82608 and Tk. 66965 per hectare respectively. The overall rate of return (BCR) was 1.69 over full cost and 2.02 over variable cost basis.

Table 5.9 Per hectare input use and profitability of jute production in Bagherhat district

Particulars	Input use *(n= 30)*	Unit price *(n=30)*	Total cost/return (Tk/ha) *(n=30)*	% of total cost
A. Variable cost			**80826**	**83.8**
Labour (man-day)	151.27	400.00	60507	62.7
Land preparation			7126	7.4
Seed (kg)	6.63	213.33	1415	1.5
Fertilizer (kg)				
Urea	96.00	17.00	1632	1.7
TSP	89.77	23.07	2071	2.1
MoP	59.43	15.10	897	0.9
Gypsum	62.87	18.30	1150	1.2
Zinc sulphate	2.12	161.25	341	0.4
Irrigation			2938	3.0
Pesticides			1956	2.0
Interest on OC			792	0.8
B. Fixed cost				
Land use cost			15643	16.2
C. Total cost (A+B)			**96469**	**100.0**
Total production (kg)	3504	41.25	144535	
Return from byproduct			18900	
D. Total return			**163434**	
E. Gross margin (D-A)			82608	
F. Net return (D-C)			66965	
G. Benefit cost ratio				
Over total cost			1.69	
Over variable cost			2.02	

5.2.7 Khesari

In Bangladesh, khesari is generally grown as relay crop in the monsoon rice field. It has potential among grain legumes for its tolerance to harsh conditions and its adaptability to unfavorable environments with little disease or insect problems. Khesari has been grown as a cover crop, generally cultivating towards the end of the monsoon rice harvest. Khesari ranks first among the pulses in respect of area and production in Bangladesh. In 2017-18, about 114 thousand tons of khesari were produced from 104 thousand hectares of land in Bangladesh (BBS, 2019). Average yield rate has been estimated at 1.10 MT per hectare in 2017-18.

The total cost of khesari cultivation was Tk. 42639 per hectare of which 63.3% were variable cost and 36.7% were fixed cost. The average return of khesari cultivation in the study areas is shown in Table 5.10. The average yield of khesari was 1.72 t/ha which is higher than national average (1.1 t/ha) and average price was Tk.35/kg. The gross return and gross margin were Tk. 64543 and Tk. 37573per hectare respectively. The net return was Tk. 21904 per hectare.

The benefit cost ratio (BCR) was estimated at 1.51 and 2.39 on full cost and variable cost basis, respectively.

Table 5.10 Per hectare input use and profitability of khesari production in Bagherhat district

Particulars	Input use *(n= 16)*	Unit price *(n=16)*	Total cost/return (Tk/ha) *(n=16)*	% of total cost
A. Variable cost			**26970**	**63.3**
Labour (man-day)	41.25	400.00	16500	38.7
Land preparation			2968	7.0
Seed (kg)	84.13	47.19	3970	9.3
Fertilizer (kg)				
Urea	41.44	17.00	704	1.7
TSP	33.69	23.56	794	1.9
MoP	26.25	16.00	420	1.0
Gypsum	27.81	18.75	521	1.2
Zinc sulphate	2.41	180.00	433	1.0
Boron	2.42	163.33	395	0.9
Interest on OC			264	0.6
B. Fixed cost				
Land use cost			15669	36.7
C. Total cost (A+B)			**42639**	**100.0**
Total production (kg)	1716	35.00	60051	
Return from byproduct			4492	
D. Total return			**64543**	
E. Gross margin (D-A)			37573	
F. Net return (D-C)			21904	
G. Benefit cost ratio				
Over total cost			1.51	
Over variable cost			2.39	

5.2.7 Lentil

On an average, 66.50 man-day of human labour per hectare were used for lentil cultivation. They used 40.03 kg of seeds per hectare which was higher than the recommended rate of 30-35 kg/ha (Krishi Projukti Hatboi, 2011). The respondent farmers applied NPK fertilizers during lentil cultivation. Table 5.11 reveals that they used urea, TSP and MP at the rate of 37.13 kg/ha, 79.81 kg/ha and 53.31 kg/ha respectively. Besides, they also used other fertilizers like Zinc and gypsum at the rate of 3.03 kg/ha and 68.19 kg/ha respectively.

The cost of lentil cultivation was estimated at Tk. 51865/ha. The cost of human labour incurred 44.5% of the total cost followed by land use cost (26.1%). The average yield of lentil was estimated at 1469 kg/ha which was much higher than the national average of 1237 kg/ha (BBS, 2019). The estimated average gross return, gross margin and net return were Tk. 82828/ha, Tk. 38598/ha and Tk. 23006/ha respectively. The benefit cost ratio (BCR) was estimated at 1.38 and 1.87 on full cost and variable cost basis, respectively.

Table 5.11 Per hectare input use and profitability of lentil production in Bagherhat district

Particulars	Input use *(n= 16)*	Unit price *(n=16)*	Total cost/return (Tk/ha) *(n=16)*	% of total cost
A. Variable cost			**44230**	**73.9**
Labour (man-day)	66.50	400.00	26600	44.5
Land preparation			6591	11.0
Seed (kg)	40.03	100.00	4003	6.7
Fertilizer (kg)				
Urea	37.13	17.00	631	1.1
TSP	79.81	23.69	1891	3.2
MoP	53.31	16.00	853	1.4
Gypsum	68.19	25.00	1705	2.8
Zinc sulphate	3.03	180.00	545	0.9
Pesticides			978	1.6
Interest on OC			434	0.7
B. Fixed cost				
Land use cost			15592	26.1
C. Total cost (A+B)			**59822**	**100.0**
Total production (kg)	1469	54.22	79673	
Return from byproduct			3155	
D. Total return			**82828**	
E. Gross margin (D-A)			38598	
F. Net return (D-C)			**23006**	
G. Benefit cost ratio				
Over total cost			1.38	
Over variable cost			1.87	

5.2.8 Maize

According to International Maize and Wheat Improvement Center (CIMMYT) maize has become an emerging crop in Bangladesh with the highest productivity. The crop is now grown on 4.47 lakh hectares of land with productivity of 8.7 tons per hectare. Bangladesh's annual demand for maize was 40 lakh tons and three-fourths of the requirement were locally produced. Maize is now gaining popularity as human food alternative to rice or wheat. It can be grown in all the three seasons of the year. Winter maize is, however, found to be predominant with a share of 84% of the country's total maize area. About the timing of the maize plantation, it is planted at any time during October to February covering five months of the year depending on the land suitability and the cropping practice (BBS, 2014).

The total human labour used for producing maize were found 87.60 man days/ha. The average cost of land preparation was Tk. 6822/ha. On an average farmers used per hectare 21.90 kg seed in their maize field. The average quantity of urea, TSP, MoP, Gypsum, Zinc Sulphate and manures were found 222.60, 122.40, 117.40, 60.20, 5.43 and 2105kg per hectare respectively (Table 5.12).

The average cost of maize production were Tk. 85960, Tk. 70028 and Tk. 15932 per hectare on total cost, total variable cost and fixed cost basis respectively (Table 8). The major share in gross cost was human labour (40.8%) followed by land use cost (18.5%), seed cost (8 %), land preparation cost (7.9%). The average yield of maize was estimated at 6577 kg/ha which was lower than the national average of 8207.11 kg/ha (BBS, 2019). The estimated average gross return, gross margin and net return were Tk. 135805/ha, Tk. 65777/ha, and Tk.

49846/ha respectively. The benefit cost ratio (BCR) was estimated at 1.58 and 1.94 on full cost and variable cost basis, respectively.

Table 5.12 Per hectare input use and profitability of maize production in Bagherhat district

Particulars	Input use *(n= 10)*	Unit price *(n=10)*	Total cost/return (Tk/ha) *(n=10)*	% of total cost
A. Variable cost			**70028**	**81.5**
Labour (man-day)	87.60	400.00	35040	40.8
Land preparation			6822	7.9
Seed (kg)	21.90	315.00	6899	8.0
Fertilizer (kg)				0.0
Urea	222.60	17.00	3784	4.4
TSP	122.40	24.00	2938	3.4
MoP	117.40	15.30	1796	2.1
Gypsum	60.20	23.00	1385	1.6
Zinc sulphate	5.43	171.11	929	1.1
Manure (kg)	2105.10	0.50	1053	1.2
Irrigation			6604	7.7
Pesticides			2092	2.4
Interest on OC			687	0.8
B. Fixed cost				
Land use cost			15932	18.5
C. Total cost (A+B)			**85960**	**100.0**
Total production (kg)	6577	20.00	131546	
Return from byproduct			4259	
D. Total return			**135805**	
E. Gross margin (D-A)			65777	
F. Net return (D-C)			49846	
G. Benefit cost ratio				
Over total cost			1.58	
Over variable cost			1.94	

5.2.9 Mustard

Mustard is an important oilseed crop of the world after soybean. It is a cool loving crop and grows during *Rabi* season (October-February). Mustard is mainly cultivated before *Boro* rice cultivation. Successful adoption of short duration varieties the area and production increasing day by day. The present area and production of mustard are 307641 ha and 351537 MT with an average yield of 1142.69 kg/ha (BBS, 2019).

Table 5.13 shows that per hectare input use pattern and profitability of mustard in the study areas. As a using short duration varieties requires a small number of inputs like human labour, seed, fertilizer, manure, insecticide, irrigation and land preparation tools. The average cost of cultivating mustard was estimated to be Tk 57613 which was 74.3% variable cost and rest of 25.7% land use cost treated as a fixed cost. The average yield of mustard was estimated at 1279 kg/ha which was little bit higher than the national average of 1142.69 kg/ha (BBS, 2019). The estimated average total return, gross margin and net return were Tk. 67034/ha, Tk. 24241/ha and Tk. 9421/ha respectively. The benefit cost ratio (BCR) was estimated at 1.16 and 1.57 on full cost and variable cost basis, respectively.

Table 5.13 Per hectare input use and profitability of mustard production in Bagherhat district

Particulars	Input use *(n= 12)*	Unit price *(n=12)*	Total cost/return (Tk/ha) *(n=12)*	% of total cost
A. Variable cost			**42793**	**74.3**
Labour (man-day)	58.67	400.00	23467	40.7
Land preparation			6555	11.4
Seed (kg)	7.22	80.00	577	1.0
Fertilizer (kg)				
Urea	114.50	16.83	1927	3.3
TSP	95.08	23.50	2234	3.9
MoP	57.00	15.42	879	1.5
Gypsum	38.42	17.22	662	1.1
Zinc sulphate	2.46	160.00	393	0.7
Boron	1.91	160.00	305	0.5
Manure (kg)	372.17	0.50	186	0.3
Irrigation			3882	6.7
Pesticides			1305	2.3
Interest on OC			420	0.7
B. Fixed cost				0.0
Land use cost			14820	25.7
C. Total cost (A+B)			**57613**	**100.0**
Total production (kg)	1279	50.00	63967	
Return from byproduct			3067	
D. Total return			**67034**	
E. Gross margin (D-A)			24241	
F. Net return (D-C)			**9421**	
G. Benefit cost ratio				
Over total cost			1.16	
Over variable cost			1.57	

5.2.10 Potato

Potato is a prominent crop in consideration of production and its internal demand in Bangladesh. Almost every family in Bangladesh consumes potatoes as a vegetable throughout the year. It is a short duration and labour intensive crop. In fact, short cycle of potato frees the land for cultivating other crops. In Bangladesh potato is grown in an area of about 4,77,400 hectares and the total annual production is about 97,44,412 MT. The productivity of potato depends on many factors such as varietal character, use of appropriate amount of inputs, intercultural operations, disease and insect-pest management, and local weather variables. The national average yield of potato was 20.411MT per hectare in 2017-18. (BBS, 2019).

The human labour used for producing potato was found to be 134.73 man days per hectare in which cover 33.7% of total variable cost. The cost of land preparation was Tk. 10112 per hectare (Table 5.14). The quantity of seed and manure used by the farmers were 550.82 kg and 3903.54 kg per hectare. They used chemical fertilizers like urea, TSP, MoP, gypsum, Zinc sulphate, and Boron at the rate of 363.82 kg, 248 kg, 276.27 kg, 118.18 kg, 8.27 kg, and 6.06 kg per hectare. They used higher doses of urea, TSP and MoP than the recommended doses (220-250kg/ha, 120-150kg/ha and 220-250 kg/ha, Source: BARI, 2005) and also used lower doses of Gyppsum, Zinc sulphate and Boron than the recommended doses (100-120 kg/ha, 8-10 kg/ha and 8-10 kg/ha, source: BARC, 2005).

For calculating the cost of cultivation of potato, all variable costs like human labor, land preparation, seed, manures, fertilizers, insecticides, irrigation, and interest on operating capital were calculated per hectare basis. The fixed cost of potato cultivation included cost of land use and family labour. The cost of land use was calculated on the basis of lease value of land. The total cost included fixed cost and variable cost. The cost of potato cultivation was estimated to be Tk. 159806and Tk. 142516 per hectare on total cost and variable cost basis, respectively. The major share in total cost was labour (33.7%) followed by seed (20.7%), chemical fertilizers (15.9%), irrigation (7.1%) and pesticides (4.6%).

The yield of potato was 13.98 t/ha which was below than the national average yield (20.41 t/ha) (BBS, 2019). The total return, gross margin and net return of potato cultivation were Tk. 276419, Tk. 133903, and Tk. 116613 per hectare respectively. The benefit cost ratios were 1.73 and 1.94 on full cost and variable cost basis.

Table 5.14 Per hectare input use and profitability of potato production in Bagherhat district

Particulars	Input use *(n= 11)*	Unit price *(n=11)*	Total cost/return (Tk/ha) *(n=11)*	% of total cost
A. Variable cost			**142516**	**89.2**
Labour (man-day)	134.73	400.00	53891	33.7
Land preparation			10112	6.3
Seed (kg)	550.82	60.00	33049	20.7
Fertilizer (kg)				
Urea	363.82	17.00	6185	3.9
TSP	248.00	24.55	6087	3.8
MoP	276.27	16.00	4420	2.8
Gypsum	118.18	30.71	3630	2.3
Zinc sulphate	8.27	180.00	1489	0.9
Boron	6.06	187.50	1137	0.7
Manure (kg)	3903.45	0.61	2395	1.5
Irrigation			11369	7.1
Pesticides			7354	4.6
Interest on OC			1397	0.9
B. Fixed cost				0.0
Land use cost			17290	10.8
C. Total cost (A+B)			**159806**	**100.0**
Total production (kg)	13982	19.77	276419	
Return from byproduct			0.00	
D. Total return			**276419**	
E. Gross margin (D-A)			133903	
F. Net return (D-C)			116613	
G. Benefit cost ratio				
Over total cost			1.73	
Over variable cost			1.94	

5.3 Input Use and Profitability of Crop Production in Gopalgonj District

5.3.1 Transplanted Aman (*T.Aman*)

Respondent farmers in the study areas used a total number of 87.37 man-days of human labour and about 42.52 kg of seed per hectare in producing *T.Aman* rice. Irrespective of farm category, they used 215.79 kg urea, 114.89 kg TSP, 91.42 kg MoP, 69.32 kg Gypsum and 6.47 kg Zinc sulphate per hectare. Except urea, they used over dose of these fertilizers

compared to their recommended doses (FRG, 2012). All the respondent farmers did not used manure in their rice field. No particular pattern of using fertilizers did not find among farm categories. However, large and medium category farmers used higher amount of TSP, MoP, Gypsum and Zinc sulphate compared to other category of farmers in the study areas (Table 5.15).

Table 5.15 Per hectare input use by farm size in Aman rice production in Gopalgonj district

Particulars	Large & medium	Small	Marginal	All category
	n= 19	*n=52*	*n=23*	*n=94*
Human labour (man-day)	87.37	87.02	92.22	88.36
Seed (kg)	42.52	42.82	42.64	42.71
Urea (kg)	215.79	147.12	127.70	156.24
TSP (kg)	114.89	88.69	86.74	93.51
MoP (kg)	91.42	60.33	52.17	64.62
Gypsum (kg)	69.32	49.50	52.61	54.27
DAP (kg)	75.26	28.63	34.35	39.46
Zinc sulphate (kg)	6.47	5.30	4.97	5.45

Table 5.16 Per hectare cost and return of Aman rice production in Gopalgonj district

Particulars	Large & medium (n= 19)	Small (n=52)	Marginal (n=23)	All category (n=94)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**52177**	**47434**	**47030**	**48294**	**71.6**
Labour	28793	28966	28777	28885	42.8
Land preparation	5458	5384	5497	5427	8.0
Seed	1921	1859	1882	1877	2.8
Urea	3495	2381	2067	2530	3.8
TSP	2567	1974	1920	2081	3.1
MoP	1400	920	787	984	1.5
Gypsum	1655	1182	1263	1297	1.9
DAP	2345	877	1085	1224	1.8
Zinc sulphate	1102	895	832	922	1.4
Pesticides	2929	2529	2459	2593	3.8
Interest on OC	511	465	461	473	0.7
B. Fixed cost					
Land use cost	19500	19048	19008	19130	28.4
C. Total cost (A+B)	**71677**	**66482**	**66038**	**67423**	**100.0**
Total production (kg)	4742	4032	3977	4162	
Product price (Tk/kg)	17.17	17.31	17.17	17.25	
Return from main product	81425	69782	68299	71783	
Return from byproduct	14378	12409	12259	12770	
D. Total return	**95804**	**82191**	**80558**	**84553**	
E. Gross margin (D-A)	43627	34757	33528	36259	
F. Net return (D-C)	24127	15709	14520	17120	
G. Benefit cost ratio					
Over total cost	1.34	1.24	1.22	1.25	
Over variable cost	1.84	1.73	1.71	1.75	

The average yield of *T. Aman* rice was estimated at 4.74 t/ha in the study areas which was much higher than the national average of 2.464 t/ha (BBS, 2019). The highest yield (4.742 t/ha) was recorded for large and medium farmer and the lowest (3.977 t/ha) for small farmer.

The higher yields were attributed to the higher use of fertilizers. This rice crop is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 84553 and Tk. 17120 respectively. Due to higher yield and price large and medium farmers received the highest gross as well as net return. The average benefit cost ratios (BCRs) on variable cost and full cost basis were 1.25 and 1.75 respectively (Table 5.16).

5.3.2 Boro rice

According to farm categories in Gopalgonj district the respondent farmers used different does of fertilizer and manures in their *Boro* paddy field. Table 5.17 shows that on an average 104.32 man-days human labour required to produce *Boro* for different farming activities. Farmers also used 43.35 kg seed per hectare *Boro* rice. In the study areas, *Boro* rice producers used the following types of fertilizers available such as urea (219.19kg/ha), TSP (151.71 kg/ha), MoP (91.51 kg/ha), Gypsum (77.24 kg/ha), DAP (35.92 kg/ha) and Zinc sulphate (8.23 kg/ha).

Table 5.18 revealed that respondent in the study areas the average yield of *Boro* rice was 6.57 t/ha which was much higher that national average of 4.02 t/ha (BBS, 2019). The highest yield was received by the large and medium category farmers and the lowest yield by the marginal category farmers in the study areas. Attaining higher yield might be due to intensive care (involve more labour), much irrigation and crop protection (use higher amount of pesticides).

The average cost of *Boro* rice production was Tk. 86502 per hectare of which the share of variable cost was 77.6% and the rest (22.4%) was fixed cost. In terms of the various inputs, labour costs incurred the highest share (45.3%) of total cost followed by manure & fertilizer (14.8%), pesticides (3.6%) and irrigation (2.9%) (Table 5.18). Most of the famers used surface water irrigation as a result irrigation cost was very low in the study areas. *Boro* rice is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 106421 and Tk. 19925 per hectare respectively. The overall rate of return (BCR) was 1.23 over full cost and 1.59 over variable cost basis. The highest net return was received by small category farmers and the lowest net return was received by large & medium category farmers.

Table 5.17 Per hectare input use by farm size in Boro rice production in Gopalgonj district

Particulars	Large & medium	Small	Marginal	All category
	n= 13	*n=33*	*n=13*	*n=59*
Human labour (man-day)	104.46	104.09	104.77	104.32
Seed (kg)	45.52	41.43	46.03	43.35
Urea (kg)	252.31	209.33	211.08	219.19
TSP (kg)	179.46	148.18	132.92	151.71
MoP (kg)	119.38	88.00	72.54	91.51
Gypsum (kg)	117.77	65.64	66.15	77.24
DAP (kg)	29.54	35.30	43.85	35.92
Zinc sulphate (kg)	11.12	7.64	6.85	8.23

Table 5.18 Per hectare cost and return of Boro rice production in Gopalgonj district

Particulars	Large & medium (n= 13)	Small (n=33)	Marginal (n=13)	All category (n=59)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**72787**	**65589**	**65426**	**67139**	**77.6**
Labour	38562	39495	39023	39185	45.3
Land preparation	6699	5760	5568	5924	6.8
Seed	3017	2812	3147	2931	3.4
Fertilizer					
Urea	4130	3428	3502	3599	4.2
TSP	4040	3363	3126	3460	4.0
MoP	1832	1352	1134	1410	1.6
Gypsum	2292	1484	1749	1720	2.0
DAP	916	1094	1343	1109	1.3
Zinc sulphate	1896	1500	1131	1506	1.7
Irrigation	5549	1519	1927	2497	2.9
Pesticides	3142	3141	3135	3140	3.6
Interest on OC	714	643	641	658	0.8
B. Fixed cost					
Land use cost	19190	19461	19285	19363	22.4
C. Total cost (A+B)	**91977**	**85050**	**84711**	**86502**	**100.0**
Total production (kg)	6688	6540	6552	6575	
Product price (Tk/kg)	15.96	15.76	15.77	15.81	
Return from main product	106746	103054	103318	103921	
Return from byproduct	2790	2708	1685	2501	
D. Total return	**109536**	**105762**	**105003**	**106421**	
E. Gross margin (D-A)	36749	40172	39577	39282	
F. Net return (D-C)	17559	20711	20292	19925	
G. Benefit cost ratio					
Over total cost	1.19	1.24	1.24	1.23	
Over variable cost	1.50	1.61	1.60	1.59	

5.3.3 Jute

Table 5.19 shows that per hectare input use and profitability of jute production in Gopalgonj district. A total of 163.12 man-days human labour and 7.81 kg seed were used per hectare jute production in the study area. Human labour was mainly used land preparation, fertilizer application, weeding, harvesting etc. Respondent in the study areas applied different dose of fertilizer like urea (80.12 kg/ha), TSP (77.14 kg/ha), MoP (44.98 kg/ha), gypsum (62.87 kg/ha) and zinc sulphate (2.12 kg/ha). Per hectare variable cost was estimated Tk. 72492 which 78.8 % of total cost and rest of 21.2% was fixed cost. The total yield of per hectare was estimated 3.055 MT in the study areas which is higher than national average. Estimation of jute cultivation found that it was a profitable crop in Gopalgonj district. The total return was estimated Tk. 148843 per hectare which Tk. 16351 from byproduct of raw materials. Gross margin and net margin were estimated Tk. 76351 and Tk. 56857 per hectare respectively indicated that jute cultivation was profitable in Gopalgonj district. The overall rate of return (BCR) was 1.62 over full cost and 2.05 over variable cost basis.

Table 5.19 Per hectare input use and profitability of jute production in Gopalgonj district

Particulars	Input use *(n= 93)*	Unit price *(n=93)*	Total cost/return (Tk/ha) *(n=93)*	% of total cost
A. Variable cost			**72492**	**78.8**
Labour (man-day)	163.12	356.99	58231	63.3
Land preparation			5383.8	5.9
Seed (kg)	7.81	170.38	1330	1.4
Fertilizer (kg)				
Urea	80.12	16.20	1298	1.4
TSP	77.14	22.44	1731	1.9
MoP	44.98	15.35	691	0.8
Gypsum	37.20	22.86	850	0.9
DAP	28.56	30.95	884	1.0
Zinc sulphate	1.52	149.92	228	0.2
Irrigation			525	0.6
Pesticides			628	0.7
Interest on OC			711	0.8
B. Fixed cost				
Land use cost			19494	21.2
C. Total cost (A+B)			**91986**	**100.0**
Total production (kg)	3055	43.37	132493	
Return from byproduct			16351	
D. Total return			**148843**	
E. Gross margin (D-A)			76351	
F. Net return (D-C)			56857	
G. Benefit cost ratio				
Over total cost			1.62	
Over variable cost			2.05	

5.3.4 Khesari

Table 5.20 presents per hectare input used and profitability of Khesari in the study areas. The total cost of khesari cultivation was Tk. 47521 per hectare of which 60.0% were variable cost and 40.0% were fixed cost. The average yield of Khesari was 1.72 t/ha which is higher than national average (1.10 t/ha) and average price was Tk.36.28/kg. The gross return and net return were Tk. 60782/ha and Tk. 13261/ha respectively means that Khesari cultivation is a profitable business in the study areas. The benefit cost ratio (BCR) was estimated at 1.28 and 2.13 on full cost and variable cost basis, respectively.

Table 5.20 Per hectare input use and profitability of khesari production in Gopalgonj district

Particulars	Input use *(n= 49)*	Unit price *(n=49)*	Total cost/return (Tk/ha) *(n=49)*	% of total cost
A. Variable cost			**28492**	**60.0**
Labour (man-day)	57.33	350.00	20064	42.2
Land preparation			2796	5.9
Seed (kg)	78.37	47.55	3727	7.8
Fertilizer (kg)				0.0
Urea	28.76	16.45	473	1.0
TSP	25.86	22.76	588	1.2
MoP	7.16	15.41	110	0.2
Gypsum	6.78	22.84	155	0.3
DAP	8.04	30.84	248	0.5
Pesticides			52	0.1
Interest on OC			279	0.6
B. Fixed cost				0.0
Land use cost			19029	40.0
C. Total cost (A+B)			**47521**	**100.0**
Total production (kg)	1583	36.28	57432	
Return from byproduct			3350	
D. Total return			**60782**	
E. Gross margin (D-A)			32290	
F. Net return (D-C)			13261	
G. Benefit cost ratio				
Over total cost			1.28	
Over variable cost			2.13	

5.3.5 Lentil

Table 5.21 shows that respondent in the study areas used per hectare 57.33 man-days human labour and 78.37 kg seed for producing lentil. Farmers applied different does of fertilizer and manures such urea 28.76 kg/ha, TSP 25.86 kg/ha, MoP 7.16 kg/ha, Gypsum 6.78 kg/ha and DAP 8.04 kg/ha. The total variable cost and fixed cost was found that Tk. 31963/ha and Tk. 19160/ha respectively. The average per hectare total cost, per hectare total return and per kilogram sales price of lentil crops in Gopalgonj were estimated at Tk. 51123, Tk. 72601 and 47.43 kilograms respectively. It is evident from the Table 5.21 that benefit cost ratio of lentil on the basis of total cost and variable cost 1.42 and 2.27 respectively.

Table 5.21 Per hectare input use and profitability of lentil production in Gopalgonj district

Particulars	Input use *(n= 35)*	Unit price *(n=35)*	Total cost/return (Tk/ha) *(n=35)*	% of total cost
A. Variable cost			**31963**	**62.5**
Labour (man-day)	57.33	300.00	17198	33.6
Land preparation			4672	9.1
Seed (kg)	78.37	93.14	7300	14.3
Fertilizer (kg)				
Urea	28.76	16.14	464	0.9
TSP	25.86	22.06	570	1.1
MoP	7.16	15.09	108	0.2
Gypsum	6.78	23.89	162	0.3
DAP	8.04	28.00	225	0.4
Pesticides			951	1.9
Interest on OC			313	0.6
B. Fixed cost				0.0
Land use cost			19160	37.5
C. Total cost (A+B)			**51123**	**100.0**
Total production (kg)	1469	47.43	69653	
Return from byproduct			2948	
D. Total return			**72601**	
E. Gross margin (D-A)			40638	
F. Net return (D-C)			21478	
G. Benefit cost ratio				
Over total cost			1.42	
Over variable cost			2.27	

5.3.6 Mustard

Table 5.22 reveals that per hectare input use pattern and profitability of mustard in the study areas. It is evident from the table respondent in the study areas used 58.69 man-days human labour and 7.51 kg seed in their per hectare mustard crop. They also applied different does of fertilizer and manures like as urea (90.81 kg/ha), TSP (75.31 kg/ha), MoP (61.56 kg/ha), gypsum (42.25 kg/ha), DAP (47.69 kg/ha) and zinc sulphate (3.39 kg/ha). The total cost of cultivating mustard was estimated to be Tk. 53585 which was 65.4% variable cost and rest of 34.6% land use cost treated as a fixed cost. The average yield of mustard was estimated at 1452 kg/ha which was much higher than the national average of 1142.69 kg/ha (BBS, 2019). The estimated total return, gross margin and net return were Tk. 72638/ha, Tk. 37578/ha and Tk. 19053/ha respectively. The benefit cost ratio (BCR) was estimated at 1.36 and 2.07 on full cost and variable cost basis, respectively.

Table 5.22 Per hectare input use and profitability of mustard production in Gopalgonj district

Particulars	Input use *(n= 16)*	Unit price *(n=16)*	Total cost/return (Tk/ha) *(n=16)*	% of total cost
A. Variable cost			**35060**	**65.4**
Labour (man-day)	58.69	300.00	17606	32.9
Land preparation			6887	12.9
Seed (kg)	7.51	76.56	575	1.1
Fertilizer (kg)				
Urea	90.81	16.00	1453	2.7
TSP	75.31	22.00	1657	3.1
MoP	61.56	15.00	923	1.7
Gypsum	42.25	24.00	1014	1.9
DAP	47.69	28.00	1335	2.5
Zinc sulphate	3.39	200.00	679	1.3
Boron	1.98	180.00	356	0.7
Irrigation			1351	2.5
Pesticides			881	1.6
Interest on OC			344	0.6
B. Fixed cost				0.0
Land use cost			18525	34.6
C. Total cost (A+B)			**53585**	**100.0**
Total production (kg)	1452	47.81	69399	
Return from byproduct			3239	
D. Total return			**72638**	
E. Gross margin (D-A)			37578	
F. Net return (D-C)			19053	
G. Benefit cost ratio				
Over total cost			1.36	
Over variable cost			2.07	

5.4 Input Use and Profitability of Crop Production in Khulna District

5.4.1 Transplanted Aman (*T.Aman)* rice

The input use pattern and productivity of *T.Aman* rice cultivation in the study areas are presented in Table 5.23. The rice farmers in the study areas used 76.04 man-days human labour for performed many physical operations such as land preparation, laddering, dressing, transplanting, weeding, application of fertilizer & manure, application of insecticides, harvesting and carrying, threshing, cleaning, drying and storing etc. on an average farmers used 45.19 kg/ha seed which was substantially more seed than the recommended rate (30 kg/ha). The *T.Aman* rice growers in the study areas, fertilizer and manures applied on an average 136.21, 117.63, 68.47, 59.54, 41.24, 37.33 4.72 and 585.90 kg/ha of Urea, TSP, MoP, Gypsum, DAP, Zinc sulphate and manures respectively. The marginal category farmers used lowest amount of all fertilizers due to their inability. Likewise, large and medium category farmers consciously used highest doses of fertilizers than small farmers and marginal farmers.

The average yield of main product (rice) was 4.874 t/ha which much higher than the national average of 2.464 t/ha (BBS, 2019). The highest yield (5.067 t/ha) was recorded for large and medium farmer and the lowest (4.794 t/ha) for small farmer. The average return from main product and by product (straw) were estimated Tk.79199 and Tk.15839 per hectare

respectively. The gross margin and net return were estimated as Tk.35903/ha and Tk. 19658/ha, respectively.

Table 5.23 Per hectare input use by farm size in Aman rice production in Khulna district

Particulars	Large & medium	Small	Marginal	All category
	n=26	*n=60*	*n=5*	*n=91*
Human labour (man-day)	80.23	74.80	69.20	76.04
Seed (kg)	47.82	44.41	41.02	45.19
Urea (kg)	163.35	125.00	129.60	136.21
TSP (kg)	154.77	103.07	99.20	117.63
MoP (kg)	92.88	59.97	43.60	68.47
Gypsum (kg)	59.54	34.65	25.20	41.24
DAP (kg)	58.31	30.93	5.00	37.33
Zinc sulphate (kg)	5.70	4.51	2.08	4.72
Manure (kg)	468.27	560.95	1497.00	585.90

Table 5.24 Per hectare cost and return of Aman rice production in Khulna district

Particulars	Large & medium (n= 26)	Small (n=60)	Marginal (n=5)	All category (n=91)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**64604**	**57313**	**52561**	**59135**	**78.4**
Labour	32119	28669	24259	29412	39.0
Land preparation	5555	6143	6274	5982	7.9
Seed	2200	2052	1895	2086	2.8
Urea	2690	2091	2182	2267	3.0
TSP	3406	2266	2183	2587	3.4
MoP	1396	918	687	1042	1.4
Gypsum	1429	843	628	999	1.3
DAP	1655	882	148	1062	1.4
Zinc sulphate	957	821	417	838	1.1
Manure	351	410	1123	433	0.6
Irrigation	9815	9340	9501	9485	12.6
Pesticides	2396	2315	2750	2362	3.1
Interest on OC	633	562	515	580	0.8
B. Fixed cost					
Land use cost	16150	16364	15314	16245	21.6
C. Total cost (A+B)	**80754**	**73677**	**67875**	**75380**	**100.0**
Total production (kg)	5067	4794	4824	4874	
Product price (Tk/kg)	16.25	16.25	16.25	16.25	
Return from main product	82338	77905	78393	79199	
Return from byproduct	16468	15581	15678	15839	
D. Total return	**98806**	**93486**	**94072**	**95038**	
E. Gross margin (D-A)	34202	36173	41511	35903	
F. Net return (D-C)	18052	19809	26197	19658	
G. Benefit cost ratio					
Over total cost	1.22	1.27	1.39	1.26	
Over variable cost	1.53	1.63	1.79	1.61	

The higher yields were attributed to the higher use of fertilizers. This rice crop is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 87,852 and Tk.15, 985 respectively. Due to lower cost of production marginal farmers received the highest gross as well as net return. The average benefit cost ratios (BCRs) on variable cost and full cost basis were 1.26 and 1.62 respectively (Table 5.24).

5.4.2 Transplanted Aus (*T. Aus*) rice

Among the five study areas, only the respondent farmers of Bagherhat and Khulna district cultivated *T. Aus* rice. Respondent farmers in the study areas used a total number of 87.86 man-days of human labour and about 74.69 kg of seed per hectare in producing *T.Aus* rice. The respondent farmers applied both organic and inorganic fertilizers in cultivating *T.Aus* rice. They applied on an average 87.14 kg of Urea per hectare which is lower than the recommended dose. Again, they used TSP, MoP and Gypsum at the rate of 80.86 kg, 57.29 kg and 33.71 kg per hectare respectively which are higher than the recommended dose (FRG, 2012). Respondent farmers did not use Cowdung manure at all. There is a positive relationship between farm size and input use meaning that farmers having higher land resources apply higher amount of inputs and vice versa (Table 5.25).

Table 5.25 Per hectare input use by farm size in *T. Aus* rice production in Khulna district

Particulars	Large & medium	Small	Marginal	All category
	n=2	n=5	n=0	n=7
Human labour (man-day)	92.00	86.20	--	87.86
Seed (kg)	75.45	74.38	--	74.69
Urea (kg)	90.50	85.80	--	87.14
TSP (kg)	74.00	83.60	--	80.86
MoP (kg)	60.50	56.00	--	57.29
Gypsum (kg)	33.00	34.00	--	33.71

The average cost of *T.Aus* rice production was estimated at Tk. 65,747 per hectare of which the share of variable cost was 77.5% and the rest 22.5% was fixed cost. In terms of the various inputs, labour costs incurred the highest share (41.1%) of total cost followed by land preparation (11.1%), irrigation (9.7%) fertilizers (7.5%) and pesticides (3.5%) (Table 5.26). There is a positive relationship exist between farm size category and production cost meaning that large category farmers incur the higher cost of production due to higher use of inputs and vice versa.

The average yield of *T.Aus* rice was reported to be 4.092t/ha in the study areas which was higher than the national average of 2.51 t/ha (BBS, 2019). *T.Aus* rice is reported to be a marginally profitable crop in the study areas. The average gross margin and net return were estimated at Tk. 19653 and Tk. 4833 respectively. The benefit cost ratios (BCRs) on variable cost and full cost basis were 1.39 and 1.07 respectively (Table 5.26). The main reasons for producing less return were lower yield, lower price of output and higher cost of land preparation compared to *Boro* and *T.Aman* rice. Table 5.4 further reveals that there is a negative relationship between farm size and rate of return (BCR) in the study areas due to higher production and lower cost of production.

Table 5.26 Per hectare cost and return of *T. Aus* rice production in Khulna district

Particulars	Large & medium (n= 2)	Small (n=5)	Marginal (n=0)	All category (n=7)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**53884**	**49745**	--	**50927**	**77.5**
Labour	29915	25845	--	27008	41.1
Land preparation	7447	7208	--	7276	11.1
Seed	2072	2457	--	2347	3.6
Urea	1540	1462	--	1484	2.3
TSP	1630	1841	--	1781	2.7
MoP	906	841	--	859	1.3
Gypsum	790	817	--	810	1.2
Irrigation	6175	6414	--	6346	9.7
Pesticides	2882	2371	--	2517	3.8
Interest on OC	528	488	--	499	0.8
B. Fixed cost					
Land use cost	14820	14820	--	14820	22.5
C. Total cost (A+B)	**68704**	**64565**	--	**65747**	**100.0**
Total production (kg)	4336	3994	--	4092	
Product price (Tk/kg)	13.75	13.75	--	13.75	
Return from main product	59620	54915	--	56259	
Return from byproduct	15177	13979	--	14321	
D. Total return	**74797**	**68893**	--	70580	
E. Gross margin (D-A)	20913	19149	--	19653	
F. Net return (D-C)	6093	4329	--	4833	
G. Benefit cost ratio					
Over total cost	1.09	1.07	--	1.07	
Over variable cost	1.39	1.38	--	1.39	

5.4.3 *Boro* rice

Table 5.27 shows that on an average 85.35 man-days human labour required to produce *Boro* for different farming activities. Farmers also used 44.64 kg seed per hectare *Boro* rice. In the study areas, *Boro* rice producers used the following types of fertilizers available such as urea (169.96kg/ha), TSP (144.41 kg/ha), MoP (79.76 kg/ha), Gypsum (53.59 kg/ha), DAP (28.45 kg/ha) and Zinc sulphate (5.93 kg/ha).

Table 5.28 revealed that respondent in the study areas the average yield of *Boro* rice was 6.807 t/ha which was much higher that national average of 4.02 t/ha (BBS, 2019). The highest yield was received by the large and medium category farmers and the lowest yield by the small category farmers in the study areas. Attaining higher yield might be due to intensive care (involve more labour), much irrigation and crop protection (use higher amount of pesticides). The average cost of *Boro* rice production was Tk. 85856 per hectare of which the share of variable cost was 78.9% and the rest (21.1%) was fixed cost. In terms of the various inputs, labour costs incurred the highest share (39.7%) of total cost followed by manure & fertilizer (12.7%), irrigation (11.6%), land preparation (8.00%), seed (3.2%), and pesticides (2.8%) (Table 5.28). *Boro* rice is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 106034 and Tk. 20175 per hectare respectively. The overall rate of return (BCR) was 1.24 over full cost and 1.57 over variable

cost basis. The highest net return was received by small category farmers and the lowest net return was received by large & medium category farmers.

Table 5.27 Per hectare input use by farm size in Boro rice production in Khulna district

Particulars	Large & medium	Small	Marginal	All category
	n=25	n=79	n=7	n=111
Human labour (man-day)	88.92	83.94	88.57	85.35
Seed (kg)	45.504	44.72	40.64	44.64
Urea (kg)	249.4	143.75	182.14	169.96
TSP (kg)	193	129.91	134.57	144.41
MoP (kg)	120.72	67.66	70.00	79.76
Gypsum (kg)	97.36	39.76	53.43	53.59
DAP (kg)	19.88	30.09	40.57	28.45
Zinc sulphate (kg)	6.036	6.08	3.90	5.93
Manure (kg)	1637.32	528.52	1773.14	856.74

Table 5.28 Per hectare cost and return of Boro rice production in Khulna district

Particulars	Large & medium (n= 25)	Small (n=79)	Marginal (n=7)	All category (n=111)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**73996**	**65446**	**71334**	**67743**	**78.9**
Labour	35559	33556	35438	34126	39.7
Land preparation	7306	6759	6985	6896	8.0
Seed	2777	2727	2580	2729	3.2
Urea	4065	2353	2991	2779	3.2
TSP	4547	3053	3121	3394	4.0
MoP	1878	1053	1081	1240	1.4
Gypsum	1601	682	710	891	1.0
DAP	582	888	1189	838	1.0
Zinc sulphate	1138	1114	775	1098	1.3
Manure	1339	464	1385	719	0.8
Irrigation	10135	9782	11464	9968	11.6
Pesticides	2344	2373	2915	2400	2.8
Interest on OC	725	642	699	664	0.8
B. Fixed cost					
Land use cost	18525	17947	18525	18114	21.1
C. Total cost (A+B)	**92521**	**83393**	**89859**	**85856**	**100.0**
Total production (kg)	7195	6651	7187	6807	
Product price (Tk/kg)	15.05	15.19	15.18	15.16	
Return from main product	108278	101024	109093	103170	
Return from byproduct	3699	2709	1641	2864	
D. Total return	**111977**	**103733**	**110733**	**106034**	
E. Gross margin (D-A)	37981	38287	39399	38291	
F. Net return (D-C)	19456	20340	20874	20175	
G. Benefit cost ratio					
Over total cost	1.21	1.24	1.23	1.24	
Over variable cost	1.51	1.59	1.55	1.57	

5.4.4 Brinjal

Table 5.29 revealed that respondent in the study areas used on an average 402 man-days/ha human labour and 1.07 kg seed for brinjal cultivation. It implies that cultivation of brinjal required huge amount of human labour. In the survey area farmer applied cowdung, urea, TSP, MoP, gypsum, DAP, and zinc sulphate at the rate of 271.00 kg, 371.90 kg, 138.30 kg, 115.80 kg, and 9 kg per hectare respectively. The average cost of *Brinjal* production was Tk. 233739 per hectare of which the share of variable cost was 92.6% and the rest of fixed cost (7.4%). The average yield of brinjal was estimated 25.06 MT per hectare. The average gross return and net return were estimated at Tk. 548479 and Tk. 314741 per hectare respectively. The overall rate of return (BCR) was 2.35 over full cost and 2.54 over variable cost basis.

Table 5.29 Per hectare input use and profitability of brinjal production in Khulna district

Particulars	Input use *(n= 10)*	Unit price *(n=10)*	Total cost/return (Tk/ha) *(n=10)*	% of total cost
A. Variable cost			**216325**	**92.6**
Labour (man-day)	402.50	400.00	161000	68.9
Land preparation			6741	2.9
Seed (kg)	1.07	2930.00	3135	1.3
Fertilizer (kg)				0.0
Urea	271.00	17.00	4607	2.0
TSP	317.90	24.80	7884	3.4
MoP	138.30	16.30	2254	1.0
Gypsum	115.80	21.60	2501	1.1
DAP	65.90	30.00	1977	0.8
Zinc sulphate	3.49	160.00	558	0.2
Manure (kg)	5112.10	0.85	4345	1.9
Irrigation			12726	5.4
Pesticides			5399	2.3
Interest on OC			3197	1.4
B. Fixed cost				
Land use cost			17414	7.4
C. Total cost (A+B)			**233739**	**100.0**
Total production (kg)	25068	21.88	548479	
Return from byproduct			0.00	
D. Total return			**548479**	
E. Gross margin (D-A)			332154	
F. Net return (D-C)			314741	
G. Benefit cost ratio				
Over total cost			2.35	
Over variable cost			2.54	

5.4.5 Tomato

Tomato (Lycopersion esculentum) is an important winter vegetable in Bangladesh. It is a good source of vitamin C and contains vitamin A, vitamin B, calcium, iron; used as fresh or cooked, and are ingredients for salad, soup, pickle, chatney, ketchup, sauce etc. Due to its palatability and vitamin content its demand is growing day by day, while its production is far from the requirements. In Bangladesh, the area of tomato cultivation is 28141 ha with the production of 385038 MT and yield is 13.68 MT/ha (BBS, 2019).

The human labor used for producing tomato was found to be 383.25 man-days per hectare (Table 5.30). Land preparation cost was 7320 tk/ha. Seed was used 421 gm/ha for cultivating summer tomato. The total quantity of fertilizer require was 844.38 kg/ha of which urea, TSP, MoP, Gypsum, DAP and Zinc sulphate were 203.33 kg/ha, 208.42 kg/ha, 151.33 kg/ha, 174.17 kg/ha, 89.67 kg/ha, and 17.46 kg/ha respectively. Total cowdung used 4231.25 kg per hectare when land is prepared.

Economic analysis of tomato cultivation in the study areas were made on per hectare basis. As shown in table 5.30 cost of cultivation of tomato was worked out be Tk. 228929. The cost structure of the variable cost shows that the highest proportion amounting to Tk 211021 (92.2%)was spent on labour cost Tk. 153300 (67%) followed by land preparation Tk. 7320, TSP Tk. 5210 (2.3%), irrigation Tk. 10831 (4.7%), pesticides Tk.7610(3.3%). The share of rental value of land in cost of cultivation of tomato was worked out to be Tk. 17908 (7.8%). On an average, the yield of tomato in the study areas was found 21.18 MT/ha which is greater than the national average of 13.68 t/ha (BBS, 2019). Also sale price received tomato growers was Tk. 30.63 per kg. The data pertaining to returns from tomato production gross return per hectare was estimated Tk. 648963. Gross margin and net margin were calculated Tk. 437942 and Tk. 420034 respectively. The benefit cost ratios were 2.83 and 3.08 on full cost and variable cost basis.

Table 5.30 Per hectare input use and profitability of tomato production in Khulna district

Particulars	Input use *(n= 12)*	Unit price *(n=12)*	Total cost/return (Tk/ha) *(n=12)*	% of total cost
A. Variable cost			**211021**	**92.2**
Labour (man-day)	383.25	400.00	153300	67.0
Land preparation			7320	3.2
Seed (kg)			3992	1.7
Fertilizer (kg)				
Urea	203.33	16.9	3440	1.5
TSP	208.42	25.0	5210	2.3
MoP	151.33	16.3	2459	1.1
Gypsum	174.17	20.7	3599	1.6
DAP	89.67	30.0	2690	1.2
Zinc sulphate	17.46	184.4	3220	1.4
Manure (kg)	4231.25	1.00	4231	1.8
Irrigation			10831	4.7
Pesticides			7610	3.3
Interest on OC			3119	1.4
B. Fixed cost				
Land use cost			17908	7.8
C. Total cost (A+B)			**228929**	**100.0**
Total production (kg)	21187	30.63	648963	
Return from byproduct			0.00	
D. Total return			**648963**	
E. Gross margin (D-A)			437942	
F. Net return (D-C)			420034	
G. Benefit cost ratio				
Over total cost			2.83	
Over variable cost			3.08	

5.5 Input Use and Profitability of Crop Production in Pirojpur District

5.5.1 Transplanted Aman (*T.Aman)* rice

The input use pattern and productivity of *T.Aman* rice cultivation in the study areas are presented in Table 5.31. The rice farmers in the study areas used 73.20 man-days human labour for performed many physical operations such as land preparation, laddering, dressing, transplanting, weeding, application of fertilizer & manure, application of insecticides, harvesting and carrying, threshing, cleaning, drying and storing etc. on an average farmers used 45.44 kg/ha seed which was substantially more seed than the recommended rate (30 kg/ha). The *T.Aman* rice growers in the study areas, fertilizer and manures applied on an average 170.14, 106.97, 51.71, 32.83, 41.24, 15.45, 3.00, 0.31 and 159.83 kg/ha of Urea, TSP, MoP, Gypsum, DAP, Zinc sulphate, boron and manures respectively. The marginal category farmers used lowest amount of all fertilizers due to their inability. Likewise, large and medium category farmers consciously used highest doses of fertilizers than small farmers and marginal farmers.

The average yield of main product (rice) was 4.057 t/ha which much higher than the national average of 2.464 t/ha (BBS, 2019). The highest yield (4423 t/ha) was recorded for large and medium farmer and the lowest (3779 t/ha) for small farmer. The average return from main product and by product (straw) were estimated Tk. 69241 and Tk. 14199 per hectare respectively. The gross return and net return were estimated as Tk. 83440 and Tk. 16214 per hectare respectively. The average benefit cost ratios (BCRs) on variable cost and full cost basis were 1.24 and 1.66 respectively (Table 5.32).

Table 5.31 Per hectare input use by farm size in *T. Aman* rice production in Pirojpur district

Particulars	Large & medium	Small	Marginal	All category
	n=47	*n=74*	*n=12*	*n=133*
Human labour (man-day)	68.57	75.16	79.17	73.20
Seed (kg)	44.56	46.19	44.28	45.44
Urea (kg)	212.28	148.47	138.67	170.14
TSP (kg)	135.32	92.26	86.67	106.97
MoP (kg)	64.74	44.46	45.42	51.71
Gypsum (kg)	50.98	22.32	26.58	32.83
DAP (kg)	20.51	11.12	22.33	15.45
Zinc sulphate (kg)	3.69	2.73	1.99	3.00
Boron (kg)	0.37	0.32	0.00	0.31
Manure (kg)	50.96	254.89	0.00	159.83

Table 5.32 Per hectare cost and return of *T. Aman* rice production in Pirojpur district

Particulars	Large & medium (n= 47)	Small (n=74)	Marginal (n=12)	All category (n=133)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**51082**	**49813**	**51117**	**50379**	**74.9**
Labour	27433	30033	31671	29262	43.5
Land preparation	8508	8183	7489	8235	12.2
Seed	1673	1723	1634	1697	2.5
Urea	3576	2499	2374	2868	4.3
TSP	3225	2206	2118	2558	3.8
MoP	1017	703	724	816	1.2
Gypsum	1180	514	531	751	1.1
DAP	623	345	674	473	0.7
Zinc sulphate	686	506	358	557	0.8
Boron	102	90	0	86	0.1
Manure	38	191	0	120	0.2
Irrigation	566	425	686	498	0.7
Pesticides	1954	1908	2357	1965	2.9
Interest on OC	501	488	501	494	0.7
B. Fixed cost					
Land use cost	17001	16806	16570	16854	25.1
C. Total cost (A+B)	**68083**	**66619**	**67687**	**67233**	**100.0**
Total production (kg)	4423	3869	3779	4057	
Product price (Tk/kg)	17.10	17.06	16.98	17.07	
Return from main product	75637	66014	64166	69241	
Return from byproduct	15480	13543	13227	14199	
D. Total return	**91117**	**79557**	**77393**	**83440**	
E. Gross margin (D-A)	40035	29744	26276	33061	
F. Net return (D-C)	23034	12938	9706	16214	
G. Benefit cost ratio					
Over total cost	1.34	1.19	1.14	1.24	
Over variable cost	1.78	1.60	1.51	1.66	

5.5.2 Boro rice

Table 5.33 shows that on an average 91.56 man-days human labour required to produce *Boro* for different farming activities. Farmers also used 56.46 kg seed per hectare *Boro* rice. In the study areas, *Boro* rice producers used the following types of fertilizers available such as urea (215.24 kg/ha), TSP (164.76 kg/ha), MoP (89.18 kg/ha), Gypsum (31.03 kg/ha), DAP (32.06 kg/ha) and Zinc sulphate (7.09 kg/ha).

Table 5.34 revealed that respondent in the study areas the average yield of *Boro* rice was 7.026 t/ha which was much higher that national average of 4.02 t/ha (BBS, 2019). The highest yield was received by the large and medium category farmers and the lowest yield by the small category farmers in the study areas. Attaining higher yield might be due to intensive care (involve more labour), much irrigation and crop protection (use higher amount of pesticides). The average cost of *Boro* rice production was Tk. 85856 per hectare of which the share of variable cost was 82% and the rest (18%) was fixed cost. In terms of the various inputs, labour costs incurred the highest share (40.1%) of total cost followed by fertilizer (13.6%), irrigation (12.1%), land preparation (9.7%), pesticides (2.9%), and seed (Table 5.34). *Boro* rice is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 113310 and Tk. 22093 per hectare respectively. The

overall rate of return (BCR) was 1.24 over full cost and 1.52 over variable cost basis. The highest net return was received by large & medium category farmers and the lowest net return was received by small category farmers.

Table 5.33 Per hectare input use in Boro rice production in Pirojpur district

Particulars	Large & medium	Small	Marginal	All category
	n=10	*n=20*	*n=4*	*n=34*
Human labour (man-day)	90.80	90.85	97.00	91.56
Seed (kg)	52.39	57.25	62.70	56.46
Urea (kg)	285.80	189.05	169.75	215.24
TSP (kg)	222.00	148.20	104.50	164.76
MoP (kg)	113.00	80.70	72.00	89.18
Gypsum (kg)	41.80	31.85	0.00	31.03
DAP (kg)	49.50	22.45	36.50	32.06
Zinc sulphate (kg)	9.41	6.64	3.53	7.09

Table 5.34 Per hectare cost and return of Boro rice production in Pirojpur district

Particulars	Large & medium (n= 10)	Small (n=20)	Marginal (n=4)	All category (n=34)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**78340**	**73727**	**70998**	**74763**	**82.0**
Labour	36381	36304	38751	36614	40.1
Land preparation	8854	9006	7921	8834	9.7
Seed	2296	2511	2752	2476	2.7
Urea	4800	3187	2885	3626	4.0
TSP	6092	3928	2687	4418	4.8
MoP	1861	1339	1094	1464	1.6
Gypsum	833	743	0	682	0.7
DAP	1475	657	1055	944	1.0
Zinc sulphate	1761	1251	600	1324	1.5
Irrigation	10503	11325	10672	11006	12.1
Pesticides	2718	2754	1888	2642	2.9
Interest on OC	768	723	696	733	0.8
B. Fixed cost					
Land use cost	16549	16426	16364	16455	18.0
C. Total cost (A+B)	**94889**	**90153**	**87362**	**91218**	**100.0**
Total production (kg)	7267	6974	6679	7026	
Product price (Tk/kg)	16.00	15.81	15.94	15.88	
Return from main product	116270	110283	106443	111592	
Return from byproduct	2244	1505	1469	1718	
D. Total return	**118514**	**111788**	**107911**	**113310**	
E. Gross margin (D-A)	40174	38061	36913	38548	
F. Net return (D-C)	23625	21635	20549	22093	
G. Benefit cost ratio					
Over total cost	1.25	1.24	1.24	1.24	
Over variable cost	1.51	1.52	1.52	1.52	

5.5.3 Jute

Table 5.35 shows that per hectare input use and profitability of jute production in Pirojpur district. A total of 158.07 man-days human labour and 6.44 kg seed were used per hectare jute production in the study area. Human labour was mainly used land preparation, fertilizer application, weeding, harvesting etc. Respondent in the study areas applied different dose of fertilizer like urea, TSP, MoP, gypsum and zinc sulphate at the rate of 93.14 kg, 85.96 kg, 49.18 kg, 53.75 kg, and 3.94 kg per hectare Respectively. The average total cost of jute production was estimated at Tk. 105244 of which 84.4% is variable cost and the rest 15.6% is fixed cost. The yield was estimated at 2.94 t/ha in the study areas which is higher than national average. Estimation of jute cultivation found that it was a profitable crop in Pirojpur district. The total return was estimated at Tk. 133637 per hectare of which Tk. 18437 come from byproduct. The gross margin and net margin were estimated Tk. 44845 and Tk. 28393 per hectare respectively. The overall rate of return (BCR) was 1.27 over full cost and 1.51 over variable cost basis.

Table 5.35 Per hectare input use and profitability of jute production in Pirojpur district

Particulars	Input use *(n= 28)*	Unit price *(n=28)*	Total cost/return (Tk/ha) *(n=28)*	% of total cost
A. Variable cost			**88792**	**84.4**
Labour (man-day)	158.07	400.00	63229	60.1
Land preparation			10841	10.3
Seed (kg)	6.44	237.14	1526	1.5
Fertilizer (kg)				
Urea	93.14	16.43	1530	1.5
TSP	85.96	24.46	2103	2.0
MoP	49.18	16.05	789	0.7
Gypsum	53.75	21.87	1175	1.1
Zinc sulphate	3.94	193.33	761	0.7
Irrigation			3460	3.3
Pesticides			2506	2.4
Interest on OC			871	0.8
B. Fixed cost				0.0
Land use cost			16452	15.6
C. Total cost (A+B)			**105244**	**100.0**
Total production (kg)	2939	39.2	115200	
Return from byproduct			18437	
D. Total return			**133637**	
E. Gross margin (D-A)			44845	
F. Net return (D-C)			**28393**	
G. Benefit cost ratio				
Over total cost			1.27	
Over variable cost			1.51	

5.5.4 Khesari

The total cost of khesari cultivation was Tk. 42299 per hectare of which 60.8% were variable cost and 39.2% were fixed cost. The average yield of khesari was 1.54 t/ha which is higher than national average (1.1 t/ha) and famers got average price Tk. 31.60 per kg. The gross return, gross margin and net return were Tk. 51626, Tk. 25897, and Tk. 21904 per hectare

respectively. The benefit cost ratio (BCR) was estimated at 1.22 and 2.01 on full cost and variable cost basis, respectively.

Table 5.36 Per hectare input use and profitability of khesari production in Pirojpur district

Particulars	Input use *(n= 36)*	Unit price *(n=36)*	Total cost/return (Tk/ha) *(n=36)*	% of total cost
A. Variable cost			**25729**	**60.8**
Labour (man-day)	46.86	400.00	18744	44.3
Land preparation			1904	4.5
Seed (kg)	47.62	61.39	2923	6.9
Fertilizer (kg)				
Urea	18.58	17.06	317	0.7
TSP	17.56	25.00	439	1.0
MoP	13.00	16.13	210	0.5
Gypsum	7.17	28.00	201	0.5
Zinc sulphate	1.41	195.56	275	0.6
Pesticides			465	1.1
Interest on OC			252	0.6
B. Fixed cost				
Land use cost			16570	39.2
C. Total cost (A+B)			**42299**	**100.0**
Total production (kg)	1545	31.60	48827	
Return from byproduct			2799	
D. Total return			**51626**	
E. Gross margin (D-A)			25897	
F. Net return (D-C)			9327	
G. Benefit cost ratio				
Over total cost			1.22	
Over variable cost			2.01	

5.5.5 Lentil

Table 5.37 reveals that respondent of the Pirojpur district used on an average human labour 69.20 man-days per hectare in lentil cultivation. They used 35.97 kg of seeds per hectare which was higher than the recommended rate of 30-35 kg/ha (Krishi Projukti Hatboi, 2011). The respondent farmers applied urea, TSP and MP at the rate of 50.10 kg/ha, 77.50 kg/ha and 54.60 kg/ha respectively. Besides, they also used other fertilizers like gypsum and Zinc at the rate of 46.20 kg/ha and 3.85 kg/ha respectively.

The cost of lentil cultivation was estimated at Tk. 59884 per ha. The cost of human labour incurred 46.2% of the total cost followed by land use cost (26.8%), fertilizer cost (9.5%), and seed (4.8%). The average yield of lentil was estimated at 1357 kg/ha which was higher than the national average of 1237 kg/ha (BBS, 2019). The estimated average gross return, gross margin and net return were Tk. 77199, Tk. 33370 and Tk. 17315 per hectare respectively. The benefit cost ratio (BCR) was estimated at 1.29 and 1.76 on full cost and variable cost basis, respectively.

Table 5.37 Per hectare input use and profitability of lentil production in Pirojpur district

Particulars	Input use *(n= 36)*	Unit price *(n=36)*	Total cost/return (Tk/ha) *(n=36)*	% of total cost
A. Variable cost			**43829**	**73.2**
Labour (man-day)	69.20	400.00	27680	46.2
Land preparation			6003	10.0
Seed (kg)	35.97	80.00	2878	4.8
Fertilizer (kg)				
Urea	50.10	16.00	802	1.3
TSP	77.50	25.00	1938	3.2
MoP	54.60	17.00	928	1.5
Gypsum	46.20	28.00	1294	2.2
Zinc sulphate	3.85	197.14	758	1.3
Pesticides			1119	1.9
Interest on OC			430	0.7
B. Fixed cost				
Land use cost			16055	26.8
C. Total cost (A+B)			**59884**	**100.0**
Total production (kg)	1357	55.00	74624	
Return from byproduct			2575	
D. Total return			**77199**	
E. Gross margin (D-A)			33370	
F. Net return (D-C)			**17315**	
G. Benefit cost ratio				
Over total cost			1.29	
Over variable cost			1.76	

5.5.6 Mungbean

Mungbean (*Vigna radiata*) is one of the most important pulse crops in Bangladesh in both area and production. Much area of mungbean is planted to cereals (Abedin et al., 1991). Now a days, it is cultivated after harvesting of Rabi crops (i.e., wheat mustard, lentil, etc.). Due to its short duration, mungbean can fit in as a cash crop between major cropping seasons. The national statistics of mungbean shows fluctuating trend in area and production and registered increasing trend in productivity due to introduction of HYV mungbean. It is grown three seasons a year covering 43,680 ha with an average yield of 0.68 t/ha (BBS, 2004).

The pattern of input use is shown in Table 5.38. Irrespective of area, a mungbean farmer used 59.05 man-days of human labour per hectare of which covered 37.7% of total cost. On an average, 9.08 kg of mungbean seed was used per hectare. They used chemical fertilizers like urea, TSP, MoP, Gypsum, zinc sulphate at the rate of 52.58 kg, 68.21 kg, 48.05 kg, 32.89 kg and 10.57 kg per hectare, respectively, which were much lower than the recommended doses of urea 40 kg/ha, TSP 100 kg/ha and MP 55 kg/ha. The total cost of mungbean cultivation was estimated at Tk. 45813 /ha on variable cost basis and Tk. 167707/ha on full cost basis. On an average yield of mungbean in the study areas was found 1297 kg/ha which is greater than the national average (BBS, 2019). Also sale price received mungbean growers was Tk. 62.37 per kg. The data pertaining to returns from mungbean production gross return per hectare was estimated Tk. 83338. Gross margin and net margin were calculated Tk.37525 and Tk. 20755 respectively. The benefit cost ratios were 1.33 and 1.82 on full cost and variable cost basis.

Table 5.38 Per hectare input use and profitability of mungbean production in Pirojpur district

Particulars	Input use *(n= 19)*	Unit price *(n=19)*	Total cost/return (Tk/ha) *(n=19)*	% of total cost
A. Variable cost			**45813**	**73.2**
Labour (man-day)	59.05	400.00	23621	37.7
Land preparation			9076	14.5
Seed (kg)	9.08	87.37	794	1.3
Fertilizer (kg)				0.0
Urea	52.58	16.68	877	1.4
TSP	68.21	23.74	1619	2.6
MoP	48.05	16.11	774	1.2
Gypsum	32.89	26.09	858	1.4
Zinc sulphate	10.57	200.00	2114	3.4
Irrigation			2750	4.4
Pesticides			2881	4.6
Interest on OC			449	0.7
B. Fixed cost				0.0
Land use cost			16770	26.8
C. Total cost (A+B)			**62583**	**100.0**
Total production (kg)	1297	62.37	80891	
Return from byproduct			2447	
D. Total return			**83338**	
E. Gross margin (D-A)			37525	
F. Net return (D-C)			**20755**	
G. Benefit cost ratio				
Over total cost			1.33	
Over variable cost			1.82	

5.5.7 Potato

The human labour used for producing potato was found to be 132.58 man days per hectare in which cover 35.8% of total variable cost. The cost of land preparation was Tk. 7909 per hectare (Table 5.39). The quantity of seed and manure used by the farmers were 486.92 kg and 1333.25 kg per hectare respectively. They used chemical fertilizers like urea, TSP, MoP, gypsum, DAP, Zinc sulphate, and Boron at the rate of 442.08 kg, 252.83 kg, 277.92 kg, 102.92 kg, 66.42 kg, and 4.67kg per hectare. They used higher doses of urea, TSP and MoP than the recommended doses (220-250kg/ha, 120-150kg/ha and 220-250 kg/ha, source: BARI, 2005) and also used lower doses of Gypsum, Zinc sulphate and Boron than the recommended doses (100-120 kg/ha, 8-10 kg/ha and 8-10 kg/ha, source: BARC, 2005).

The cost of potato cultivation was estimated to be Tk. 147995 and Tk. 131117 per hectare on total cost and variable cost basis, respectively. The major share in total cost was labour (35.8%) followed by seed (19.2%), fertilizers (16.6%), irrigation (6.1%) and pesticides (4.5%). The yield of potato was 15.098 ton per hectare which was below than the national average yield (20.41 t/ha) (BBS, 2019). The total return, gross margin and net return of potato cultivation were Tk. 147995, Tk. 170848, and Tk. 153970 per hectare respectively. The benefit cost ratios were 2.04 and 2.30 on full cost and variable cost basis.

Table 5.39 Per hectare input use and profitability of potato production in Pirojpur district

Particulars	Input use *(n= 12)*	Unit price *(n=12)*	Total cost/return (Tk/ha) *(n=12)*	% of total cost
A. Variable cost			**131117**	**88.6**
Labour (man-day)	132.58	400.00	53033	35.8
Land preparation			7909	5.3
Seed (kg)	486.92	58.33	28403	19.2
Fertilizer (kg)				
Urea	442.08	16.83	7442	5.0
TSP	252.83	26.00	6574	4.4
MoP	277.92	16.67	4632	3.1
Gypsum	102.92	22.27	2292	1.5
DAP	66.42	30.00	1993	1.3
Zinc sulphate	4.67	200.00	933	0.6
Manure (kg)	1333.25	0.75	1000	0.7
Irrigation			9025	6.1
Pesticides			6597	4.5
Interest on OC			1285	0.9
B. Fixed cost				
Land use cost			16878	11.4
C. Total cost (A+B)			**147995**	**100.0**
Total production (kg)	15098	20.00	301965	
Return from byproduct			0.00	
D. Total return			**301965**	
E. Gross margin (D-A)			170848	
F. Net return (D-C)			**153970**	
G. Benefit cost ratio				
Over total cost			2.04	
Over variable cost			2.30	

5.6 Input Use and Profitability of Crop Production in Satkhira District

5.6.1 Transplanted Aman (*T.Aman*) rice

The input use pattern and productivity of *T.Aman* rice cultivation in the study areas are presented in Table 5.40. The rice farmers in the study areas used 90.65 man-days human labour for performed many physical operations such as land preparation, laddering, dressing, transplanting, weeding, application of fertilizer & manure, application of insecticides, harvesting and carrying, threshing, cleaning, drying and storing etc. on an average farmers used 43.15 kg/ha seed which was substantially more seed than the recommended rate (30 kg/ha). The *T.Aman* rice growers in the study areas, fertilizer and manures applied on an average 206.33, 148.63, 85.32, 54.99, 65.17, 7.75, 0.07 and 353.58 kg/ha of Urea, TSP, MoP, Gypsum, DAP, Zinc sulphate and manures respectively. The marginal category farmers used lowest amount of all fertilizers due to their inability but used more manures from their own sources. Likewise, large and medium category farmers consciously used highest doses of fertilizers than small farmers and marginal farmers.

Table 5.40 Per hectare input use by farm size in *T. Aman* rice production in Satkhira district

Particulars	Large & medium	Small	Marginal	All category
	n=15	*n=68*	*n=21*	*n=104*
Human labour (man-day)	85.67	91.46	91.62	90.65
Seed (kg)	46.84	42.23	43.50	43.15
Urea (kg)	255.13	205.65	173.67	206.33
TSP (kg)	174.47	148.51	130.52	148.63
MoP (kg)	109.60	84.19	71.62	85.32
Gypsum (kg)	73.87	54.44	43.29	54.99
DAP (kg)	59.73	62.97	76.19	65.17
Zinc sulphate (kg)	9.89	7.34	7.56	7.75
Boron (kg)	0.00	0.11	0.00	0.07
Manure (kg)	324.33	353.93	373.33	353.58

The average yield of main product (rice) was 4.752 t/ha which much higher than the national average of 2.464 t/ha (BBS, 2019). The highest yield (5.327 t/ha) was recorded for large and medium farmer and the lowest (4.622 t/ha) for small farmer. The average return from main product and by product (straw) were estimated Tk. 84186 and Tk. 15444 per hectare respectively. The gross margin and net return were estimated as Tk. 37927/ha and Tk. 18063/ha, respectively. Due to lower cost of production marginal farmers received the highest gross as well as net return. The average benefit cost ratios (BCRs) on variable cost and full cost basis were 1.22 and 1.60 respectively (Table 5.41).

5.6.2 Boro rice

Table 5.42 shows that on an average 96.64 man-days human labour required to produce *Boro* for different farming activities. Farmers also used 44.42 kg seed per hectare *Boro* rice. In the study areas, *Boro* rice producers used the following types of fertilizers available such as urea (230.30 kg/ha), TSP (176.46 kg/ha), MoP (112.58 kg/ha), Gypsum (76.36 kg/ha), DAP (50.43 kg/ha) and Zinc sulphate (8.97 kg/ha).

Table 5.43 revealed that respondent in the study areas the average yield of *Boro* rice was 6738 t/ha which was much higher that national average of 4.02 t/ha (BBS, 2019). The highest yield was received by the large and medium category farmers and the lowest yield by the marginal category farmers in the study areas. Attaining higher yield might be due to follow recommended dose of fertilizer, much irrigation and crop protection (use higher amount of pesticides).

Table 5.41 Per hectare cost and return of T. Aman rice production in Satkhira district

Particulars	Large & medium (n= 15)	Small (n=68)	Marginal (n=21)	All category (n=104)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**63184**	**63521**	**62120**	**63190**	**76.1**
Labour	34329	37259	37215	36828	44.4
Land preparation	6404	6321	5984	6265	7.5
Seed	2078	2051	1928	2030	2.4
Urea	4210	3340	2835	3363	4.1
TSP	4388	3796	3279	3777	4.5
MoP	1710	1303	1102	1321	1.6
Gypsum	1110	818	655	827	1.0
DAP	1740	1856	2257	1920	2.3
Zinc sulphate	1353	1156	957	1144	1.4
Manure	243	265	280	265	0.3
Irrigation	1246	1198	1267	1219	1.5
Pesticides	3754	3535	3754	3611	4.3
Interest on OC	619	623	609	619	0.7
B. Fixed cost					
Land use cost	20007	19796	19878	19843	23.9
C. Total cost (A+B)	**83191**	**83317**	**81998**	**83033**	**100.0**
Total production (kg)	5327	4665	4622	4752	
Product price (Tk/kg)	17.83	18.01	18.21	18.03	
Return from main product	95001	84043	84186	85673	
Return from byproduct	17313	15162	15021	15444	
D. Total return	**112314**	**99205**	**99208**	**101116**	
E. Gross margin (D-A)	49130	35684	37087	37927	
F. Net return (D-C)	29123	15888	17209	18063	
G. Benefit cost ratio					
Over total cost	1.35	1.19	1.21	1.22	
Over variable cost	1.78	1.56	1.60	1.60	

The average cost of *Boro* rice production was Tk. 99143 per hectare of which the share of variable cost was 81.1% and the rest (19.9%) was fixed cost. In terms of the various inputs, labour costs incurred the highest share (39.1%) of total cost followed by manure & fertilizer (14.8%), irrigation (12.3%), land preparation (6.5%), pesticides (4.0%), and seed (2.6%) (Table 5.43). *Boro* rice is reported to be a profitable crop in the study areas. The average gross return and net return were estimated at Tk. 115263 and Tk. 16119 per hectare respectively. The overall rate of return (BCR) was 1.16 over full cost and 1.45 over variable cost basis. The highest net return was received by large & medium farmers and the lowest net return was received by small category farmers.

Table 5.42 Per hectare input use by farm size in *Boro* rice production in Satkhira district

Particulars	Large & medium	Small	Marginal	All category
	n=10	*n=57*	*n=14*	*n=81*
Human labour (man-day)	96.6	97.21	94.36	96.64
Seed (kg)	47.5	44.08	43.61	44.42
Urea (kg)	267.8	233.04	192.36	230.30
TSP (kg)	222.9	174.49	151.29	176.46
MoP (kg)	137.1	112.07	97.14	112.58
Gypsum (kg)	62.1	76.53	85.86	76.36
DAP (kg)	84.1	40.19	68.07	50.43
Zinc sulphate (kg)	14.23	8.51	7.09	8.97
Manure (kg)	1404.9	541.53	686.14	673.11

Table 5.43 Per hectare cost and return of *Boro* rice production in Satkhira district

Particulars	Large & medium (n= 15)	Small (n=68)	Marginal (n=21)	All category (n=104)	
	Tk/ha	Tk/ha	Tk/ha	Tk/ha	% of total
A. Variable cost	**84920**	**78999**	**76993**	**79383**	**80.1**
Labour	38658	39008	37769	38750	39.1
Land preparation	7196	6378	6312	6468	6.5
Seed	2731	2576	2572	2595	2.6
Urea	4436	3874	3178	3823	3.9
TSP	5786	4512	3918	4567	4.6
MoP	2173	1740	1481	1749	1.8
Gypsum	873	1060	1215	1064	1.1
DAP	2562	1206	2043	1518	1.5
Zinc sulphate	2311	1289	1073	1378	1.4
Manure	1054	406	515	505	0.5
Irrigation	12381	12326	11788	12240	12.3
Pesticides	3928	3849	4375	3949	4.0
Interest on OC	832	774	755	778	0.8
B. Fixed cost					
Land use cost	19760	19760	19760	19760	19.9
C. Total cost (A+B)	**104680**	**98759**	**96753**	**99143**	**100.0**
Total production (kg)	7098	6711	6592	6738	
Product price (Tk/kg)	17.25	16.80	16.94	16.88	
Return from main product	122437	112732	111654	113744	
Return from byproduct	2026	1460	1395	1519	
D. Total return	**124463**	**114192**	**113050**	**115263**	
E. Gross margin (D-A)	39543	35193	36057	30998	
F. Net return (D-C)	19783	15433	16297	16119	
G. Benefit cost ratio					
Over total cost	1.19	1.16	1.17	1.16	
Over variable cost	1.47	1.45	1.47	1.45	

5.6.3 Jute

Table 5.44 presents per hectare input use and profitability of jute production in Satkhira district. A total of 175.23 man-days human labour and 7.51 kg seed were used per hectare jute production in the study area. Human labour was mainly used land preparation, fertilizer

application, weeding, harvesting etc. Respondent in the study areas applied different dose of fertilizer like urea (130.45 kg/ha), TSP (114.09 kg/ha), MoP (63.50 kg/ha), gypsum (34.95 kg/ha), DAP (33.00) and zinc sulphate (4.79 kg/ha). The total cost of production was estimated at Tk. 111652 per hectare of which 82.1% is variable cost and the rest is fixed cost. The yield was estimated 3.382 t/ha in the study areas which is higher than national average. Estimation of jute cultivation found that it was a profitable crop in Satkhira district. The total return was estimated Tk. 153911 per hectare which Tk. 23996 from byproduct of raw materials. Gross margin and net margin were estimated Tk. 62244 and Tk. 42259 per hectare respectively. The overall rate of return (BCR) was 1.38 over full cost and 1.68 over variable cost basis.

Table 5.44 Per hectare input use and profitability of jute production in Satkhira district

Particulars	Input use *(n= 22)*	Unit price *(n=22)*	Total cost/return (Tk/ha) *(n=22)*	% of total cost
A. Variable cost			**91667**	**82.1**
Labour (man-day)	175.23	400.00	70091	62.8
Land preparation			6441	5.8
Seed (kg)	7.51	221.36	1663	1.5
Fertilizer (kg)				
Urea	130.45	15.95	2081	1.9
TSP	114.09	24.18	2759	2.5
MoP	63.50	15.41	978	0.9
Gypsum	34.95	11.09	388	0.3
DAP	33.00	29.09	960	0.9
Zinc sulphate	4.79	149.23	714	0.6
Irrigation			2225	2.0
Pesticides			2467	2.2
Interest on OC			899	0.8
B. Fixed cost				
Land use cost			19985	17.9
C. Total cost (A+B)			**111652**	**100.0**
Total production (kg)	3382	38.41	129915	
Return from byproduct			23996	
D. Total return			**153911**	
E. Gross margin (D-A)			62244	
F. Net return (D-C)			**42259**	
G. Benefit cost ratio				
Over total cost			1.38	
Over variable cost			1.68	

5.6.4 Mustard

Table 5.45 reveals that per hectare input use pattern and profitability of mustard in the study areas. It is evident from the table respondent in the study areas used 59.90 man-days human labour and 7.48 kg seed in their per hectare mustard crop. They also applied different does of fertilizer and manures like as urea (138.32 kg/ha), TSP (136.02 kg/ha), MoP (73.39 kg/ha), gypsum (56.95 kg/ha), DAP (34.83 kg/ha), boron (1.28 kg/ha) and zinc sulphate (6.28 kg/ha). The total cost of cultivating mustard was estimated to be Tk. 64880 which was 69.5% variable cost and rest of 30.5% land use cost treated as a fixed cost. The average yield of mustard was estimated at 1631 kg/ha which was much higher than the national average of 1142.69 kg/ha (BBS, 2019). The estimated total return, gross margin and net return were Tk.

77641, Tk. 32521 and Tk. 12761 per hectare respectively. The benefit cost ratio (BCR) was estimated at 1.20 and 1.72 on full cost and variable cost basis, respectively.

Table 5.45 Per hectare input use and profitability of mustard production in Satkhira district

Particulars	Input use *(n= 41)*	Unit price *(n=41)*	Total cost/return (Tk/ha) *(n=41)*	% of total cost
A. Variable cost			**45120**	**69.5**
Labour (man-day)	59.90	400.00	23961	36.9
Land preparation			5513	8.5
Seed (kg)	7.48	80.00	598	0.9
Fertilizer (kg)				
Urea	138.32	16.00	2213	3.4
TSP	136.02	25.54	3474	5.4
MoP	73.39	15.98	1172	1.8
Gypsum	56.95	15.03	856	1.3
DAP	34.83	28.00	975	1.5
Zinc sulphate	6.28	112.67	708	1.1
Boron	1.28	80.00	102	0.2
Manure (kg)	415.80	0.75	312	0.5
Irrigation			2634	4.1
Pesticides			2159	3.3
Interest on OC			442	0.7
B. Fixed cost				
Land use cost			19760	30.5
C. Total cost (A+B)			**64880**	**100.0**
Total production (kg)	1631	45.15	73620	
Return from byproduct			4021	
D. Total return			**77641**	
E. Gross margin (D-A)			32521	
F. Net return (D-C)			12761	
G. Benefit cost ratio				
Over total cost			1.20	
Over variable cost			1.72	

5.6.5 Potato

The human labour used for producing potato was found to be 136.60 man-days per hectare in which cover 33.2% of total variable cost. The cost of land preparation was Tk. 9116 per hectare (Table 5.46). The quantity of seed and manure used by the farmers were 550.60 kg and 3761 kg per hectare. They used chemical fertilizers like urea, TSP, MoP, gypsum, DAP, Zinc sulphate, and Boron at the rate of 457.30 kg, 297.70 kg, 272.70 kg, 108.70 kg, 92.20 kg, 8.25 kg and 6.66 kg per hectare respectively.

The total cost included fixed cost and variable cost. The total cost and variable cost of potato cultivation were estimated at Tk. 159806 and Tk. 142516 per hectare respectively. The major share in total cost was labour (33.2%) followed by seed (20.1%), chemical fertilizers (17.7%), irrigation (5.5%) and pesticides (4.9%). The yield of potato was 26.91 t/ha which was much higher than the national average yield of 20.41 t/ha (BBS, 2019). The total return, gross margin and net return of potato cultivation were Tk. 336454, Tk. 192177, and Tk. 171923 per hectare respectively. The benefit cost ratios were 2.04 and 2.3 on full cost and variable cost basis.

Table 5.46 Per hectare input use and profitability of potato production in Satkhira district

Particulars	Input use *(n= 10)*	Unit price *(n=10)*	Total cost/return (Tk/ha) *(n=10)*	% of total cost
A. Variable cost			**144277**	**87.7**
Labour (man-day)	136.60	400.00	54640	33.2
Land preparation			9116	5.5
Seed (kg)	550.60	60.00	33036	20.1
Fertilizer (kg)				
Urea	457.30	16.40	7500	4.6
TSP	297.70	25.80	7681	4.7
MoP	272.70	16.00	4363	2.7
Gypsum	108.70	16.00	1739	1.1
DAP	92.20	30.00	2766	1.7
Zinc sulphate	8.25	100.00	825	0.5
Boron	6.66	180.00	1199	0.7
Manure (kg)	3761	0.75	2821	1.7
Irrigation			9041	5.5
Pesticides			8137	4.9
Interest on OC			1414	0.9
B. Fixed cost				
Land use cost			20254	12.3
C. Total cost (A+B)			**164531**	**100.0**
Total production (kg)	26916	12.50	336454	
D. Total return			**336454**	
E. Gross margin (D-A)			192177	
F. Net return (D-C)			171923	
G. Benefit cost ratio				
Over total cost			2.04	
Over variable cost			2.33	

5.6.6 Tomato

Table 5.47 presents the input use pattern and profitability of Satkhira district. The human labor used for producing tomato was found to be 386.45 man-days per hectare. The respondent in the study areas applied different fertilizer like as urea, TSP, MoP, Gypsum, DAP, Zinc sulphate and boron were 293.14, 972.05, 513.86, 251.05, 106.77, 33.25 and 3.54 kg per hectare respectively. Total cowdung used 4047.82 kg per hectare when land is prepared.

Economic analysis of tomato cultivation in the study areas were made on per hectare basis. As shown in table 5.47 cost of cultivation of tomato was worked out be Tk. 280782. The cost structure of the variable cost shows that the highest proportion amounting to Tk. 257991 (91.9%) was spent on labour cost Tk. 154582 (55.1%) followed by land preparation Tk. 9228 (3.3%), seed Tk. 4481(1.6%), fertilizer Tk. 55208 (19.7%), irrigation Tk. 23473 (8.4%), pesticides Tk. 8191 (2.9%). The share of rental value of land in cost of cultivation of tomato was worked out to be Tk. 22791 (8.1%). The average yield of tomato in the study areas was found 24573 kg/ha. Also sale price received tomato growers was Tk. 39.55 per kg. The data pertaining to returns from tomato production gross return per hectare was estimated Tk. 971880. The gross margin and net margin were calculated Tk. 713889 and Tk. 691098 per hectare respectively. The benefit cost ratios were 3.46 and 3.77 on full cost and variable cost basis.

Table 5.47 Per hectare input use and profitability of tomato production in Satkhira district

Particulars	Input use *(n= 22)*	Unit price *(n=22)*	Total cost/return (Tk/ha) *(n=22)*	% of total cost
A. Variable cost			**257991**	**91.9**
Labour (man-day)	386.45	400.00	154582	55.1
Land preparation			9228	3.3
Seed (kg)			4481	1.6
Fertilizer (kg)				
Urea	293.14	17.55	5143	1.8
TSP	972.05	27.09	26334	9.4
MoP	513.86	16.14	8292	3.0
Gypsum	251.05	16.41	4119	1.5
DAP	106.77	30.00	3203	1.1
Zinc sulphate	33.25	133.64	4444	1.6
Boron	3.54	180.00	637	0.2
Manure (kg)	4047.82	0.75	3036	1.1
Irrigation			23473	8.4
Pesticides			8191	2.9
Interest on OC			2828	1.0
B. Fixed cost				
Land use cost			22791	8.1
C. Total cost (A+B)			**280782**	**100.0**
Total production (kg)	24573	39.55	971880	
Return from byproduct				
D. Total return			**971880**	
E. Gross margin (D-A)			713889	
F. Net return (D-C)			691098	
G. Benefit cost ratio				
Over total cost			3.46	
Over variable cost			3.77	

5.6.7 Wheat

Wheat is the important cereal crop and has tremendous potentials for supplementary human food in Bangladesh. The area of wheat cultivation in Bangladesh is about 3,51,213 hectare with the production of about 10,99,373 MT and average yield is 3.13 t/ha (BBS, 2019). The area and production of wheat is decreasing year after year due to its less profitability compared to most competing crops especially maize. Therefore, the current production of wheat cannot fulfill the national demand as well. The Respondent farmers in study areas used a total number of 105.50 man-days of human labour and about 139.80 kg of seed per hectare in producing wheat. Human labour was mainly used for land preparation, seeding, weeding and crop harvesting. They also applied different types of fertilizers in cultivating wheat. Farmers in the study areas used 176.40 kg urea, 140.30 kg TSP, 75.10 kg MoP, 46.00 kg Gypsum, 57.20 DAP and 5.53 kg boron per hectare.

The average cost of wheat production was estimated at Tk. 92691 per hectare of which 78.7% was variable cost and the rest (21.3%) was fixed cost. In terms of variable inputs, human labour incurred the highest share of the total cost (45.5%) followed by manure & fertilizer (11.8%), land preparation (6.2%), and seed (6%) (Table 4.48). The average yield of wheat was estimated at 3.254 t/ha in the study areas which was much higher than the national average of 3.130 t/ha (BBS, 2019). It is reported to be a profitable crop in the study areas.

The average gross margin and net return were estimated at Tk. 30464 and Tk. 10704 respectively. The average benefit cost ratios (BCRs) on variable cost and full cost basis were 1.12 and 1.42 respectively

Table 5.48 Per hectare input use and profitability of wheat production in Satkhira district

Particulars	Input use *(n= 10)*	Unit price *(n=10)*	Total cost/return (Tk/ha) *(n=10)*	% of total cost
A. Variable cost			**72931**	**78.7**
Labour (man-day)	105.50	400.00	42200	45.5
Land preparation			5733	6.2
Seed (kg)	139.80	40.00	5592	6.0
Fertilizer (kg)				0.0
Urea	176.40	16.00	2822	3.0
TSP	140.30	25.00	3508	3.8
MoP	75.10	15.70	1179	1.3
Gypsum	46.00	15.00	690	0.7
DAP	57.20	30.00	1716	1.9
Boron	5.53	180.00	995	1.1
Irrigation			5525	6.0
Pesticides			2256	2.4
Interest on OC			715	0.8
B. Fixed cost				0.0
Land use cost			19760	21.3
C. Total cost (A+B)			**92691**	**100.0**
Total production (kg)	3254	30.00	97626	
Return from byproduct			5769	
D. Total return			**103395**	
E. Gross margin (D-A)			30464	
F. Net return (D-C)			10704	
G. Benefit cost ratio				
Over total cost			1.12	
Over variable cost			1.42	

Chapter VI

PROBLEMS AND CONSTRAINTS OF CROP PRODUCTION

6.1 Introduction

Agriculture is constrained every year by challenges, such as rapid shrinkage of agricultural land, population growth, inadequate management practices, inadequate supply of agricultural inputs like fertilizers and seeds, unfair price of produces, climate change and variations, inadequate value addition and lagging technology adoption. Country's crop production is also affected frequently by flood, drought, and salinity. Varieties/technologies tolerant to these natural hazards need to be developed. Incidence of pests and diseases has lately become severe due to climate change impacts. Therefore, more varieties resistant to the pests should be evolved. Research should as well be raised to help generate technologies to cope with climate change hazards and disseminate such technologies at farmer's level. To know the real problems and constraints of crop production, processing, marketing etc. some key informants as well as advanced farmers need to be gathered in a place to document necessary information with fruitful discussion so that they can identify real situation or problems. They can also discover some important and appropriate solutions of the problems. An attempt was made to collect farm level problems relating to production, processing and marketing of crops from respondent farmers in the study areas. The following sections of this chapter discuss the problems and constraints of crop production in the study areas.

6.2 Unfavorable Climate Faced by the Respondent Farmers

Respondent farmers were asked to inform about unfavorable climate faced in the last five years. They answered from their own experience and memory. The output of these discussions were summarized and showed in Table 6.1.

Considering all districts, about 29.2%, 39.7%, 24.8% and 31.9% of the respondent farmers reported that they faced various unfavorable climate for crop production as salinity, drought, flood and heavy rainfall respectively in the last five years. In the case of salinity, the highest percent of farmers (43.3%) reported that more salinity was existing in Khulna division followed by Bagherhat and Khulna district. Most of the farmers (70.7%) of Gopalgonj expressed that they faced more drought in the last five years compared to Khulna and Bagherhat district. About 74% farmers of Pirojpur district opined that they were facing unfavorable climate as flood during the last five years. Majority farmers of Gopalgonj district (50.7%) faced heavy rainfall followed by Satkhira (40.7%) and Khulna district (26%) as unfavorable climate in the last five years to minimize the vulnerability (Table 6.1)

Table 6.1 Farmers faced unfavorable climate in the last five years

District	N	Percent farmers responses			
		Salinity	Drought	Flood	Heavy rainfall
Bagherhat	150	37.3	37.3	20.0	24.0
Gopalgonj	150	26.7	70.7	7.3	50.7
Khulna	150	43.3	46.7	14.7	26.0
Pirojpur	150	5.3	13.3	74.0	18.0
Satkhira	150	33.3	30.7	8.0	40.7
All districts	750	29.2	39.7	24.8	31.9

6.3 Actions Taken Against Unfavorable Climate

Respondent farmers in the study areas took several actions against unfavorable climate in the last five years. The adopted steps and actions are shown in Table 6.2.

About 32.7% farmers of Bagherhat district, 10.0% farmers of Gopalgonj district, 26.7% farmers of Khulna district, and 4.0% farmers of Pirojpur district opined that they used gypsum fertilizer for minimizing of salinity, while 18% farmers of Satkhira district used sulfur and 16.7% farmers of Gopalgonj district used zinc fertilizer for minimizing of salinity for crop production in the study area.

About 32.0% farmers of Bagherhat district, 60% farmers of Gopalgonj district, 42.7% farmers of Khulna district, 12.7% farmers of Pirojpur district, and 29.3% farmers of Satkhira district reported that they provided supplement irrigation as well as provided mulching, used draught and saline tolerant varieties for drought problem mitigation.

About 24.7% farmers of Bagherhat district, 18% farmers of Khulna district, and 26.7% farmers of Satkhira district opined that they drained out flood water when flood and heavy rainfall occurred. On the other hand, about 32% farmers of Gopalgonj district and 81.3% farmers of Pirojpur district expressed that when flood and heavy rainfall occurred no action could be taken possible.

Table 6.2 Farmers took several actions against unfavorable climate in the last five years

Actions taken	Percent farmers responses				
	Bagherhat	Gopalgonj	Khulna	Pirojpur	Satkhira
A. Salinity					
Use Gypsum fertilizer	32.7	8.7	26.7	4.0	2.0
Use Sulfur	2.0	5.3	4.0	--	18.0
Use Zinc fertilizer	0.7	16.7	7.3	0.7	10.0
B. Drought					
Provide supplement irrigation	32.0	60.0	42.7	12.7	29.3
Others[1]	2.0	0.7	3.3	--	--
C. Flood and heavy rainfall					
Drainage of flood water	24.7	5.3	18.0	3.3	26.7
Cultivate crops after removal of water	3.3	--	0.7	2.7	1.3
Harvest crops quickly with extra labour	0.7	--	1.3	--	1.3
Make sluice gates open	--	--	2.7	--	2.7
No action could be taken possible	16.7	32.0	3.3	81.3	20.7
Others[2]	--	--	2.0	--	0.7

Note: [1]Provide mulching, use draught and saline tolerant varieties
[2]Keep lands fallow, preserve/protect fish in the field with net

6.4 Services Provided by Different Institutions

Most of the farmers in the study areas reported that they received technical advice for crop production, processing and agricultural related information and different types of training from local DAE office and different research institutes during adverse weather condition. They also received production inputs and demonstration plots from DAE and research institutes (Table 6.3).

About 16.7% farmers of Bagherhat district, 10.0% farmers of Gopalgonj district, 13.3% farmers of Khulna district, and 8.7% farmers of Pirojpur district opined that they received short-term loan facility from local NGOs. They also received technical advice, training and

production inputs from local NGOs. Besides, 3.3% farmers of Bagherhat district, 10.0% farmers of Gopalgonj and Khulna district, 4.7% farmers of Pirojpur district and 4% farmers of Satkhira district expressed that they also received short-term loan facility from financial institutes in the study area (Table 6.3).

Table 6.3 Farmers received various services from different institutions

Services	Percent farmers responses				
	Bagherhat	Gopalgonj	Khulna	Pirojpur	Satkhira
A. Local DAE Office					
Received advice	70.7	58.0	70.0	96.7	74.7
Received production inputs	46.7	40.0	32.7	64.7	24.0
Received training	61.3	42.0	51.3	68.7	61.3
Received govt. facilities/subsidies	6.7	8.0	7.3	9.3	6.7
Setting demonstration plot	22.0	11.3	16.7	70.7	34.0
B. Research Institutes					
Received advice	46.7	39.3	16.7	88.0	47.3
Received production inputs	26.0	42.0	13.3	53.3	24.0
Received training	45.3	50.0	28.7	58.0	41.3
Setting on-farm research plot	25.3	14.0	22.7	62.7	34.7
C. Local NGOs					
Received advice	2.0	3.3	2.0	2.7	5.3
Received production inputs	1.3	2.0	2.0	1.3	3.3
Received training	4.7	5.3	4.0	3.3	16.7
Received short-term loan facility	16.7	10.0	13.3	8.7	12.7
D. Financial Institutes					
Received short-term loan facility	3.3	10.0	10.0	4.7	4.0

6.5 Problems of Crop production, Processing and Marketing

Different unfavorable climatic condition faced by the respondent farmers in the last five years have been discussed in the previous sections. The respondent farmers were asked to put their opinion about the extent of problem they faced during crop production, processing, and their marketing. It was observed that the farmers faced various problems having different magnitude as production, processing and marketing. An attempt was made in this section to identify the major problems faced by the sample farmers with their magnitude in the study area and shown in Table 6.4.

Farmers were asked about the problems of crop production and they answered about ten types of problems. About 83.3% respondent farmers of Gopalgonj district, 76.7% respondent farmers of Pirojpur district and 61.3% respondent farmers of Satkhira district reported that lack of quality or improved seed was their first ranked problem, while the scarcity of human labour was the first most constraint to the farmers of Bagherhat and Khulna district. The second most important problem was the scarcity of human labour that was identified by the farmers of Gopalgonj (68.7%), Pirojpur (73.3%) and Satkhira district (36%), while the lack of quality or improved seed and lack of agricultural machinery were the second most problem to the farmers of Khulna district (68.7%) and Bagherhat district (43.3%), respectively. The third most important problem for crop production was lack of quality or improved seed to the 34% farmers of Bagherhat district, damage of crops due to untimely rainfall to 64% farmers of Gopalgonj district and 28% farmers of Satkhira district, lack of agricultural machinery to 66.7% farmers of Pirojpur district, and low yield due to drought to about 35.3% farmers of Pirojpur district.

About 20% farmers of Gopalgonj district, 8% farmers of Bagherhat district and 5.3% farmers of Khulna district opined that decomposition problem of jute was the major problem for jute processing. About 2-4% farmers reported that lack of technical know-how related to jute processing exist in all districts.

The lack of fair price was identified as major problem for marketing crops by about 74.7% farmers of Bagherhat district, 63.3% farmers of Gopalgonj district, 71.3% farmers of Khulna district, 88.0% farmers of Pirojpur district, and 56.0% farmers of Satkhira district. A good percentage of farmers from different study areas also mentioned some marketing problems that were lower output price due to trader's syndicate, lack of cold storage, and higher price of fertilizers.

Respondent farmers also faced some social problems during crop production. Same person received training repeatedly was the major social problem mentioned by 15.3%, 8%, 3.3% and 2.7% farmers of Khulna, Gopalgonj, Pirojpur and Satkhira district respectively. Stolen of high value crops is another social problem stated by 3.3% of the farmers of Bagherhat district followed by 2.7% farmers in Gopalgonj district and 2.0% farmers in Pirojpur district (Table 6.4)

Table 6.4 Farmers faced different problems during crop production, processing and marketing

Type of problem	% farmers responses				
	Bagherhat	Gopalgonj	Khulna	Pirojpur	Satkhira
A. Production problems	*n=150*	*n=150*	*n=150*	*n=150*	*n=150*
Lack of quality/improved seed	34.0	83.3	68.7	76.7	61.3
Scarcity of human labour	55.3	68.7	72.0	73.3	36.0
Lack of irrigation and its higher cost	34.0	21.3	34.7	72.0	20.0
Damage of crops due to untimely rainfall	19.3	64.0	19.3	48.7	28.0
Lack of agricultural machinery	43.3	6.7	19.3	66.7	26.0
Low yield due to drought	34.7	30.0	35.3	21.3	13.3
Adulteration of seed	12.7	48.0	28.0	19.3	23.3
Lack of technical know-how	19.3	21.3	14.0	9.3	20.7
Adulteration of pesticides	5.3	11.3	17.3	16.0	6.7
Lack of knowledge on proper fertilizer dose	4.0	4.7	9.3	3.3	2.0
B. Processing problems					
Lack of technical know-how	2.7	2.7	4.7	2.0	4.0
Decomposition problem of jute	8.0	20.0	5.3	--	--
C. Marketing problems					
Lack of fair price	74.7	63.3	71.3	88.0	56.0
Low price due to traders' syndicate	26.7	37.3	16.0	8.7	31.3
Lack of cold storage	24.7	21.3	20.7	55.3	8.0
Higher price of fertilizer	6.7	6.7	8.0	37.3	28.7
D. Social problems					
Same person receive training repeatedly	2.0	8.0	15.3	3.3	2.7
Stolen of crops	3.3	2.7	1.3	2.0	1.3

Chapter VII

CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- The primary occupation of the most farmers are crop farming having average farm size of 198 decimal and 23 years of experience followed by business as secondary occupation. They could receive some agricultural related training from DAE, research institutes, and pesticides/seed companies. They own some modern agricultural machineries like STW, PT, thresher, and weeder along with different traditional equipment.

- Diverse cropping patterns are found across the study areas. *Boro-Fallow-T.Aman* is the dominant cropping pattern found in Bagherhat, Khulna and Satkhira districts. The next important cropping pattern is *Fallow-Fallow-T.Aman.* Again, *Fallow-Fallow-T.Aman* is the major practiced pattern in Pirojpur district, whereas *Boro-Fallow-Fallow* is the major pattern found in Gopalgonj district.

- The maize and wheat farmers and majority of the rice farmers use improved variety of seed. But still some farmers are using local cultivars of rice. A lion share of the respondent pulses, oilseeds, sweet potato, vegetables and chili farmers use local variety of seed. Most banana, mango, guava, malta, litchi and dragon fruit farmers use improved variety of seed, but still a good percentage of farmers are using local cultivars. Many traditional varieties of the minor fruits are being used by the majority of the farmers.

- Profitability analysis reveals that the cultivations of different crops are financially profitable having different scales. The highest profitable crops are tomato, brinjal and potato and the lowest profitable crops are cereal crops (i.e. *Aus, Aman* & wheat) considering the net returns and BCRs. However, the cultivation of jute and pulse crops are in the middle group.

- Respondent farmers in the study areas encounter different abiotic stresses like salinity, drought, flooding and heavy rainfall in the last five years. During these stress situations many farmers receive advice, production inputs, training, govt. subsidies, demonstration facility, and loan from DAE, research institutes, NGOs and financial institutions.

- Farmers also face various problems relating to crop production, processing and marketing having different magnitudes. Production related problems are lacking of improved seed, scarcity of human labour, lack of irrigation facility, untimely rainfall, drought, lack of agricultural machinery, adulteration of seed and pesticides, and lack of technical know-how. Major marketing problems are lacking of fair price, low price due to traders' syndicate, lack of cold storage, and higher price of fertilizer.

7.2 Recommendations

- Agriculture of South-western part in Bangladesh always faces various adverse climatic condition such as salinity, water lodging, drought, flooding and storm etc.

which impeding agricultural production in the study areas. To overcome these problems short time, medium term and long term planning by the government is needed. Excavation and re-excavation of canal and rivers are necessary for addressing water lodging and salinity. More agro-forestation and embankment of rivers and sea side are essential to fighting frequent storm and flood in coastal areas.

- Adoption levels of crop management technologies are very low. They apply inputs like seed, fertilizers, pesticides and irrigation deviated from recommendation. Regular training programme on crop production and other technologies should be organized for farmers, extension workers and private seed companies for efficient use of inputs and production technologies at farm level.
- The seed of improved varieties should be made locally available to the farmers at proper time and fair price. So, government should encourage BADC and private seed companies to produce improved varieties seed and supply those seeds to the farmers at reasonable price.
- Crop production is also limited by salinity and submergence in the study areas. The research institutes have already developed some salt and submergence tolerant variety for farmers practice. This effort should be continued for further development of new salt and submergence tolerant varieties.
- Motivational campaign through providing training, booklets and other supporting materials to farmers and extension personnel about modern agriculture farming should be continued.
- More demonstration of crop and fruits production at different upazila level should be initiated to encourage farmers for dissemination of the techniques.
- There is a scope for improvement of modern crop and fruits cultivation with high yielding variety, local varieties with appropriate methods of production to increase yield, profitability and income of the farmers.
- GoB, Private entrepreneurs and NGOs should establish agro-based processing plant at study areas with a view to domestic use as well as to export the product at international markets for increasing income and livelihood pattern of the hilly farmers
- To increase the number of farmers under this credit policy, government and banks should take initiatives to disseminate the information about special credit facility for crop cultivation among the farmers. If these initiatives are undertaken each farmer would get opportunities of receiving more amounts and the number of beneficiaries will also be increased.
- To improving farmers livelihood, soil health and modern farming necessary steps should be taken by the government, NGO, agricultural company and personal entrepreneurship in south-western part of Bangladesh

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Executive Summary

The baseline survey on Integrated Agricultural Development Project in Pirojpur-Gopalganj-Bagerhat was conducted by On-farm Research Division, Bangladesh Agricultural Research Instrtute (BARI) during July to December, 2013. The survey was conducted to document xiformation regarding farmers crops, variety, cropping pattern, fertilizer and pesticides, traditional agricultural technologies, socioeconomic, agro'climatic situation, livelihood rnformation, problems and potentials affecting the present farming systems etc. and to analyze the opportunities and constrains related to production and socio-economic aspects for their further expansion.

The survey was conducted at three districts under five agro-ecological zones (AEZ) such as Pirojpur (AEZ: 12, 13 & 14), Gopalganj (AEZ: 10, 12, 14 & 19) and Bagerhat (AEZ: 14 & 19). A total of 21 upazilas were covered by the study. Among them seven upazilas in Pirojpur, five upazilas in Gopalganj and nine upazilas in Bagerhat were studied. Thirty farm families from each upazila with five different farm categories namely landless, marginal, small, medium and large was selected randomly. As such a total of 630 farm families constituted the sample of the study. Direct interview technique administered by the researchers and personnel of Department of Agriculture Extension (DAE) for collecting information from the selected farm households with the help of a predesigned questionnaire. After collection of the data, each interview schedule was verified for the sake of consistency and completeness. Summarization, careful scrutiny and necessary summary tables have been made horn the data. Tabular techniques have been used for analysis, interpretation and presentation of data to fulfill the objectives of the baseline survey.

Pirojpur, the higher family size was found in Vandaria (5.92) and lower in Mothbaria and Kaokhali (4.68) which was more than the national average of 4.5. On the other hand effective family member was found higher (68%) in Vandaria and lower (45%) in Zianagar upazila. In Gopalganj, the average family size was higher in Tungipara (6.30) followed by Kashiani and Gopalganj seder; and effective family member was found higher in Gopalganj sadar (48%) followed by Mukshudpur and Tungipara. In Bagerhat, the average family size was found higher (7.00) in Mollahat followed by Bagerhat sadar and Fakirhat which was higher than national average (4.13). The effective family member was also highest (71%) in Mollahat and the lowest was at Bagerhat Sadar (50%).

The highest average farm size was found at Pirojpur (1.18 ha) followed by Bagerhat (1.13 ha) and Gopalganj (0.931 ha). The average age of sample farmers in Pirojpur was 45 years, Gopalganj was 43.2 and Bagerhat was 45 years. The literacy rate of the sample farmers was also higher in Gopalganj (74%) and lower in Pirojpur (62%). Whereas 68% literacy rate of the sample farmers were observed in Bagerhat. The literacy rate seems to be higher than national average because the sample farmers were selected purposively for crop production.

Four distinct land types prevail in the survey areas. These are high, medium high, medium low and low land. But in Gopalganj very low land was also found which was about 9 percent. Medium high land is normally flooded up to 90 cm during the rainy season and medium low land normally flooded between 90 to 180 cm during the rainy season (BARC, 2005). In three districts land topography is different. Pirojpur had higher medium highland (61%) followed by Bagerhat (45%) and Gopalganj (11%). This land is suitable for crop production. Medium low land also found higher in Gopalganj (37%) followed by Bagerhat (35%) and Pirojpur (21%). Low land was found higher in Gopalganj (35%) compared to other districts under study (4-7%) indicating that there is limited scope for crop diversification. These areas only

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